

IFBC NO. 19-TA003100SAM  
SWWRF & SEWRF BELT FILTER PRESS  
REHABILITATION  
PROJECT NO. 6091680  
(913-59)  
AUGUST 9, 2019

Manatee County BCC  
Procurement Division  
1112 Manatee Avenue West Ste 803  
Bradenton, FL 34205  
[purchasing@mymanatee.org](mailto:purchasing@mymanatee.org)



**ADVERTISEMENT  
INVITATION FOR BID CONSTRUCTION  
NO. 19-TA003100SAM  
SWWRF & SEWRF BELT FILTER PRESS REHABILITATION**

Manatee County, a political subdivision of the State of Florida (hereinafter referred to as County), will receive sealed bids from individuals, corporations, partnerships, and other legal entities authorized to do business in the State of Florida, to provide Southwest Water Reclamation Facility (SWWRF) and Southeast Water Reclamation Facility (SEWRF) Belt Filter Press Rehabilitation, as specified in this Invitation for Bid Construction to include the demolition of sludge feed pumps, polymer feed pumps, belt filter presses/associated equipment, screw conveyor, demolition and replacement of the HVAC System, doors and windows, installation of new belt filter presses, polymer feed systems and pumps, screw conveyors, sludge feed pumps and modifications to the electrical and control systems.

**DATE, TIME AND PLACE DUE:**

The Due Date and Time for submission of Bids in response to this IFBC is **September 9, 2019 at 3:00 P.M. ET**. Bids must be delivered to the following location: Manatee County Administration Building, 1112 Manatee Ave. W., Suite 803, Bradenton, FL 34205 prior to the Due Date and Time.

**SOLICITATION INFORMATION CONFERENCE:**

A non-mandatory Solicitation Information Conference will be held at 8:30 a.m. on Thursday, August 15, 2019 at the SWWRF Site, 5101 65th Street West, Administration Building, Bradenton, FL 34210 with a MANDATORY site visit of the SWWRF at approximately 9:30 a.m. A MANDATORY site visit of the SEWRF site will be conducted at 8:30 a.m., on Friday, August 16, 2019 at 3331 Lena Road, Bradenton, FL 34211.

**DEADLINE FOR QUESTIONS AND CLARIFICATION REQUESTS:**

The deadline to submit all questions, inquiries, or requests concerning interpretation, clarification or additional information pertaining to this Invitation for Bid Construction to the Manatee County Procurement Division is August 23, 2019. Questions and inquiries should be submitted via email to the Designated Procurement Contact shown below.

**Important: A prohibition of lobbying is in place. Review Section A.13 carefully to avoid violation and possible sanctions.**

**DESIGNATED PROCUREMENT CONTACT:** Sherri Meier, Sr. Procurement Agent  
(941) 749-3042, Fax (941) 749-3034  
Email: sherri.adamsmeier@mymanatee.org  
Manatee County Financial Management Department  
Procurement Division

AUTHORIZED FOR RELEASE: \_\_\_\_\_

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## **SECTION A, INFORMATION FOR BIDDERS**

To receive consideration, entities who submit a response to this Invitation for Bid (Bidders) must meet the minimum qualification requirements and comply with the following instructions. Bid responses (Bids) will be accepted from single business entities, joint ventures, partnerships or corporations.

### **A.01 BID DUE DATE**

The Due Date and Time for submission of Bids in response to this Invitation for Bid Construction (IFBC) is **September 9, 2019 at 3:00 P.M. ET**. Bids must be delivered to the following location: Manatee County Administration Building, 1112 Manatee Ave. W., Suite 803, Bradenton, FL 34205 and time stamped by a Procurement representative prior to the Due Date and Time.

Bids received after the Due Date and Time will not be considered. It will be the sole responsibility of the Bidder to deliver its Bid to the Manatee County Procurement Division for receipt on or before the Due Date and Time. If a Bid is sent by U.S. Mail, courier or other delivery services, the Bidder will be responsible for its timely delivery to the Procurement Division. Bids delayed in delivery will not be considered, will not be opened at the public opening, and arrangements will be made for their return at the Bidder's request and expense.

### **A.02 SOLICITATION INFORMATION CONFERENCE:**

A non-mandatory Solicitation Information Conference will be held at 8:30 a.m. on Thursday, August 15, 2019 at the SWWRF Site, 5101 65th Street West, Administration Building, Bradenton, FL 34210 with a MANDATORY site visit of the Southwest Water Reclamation Facility (SWWRF) at approximately 9:30 a.m. A MANDATORY site visit of the Southeast Water Reclamation Facility (SEWRF) site will be conducted at 8:30 a.m., on Friday, August 16, 2019 at 3331 Lena Road, Bradenton, FL 34211.

Attendance to mandatory information conferences and/or site visits are required to meet the minimum qualification requirements of the IFBC. Attendance to non-mandatory information conferences is not required, but is strongly encouraged.

### **A.03 PUBLIC OPENING OF BIDS**

Bids will be opened immediately following the Due Date and Time at the Manatee County Administration Building, Suite 803 in the presence of County officials. Bidders or their representatives may attend the Bid opening.

Manatee County will make public at the opening the names of the business entities which submitted a Bid and the total bid price submitted. No review or analysis of the Bids will be conducted at the Bid opening.

### **A.04 SUBMISSION OF BIDS**

The contents of the Bid sealed package must include:

- One (1) bound original clearly identifying Bidder and marked "ORIGINAL".
- Two (2) bound copies clearly identifying Bidder and marked "COPY" with all required information and identical to the original.
- One (1) electronic format copy clearly identifying Bidder.

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Electronic format copy should be submitted on a Universal Serial Bus (USB) portable flash memory drive or compact disc (CD) in MicroSoft Office® or Adobe Acrobat® portable document format (PDF) in one continuous file. Do not password protect or otherwise encrypt electronic Bid copies. Electronic copies must be searchable and contain an identical Bid to the original.

Submit the Bid package in a sealed container with the following information clearly marked on the outside of the package: IFBC No. 19-TA003100SAM, SWWRF & SEWRF Belt Filter Press Rehabilitation, Bidder's name, and Bidder's address. Bids must be delivered to the Manatee County Procurement Division prior to the Due Date and Time at the following address:

Manatee County Procurement Division  
1112 Manatee Ave. West, Ste. 803  
Bradenton, FL 34205

**A.05 DISTRIBUTION OF SOLICITATION DOCUMENTS**

All documents issued pursuant to this IFBC are distributed electronically and available for download at no charge at [www.mymanatee.org](http://www.mymanatee.org) > *Bids and Proposals*. This link is located on the County website home page. Documents may be viewed and downloaded for printing using Adobe Reader® software.

At its sole discretion, the County may utilize a third-party provider, such as DemandStar to distribute proposals. Visit the DemandStar website at [www.Demandstar.com](http://www.Demandstar.com) for more information regarding this service. Participation in the DemandStar system is not a requirement for doing business with Manatee County.

Additionally, the IFBC and all related documents are available for public inspection at the Manatee County Procurement Division, 1112 Manatee Avenue West, Suite 803, Bradenton, FL 34205. Call (941) 749-3014 to schedule an appointment. Documents are available between the hours of 8:00 A.M. and 5:00 P.M., Monday through Friday, with the exception of County holidays.

As a courtesy, Manatee County notifies the Manatee County Chamber of Commerce and the Manatee County Black Chamber of Commerce of all active solicitations, who then distributes the information to its members.

**A.06 EXAMINATION OF BID DOCUMENTS AND SITE(S)**

It is the responsibility of each bidder before submitting a bid, to (a) examine the IFBC documents thoroughly; (b) visit the Project Site(s) to become familiar with local conditions that may affect cost, progress, performance, or furnishing of the Work; (c) consider federal, state, and local codes, laws, and regulations that may affect costs, progress, performance, or furnishing of the Work; (d) study and carefully correlate bidder's observations with the IFBC documents; and (e) notify County in writing of all conflicts, errors, or discrepancies in the IFBC documents.

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Each bidder may, at bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies, and obtain any additional information and data which pertain to the physical conditions at or contiguous to the Project Site(s) or otherwise which may affect cost, progress, performance or furnishing of the Work and which bidder deems necessary to determine his bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the IFBC documents. County will provide each bidder access to the site(s) to conduct such explorations and tests.

Bidder shall fill all holes, clean up and restore the Project Site(s) to its former condition upon completion of such explorations. The lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and other lands designated for use by successful bidder in performing the Work are identified in the IFBC documents.

All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by successful bidder. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by County unless otherwise provided in the IFBC documents.

Inspection of the Project Site(s) is a requirement to be considered for award of this bid. Prior to submitting a bid, each bidder shall examine the Project Site(s) and all conditions thereon fully familiarizing themselves with the full scope of the Work. Failure to become familiar with Project Site conditions will in no way relieve the successful bidder from the necessity of furnishing any materials or performing any Work that is required to complete the Project in accordance with the Project Plans and Specifications. Bidder shall acknowledge inspection of the Project Site(s) on his/her signed, submitted Bid Form.

#### **A.07 ADDENDA**

Any interpretations, corrections or changes to this IFBC will be made by addenda. Addenda will be posted on the Procurement Division's web page of the County website at <http://www.mymanatee.org/purchasing> > *Bids and Proposals*. For those solicitations that are advertised on DemandStar, addenda will also be posted on the DemandStar distribution system on the 'Planholders' link.

All addenda are a part of the IFBC and each Bidder will be bound by such addenda. It is the responsibility of each Bidder to read and comprehend all addenda issued. Failure of any Bidder to acknowledge an issued addendum in its Bid will not relieve the Bidder from any obligation contained therein.

#### **A.08 BID FORMS**

Bids must include the forms provided in this IFBC. If needed, additional pages may be attached to a form. Bidders must fully complete and execute all Bid Forms. Bid Forms must be executed by an authorized official of the company who has the legal authority to bind the company.

#### **A.09 BID EXPENSES**

All costs incurred by Bidder in responding to this IFBC will be the sole responsibility of the Bidder.

**A.10 QUESTION AND CLARIFICATION PERIOD**

Each Bidder shall examine all IFBC documents and will judge all matters relating to the adequacy and accuracy of such documents. Any questions or requests concerning interpretation, clarification or additional information pertaining to this IFBC, including the sample Agreement, shall be made in writing via email to the Manatee County Procurement Division to the Designated Procurement Contact or to [purchasing@mymanatee.org](mailto:purchasing@mymanatee.org). All questions received and responses given will be provided to potential bidders via an addendum to this IFBC.

Manatee County will not be responsible for oral interpretations given by other sources including County staff, representative, or others. The issuance of a written addendum by the Procurement Division is the only official method whereby interpretation, clarification or additional information will be given.

**A.11 FALSE OR MISLEADING STATEMENTS**

Bids which contain false or misleading statements or which provide references which do not support an attribute or condition claimed by the Bidder, may be rejected. If, in the opinion of the County, such information was intended to mislead the County in its evaluation of the Bid, and the attribute, condition or capability is a requirement of this IFBC. Such Bidder will be disqualified from consideration for this IFBC and may be disqualified from submitting a response on future solicitation opportunities with the County.

**A.12 CONFIDENTIALITY OF SECURITY RELATED RECORDS**

- a. Pursuant to Florida Statutes § 119.071(3), the following records (hereinafter referred to collectively as “the Confidential Security Records”) are confidential and exempt from the disclosure requirements of Florida Statutes § 119.07(1):
  - i. A Security System Plan or portion thereof for any property owned by or leased to County or any privately owned or leased property held by County.
  - ii. Building plans, blueprints, schematic drawings, and diagrams, including draft, preliminary, and final formats, which depict the internal layout and structural elements of a building, arena, stadium, water treatment facility, or other structure owned or operated by County.
  - iii. Building plans, blueprints, schematic drawings, and diagrams, including draft, preliminary, and final formats, which depict the internal layout or structural elements of an attractions and recreation facility, entertainment or resort complex, industrial complex, retail and service development, office development, or hotel or motel development in the possession of, submitted to County.
- b. Successful Bidder agrees that, as provided by Florida Statute, it shall not, as a result of a public records request, or for other reason disclose the contents of, or release or provide copies of the Confidential Security Records to any other party absent the express written authorization of County’s Property Management Director or to comply with a court order requiring such release or disclosure. To the extent successful Bidder receives a request for such records, it shall immediately contact the County’s designated Contract administrator who shall coordinate County’s response to the request.

**A.13 LOBBYING**

After the issuance of any IFBC, prospective bidders, bidders, or their agents, representatives or persons acting at the request of such bidder shall not contact, communicate with or discuss any matter relating to the IFBC with any officer, agent or employee of Manatee County other than the Procurement Official or the contact identified in this IFBC, pursuant to the Manatee County Code of Laws. This prohibition includes copying such persons on all written communication, including email correspondence. This requirement begins with the issuance of an IFBC and ends upon execution of the final Agreement or when the IFBC has been cancelled. Violators of this prohibition shall be subject to sanctions as provided in the Manatee County Code of Laws.

**A.14 UNBALANCED BIDDING PROHIBITED**

County recognizes that large and/or complex projects will often result in a variety of methods, sources, and prices. However, where in the opinion of the County such variation does not appear to be justified given bid requirements and industry and market conditions, the Bid will be presumed to be unbalanced. Examples of unbalanced Bids will include:

- a. Bids showing omissions, alterations of form, additions not specified, or required conditional or unauthorized alternate bids.
- b. Bids quoting prices that substantially deviate, either higher or lower, from those included in the Bids of competitive Bidders for the same line item unit costs.
- c. Bids where the unit costs offered are in excess of, or below reasonable cost analysis values.

In the event County determines that a Bid is presumed unbalanced, it will request the opportunity to and reserves the right to, review all source quotes, bids, price lists, letters of intent, and other supporting documentation which the Bidder obtained and upon which the Bidder relied upon to develop its Bid. County reserves the right to deem any presumptive unbalanced Bid where the Bidder is unable to demonstrate the validity and/or necessity of the unbalanced unit costs as non-responsive.

**A.15 FRONT LOADING OF BID PRICING PROHIBITED**

Prices offered for performance and/or acquisition activities which occur early in the Project Schedule, such as mobilization; clearing and grubbing; or maintenance of traffic; that are substantially higher than pricing of competitive bidders within the same portion of the Project Schedule, will be presumed to be front loaded. Front loaded bids could reasonably appear to be an attempt to obtain unjustified early payments creating a risk of insufficient incentive for the bidder to complete the Work or otherwise creating an appearance of an undercapitalized bidder.

In the event County determines that a bid is presumed to be front loaded, it will request the opportunity to, and reserves the right to, review all source quotes, bids, price lists, letters of intent, and other documents which the bidder obtained and upon which the bidder relied upon to develop the pricing or acquisition timing for these bid items. County reserves the right to reject as nonresponsive any presumptive front loaded bids where the bidder is unable to demonstrate the validity and/or necessity of the front-loaded costs.

**A.16 WITHDRAWAL OR REVISION OF BIDS**

Bidders may withdraw Bids under the following circumstances:

- a. If Bidder discovers a mistake(s) prior to the Due Date and Time. Bidder may withdraw its Bid by submitting a written notice to the Procurement Division. The notice must be received in the Procurement Division prior to the Due Date and Time for receiving Bids. A copy of the request shall be retained and the unopened Bid returned to the Bidder; or
- b. After the Bids are opened but before a contract is signed, Bidder alleges a material mistake of fact if:
  1. The mistake is clearly evident in the solicitation document; or
  2. Bidder submits evidence which clearly and convincingly demonstrates that a mistake was made in the Bid. Request to withdraw a Bid must be in writing and approved by the Procurement Official.

**A.17 IRREVOCABLE OFFER**

Any Bid may be withdrawn up until the Due Date and Time. Any Bid not so withdrawn shall, upon opening, constitute an irrevocable offer for a period of ninety (90) days to provide the goods or services set forth in this IFBC or until one or more of the Bids have been duly accepted by County, whichever occurs first.

**A.18 RESERVED RIGHTS**

County reserves the right to accept or reject any and/or all bids, to waive irregularities and minor technicalities, and to request resubmission. Also, County reserves the right to accept all or any part of the bid and to increase or decrease quantities to meet additional or reduced requirements of County. Any sole response received by the first submission date may or may not be rejected by County depending on available competition and current needs of County. For all items combined, the bid of the lowest, responsive, responsible bidder will be accepted, unless all bids are rejected.

The lowest, responsible bidder shall mean that Bidder who makes the lowest Bid to sell goods and/or services of a quality which meets or exceeds the quality of goods and/or services set forth in the IFBC documents or otherwise required by County.

To be responsive, a Bidder shall submit a Bid which conforms in all material respects to the requirements set forth in the IFBC.

To be a responsible bidder, the bidder shall have the capability in all respects to perform fully the bid requirements, and the tenacity, perseverance, experience, integrity, reliability, capacity, facilities, equipment, and credit which will assure good faith performance.

Also, County reserves the right to make such investigation as it deems necessary to determine the ability of any bidder to furnish the service requested. Information County deems necessary to make this determination shall be provided by the bidder. Such information may include, but shall not be limited to current financial statements, verification of availability of equipment and personnel, and past performance records.

**A.19 APPLICABLE LAWS**

Bidder must be authorized to transact business in the State of Florida. All applicable laws and regulations of the State of Florida and ordinances and regulations of Manatee County will apply to any resulting Agreement. Any involvement with the Manatee County Procurement Division shall be in accordance with the Manatee County Procurement Ordinance as amended.

**A.20 COLLUSION**

By submitting a bid in response to this IFBC, Bidder certifies that it has not divulged, discussed or compared its bid with any other bidder, and has not colluded with any other bidder or parties to this bid whatsoever. Further, Bidder, and in the case of a joint bid each party thereto, certifies as to their own organization, that in connection with this IFBC that:

- a. All prices and/or cost data submitted have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices and/or cost data, with any other bidder or with any competitor;
- b. All prices and/or cost data quoted for this bid have not been knowingly disclosed by the Bidder and will not knowingly be disclosed by the Bidder, prior to the scheduled opening, directly or indirectly to any other bidder or to any competitor;
- c. No attempt has been made, or will be made, by Bidder to induce any other person or firm to submit or not to submit a bid for the purpose of restricting competition;
- d. The only person or persons interested in this bid is/are named in Bidder's Bid and that no person other than those identified has any interest in the Bid or in the resulting Agreement to be entered into.
- e. No person or agency has been employed or retained to solicit or secure the resulting Agreement upon an agreement or understanding or a commission, percentage, brokerage, or contingent fee except bona fide employees or established commercial agencies maintained by Bidder for purpose of doing business.

**A.21 CODE OF ETHICS**

With respect to this and any bid, if a Bidder violates, directly or indirectly, the ethics provisions of the Manatee County Procurement Code and/or Florida criminal or civil laws related to public procurement, including but not limited to Florida Statutes Chapter 112, Part II, Code of Ethics for Public Officers and Employees, such Bidder will be ineligible for award to perform the work described in this IFBC, and may be disqualified from submitting on any future quote or bid requests to supply goods or services to Manatee County. By submitting a bid, the Bidder represents to County that all statements made and materials submitted are truthful, with no relevant facts withheld.

**A.22 PUBLIC CONTRACTING AND ENVIRONMENTAL CRIMES**

A person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime, as that term is defined in Section 287.133, Florida Statutes, may not submit a bid to provide any goods or services to a public entity; may not submit a bid with a public entity for the construction or repair of a public building or public work; may not submit bids on leases of real property to a public entity; may not be awarded or perform Work as a contractor, supplier, Subcontractor, or consultant under an agreement with any public entity; and may not transact business with any public entity in excess of the threshold amount provided in Section 287.017, Florida Statutes, for CATEGORY TWO for a period of thirty-six (36) months following the date of being placed on the convicted list.

In addition, the Manatee County Code of Laws prohibits the award of any bid to any person or entity who/which has, within the past five (5) years, been convicted of, or admitted to in court or sworn to under oath, a public entity crime or of any environmental law that, in the reasonable opinion of the Procurement Official, establishes reasonable grounds to believe the person or business entity will not conduct business in a responsible matter.

To ensure compliance with the foregoing, the Code requires all persons or entities desiring to do business with County to execute and file with the Purchasing Official an affidavit, executed under the pain and penalties of perjury, confirming that person, entity and any person(s) affiliated with the entity, does not have such a record and is therefore eligible to seek and be awarded business with County. In the case of a business entity other than a partnership or a corporation, such affidavit shall be executed by an authorized agent of the entity. In the case of a partnership, such affidavit shall be executed by the general partner(s). A Public Contracting and Environmental Crimes Certification form is attached herein for this purpose.

**A.23 SCRUTINIZED COMPANIES**

Florida Statutes § 287.135, as amended from time to time, may contain limitations on the part of a company to conduct business with the County. Submission of a response to this solicitation shall be subject to all procedural requirements contained within that statute including the submission of any required certification of eligibility to contract with the County. It shall be the responsibility of the company responding to this solicitation to concurrently review the current version of the statute and ensure it is compliant. To the extent a certification is required, it shall be provided on the form located at Appendix E *Vendor Certification Regarding Scrutinized Companies Lists*.

**A.24 AGREEMENT**

The successful Bidder will be required to execute the Agreement, a sample of which is attached hereto and made a part hereof. The County will transmit the Agreement to the successful Bidder for execution. The successful Bidder agrees to deliver the required number of duly executed copies of the Agreement, with any other required documents, to the County within ten calendar days of receipt.

**A.25 LEGAL NAME**

Bidders shall clearly indicate the full legal name, including any d/b/a, address, email address, and telephone number on the Bid Form. Bid Forms shall be signed above the typed or printed name and title of the signer. The signer must be an official of the organization and have the authority to bind the bidder to the submitted bid.

When bidder is a partnership, the Bid Form shall be signed in the name of the firm and by all partners required under the terms of the partnership agreement. When a corporation is a bidder, the authorized corporate officers shall sign.

Bidders who are corporations or limited partnerships shall provide a certified copy of their permit to transact business in the State of Florida, preferably along with the Bid Form, or within forty-eight (48) hours after request by County.

When submitting a bid as a joint venture, it must have filed paper documents with the Division of Profession's Construction Industry Licensing Board prior to submitting a bid.

**A.26 DISCOUNTS**

All discounts must be incorporated in the prices contained in the bid and not shown separately. Unless otherwise specified in this IFBC, pricing must be all inclusive, including delivery costs. The prices indicated on the Pricing Form shall be the prices used in determining award.

**A.27 TAXES**

Manatee County is exempt from Federal Excise and State Sales Taxes. (F.E.T. Cert. No. 59-78-0089K; Florida Sales Tax Exempt Cert. No. 85-8012622206C-6). Therefore, the Bidder is prohibited from delineating a separate line item in its bid for any sales or service taxes.

The successful Bidder will be responsible for the payment of taxes of any kind, including but not limited to sales, consumer, use, and other similar taxes payable on account of the work performed and/or materials furnished under the award in accordance with all applicable laws and regulations.

**A.28 QUALITY**

Unless otherwise specifically provided in the IFBC documents, all goods provided shall be new, the latest make or model, of the best quality, of the highest grade of workmanship, and of the most suitable for the purpose intended.

Unless otherwise specifically provided in the IFBC documents, reference to any equipment, material, article or patented process, by trade name, brand name, make or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition.

**A.29 AUTHORIZED PRODUCT REPRESENTATION**

Bidder, by virtue of submitting the name and specifications of a manufacturer's product, will be required to furnish the named manufacturer's product. Failure to do so may, in the County's sole discretion, be deemed a material breach of the resulting agreement and shall

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constitute grounds for County's immediate termination of the resulting agreement.

**A.30 ROYALTIES AND PATENTS**

The successful Bidder shall pay all royalties and license fees for equipment or processes in conjunction with the equipment and/or services being furnished. Successful Bidder shall defend all suits or claims for infringement of any patent, trademark or copyright, and shall save County harmless from loss on account thereof, including costs and attorney's fees.

**A.31 AMERICANS WITH DISABILITIES ACT**

Manatee County does not discriminate upon the basis of any individual's disability status. This non-discrimination policy involves every aspect of County's functions including one's access to participation, employment, or treatment in its programs or activities. Anyone requiring reasonable accommodation for an information conference or bid opening should contact the person named on the cover page of this document at least twenty-four (24) hours in advance of either activity.

**A.32 EQUAL EMPLOYMENT OPPORTUNITY**

In accordance with Title VI of the Civil Rights Act of 1964, Title 15, Part 8 of the Code of Federal Regulations and the Civil Rights Act of 1992, Manatee County hereby notifies all Bidders that it will affirmatively ensure minority business enterprises are afforded full opportunity to participate in response to this IFBC and will not be discriminated against on the grounds of race, color, national origin, religion, sex, age, handicap, or marital status in consideration of award.

**A.33 MINORITY AND/OR DISADVANTAGED BUSINESS ENTERPRISES**

The State of Florida Office of Supplier Diversity provides the certification process and maintains the database of certified MBE/DBE firms. Additional information may be obtained at [www.dms.myflorida.com/agency\\_administration/office\\_of\\_supplier\\_diversity\\_osd](http://www.dms.myflorida.com/agency_administration/office_of_supplier_diversity_osd) or by calling (850) 487-0915.

**A.34 DELIVERY**

Unless otherwise specified, all prices shall include all delivery cost (FOB Destination).

**A.35 MATHEMATICAL ERRORS**

1. Bid pricing forms without imbedded mathematical formulas: In the event of multiplication/extension error(s), the unit price shall prevail. In the event of addition error(s) the extension totals will prevail. In the event the dollar amount for contract contingency is omitted, it will be added to the total price of the Bid.
2. Bid pricing forms with imbedded mathematical formulas: Interactive bid pricing forms that contain mathematical formulas may be provided to automate lengthy and complex bid forms. In the event bid pricing forms with imbedded formulas are used and a multiplication/extension error(s) is discovered in the formula, the unit price entered by the Bidder shall prevail.
3. Bidder shall assume the responsibility and accuracy of the information input in the bid pricing form and therefore shall verify that the calculations are correct before submitting its Bid.

4. Regardless of the type of bid pricing form used, all Bids shall be reviewed mathematically by the County using these standards.

**A.36 SUBCONTRACTORS**

The successful bidder will obtain prior written approval from the County for any subcontractor(s) and the work each will perform. A subcontractor is defined as any entity performing work within the scope of the project who is not an employee of the successful Bidder.

Bidders subcontracting any portion of the work shall include a list of subcontractors along with their bid. The list shall include: name and address of subcontractor, type of work to be performed and the percent of the contract amount to be subcontracted.

**A.37 E-VERIFY**

Prior to the employment of any person under this contract, the successful Bidder shall utilize the U.S. Department of Homeland Security's E-Verify system to verify the employment eligibility of (a) all persons employed during the contract term by the successful Bidder to perform employment duties within Florida and (b) all persons, including subcontractors, assigned by the successful Bidder to perform work pursuant to the contract with Manatee County. For more information on this process, please refer to United States Citizenship and Immigration Service site at: <http://www.uscis.gov/>.

Only those individuals determined eligible to work in the United States shall be employed under this contract.

By submission of a bid in response to this IFBC, the successful Bidder commits that all employees and subcontractors will undergo e-verification before placement on this contract.

The successful Bidder shall maintain sole responsibility for the actions of its employees and subcontractors. For the life of the contract, all employees and new employees brought in after contract award shall be verified under the same requirement stated above.

**A.38 DISCLOSURE**

Upon receipt, all inquiries and responses to inquiries related to this IFBC become "Public Records," and shall be subject to public disclosure consistent with Florida Statutes, Chapter 119.

Bids become subject to disclosure thirty (30) days after the opening or if a notice of intent to award decision is made earlier than this time as provided by Florida Statutes § 119.071(1)(b). No announcement or review of the bids shall be conducted at the public opening.

Based on the above, County will receive bids at the time and date stated and will make public at the opening the names of the business entities of all that submitted a bid.

If County rejects all bids and concurrently notices its intent to reissue the solicitation, the rejected bids are exempt from public disclosure until such time as County provides notice of an intended decision concerning the reissued solicitation or until County withdraws the reissued

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solicitation. A bid is not exempt for longer than twelve (12) months after the initial notice rejecting all bids.

Pursuant to Florida Statutes 119.0701, to the extent successful Bidder is performing services on behalf of the County, successful Bidder must:

- a. Keep and maintain public records required by public agency to perform the service.
- b. Upon request from the public agency's custodian of public records, provide the public agency with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided in Florida Statutes, Chapter 119, or as otherwise provided by law.
- c. Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the contract term and following completion of the contract if the successful Bidder does not transfer the records to the public agency.
- d. Upon completion of the contract, transfer, at no cost, to the public agency all public records in possession of contractor or keep and maintain public records required by the public agency to perform the service. If the successful Bidder transfers all public records to the public agency upon completion of the contract, the successful Bidder shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If the successful Bidder keeps and maintains public records upon completion of the contract, the successful Bidder shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the public agency, upon request from public agency's custodian of public records, in a format that is compatible with the information technology systems of the public agency.

**IF THE SUCCESSFUL BIDDER HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE SUCCESSFUL BIDDER'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO ANY RESULTING CONTRACT, CONTACT COUNTY'S CUSTODIAN OF PUBLIC RECORDS AT:**

**Phone: (941) 742-5845**

**Email: [debbie.scaccianoce@mymanatee.org](mailto:debbie.scaccianoce@mymanatee.org)**

**Mail: Manatee County BCC**

**Attn: Records Manager**

**1112 Manatee Ave W.**

**Bradenton, FL 34205.**

**A.39 LOCAL PREFERENCE**

Local business is defined as a business legally authorized to engage in the sale of the goods and/or services, and which certifies within its Bid that for at least six (6) full months prior to the advertisement of this IFBC it has maintained a physical place of business in Manatee, Desoto, Hardee, Hillsborough, Pinellas or Sarasota County with at least one full-time employee at that location.

Local preference shall not apply to the following categories of agreements:

1. Purchases or agreements which are funded, in whole or in part, by a governmental or other funding entity, where the terms and conditions governing the funds prohibit the preference.
2. Any bid announcement which specifically provides that local preference, as set forth in this section, is suspended due to the unique nature of the goods or services sought, the existence of an emergency as found by either the County Commission or County Administrator, or where such suspension is, in the opinion of the County Attorney, required by law.
3. For a competitive solicitation for construction services in which fifty percent (50%) or more of the cost will be paid from state.
4. To qualify for local preference under this section, **a local business must certify to County** by completing an **"Affidavit as to Local Business Form,"** which is available for download at [www.mymanatee.org/vendor](http://www.mymanatee.org/vendor). Click on "Affidavit for Local Business" to access and print the form. Complete, notarize, and mail the notarized original to the following address: Manatee County Procurement Division, 1112 Manatee Avenue West, Suite 803, Bradenton, FL 34205.
5. It is the responsibility of the bidder to ensure accuracy of the Affidavit as to Local Business and notify County of any changes affecting same.

**A.40 VENDOR REGISTRATION**

Registering your business will provide Manatee County a sourcing opportunity to identify suppliers of needed goods and services and identify local businesses. To register as a supplier with the County go to [www.mymanatee.org/vendor](http://www.mymanatee.org/vendor). For assistance with supplier registration, call the Procurement Division main number at (941) 749-3014. Office hours are Monday – Friday, 8:00 A.M. to 5:00 P.M., excluding County holidays.

A link to Vendor Registration is listed on the Procurement Division's web page at <http://www.mymanatee.org/home/government/departments/financial-management/purchasing.html>. Click on "Register as a Vendor", then "Vendor Registration Form". Registration is not mandatory to submit a Bid.

**A.41 ENVIRONMENTAL SUSTAINABILITY**

All bidders are encouraged to use as many environmentally preferable "green" products, materials, as supplies, as possible to promote a safe and healthy environment. Environmentally preferable are products or services that have a reduced adverse effect on the environment.

Bidder shall acknowledge in its Bid if Bidder has an environmental sustainability initiative. In addition, Bidder shall submit with its Bid a brief summary of Bidder's environmental sustainability initiative. This information will be used as a determining factor in the award decision when all other factors, including local preference, are otherwise equal.

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**A.42 ePAYABLES**

Manatee County Board of County Commissioners and the Manatee County Clerk of the Circuit Court have partnered to offer the ePayables program, which allows payments to be made to vendors via credit cards.

The Clerk of the Circuit Court will issue a unique credit card number to vendor after goods are delivered or services rendered, vendors submit invoices to the remit to address on the purchase order. When payments are authorized, an email notification is sent to the vendor. The email notification includes the invoice number(s), invoice date(s), and amount of payment. There is no cost for vendors to participate in this program; however, there may be a charge by the company that processes your credit card transactions.

If Bidder is interested in participating in this program, complete the ePayables Application attached herein and return the completed form via email to [lori.bryan@manateeclerk.com](mailto:lori.bryan@manateeclerk.com).

**A.43 BASIS OF AWARD**

County will not make award to a Bidder who is delinquent in payment of any taxes, fees, fines, contractual debts, judgments, or any other debts due and owed to the County, or is in default on any contractual or regulatory obligation to the County. By submitting this solicitation response, Bidder attests that it is not delinquent in payment of any such debts due and owed to the County, nor is it in default on any contractual or regulatory obligation to the County. In the event the Bidder's statement is discovered to be false, bidder will be subject to suspension and/or debarment and the County may terminate any award it has with bidder.

Award shall be to the lowest, responsive, responsible bidder(s) meeting specifications which includes delivery time requirements, qualification requirements, and having the lowest total offer for requirements listed on the Bid Form for the Work as set forth in this IFBC. Bid prices shall include costs for furnishing all labor, equipment and/or materials for the completion of the Work to the County's satisfaction, in accordance with and in the manner set forth and described in the IFBC documents and within the prescribed time.

Multiple schedules for completion of Work shall be considered. Two bids shall be submitted and considered, Bid 'A' based on 457 calendar days completion time and Bid 'B' based on 548 calendar days completion time. County, at its sole discretion, shall select either Bid A or Bid B, whichever is in the best interest of the County. Only one (1) award will be made.

In evaluating Bids, County shall consider the qualifications of the Bidders; and if required, may also consider the qualifications of the subcontractors, suppliers, and other persons and organizations proposed. County may also consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work.

Whenever two or more responsive, responsible bids which are equal with respect to price and all other evaluation factors are received, the bid from the local business shall be given preference in award.

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Whenever two or more responsive, responsible bids which are equal with respect to price are received, and both or neither of these bids are from a local business, the award shall be determined by a chance drawing, coin toss, or similar tie-breaking method conducted by the Procurement Division and open to the public.

Bidder acknowledges that County has, or may hire, others to perform work similar to or the same as that which is within the scope of work of this IFBC. In the event that the successful Bidder cannot meet the delivery time or availability requirements of materials, the County, at its sole discretion can obtain the goods and services from other sources.

**A.44 SCOPE OF WORK**

The successful Bidder shall furnish and install all materials, equipment and labor which is reasonably inferable and necessary for the proper completion of the Work specified in this IFBC, whether specifically indicated in the IFBC or not.

The successful Bidder shall furnish all shop drawings, work drawings, labor, materials, equipment, tools, services and incidentals necessary to complete all Work required by these Specifications.

The successful Bidder shall perform the Work complete, in place and ready for continuous service and shall include any repairs, replacements, and / or restoration required as a result of damages caused prior to acceptance by the County.

The rehabilitation of electrical systems at the SWWRF & SEWRF Facilities in regard to the operation of the plant's Belt Filter Presses. Two new Belt Filter Presses, a new Polymer addition system and new sludge feed pumps are also required work at the SWWRF. See individual plans which are made part of this IFBC for specific rehabilitation requirement at each location.

**A.45 COMPLETION OF WORK**

The Work will be completed and ready for final inspection within the specified calendar days from the date the Contract Time commences to run. Completion time shall be based on Bid 'A' for 457 calendar days or Bid 'B' based on 548 calendar days completion time at the County's sole discretion.

**A.46 LIQUIDATED DAMAGES**

If the successful Bidder fails to achieve substantial completion of the Work within the contract time and as otherwise required by the Agreement (to include not only the entire Work but any portion of the Work as set forth therein), the County shall be entitled to retain or recover from the successful Bidder, as liquidated damages and not as a penalty, the sum of \$921.00 per calendar day, commencing upon the first day following expiration of the contract time and continuing until the actual date of substantial completion.

Such liquidated damages are hereby agreed to be a reasonable estimate of damages the County will incur because of delayed completion of the Work. The County may deduct liquidated damages as described in this paragraph from any unpaid amounts then or thereafter due the successful bidder under this Agreement. Any liquidated damages not so deducted from any unpaid amounts due the successful bidder shall be payable to the County at the demand of the County, together with interest from the date of the demand at the maximum allowable rate.

**A.47 CONTRACT CONTINGENCY WORK**

Contract contingency is a monetary allowance used solely at County's discretion to handle unexpected conditions as required to satisfactorily complete the Work in accordance with the IFBC documents. A Field Directive must be issued by an authorized County representative to authorize use of contract contingency funds.

The percentage for contract contingency is listed on the Bid Form. Bidder shall enter the dollar amount for contract contingency based on the percentage of the total base bid. The total contract award will include contract contingency.

Appropriate uses of contract contingency include increases to existing bid item quantities that do not change the initial scope of Work, which may be directed by County staff; modification items not originally bid which were unforeseen yet necessary during the Work to provide a safe, complete Project and that do not change the initial scope of Work; and unanticipated conflicts and/or design changes required during construction which are necessary to provide a safe, complete Project and that do not change the initial Scope of Work.

Inappropriate uses of contract contingency include anything that changes the initial scope of Work, including the Contract Sum and Contract Time, and adding bid items not previously contemplated that change the initial scope of Work.

**A.48 LICENSES AND PERMITS**

The successful Bidder shall be solely responsible for obtaining all necessary license and permit fees, including, but not limited to, all license fees, permit fees, impact fees, or inspection fees, and responsible for the costs of such fees. Successful Bidder is solely responsible for ensuring all work complies with all Federal, State, local, and Manatee County ordinances, orders, codes, laws, rules, regulations, directives, and guidelines.

**A.49 PROTEST**

Any actual bidder, proposer, or contractor who is aggrieved in connection with the notice of intent to award of a contract with a value greater than \$250,000 where such grievance is asserted to be the result of a violation of the requirements of the Manatee County Procurement Code or any applicable provision of law by the officers, agents, or employees of the County, may file a protest to the Procurement Official.

Protest must be in writing and delivered via email at [purchasing@mymanatee.org](mailto:purchasing@mymanatee.org) or by hand delivery to the Procurement Division at 1112 Manatee Avenue West, Suite 803, Bradenton, FL 34205 by 5:00 p.m. on the fifth business day following the date of posting of the Notice of Intent to Award on the County website. There is no stay of the procurement process during a protest. The Procurement Official shall have the authority to settle and resolve a protest concerning the intended award of a contract.

For additional information regarding the County protest process, visit the Procurement Division webpage on the County website.

**A.50 ACCESSIBILITY**

The County is committed to making its documents and information technologies accessible to individuals with disabilities by meeting the requirements of Section 504 of the Rehabilitation Act and best practices (W3C WCAG 2). **For assistance with accessibility regarding this solicitation, contact the Manatee County Procurement Division via email at [purchasing@mymanatee.org](mailto:purchasing@mymanatee.org) or by phone at 941-748-4501 X3014.**

Successful Bidder shall ensure all its electronic information, documents, applications, reports, and deliverables required under this Agreement are in a format that meets the requirements of Section 504 of the Rehabilitation Act and best practices (W3C WCAG 2).

Where not fully compliant with these requirements and best practices, Successful Bidder shall provide clear points of contact for each document and information technology to direct users in how to obtain alternate formats. Further, successful Bidder shall develop accommodation strategies for those non-compliant resources and implement strategies to resolve the discrepancies.

**A.51 SOLICITATION SCHEDULE**

The following schedule has been established for this Solicitation process. Refer to the County's website ([www.mymanatee.org](http://www.mymanatee.org) > Business > *Bids & Proposals*) for meeting locations and updated information pertaining to any revisions to this schedule.

Scheduled Item	Scheduled Date
Mandatory Walkthrough at the SWWRF Site, 5101 65th Street West, Bradenton, FL 34210 and a Mandatory Walkthrough at the SEWRF Site, 3331 Lena Road, Bradenton, FL 34211	August 15, 2019, 9:30 AM, ET August 16, 2019, 8:30 AM, ET,
Question and Clarification Deadline	August 23, 2019
Final Addendum Posted	August 29, 2019
Bid Response Due Date and Time	September 9, 2019, 3:00 PM, ET
Due Diligence Review Completed	September 13, 2019
Projected Award	October 2019

NOTE: Any statements contained in the Scope of Work, Bid Summary, Construction Agreement, General Conditions of the Construction Agreement and/or Exhibits which vary from the information in Section A, Information for Bidders, shall have precedence over the Information for Bidders.

**END OF SECTION A**

## **SECTION B, BID FORMS**

(To be completed and returned with Bid)

BID FORM  
(Submit in Duplicate)

SWWRF & SEWRF BELT FILTER PRESS REHABILITATION  
Bid "A" Based on Completion Time of 457 Calendar Days

Bidders must provide prices for each line item for their bid to be considered responsive.

Pay Item No.	Description	Unit	Qty	Unit Price(\$)	Total Amount (\$)
1	SWWRF - Mobilization, Demobilization and Site Work	LS	1		\$ -
2	SWWRF - Demolition	LS	1		\$ -
3	SWWRF - Structural, HVAC and Plumbing Improvements	LS	1		\$ -
4	SWWRF - BFP Improvements	LS	1		\$ -
5	SWWRF - Sludge Feed and Polymer Feed Pumps Improvements	LS	1		\$ -
6	SWWRF - Polymer System Improvements	LS	1		\$ -
7	SWWRF - Electrical and Instrumentation Improvements	LS	1		\$ -
8	SEWRF Improvements	LS	1		\$ -
SWWRF SUBTOTAL A PRICE (Total of item No. 1 -2)					
SEWRF SUBTOTAL B PRICE (Total of item No. 8)					
Construction Contingency (10% of Subtotal (A+B) Price)					
Allowance for permits and fees issued by Manatee County Government					\$ 5,000.00
TOTAL BID PRICE (Subtotal (A+B) Price plus the Construction Contingency and Allowance)					\$5,000.00

TOTAL BID PRICE written in words:

Alternates

A. Supply alternate rotar and stator configuration, as outlined per specification 11390-2.03-B.

Deductive Alternate \$

Notes: The Contractor/Installer shall provide all of the submittals required by the General Conditions, Special Conditions, and Technical Specifications of the Contract Documents, and as may be specifically required in other parts of the CONTRACT documents.

At the time bid submittal, all contractors must provide copies of all licenses and certifications as per the Contract Documents and Technical Specifications, including all federal and state required licenses and certifications.

Bidder Name:

Authorized Signature:

BID FORM  
(Submit in Duplicate)

SWWRF & SEWRF BELT FILTER PRESS REHABILITATION  
Bid "B" Based on Completion Time of 548 Calendar Days

Bidders must provide prices for each line item for their bid to be considered responsive.

Pay Item No.	Description	Unit	Qty	Unit Price(\$)	Total Amount (\$)
1	SWWRF - Mobilization, Demobilization and Site Work	LS	1		\$ -
2	SWWRF - Demolition	LS	1		\$ -
3	SWWRF - Structural, HVAC and Plumbing Improvements	LS	1		\$ -
4	SWWRF - BFP Improvements	LS	1		\$ -
5	SWWRF - Sludge Feed and Polymer Feed Pumps Improvements	LS	1		\$ -
6	SWWRF - Polymer System Improvements	LS	1		\$ -
7	SWWRF - Electrical and Instrumentation Improvements	LS	1		\$ -
8	SEWRF Improvements	LS	1		\$ -
SWWRF SUBTOTAL A PRICE (Total of item No. 1 -2)					\$0.00
SEWRF SUBTOTAL B PRICE (Total of item No. 8)					
Construction Contingency (10% of Subtotal (A+B) Price)					0.00
Allowance for permits and fees issued by Manatee County Government					\$ 5,000.00
TOTAL BID PRICE (Subtotal (A+B) Price plus the Construction Contingency and Allowance)					\$5,000.00
TOTAL BID PRICE written in words:					

Alternates

- A. Supply alternate rotar and stator configuration, as outlined per specification 11390-2.03-B.

Deductive Alternate \$ \_\_\_\_\_

Notes: The Contractor/Installer shall provide all of the submittals required by the General Conditions, Special Conditions, and Technical Specifications of the Contract Documents, and as may be specifically required in other parts of the CONTRACT documents.

At the time bid submittal, all contractors must provide copies of all licenses and certifications as per the Contract Documents and Technical Specifications, including all federal and state required licenses and certifications.

Bidder Name: \_\_\_\_\_

Authorized Signature: \_\_\_\_\_

## APPENDIX A BIDDER'S QUESTIONNAIRE

IFBC No. 19-TA003100SAM

**Bidder must fully complete and return this form with its Bid. Bidder warrants the truth and accuracy of all statements and answers herein contained. (Attach additional pages if necessary.)**

### **THIS QUESTIONNAIRE MUST BE COMPLETED AND SUBMITTED WITH YOUR BID**

1. Contact Information:

FEIN #: \_\_\_\_\_  
License #: \_\_\_\_\_  
License Issued to: \_\_\_\_\_  
Date License Issued (MM/DD/YR): \_\_\_\_\_  
Company Name: \_\_\_\_\_  
Physical Address: \_\_\_\_\_  
City: \_\_\_\_\_ State of Incorporation: \_\_\_\_\_ Zip Code: \_\_\_\_\_  
Phone Number: ( ) \_\_\_\_\_ Fax Number: ( ) \_\_\_\_\_  
Email address: \_\_\_\_\_

2. Bidding as: an individual \_\_; a partnership \_\_; a corporation \_\_; a joint venture \_\_

3. If a partnership, list names and addresses of partners; if a corporation, list names of officers, directors, shareholders, and state of incorporation; if joint venture, list names and address of ventures' and the same if any venture are a corporation for each such corporation, partnership, or joint venture:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. Bidder is authorized to do business in the State of Florida: ☐ Yes ☐ No

For how many years? \_\_\_\_\_

5. Your organization has been in business (under this firm's name) as a

\_\_\_\_\_

Is this firm in bankruptcy? \_\_\_\_\_

6. Attach a list of projects where this specific type of Work was performed.

BIDDER: \_\_\_\_\_

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7. Is this firm currently contemplating or in litigation? Provide summary details.

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8. Have you ever been assessed liquidated damages under a contract during the past five (5) years? If so, state when, where (contact name, address and phone number) and why.

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9. Have you ever failed to complete Work awarded to you? Or failed to complete projects within contract time? If so, state when, where (contact name, address, phone number) and why.

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10. Have you ever been debarred or prohibited from providing a bid to a governmental entity? If yes, name the entity and describe the circumstances.

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11. Will you subcontract any part of this Work? If so, describe which portion(s) and to whom.

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12. If any part of work will be subcontracted, list MBE/DBE/WBE/VETERAN to be utilized. Include the estimated dollar amount of the portion of Work each will perform.

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BIDDER: \_\_\_\_\_

13. What equipment do you own to accomplish this Work? (A listing may be attached)

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14. What equipment will you purchase/rent for the Work? (Specify which)

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15. If applicable to the Work for this IFBC, Drilling Supervisor Qualifications: Contractor shall provide a boring specialist who shall remain on the project site during the entirety of the directional boring operation. This includes, but is not limited to, drilling fluid preparation, seaming, boring and pulling. The boring specialist shall have a minimum of five (5) years' experience in supervising directional bores of similar nature, diameter, materials and lengths. (Reference: Specification Section 02619, Horizontal Directional Drilling).

Provide the contact information for a minimum of three (3) projects wherein the boring specialist has performed this type of work, diameter, materials and lengths.

Boring specialist's name: \_\_\_\_\_

Boring specialist's years of experience in supervising directional bores \_\_\_\_\_

Provide contact name, and contact number for projects:

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16. If applicable to the Work for this IFBC, Pipe Fusion Qualifications: All boring and fusing equipment shall be certified for operation. The Contractor responsible for thermal butt fusing pipe and fittings shall have manufacturer certification for performing such work or a minimum of five (5) years of experience performing this type of work.

Thermal butt fusing pipe and fittings contractor or subcontractor's name: \_\_\_\_\_

Attach a copy of contractor's/subcontractor's manufacturer certification to this Questionnaire

OR

Provide contractor's/subcontractor's years of experience in thermal butt fusing pipe and fittings \_\_\_\_\_

If manufacturer certification is not provided, include contact name, and contact number for projects that confirms five years of experience:

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BIDDER: \_\_\_\_\_

IFBC No. 19-TA003100SAM

17. If applicable to the Work for this IFB, Pipe Bursting Qualifications: The Contractor shall be certified by the manufacturer of the pipe bursting system that they are fully trained licensed installer of the manufacturer's pipe bursting system. Contractor shall provide a letter to the County documenting this requirement. (Reference: Specification Section 02619A, Pipe Bursting (PB) of Existing Mains).

18. List the following regarding the surety which is providing the bond(s):

Surety's Name: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

Name, address, phone number and email of surety's resident agent for service of process in Florida:

Agent's Name: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

Phone: \_\_\_\_\_

Email: \_\_\_\_\_

19. Is Bidder a local business as defined in Section A.38, Local Preference?

☐ Yes

☐ No

If yes, by signing below Bidder certifies that for at least six months prior to the advertisement date of this IFB it has maintained a physical place of business in Manatee, Desoto, Hardee, Hillsborough, Pinellas or Sarasota counties with at least one full-time employee at that location.

BIDDER: \_\_\_\_\_

BY: \_\_\_\_\_

PRINTED NAME: \_\_\_\_\_

TITLE/DATE: \_\_\_\_\_

PHYSICAL ADDRESS OF QUALIFYING LOCAL LOCATION: \_\_\_\_\_  
\_\_\_\_\_

NAME OF QUALIFYING EMPLOYEE AT LOCAL LOCATION: \_\_\_\_\_

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20. Confirm if Bidder has an environmental sustainability initiative as defined in Section A.40.

☐ Yes      ☐ No

If yes, submit a brief summary (2-3 paragraphs) of the environmental sustainability initiative.

BIDDER: \_\_\_\_\_

**APPENDIX B, ENVIRONMENTAL CRIMES CERTIFICATION**

SWORN STATEMENT PURSUANT TO ARTICLE V,  
MANATEE COUNTY PROCUREMENT CODE  
IFBC No. 19-TA003100SAM

**Bidder must fully complete and return this form with its Bid. This form must be signed and sworn to in the presence of a notary public or other official authorized to administer oaths.**

This sworn statement is submitted to the Manatee County Board of County Commissioners by

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[Print individual's name and title]

for \_\_\_\_\_ [Print name of entity submitting sworn statement]

whose business address is

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and (if applicable) its Federal Employer Identification Number (FEIN) is \_\_\_\_\_. If the entity has no FEIN, include the Social Security Number of the individual signing this sworn statement: \_\_\_\_\_.

I understand that no person or entity shall be awarded or receive an Owner's Agreement for public improvements, procurement of goods or services (including professional services) or an Owner's lease, franchise, concession or management agreement, or shall receive a grant of Owner's monies unless such person or entity has submitted a written certification to Owner that it has not:

- (1) been convicted of bribery or attempting to bribe a public officer or employee of Manatee County, the State of Florida, or any other public entity, including, but not limited to the Government of the United States, any state, or any local government authority in the United States, in that officer's or employee's official capacity; or
- (2) been convicted of an agreement or collusion among bidders or prospective bidders in restraint of freedom of competition, by agreement to bid a fixed price, or otherwise; or
- (3) been convicted of a violation of an environmental law that, in the sole opinion of Owner's Purchasing Official, reflects negatively upon the ability of the person or entity to conduct business in a responsible manner; or
- (4) made an admission of guilt of such conduct described in items (1), (2) or (3) above, which is a matter of record, but has not been prosecuted for such conduct, or has made an admission of guilt of such conduct, which is a matter of record, pursuant to formal prosecution. An admission of guilt shall be construed to include a plea of nolo contendere; or
- (5) where an officer, official, agent or employee of a business entity has been convicted of or has admitted guilt to any of the crimes set forth above on behalf of such an entity and pursuant to the direction or authorization of an official thereof (including the person committing the offense, if he is an official of the business entity), the business shall be chargeable with the conduct herein above set forth. A business entity shall be chargeable with the conduct of an affiliated entity, whether wholly owned, partially owned, or one

which has common ownership or a common Board of Directors. For purposes of this Form, business entities are affiliated if, directly or indirectly, one business entity controls or has the power to control another business entity, or if an individual or group of individuals controls or has the power to control both entities. Indicia of control shall include, without limitation, interlocking management or ownership, identity of interests among family members, shared organization of a business entity following the ineligibility of a business entity under this Article, or using substantially the same management, ownership or principles as the ineligible entity.

(Continued)

Any person or entity who claims that this Article is inapplicable to him/her/it because a conviction or judgment has been reversed by a court of competent jurisdiction shall prove the same with documentation satisfactory to Owner's Purchasing Official. Upon presentation of such satisfactory proof, the person or entity shall be allowed to contract with Owner.

I UNDERSTAND THAT THE SUBMISSION OF THIS FORM TO THE CONTRACTING OFFICER FOR MANATEE COUNTY IS VALID THROUGH DECEMBER 31 OF THE CALENDAR YEAR IN WHICH IT IS FILED. I ALSO UNDERSTAND THAT ANY AGREEMENT OR BUSINESS TRANSACTION SHALL PROVIDE FOR SUSPENSION OF PAYMENTS, OR TERMINATION, OR BOTH, IF THE CONTRACTING OFFICER OR COUNTY ADMINISTRATOR DETERMINES THAT **SUCH** PERSON OR ENTITY HAS MADE FALSE CERTIFICATION.

\_\_\_\_\_  
[Signature]

STATE OF \_\_\_\_\_  
COUNTY OF \_\_\_\_\_

Sworn to and subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_ by  
\_\_\_\_\_

Who is personally known / has produced \_\_\_\_\_ as identification  
[Type of identification]

My commission expires \_\_\_\_\_

\_\_\_\_\_  
Notary Public Signature

\_\_\_\_\_  
[Print, type or stamp Commissioned name of Notary Public]

**Signatory Requirement** - In the case of a business entity other than a partnership or a corporation, this affidavit shall be executed by an authorized agent of the entity. In the case of a partnership, this affidavit shall be executed by the general partner(s). In the case of a corporation, this affidavit shall be executed by the corporate president.

**APPENDIX C FLORIDA TRENCH SAFETY ACT**  
**IFBC No. 19-TA003100SAM**

**Bidder must fully complete and return this form with its Bid. This form must be signed in the presence of a notary public or by an officer authorized to administer oaths.**

1. This Sworn Statement is submitted with **IFBC NO. 19-TA003100SAM**
2. This Sworn Statement is submitted by \_\_\_\_\_ whose business address is \_\_\_\_\_ and, if applicable, its Federal Employer Identification Number (FEIN) is \_\_\_\_\_. If the entity has no FEIN, include the Social Security Number of the individual signing this sworn statement \_\_\_\_\_.
3. Name of individual signing this Sworn Statement is: \_\_\_\_\_  
 Whose relationship to the above entity is: \_\_\_\_\_.
4. The Trench Safety Standards that will be in effect during the construction of this project shall include, but are not limited to: Laws of Florida, Chapters 90-96, TRENCH SAFETY ACT, and OSHA RULES AND REGULATIONS 29 CFR 1926.650 Subpart P, effective October 1, 1990.
5. The undersigned assures that the entity will comply with the applicable Trench Safety Standards and agrees to indemnify and hold harmless the County and Engineer of Record, and any of their agents or employees from any claims arising from the failure to comply with said standard.
6. The undersigned has appropriated the following costs for compliance with the applicable standards:

Trench Safety Measure (Description)	Units of MeasureUnit (LF, SY)	Quantity	Unit Cost	Extended Cost
a. _____	_____	_____	\$ _____	_____
b. _____	_____	_____	\$ _____	_____
c. _____	_____	_____	\$ _____	_____
d. _____	_____	_____	\$ _____	_____

7. The undersigned intends to comply with these standards by instituting the following procedures:

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THE UNDERSIGNED, in submitting this bid, represents that they have reviewed and considered all available geotechnical information and made such other investigations and tests as they may deem necessary to adequately design the trench safety system(s) to be utilized on this project.

\_\_\_\_\_  
 (Authorized signature / Title)

SWORN to and subscribed before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.  
**(Impress official seal)**

Notary Public, State of Florida: \_\_\_\_\_

My commission expires: \_\_\_\_\_



# Angelina M. Colonnese

CLERK OF THE CIRCUIT COURT AND COMPTROLLER OF MANATEE COUNTY

1115 Manatee Avenue West, Bradenton, Florida 34205 - Phone (941) 749-1800 Fax (941) 741-4082, P.O. Box 25400, Bradenton, Florida 34206 - [www.manateeclerk.com](http://www.manateeclerk.com)

**Bidder must fully complete and return this form with its Bid.**

## APPENDIX D: ePAYABLES APPLICATION

IFBC No. 19-TA003100SAM

Company name\_\_\_\_\_

Contact person\_\_\_\_\_

Phone number\_\_\_\_\_

Email Address\_\_\_\_\_

FINANCE USE ONLY

Open orders: YES or NO

PEID \_\_\_\_\_

CREATE DATE \_\_\_\_\_

CONFIRMED WITH

\_\_\_\_\_  
Name and phone number

IFAS \_\_\_\_\_

BANK \_\_\_\_\_

INITIALS \_\_\_\_\_

Return completed form to:

Via email to:

[lori.bryan@manateeclerk.com](mailto:lori.bryan@manateeclerk.com)

Via fax to: (941) 741-4011

Via mail:

PO Box 1000

Bradenton, FL 34206

Revised: September 30, 2015

"Pride in Service with a Vision to the Future"

Clerk of the Circuit Court – Clerk of Board of County Commissioners – County Comptroller – Auditor and Recorder

## APPENDIX E Scrutinized Company Certification

IFBC No. 19-TA003100SAM

This certification is required pursuant to Florida State Statute Section 287.135.

As of July 1, 2011, a company that, at the time of bidding or submitting a proposal for a new contract or renewal of an existing contract, is on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List is ineligible for, and may not bid on, submit a proposal for, or enter into or renew a contract with an agency or local governmental entity for goods or services of \$1 million or more.

**Bidder must fully complete and return this form with its Bid.**

Company \_\_\_\_\_ FID or EIN No. \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

I, \_\_\_\_\_, as a representative of \_\_\_\_\_

certify and affirm that this company is not on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Title

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Date

## APPENDIX F MINIMUM QUALIFICATIONS

IFBC No. 19-TA003100SAM

Bidders must submit the information and documentation requested in this Attachment that confirms Bidder meets the following minimum qualification requirement(s):

1. Must have been registered with the State of Florida, Division of Corporations to do business in Florida for the past three years, since August 2016.

**No documentation is required. The County will verify registration.**

2. A bidder, or its representative, attended the mandatory site visits at: SWWRF Site, 5101 65th Street West, Bradenton, FL 34210 AND SEWRF Site, 3331 Lena Road, Bradenton, FL 34211.

**No documentation is required for attendance to the mandatory Information Conference and site visit. The County will verify attendance from the meeting sign-in sheets.**

3. Must have possessed a General Contractor's license issued by the Florida Department of Business and Professional Regulation for a period of at least three (3) consecutive years since August 2016. License must be current and valid through the Due Date for submission of bids for this IFBC.

**Provide a copy of Bidder's General Contractor's license issued by the Florida Department of Business and Professional Regulation and documentation confirming Bidder has been licensed and/or certified for the period of August 2016 through the date of submission of the Bid.**

4. Bidder has provided services for at least three clients in which each project include i) instrumentation and controls; AND (ii) selective site demolition of HVAC components and concrete/CMU since August 2016

**Provide the following information for the three qualifying clients.**

- a) Name of client
- b) Location (City/State)
- c) Client contact name
- d) Contact phone
- e) Contact email
- f) Service dates (Start/End)

5. Bidder has provided belt filter press construction services and electrical rehabilitation relating to Belt Filter Presses for at least one (1) clients since August 1, 2016.

**Provide the following information for the one qualifying clients.**

- a) Name of client
- b) Location (City/State)
- c) Client contact name

- d) **Contact phone**
- e) **Contact email**
- f) **Service dates (Start/End)**

6. Bidder, on the day the bid is submitted, has a certified or registered Qualifying Agent, as required by Section 489.119, Florida Statutes, and that Qualifying Agent has been the same Qualifying Agent of Bidder for a period of at least three consecutive years, since August 1, 2016.

**Submit a copy of Bidder's Qualifying Agent's registration or certification along with supporting documentation confirming Qualifying Agent has been the Qualifying Agent for Bidder for three years, since August 1, 2016.**

7. If Bidder is submitting as a joint venture must file the required documents with the Florida Department of Business and Professional Regulation as required by Florida Statute Section 489.119, prior to the Due Date and Time.

**If Bidder is a joint venture, provide a copy of Bidder's approved filing with the Florida Department of Business and Professional Regulation. If Bidder is not a joint venture, provide a statement to that effect.**

8. Bidder has no reported conflict of interests in relation to this IFBC.

**Submit a fully completed copy of Appendix J. If applicable, on a separate page disclose the name of any officer, director or agent who is also an employee of the County. Disclose the name of any County employee who owns, directly or indirectly, any interest in the Bidder's firm or any of its branches. If no conflicts of interests are present, Bidder must submit a statement to that effect.**

**APPENDIX G**  
**INSURANCE STATEMENT**

IFBC No. 19-TA003100SAM

**Bidder must fully complete and return this form with its Bid.**

THE UNDERSIGNED has read and understands the insurance requirements of this IFBC applicable to any contract resulting from this solicitation and shall provide the insurances required by this Attachment within ten (10) days from the date of Notice of Intent to Award.

Bidder Name: \_\_\_\_\_ Date: \_\_\_\_\_

Signature  
(Authorized  
Official): \_\_\_\_\_

Printed Name/Title: \_\_\_\_\_

Insurance Agency: \_\_\_\_\_

Agent Name: \_\_\_\_\_ Agent Phone: \_\_\_\_\_

## APPENDIX H, ACKNOWLEDGMENT OF ADDENDA

IFBC No. 19-TA003100SAM

The undersigned acknowledges receipt of the following addenda:

Addendum No. _____	Date Received:
Addendum No. _____	Date Received:
Addendum No. _____	Date Received:
Addendum No. _____	Date Received:
Addendum No. _____	Date Received:
Addendum No. _____	Date Received:
Addendum No. _____	Date Received:
Addendum No. _____	Date Received:
Addendum No. _____	Date Received:

Print or type Bidder's information below:

_____ Name of Bidder	_____ Telephone Number
_____ Street Address	_____ City/State/Zip
_____ Email Address	
_____ Print Name & Title of Authorized Officer	_____ Signature of Authorized Official Date

## **APPENDIX I, BID PRICING FORM**

### **SWWRF & SEWRF BELT FILTER PRESS REHABILITATION**

**Total Bid Price/Offer for Bid "A":** \$\_\_\_\_\_ Complete. Based on a completion time of 457 calendar days.

**Total Bid Price/Offer for Bid "B":** \$\_\_\_\_\_ Complete Based on a completion time of 548 calendar days.

We, the undersigned, hereby declare that we have carefully reviewed the IFB Documents in their entirety and with full knowledge and understanding of the Bid information and all its requirements, submit this Bid, which is complete in meeting each specification, term and condition contained herein.

As Bidder, we understand that the IFB documents, including but not limited to, all specifications, terms and conditions shall be made a part of any resulting Agreement between County and the successful Bidder. Failure by successful Bidder to comply with such specifications, terms and conditions shall result in Agreement Default, whereupon, the defaulting successful Bidder shall be required to pay for all re-procurement costs, damages, and attorney fees incurred by County, and agrees to forfeit its bid bond.

**Authorized Signature(s):**\_\_\_\_\_

Name and Title of Above Signer(s):\_\_\_\_\_

Date:\_\_\_\_\_

**APPENDIX J, AFFIDAVIT OF NO CONFLICT**

IFBC No. 19-TA003100SAM

COUNTY OF \_\_\_\_\_

STATE OF \_\_\_\_\_

BEFORE ME, the undersigned authority, this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_ personally appeared, \_\_\_\_\_, a principal with full authority to bind \_\_\_\_\_ (hereinafter the "Affiant"), who being first duly sworn, deposes and says:

(a) is not currently engaged or will not become engaged in any obligations, undertakings or contracts that will require the Affiant to maintain an adversarial role against the County or that will impair or influence the advice, recommendations or quality of work provided to the County; and

(b) has provided full disclosure of all potentially conflicting contractual relationships and full disclosure of contractual relationships deemed to raise a question of conflict(s); and

(c) has provided full disclosure of prior work history and qualifications that may be deemed to raise possible question of conflict(s).

Affiant makes this affidavit for the purpose of inducing Manatee County, a political subdivision of the State of Florida, to enter into an Agreement for SWWRF & SEWRF Belt Filter Press Rehabilitation.

If applicable, on a separate page Bidder shall disclose the name of any officer, director or agent of Bidder who is also an employee of the County and the name of any County employee who owns, directly or indirectly, any interest in the Bidder's firm or any of its branches. If no conflicts of interest are present, submit a statement to that affect.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Print Name

SUBSCRIBED to and sworn before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

[Notary Seal]

Notary Public

My commission expires: \_\_\_\_\_

\_\_\_\_\_  
Notary Signature

\_\_\_\_\_  
Print Name

Personally known OR produced identification. Type of identification produced \_\_\_\_\_  
\_\_\_\_\_.

SECTION C

SAMPLE  
CONSTRUCTION AGREEMENT

*for*

STIPULATED SUM

*between*

MANATEE COUNTY (AS OWNER)

*and*

\_\_\_\_\_ (AS CONTRACTOR)

**CONSTRUCTION AGREEMENT FOR  
STIPULATED SUM  
[PROJECT NAME]**

**THIS AGREEMENT** ("Agreement") is made and entered into by and between Manatee County, a political subdivision of the State of Florida, referred to herein as "Owner", and the firm of \_\_\_\_\_, incorporated in the State of \_\_\_\_\_ and registered and licensed to do business in the State of Florida (license # \_\_\_\_\_), referred to herein as "Contractor."

**WHEREAS**, the Owner intends to construct [PROJECT DESCRIPTION], the aforementioned improvements being hereinafter referred to and defined as the "Project"; and

**WHEREAS**, in response to Owner's Invitation for Bid No. \_\_\_\_\_ (the "IFB"), Contractor has submitted its Bid (the "Contractor's Bid") to provide the aforementioned construction services.

**NOW THEREFORE**, the Owner and the Contractor, in consideration of the mutual covenants hereinafter set forth, the sufficiency of which is hereby acknowledged, agree as follows:

**1. Contract Documents.** The Contract Documents consist of this Agreement and attached Exhibits, the attached General Conditions of the Construction Agreement, Supplementary Conditions (if any), Special Conditions (if any), Drawings (the titles of which are attached hereto as Exhibit A), Specifications (the titles of which are attached hereto as Exhibit B), Addenda issued prior to execution of this Agreement, the Invitation for Bid (including any Instructions to Bidders, Scope of Work, Bid Summary, Supplements, and Technical Specifications), any interpretations issued pursuant to the Invitation for Bid, the Contractor's Bid, permits, notice of intent to award, Notice to Proceed, purchase order(s), any other documents listed in this Agreement, and Modifications [to include written Amendment(s), Change Order(s), Work Directive Change(s) and Field Directive(s)] issued after execution of this Agreement. These form the Agreement, and are as fully a part of the Agreement as if attached or repeated herein. This Agreement represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. No other documents shall be considered Contract Documents.

**2. Work.** The Contractor shall fully execute the Work described in the Contract Documents, except to the extent specifically indicated in the Contract Documents to be the responsibility of others.

**3. Date of Commencement and Substantial Completion.**

A. Date of Commencement. The date of commencement of the Work shall be the date fixed in a Notice to Proceed issued by the Owner.

B. Contract Time. The Contract Time shall be measured from the date of commencement.

C. Substantial Completion. The Contractor shall achieve Substantial Completion of the entire Work not later than \_\_\_\_ days from the date of commencement, or as follows:

**Portion of Work**

**Substantial Completion Date**

subject to adjustments of this Contract Time as provided in the Contract Documents.

Time is of the essence in the Contract Documents and all obligations thereunder. If the Contractor fails to achieve Substantial Completion of the Work within the Contract Time and as otherwise required by the Contract Documents (to include not only the entire Work but any portion of the Work as set forth above), the Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, the sum of \$\_\_\_\_\_ per calendar day, commencing upon the first day following expiration of the Contract Time and continuing until the actual date of Substantial Completion. Such liquidated damages are hereby agreed to be a reasonable estimate of damages the Owner will incur because of delayed completion of the Work. The Owner may deduct liquidated damages as described in this paragraph from any unpaid amounts then or thereafter due the Contractor under this Agreement. Any liquidated damages not so deducted from any unpaid amounts due the Contractor shall be payable to the Owner at the demand of the Owner, together with interest from the date of the demand at the maximum allowable rate.

#### **4. Contract Sum.**

A. Payment. The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be \_\_\_\_\_ Dollars and Zero Cents (\$\_\_\_\_\_), subject to additions and deductions as provided in the Contract Documents.

B. Alternates. The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner. *(State the numbers or other identification of accepted alternates. If decisions on other alternates are to be made by the Owner subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)*

C. Unit Prices. Unit prices, if any, are reflected in the Contractor's Bid.

#### **5. Payments.**

##### A. Progress Payments.

- (1) Based upon Applications for Payment submitted to the Architect/Engineer by the Contractor and Certificates for Payment issued by the Architect/Engineer, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.
- (2) The period covered by each Application for Payment shall be one calendar month ending on the last day of the month.
- (3) Payments shall be made by Owner in accordance with the requirements of Section 218.735, Florida Statutes.
- (4) Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form and supported by such data to substantiate its accuracy as the Architect/Engineer may

require. This schedule, unless objected to by the Owner or Architect/Engineer, shall be used as a basis for reviewing the Contractor's Applications for Payment.

- (5) Applications for Payment shall indicate the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.
- (6) Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:
  - i. Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of ten percent (10.00%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 3.3.B. of the General Conditions;
  - ii. Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), supported by paid receipts, less retainage of ten percent (10.00%);
  - iii. Subtract the aggregate of previous payments made by the Owner; and
  - iv. Subtract amounts, if any, for which the Architect/Engineer has withheld or nullified an Application for Payment, in whole or in part as provided in Section 3.3.C. of the General Conditions.
- (7) The progress payment amount determined in accordance with Section 5.A(6) shall be further modified under the following circumstances:
  - i. Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect/Engineer shall determine for incomplete Work, retainage applicable to such work and unsettled claims.
  - ii. Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 3.2.B. of the General Conditions.
- (8) Reduction or limitation of retainage, if any, shall be as follows:

Notwithstanding the foregoing, upon completion of at least 50% of the Work, as determined by the Architect/Engineer and Owner, the Owner shall reduce to five percent (5%) the amount of retainage withheld from each subsequent progress payment.

- (9) Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

B. Final Payment. Final Payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when:

- (1) The Contractor has fully performed the Work except for the Contractor's responsibility to correct Work as provided in Section 2.4.C. of the General Conditions, and to satisfy other requirements, if any, which extend beyond final payment; and
- (2) A final Application for Payment has been approved by the Architect/Engineer.

## **6. Termination or Suspension.**

A. Termination. The Agreement may be terminated by the Owner or the Contractor as provided in Article XIV of the General Conditions.

B. Suspension by Owner. The Work may be suspended by the Owner as provided in Article XIV of the General Conditions.

## **7. Other Provisions.**

A. Substantial Completion Defined. Substantial Completion shall be defined as provided in Article I of the General Conditions. In the event a temporary certificate of occupancy or completion is issued establishing Substantial Completion, the Contractor shall diligently pursue the issuance of a permanent certificate of occupancy or completion.

B. Project Meetings. There shall be a project meeting, at the jobsite or other location acceptable to the parties, on a regularly scheduled basis. The meeting will be attended by a representative of the Contractor, Architect/Engineer and Owner. These representatives shall be authorized to make decisions that are not otherwise contrary to the requirements of this Agreement.

C. Weather. Any rainfall, temperatures below 32 degrees Fahrenheit or winds greater than 25 m.p.h. which actually prevents Work on a given day, shall be considered lost time and an additional day added to the Contract Time, provided no work could be done on site, and provided written notice has been submitted to the Owner by the Contractor documenting same.

D. Shop Drawings; Critical Submittals. In consideration of the impact of timely review of submittals and shop drawings on the overall progress of the Work, it is hereby agreed that the Owner shall cause his agents and design professionals to accomplish the review of any particular "critical" submittals and/or shop drawings and return same to the Contractor within fourteen (14) days.

E. Applications for Payment. Applications for Payment shall be submitted once monthly at regular intervals and shall include detailed documentation of all costs incurred.

F. Punch List. Within 30 days after obtainment of Substantial Completion, the Owner shall generate a “punch list” of all work items requiring remedial attention by the Contractor. Within 5 days thereafter the Architect/Engineer shall assign a fair value to the punch list items, which sum shall be deducted from the next scheduled progress payment to the Contractor. Upon satisfactory completion of the punch list items, as certified by the Architect/Engineer, the previously deducted sum shall be paid to the Contractor.

G. Closeout documentation. Within 30 days after obtainment of Substantial Completion and before final payment, Contractor shall gather and deliver to Owner all warranty documentation, all manufacturer’s product and warranty literature, all manuals (including parts and technical manuals), all schematics and handbooks, and all as-built drawings.

H. Governing Provisions; Conflicts. In the event of a conflict between this Agreement and the Specifications or as between the General Conditions and the Specifications, the Specifications shall govern.

I. E-Verify. The Contractor’s employment of unauthorized aliens is a violation of Section 274(e) of the Federal Immigration and Employment Act. The Contractor shall utilize the U.S. Department of Homeland Security E-Verify system to verify the employment eligibility of all new employees hired during the term of this Agreement, and shall require the same verification procedure of all Subcontractors.

**8. Insurance and Bonding.** If and to the extent required by the Invitation for Bid documents, the Contractor shall furnish insurance coverage for (but not necessarily limited to) workers’ compensation, commercial general liability, auto liability, excess liability, and builder’s risk. The Contractor shall furnish to the Owner all appropriate policies and Certificate(s) of Insurance. The Contractor shall also post a Payment and Performance Bond for the Contract Sum, within ten (\_\_\_) days following notification of intent to award, and otherwise in accordance with the Invitation for Bid documents.

**9. Independent Contractor.** The Contractor acknowledges that it is functioning as an independent contractor in performing under the terms of this Agreement, and it is not acting as an employee of the Owner.

**10. Entire Agreement.** This Agreement (inclusive of the Contract Documents incorporated herein by reference) represents the full agreement of the parties.

**11. Amendments; Waivers; Assignment.**

A. Amendments. This Agreement may be amended only pursuant to an instrument in writing that has been jointly executed by authorized representatives of the parties hereto.

B. Waivers. Neither this Agreement nor any portion of it may be modified or waived orally. However, each party (through its governing body or properly authorized officer) shall have the right, but not the obligation, to waive, on a case-by-case basis, any right or condition herein reserved or intended for the benefit or protection of such party without being deemed or considered to have waived such right or condition for any other case, situation, or circumstance and without being deemed or considered to have waived any other right or condition. No such waiver shall be effective unless made in writing with an

express and specific statement of the intent of such governing body or officer to provide such waiver.

C. Assignment. The rights and obligations of either party to this Agreement may be assigned to a third party only pursuant to a written amendment hereto.

**12. Validity.** Each of the Owner and Contractor represents and warrants to the other its respective authority to enter into this Agreement.

**13. Covenant To Defend.** Neither the validity of this Agreement nor the validity of any portion hereof may be challenged by any party hereto, and each party hereto hereby waives any right to initiate any such challenge. Furthermore, if this Agreement or any portion hereof is challenged by a third party in any judicial, administrative, or appellate proceeding (each party hereby covenanting with the other party not to initiate, encourage, foster, promote, cooperate with, or acquiesce to such challenge), the parties hereto collectively and individually agree, at their individual sole cost and expense, to defend in good faith its validity through a final judicial determination or other resolution, unless all parties mutually agree in writing not to defend such challenge or not to appeal any decision invalidating this Agreement or any portion thereof.

**14. Disclaimer of Third-Party Beneficiaries; Successors and Assigns.** This Agreement is solely for the benefit of the parties hereto, and no right, privilege, or cause of action shall by reason hereof accrue upon, to, or for the benefit of any third party. Nothing in this Agreement is intended or shall be construed to confer upon or give any person, corporation, partnership, trust, private entity, agency, or other governmental entity any right, privilege, remedy, or claim under or by reason of this Agreement or any provisions or conditions hereof. This Agreement shall be binding upon, and its benefits and advantages shall inure to, the successors and assigns of the parties hereto.

**15. Construction.**

A. Headings and Captions. The headings and captions of articles, sections, and paragraphs used in this Agreement are for convenience of reference only and are not intended to define or limit their contents, nor are they to affect the construction of or be taken into consideration in interpreting this Agreement.

B. Legal References. All references to statutory sections or chapters shall be construed to include subsequent amendments to such provisions, and to refer to the successor provision of any such provision. References to “applicable law” and “general law” shall be construed to include provisions of local, state and federal law, whether established by legislative action, administrative rule or regulation, or judicial decision.

**16. Severability.** The provisions of this Agreement are declared by the parties hereto to be severable. In the event any term or provision of this Agreement shall be held invalid by a court of competent jurisdiction, such invalid term or provision should not affect the validity of any other term or provision hereof; and all such terms and provisions hereof shall be enforceable to the fullest extent permitted by law as if such invalid term or provision had never been part of this Agreement; provided, however, if any term or provision of this Agreement is held to be invalid due to the scope or extent thereof, then, to the extent permitted by law, such term or provision shall be automatically deemed modified in order that it may be enforced to the maximum scope and extent permitted by law.

**17. Governing Law; Venue.** This Agreement shall be governed by the laws of the State of Florida. Venue for any petition for writ of certiorari or other court action allowed by this Agreement shall be in the Circuit Court of the Twelfth Judicial Circuit in and for Manatee County, Florida.

**18. Attorney's Fees and Costs.** In any claim dispute procedure or litigation arising from this Agreement, each party hereto shall be solely responsible for paying its attorney's fees and costs.

**19. Notices.** All notices, comments, consents, objections, approvals, waivers, and elections under this Agreement shall be in writing and shall be given only by hand delivery for which a receipt is obtained, or certified mail, prepaid with confirmation of delivery requested, or by electronic mail with delivery confirmation. All such communications shall be addressed to the applicable addressees set forth below or as any party may otherwise designate in the manner prescribed herein.

To the Owner:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Email: \_\_\_\_\_

To the Contractor:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Email: \_\_\_\_\_

Notices, comments, consents, objections, approvals, waivers, and elections shall be deemed given when received by the party for whom such communication is intended at such party's address herein specified, or such other physical address or email address as such party may have substituted by notice to the other.

**20. Public Records Law.** The Contractor shall comply with the Florida Public Records Act (Chapter 119, Florida Statutes), and shall:

- A. Keep and maintain public records required by the Owner to perform the services called for in this Agreement.
- B. Upon request from the Owner's custodian of public records, provide the Owner with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided in Chapter 119, Florida Statutes or as otherwise provided by law.
- C. Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of this Agreement and following completion of this Agreement if the Contractor does not transfer the records to the Owner.
- D. Upon completion of this Agreement, transfer, at no cost, to the Owner all public records in possession of the Contractor or keep and maintain such public records. If the Contractor transfers all public records to the Owner upon completion of the

Agreement, the Contractor shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If the Contractor keeps and maintains public records upon completion of the Agreement, the Contractor shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the Owner, upon request from the Owner's custodian of public records, in a format that is compatible with the information technology systems of the Owner.

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS AGREEMENT, CONTACT THE OWNER'S CUSTODIAN OF PUBLIC RECORDS AT 941-748-4501, EXT. 5845; [DEBBIE.SCACCIAOCE@MYMANATEE.ORG](mailto:DEBBIE.SCACCIAOCE@MYMANATEE.ORG); POST OFFICE BOX 1000, BRADENTON, FLORIDA 34206.

**21. Exhibits.** Exhibits to this Agreement are as follows:

Exhibit A—Title(s) of Drawings

Exhibit B—Title(s) of Specifications

Exhibit C—Affidavit of No Conflict

Exhibit D—Certificate(s) of Insurance

Exhibit E—Payment and Performance Bond

Exhibit F—Standard Forms

- 1—Application for Payment
- 2—Certificate of Substantial Completion
- 3—Final Reconciliation / Warranty / Affidavit
- 4—Change Order

***WHEREFORE, the parties hereto have executed this Agreement as of the date last executed below.***

\_\_\_\_\_  
Name of Contractor

By: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

**MANATEE COUNTY**, a political subdivision  
of the State of Florida

By: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

## Construction Agreement

### Exhibits & Standard Forms

- A. Exhibit A Drawings
- B. Exhibit B Specifications
- C. Exhibit C Affidavit of No Conflict
- D. Exhibit D Contractor's Certificate(s) of Insurance
- E. Exhibit E Contractor's Payment and Performance Bond
- F. Exhibit F Standard Forms
  - i. Application for Payment
  - ii. Contract Change Order
  - iii. Administrative Contract Adjustment (ACA)
  - iv. Certificate of Substantial Completion
  - v. Final Reconciliation Warranty Period Declaration and Contractor's Affidavit
  - vi. Public Construction Bond

Construction Agreement  
Exhibit A  
Title(s) of Drawings  
(To be inserted prior to final execution)

Title  
PROJECT NO.number

1 – 7 pages

(Signed and Sealed date)

Construction Agreement  
Exhibit B  
Title(s) of Specifications  
(To be inserted prior to final execution)

Contract Documents / Specifications  
For

Title  
PROJECT NO.

(Dated date— number pages)

Construction Agreement  
Exhibit C, Affidavit of No Conflict

COUNTY OF \_\_\_\_\_,  
STATE OF \_\_\_\_\_.

BEFORE ME, the undersigned authority, this day personally appeared,  
\_\_\_\_\_, a principal with full authority to bind  
\_\_\_\_\_ hereinafter the "Lessee"), who being first  
duly sworn, deposes and says:

(a) is not currently engaged or will not become engaged in any obligations, undertakings or contracts that will require the Lessee to maintain an adversarial role against the County or that will impair or influence the advice, recommendations or quality of work provided to the County; and

(b) has provided full disclosure of all potentially conflicting contractual relationships and full disclosure of contractual relationships deemed to raise a question of conflict(s); and

(c) has provided full disclosure of prior work history and qualifications that may be deemed to raise possible question of conflict(s).

Affiant makes this affidavit for the purpose of inducing Manatee County, a political subdivision of the State of Florida, to enter into this Agreement for

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Print Name

SUBSCRIBED to and sworn before me this \_\_\_\_ day of \_\_\_\_\_, 20\_\_.

[Notary Seal]

Notary Public

My commission expires: \_\_\_\_\_

\_\_\_\_\_  
Notary Signature

\_\_\_\_\_  
Print Name

\_\_\_\_\_ is Personally Known  
OR Produced Identification in the form of \_\_\_\_\_ (Type of  
Identification Produced)

Construction Agreement  
Exhibit D Contractor's Certificate(s) of Insurance

(to be inserted prior to final execution)

Construction Agreement  
Exhibit E Contractor's Payment and Performance Bond

(To be inserted prior to final execution)

## Exhibit F Standard Forms

## Application for Payment

<b>APPLICATION FOR PAYMENT</b>				Request No.: _____ Project No.: _____
Project: _____				Purchase Order No.: _____
From: _____ To: _____				County Bid No.: _____
				Consultant: _____

<b>CONTRACT PAYMENT SUMMARY</b>				
Original Contract Amount:				\$ -
Change Order(s):				\$ -
Change order summary:				
Number	Date Approved	Additive	Deductive	
SUBTOTALS:		\$ -	\$ -	
Net change order subtotal (Additive less Deductive):				\$ -
Current Contract Amount (CCA): (Original Amount + Change Order(s))				\$ -
		Previous Status	Total WIP	
Value of the Work in Place (WIP)		\$ -	\$ -	
Value of Stored Materials		\$ -	\$ -	
Total Earned (\$ and % of CCA)		\$ -	\$ -	
Retainage (\$ and % of CCA)		\$ -	\$ -	
Net Earned (Total earned minus retainage)				
TOTAL PREVIOUS PAYMENTS				\$ -
AMOUNT DUE THIS PAYMENT (Net Earned minus Previous Payments)				\$ -

### CONTRACTOR'S AFFIDAVIT OF NOTICE

CERTIFICATE: The undersigned CONTRACTOR certifies that all items and amounts shown on this Application for Payment are

the Amount Due this Payment shown is now due.

**NOTARY:**

**CONTRACTOR:**

State of Florida, County of \_\_\_\_\_

\_\_\_\_\_  
Name of person authorized to sign Affidavit of Notice

Sworn to (or affirmed ) and subscribed before me

this \_\_\_\_\_ day of \_\_\_\_\_ by

\_\_\_\_\_  
TITLE

\_\_\_\_\_  
(Name of person giving notice)

\_\_\_\_\_  
Contractor name, address and telephone no.:

\_\_\_\_\_  
(Signature of Notary Public - State of Florida)

Print, Type or Stamp Commissioned Name of  
Notary Public:

Personally Known \_\_\_\_\_ or Produced Identification \_\_\_\_\_

Type of Identification Produced: \_\_\_\_\_

VERIFICATION, RECOMMENDATION, CONCURRENCES AND APPROVALS

(Signatures)

(Date)

Quantities verified by:

Consultant/Engineer:

Project Management:

Department Head:

Payment approved by  
the

Board of County Commissioners:

Attested to by the Clerk of Circuit Court:

Contract Change Order

<b>CONTRACT CHANGE ORDER</b>  (for Total Contract Adjusted Amount Greater than \$1,000,000)  <b>PROJECT:</b>		<b>Change Order No.:</b>	
		<b>Contract Amount (Present Value)</b>	
		<b>Project Number:</b>	
<b>NO. OF ITEM</b>	<b>DESCRIPTION OF ITEM AND CHANGE</b>	<b>DECREASE</b>	<b>INCREASE</b>
	BY EXECUTION OF THIS CHANGE ORDER THE CONTRACTOR AGREES THAT ALL CLAIMS FOR ADDITIONAL CONTRACT TIME AND FEES FOR THE ITEMS IN THIS CHANGE ORDER HAVE BEEN SATISFIED.		
		<b>TOTAL DECREASE:</b>	<b>TOTAL INCREASE:</b>
<b>Contractor:</b> _____  <b>Address:</b> _____  <b>City / State:</b> _____		THE NET CHANGE OF \$  ADJUSTS THE CURRENT CONTRACT AMOUNT FROM  TO	
<b>Contractor Signature:</b> _____ <b>Date:</b> _____			
		_____ CALENDAR DAYS ARE ADDED TO THE SCHEDULE WHICH CHANGES THE FINAL COMPLETION DATE TO [ENTER MONTH DAY, YEAR]	
<b>RECOMMENDATION, CONCURRENCES AND APPROVALS</b>			

	<b>SIGNATURES</b>	<b>DATE</b>
<b>Consultant / Engineer:</b>	_____	_____
<b>Project Manager:</b>	_____	_____
<b>Division Manager:</b>	_____	_____
<b>Manatee County Purchasing:</b>	<b>Project Management Div. Mgr</b> _____	_____
	<b>Purchasing Official</b> _____	_____
<p>Authority to execute this contract per Manatee County Code, Chapter 2-26, and per the delegation by the County Administrator effective January 26, 2009</p>		

<b>JUSTIFICATION FOR CHANGE</b>	<b>Change Order No:</b>  <b>Project Number:</b>
<b>1. NECESSITY FOR CHANGE:</b> _____ _____ _____	
<b>2. Is change an alternate bid? (If yes, explain)</b> _____	
<b>3. Does change substantially alter the physical size of the project? (If yes, explain)</b> _____	
<b>4 Effect of this change on other 'prime' contractors?</b> _____	
<b>5 Has the Surety and insurance company been notified, if applicable? CONTRACTOR RESPONSIBILITY</b> _____	

Attachment 8, Administrative Contract Adjustment

**ADMINISTRATIVE CONTRACT ADJUSTMENT****Project  
Name:** \_\_\_\_\_**Contract  
Adjustment No.:** \_\_\_\_\_**Contract Amount:** \_\_\_\_\_**Project Number:** \_\_\_\_\_**ITEM****DESCRIPTION OF ITEM AND  
CHANGE****DECREASE****INCREASE**

BY EXECUTION OF THIS  
ADMINISTRATIVE CONTRACT  
ADJUSTMENT, THE CONTRACTOR  
AGREES THAT ALL CLAIMS FOR  
ADDITIONAL CONTRACT TIME AND  
FEES FOR THE ITEMS IN THIS  
ADMINISTRATIVE CONTRACT  
ADJUSTMENT HAVE BEEN  
SATISFIED.

**TOTAL  
DECREASE:****TOTAL INCREASE:****Contractor:** \_\_\_\_\_**Address:** \_\_\_\_\_**City/State:** \_\_\_\_\_**Contractor  
Signature:** \_\_\_\_\_

THE NET CHANGE OF

ADJUSTS THE CURRENT CONTRACT  
AMOUNT FROM \_\_\_\_\_ TO  
\_\_\_\_\_\_\_\_\_ CALENDAR DAYS ARE ADDED TO  
THE SCHEDULE WHICH CHANGES THE  
FINAL COMPLETION DATE FROM  
\_\_\_\_\_ TO \_\_\_\_\_  
\_\_\_\_\_

## RECOMMENDATION, CONCURRENCES AND APPROVALS

	SIGNATURES	DATE
Consultant / Engineer:	_____	_____
Project Manager:	_____	_____
Division Manager:	_____	_____
	Project Management Div. Mgr	
Department Director / Deputy Director	_____	_____
	Deputy Director, Engineering Services	

MANATEE COUNTY PROJECT MANAGEMENT DIVISION FORM  
PMD-14

JANUARY  
2011

JUSTIFICATION FOR CHANGE	Change Order No:  Project Number:
1. NECESSITY FOR CHANGE:	
_____	
_____	
2. Does this change alter the scope of work? (If yes, explain)	
_____	
_____	
3. It is the Contractor's responsibility to notify the bonding agency. Has the bonding agency been notified?	
_____	
_____	

Certificate of Substantial Completion

<b>CERTIFICATE OF SUBSTANTIAL COMPLETION (S.C.)</b>	CHECK ONE:	
	Partial	Total
Project Title:	Date Submitted:	
Contractor Data: Name: Address: City/State/Zip:	Project No:	
	S. C. Date (Proposed)	

If the "Partial" completion box above is checked, the following description applies to the work for which substantial completion is being sought. Otherwise, the work described in the Contract including approved changes, if any, is certified to be substantially complete:  
(Description of the portion of work substantially completed):

(USE CONTINUATION SHEETS IF NECESSARY)

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item does not alter the Contractor's responsibility to complete all of the contract work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by the Contractor \_\_\_\_\_ days of within \_\_\_\_\_ substantial completion. The approved substantial completion date is: \_\_\_\_\_

Contractor Signature \_\_\_\_\_ Date \_\_\_\_\_

Engineer's Approval \_\_\_\_\_ Date \_\_\_\_\_

Printed Name and Title \_\_\_\_\_

Printed Name and Title \_\_\_\_\_

The Contractor shall be responsible for security, operation, safety, maintenance, HVAC, insurance and warranties in accordance with the Contract. The County will assume the responsibility for paying the cost of electrical power from midnight of the date of Engineer's approval as indicated above.

ATTACH THE INSPECTOR'S FINAL WALKTHROUGH LIST OF DEFICIENCIES.

# Final Reconciliation Warranty Period

FINAL RECONCILIATION, WARRANTY PERIOD DECLARATION AND CONTRACTOR'S AFFIDAVIT	
Project Title:	Date Submitted:
Contractor Data: Name: Address: City/State/Zip:	Project No:  Warranty (months):
<p>This Final Reconciliation is for the work performed for Manatee County by the above named contractor, hereinafter called CONTRACTOR, pursuant to the contract dated _____ as amended, and acts as an addendum thereto.</p> <p>It is agreed that all quantities and prices in the attached Final Pay Estimate No. _____ are correct and that the amount of \$ _____ including retainage is due to the CONTRACTOR, that no claims are outstanding as between the parties, and that the above stated sum represents the entirety of monies owed the CONTRACTOR.</p> <p>It is further agreed that the warranty period for CONTRACTOR'S work pursuant to the Contract is from _____ to _____</p> <p>As (title) _____ for CONTRACTOR, I have authority to bind said CONTRACTOR, and as such make this final reconciliation, declaration and affidavit for the purpose of inducing Manatee County to make final payment to CONTRACTOR for work done at/upon _____ under said contract:</p> <p>CONTRACTOR has paid all social security and withholding taxes accrued in connection with the construction project.</p> <p>CONTRACTOR has paid all workers' compensation and other insurance premiums incurred in connection with this construction project.</p> <p>CONTRACTOR has paid for all required permits in connection with this construction project.</p> <p>All laborers, material, men, suppliers, subcontractors and service professionals who worked for and/or supplied materials, equipment and/or services to the CONTRACTOR under this construction contract have been paid in full.</p> <p style="text-align: right;">_____ (Affiant Signature)</p> <p>NOTARY: State of Florida, County of _____, Sworn to (or affirmed) and subscribed before me this _____ day of _____, 20____, by _____ ( person giving notice ).</p> <p>Signature of Notary Public - State of Florida: _____ Print, Type or Stamp Commissioned Name of Notary Public: _____</p> <p>Personally Known <input type="checkbox"/> or Produced Identification <input type="checkbox"/> Type of Identification Produced _____</p>	

S:\CONSTRUCTION SERVICES\2.0MASTERFORMS\DESIGN DOCUMENTS\CONSTRUCTION DOCUMENTS\CONSTRUCTION\_CONTRACTORS  
AFFIDAVIT - FINAL RECONCILIATION - JAN2010.doc  
REVISED JAN 2010  
(Previous versions are obsolete)

Public Construction Bond

**MANATEE COUNTY GOVERNMENT  
PUBLIC CONSTRUCTION BOND**

BY THIS BOND, We \_\_\_\_\_, located at \_\_\_\_\_, as  
(Name of Contractor) (Address)  
Principal and \_\_\_\_\_ a corporation, whose address is  
(Name of Surety)

---

Are bound to Manatee County, a political subdivision of the State of Florida, herein called  
County, in the sum of \$ \_\_\_\_\_, for payment of which we bind ourselves,  
our heirs, personal representatives, successors, and assigns, jointly and severally.

THE CONDITION OF THIS BOND is that Principal:

1. Performs Contract No. 19-TA003100SAM, between Principal and County for construction of  
SWWRF & SEWRF Belt Filter Press Rehabilitation,  
(Title of Project)  
the Contract Being made a part of this bond by reference, at the times and in the manner  
prescribed in the Contract; and
2. Promptly makes payments to all claimants, as defined in Section 255.05(1), Florida Statutes,  
supplying Principal with labor, materials, or supplies, used directly or indirectly by Principal in the  
prosecution of the Work provided for in the Contract; and
3. Pays County all losses, damages, expenses, costs, and attorney's fees, including appellate  
proceedings, that County Sustains because of a default by Principal under the Contract; and
4. Performs the guarantee of all Work and materials furnished under the Contract for the time  
specified in the Contract, then this bond is void; otherwise it remains in full force.

Any action instituted by a claimant under this bond for payment must be in accordance with  
the notice and time limitation provisions of Section 255.05(2), Florida Statutes.

Any changes in or under the Contract documents and compliance or non-compliance with any formalities connected with the Contract or the changes does not affect Surety's obligation under this bond.

DATED ON \_\_\_\_\_

CONTRACTOR AS PRINCIPAL

\_\_\_\_\_  
Contractor Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
(Corporate Seal)

SURETY

\_\_\_\_\_  
Surety Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
(Corporate Seal)

AGENT OR BROKER

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Address

\_\_\_\_\_  
City/State/Zip

\_\_\_\_\_  
Telephone

Licensed Florida Insurance Agent?

\_\_\_ Yes

\_\_\_ No

\_\_\_\_\_  
License #:

\_\_\_\_\_  
State of

\_\_\_\_\_  
County of

\_\_\_\_\_  
City of

GENERAL CONDITIONS  
*of the*  
CONSTRUCTION AGREEMENT

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**GENERAL CONDITIONS**  
**ARTICLE I, DEFINITIONS**

**1.1 Definitions.** For purposes of the Contract Documents, the following terms shall have the following meanings.

A. Acceptance: The acceptance of the Project into the Owner's operating public infrastructure.

B. Application for Payment: The form approved and accepted by the Owner, which is to be used by Contractor in requesting progress payments or final payment and which is to include such supporting documentation as is required by the Contract Documents.

C. Architect/Engineer: \_\_\_\_\_, a \_\_\_\_\_ corporation, registered and licensed to do business in the State of Florida.

D. Change Order: A written order signed by the Owner, the Architect/Engineer and the Contractor authorizing a change in the Project Plans and/or Specifications and, if necessary, a corresponding adjustment in the Contract Sum and/or Contract Time, pursuant to Article V.

E. Compensable Delay: Any delay beyond the control and without the fault or negligence of the Contractor resulting from Owner-caused changes in the Work, differing site conditions, suspensions of the Work, or termination for convenience by Owner.

F. Contractor's Personnel: The Contractor's key personnel designated by Contractor.

G. Construction Services: The Construction Services to be provided by Contractor pursuant to Section 2.4, in accordance with the terms and provisions of the Contract Documents..

H. Construction Team: The working team established pursuant to Section 2.1.B.

I. Contract Sum: The total compensation to be paid to the Contractor for Construction Services rendered pursuant to the Contract Documents, as set forth in Contractor's Bid (or Guaranteed Maximum Price Addendum), unless adjusted in accordance with the terms of the Contract Documents

J. Contract Time: The time period during which all Construction Services are to be completed pursuant to the Contract Documents, to be set forth in the Project Schedule.

K. Days: Calendar days except when specified differently. When time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or legal holiday, such day will be omitted from the computation.

L. Defective: When modifying the term "Work", referring to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents, or that does not meet the requirements of any inspection, reference standard, test or approval referred to in the

Contract Documents, or that has been damaged prior to Owner's approval of final payment (unless responsibility for the protection thereof has been assumed by Owner).

M. Excusable Delay: Any delay beyond the control and without the negligence of the Contractor, the Owner, or any other contractor caused by events or circumstances such as, but not limited to, acts of God or of a public enemy, fires, floods, freight embargoes, acts of government other than Owner or epidemics. Labor disputes and above average rainfall shall give rise only to excusable delays.

N. Field Directive: A written order issued by Owner which orders minor changes in the Work not involving a change in Contract Time, to be paid from the Owner's contingency funds.

O. Final Completion Date: The date upon which the Project is fully constructed and all Work required on the Project and Project Site is fully performed as verified in writing by the Owner.

P. Float or Slack Time: The time available in the Project Schedule during which an unexpected activity can be completed without delaying substantial completion of the Work.

Q. Force Majeure: Those conditions constituting excuse from performance as described in and subject to the conditions described in Article XII.

R. Inexcusable Delay: Any delay caused by events or circumstances within the control of the Contractor, such as inadequate crewing, slow submittals, etc., which might have been avoided by the exercise of care, prudence, foresight or diligence on the part of the Contractor.

S. Non-prejudicial Delay: Any delay impacting a portion of the Work within the available total Float or Slack Time and not necessarily preventing Substantial Completion of the Work within the Contract Time.

T. Notice to Proceed: Written notice by Owner (after execution of Contract) to Contractor fixing the date on which the Contract Time will commence to run and on which Contractor shall start to perform the Work.

U. Owner: Manatee County, a political subdivision of the State of Florida.

V. Owner's Project Representative: The individual designated by Owner to perform those functions set forth in Section 7.8.

W. Payment and Performance Bond: The Payment and Performance Bond security posted pursuant to Section 2.4.Y to guarantee payment and performance by the Contractor of its obligations hereunder.

X. Permitting Authority: Any applicable governmental authority acting in its governmental and regulatory capacity which is required to issue or grant any permit, certificate, license or other approval which is required as a condition precedent to the commencement or approved of the Work, or any part thereof, including the building permit.

Y. Prejudicial Delay: Any excusable or compensable delay impacting the Work and exceeding the total float available in the Project Schedule, thus preventing completion of the Work within the Contract Time unless the Work is accelerated.

Z. Pre-operation Testing: All field inspections, installation checks, water tests, performance tests and necessary corrections required of Contractor to demonstrate that individual components of the Work have been properly constructed and do operate in accordance with the Contract Documents for their intended purposes.

AA. Procurement Ordinance: The Manatee County Procurement Code, Chapter 2-26 of the Manatee County Code of Laws, as amended from time to time.

BB. Progress Report: A report to Owner that includes all information required pursuant to the Contract Documents and submitted in accordance with Section 2.4.EE, hereof.

CC. Project: The total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by Owner and by separate contractors. For the purposes of the Contract Documents, the term Project shall include all areas of proposed improvements and all areas which may reasonably be judged to have an impact on the Project.

DD. Project Costs: The costs incurred by the Contractor to plan, construct and equip the Project and included within, and paid as a component of, the Contract Sum.

EE. Project Manager: Subject to the prior written consent of Owner, the individual designated to receive notices on behalf of the Contractor, or such other individual designated by the Contractor, from time to time, pursuant to written notice in accordance with the Contract Documents.

FF. Project Plans and Specifications: The one hundred percent (100%) construction drawings and specifications prepared by the Architect/Engineer, and any changes, supplements, amendments or additions thereto approved by the Owner, which shall also include any construction drawings and final specifications required for the repair or construction of the Project, as provided herein.

GG. Project Schedule: The schedule and sequence of events for the commencement, progression and completion of the Project, developed pursuant to Section 2.3., as such schedule may be amended as provided herein.

HH. Project Site: The site depicted in the Project Plans and Specifications, inclusive of all rights of way, temporary construction easements or licensed or leased sovereign lands.

II. Punch List Completion Date: The date upon which all previously incomplete or unsatisfactory items, as identified by the Contractor, the Architect/Engineer and/or the Owner are completed in a competent and workmanlike manner, consistent with standards for Work of this type and with good building practices in the State of Florida.

JJ. Subcontractor: Any individual (other than a direct employee of the Contractor) or organization retained by Contractor to plan, construct or equip the Project pursuant to Article IV.

KK. Substantial Completion and Substantially Complete: The stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use; provided, however, that as a condition precedent to Substantial Completion, the Owner has received all

certificates of occupancy or completion and other permits, approvals, licenses, and other documents from any governmental authority which are necessary for the beneficial occupancy of the Project or any designated portion thereof.

LL. Substantial Completion Date: The date on which the Project or designated portion thereof is deemed to be Substantially Complete, as evidenced by receipt of (i) the Architect/Engineer's certificate of Substantial Completion, (ii) written Acceptance of the Project by the Owner, and (iii) approvals of any other authority as may be necessary or otherwise required.

MM. Substitute: Materials or equipment offered by the Contractor as an alternative to that set forth in the Project Plans and Specifications, where (i) the Project Plans and Specifications do not authorize an "approved equal", or (ii) the Owner, in its reasonable discretion, determines that a pre-authorized "approved equal" will result in a substantial change to the Work because of cost, quality or other difference in comparison to the materials or equipment specified.

NN. Unit Price Work: Work to be paid for on the basis of unit prices.

OO. Work: The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

PP. Work Directive Change: A written directive to Contractor, issued on or after the effective date of the Agreement pursuant to Section 5.8 and signed by Owner's Project Representative, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed or responding to emergencies.

## **ARTICLE II, RELATIONSHIP AND RESPONSIBILITIES**

**2.1 Relationship between Contractor and Owner.** The Contractor accepts the relationship of trust and confidence established with Owner pursuant to the Contract Documents. The Contractor shall furnish its best skill and judgment and cooperate with Owner and Owner's Project Representative in furthering the interests of the Owner. The Contractor agrees to provide the professional services required to complete the Project consistent with the Owner's direction and the terms of the Contract Documents. All services provided hereunder by Contractor, either directly or through Subcontractors, shall be provided in accordance with sound construction practices and applicable professional construction standards.

A. Purpose. The purpose of the Contract Documents is to provide for the provision of construction services for the Project on the Project Site by the Contractor, and construction of the Project by the Contractor in accordance with the Project Plans and Specifications. The further purpose of the Contract Documents is to define and delineate the responsibilities and obligations of the parties to the Contract Documents and to express the desire of all such parties to cooperate to accomplish the purposes and expectations of the Contract Documents.

B. Construction Team. The Contractor, Owner and Architect/Engineer shall be called the "Construction Team" and shall work together as a team commencing upon full execution of the Contract Documents through Substantial Completion. As provided in Section 2.2, the Contractor and Architect/Engineer shall work jointly through completion and shall be available thereafter should

additional services be required. The Contractor shall provide leadership to the Construction Team on all matters relating to construction. The Contractor understands, acknowledges and agrees that the Architect/Engineer shall provide leadership to the Construction Team on all matters relating to design.

C. Owner's Reliance on Bid (or Guaranteed Maximum Price Addendum). The Contractor acknowledges that the representations, statements, information and pricing contained in its Bid (or Guaranteed Maximum Price Addendum) have been relied upon by the Owner and have resulted in the award of this Project to the Contractor.

**2.2 General Contractor Responsibilities.** In addition to the other responsibilities set forth herein, the Contractor shall have the following responsibilities pursuant to the Contract Documents:

A. Personnel. The Contractor represents that it has secured, or shall secure, all personnel necessary to perform the Work, none of whom shall be employees of the Owner. Primary liaison between the Contractor and the Owner shall be through the Owner's Project Representative and Contractor's Project Manager. All of the services required herein shall be performed by the Contractor or under the Contractor's supervision, and all personnel engaged in the Work shall be fully qualified and shall be authorized or permitted under law to perform such services.

B. Cooperation with Architect/Engineer. The Contractor's services shall be provided in conjunction with the services of the Architect/Engineer. In the performance of professional services, the Contractor acknowledges that time is critical for Project delivery. The Contractor acknowledges that timely construction utilizing the services of an Architect/Engineer and a Contractor requires maximum cooperation between all parties.

C. Timely Performance. The Contractor shall perform all services as expeditiously as is consistent with professional skill and care and the orderly progress of the Work, in accordance with the Project Schedule. Verification of estimated Project Schedule goals will be made as requested by the Owner.

D. Duty to Defend Work. In the event of any dispute between the Owner and any Permitting Authority that relates to the quality, completeness or professional workmanship of the Contractor's services or Work, the Contractor shall, at its sole cost and expense, cooperate with the Owner to defend the quality and workmanship of the Contractor's services and Work.

E. Trade and Industry Terminology. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result will be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe Work, materials, or equipment, such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals or codes of any technical society, organization or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code or laws or regulations in effect at the time of opening of Bids (or at the time of execution of the Guaranteed Maximum Price Addendum), except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of Owner or Contractor, or any of their agents or employees from those set forth in the Contract Documents. Computed dimensions shall govern over scaled dimensions.

**2.3 Project Schedule.** The Contractor, within ten (10) days after being awarded the Agreement, shall prepare and submit for the Owner's and Architect/Engineer's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of Work.

- A. The Project Schedule shall show a breakdown of all tasks to be performed, and their relationship in achieving the completion of each phase of Work, subject to review of Owner and Architect/Engineer and approval or rejection by Owner. The Project Schedule shall show, at a minimum, the approximate dates on which each segment of the Work is expected to be started and finished, the proposed traffic flows during each month, the anticipated earnings by the Contractor for each month and the approximate number of crews and equipment to be used. The Project Schedule shall include all phases of procurement, approval of shop drawings, proposed Change Orders in progress, schedules for Change Orders, and performance testing requirements. The Project Schedule shall include a construction commencement date and Project Substantial Completion Date, which dates shall accommodate known or reasonably anticipated geographic, atmospheric and weather conditions.
- B. The Project Schedule shall serve as the framework for the subsequent development of all detailed schedules. The Project Schedule shall be used to verify Contractor performance and to allow the Owner's Project Representative to monitor the Contractor's efforts.
- C. The Project Schedule may be adjusted by the Contractor pursuant to Article V. The Owner shall have the right to reschedule Work provided such rescheduling is in accord with the remainder of terms of the Contract Documents.
- D. The Contractor shall prepare a submittal schedule, promptly after being awarded the Agreement and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect/Engineer's approval. The Architect/Engineer's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect/Engineer reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.
- E. The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect/Engineer.

**2.4 Construction Services.** The Contractor shall provide the following Construction Services:

- A. Construction of Project. The Contractor shall work from the receipt of a Notice to Proceed through the Substantial Completion of the Project in accordance with the terms of the Contract Documents to manage the construction of the Project. The Construction Services provided by the Contractor to construct the Project shall include without limitation (1) all services necessary and

commensurate with established construction standards, and (2) all services described in the Invitation for Bid (or Request for Proposal) and the Bid (or Guaranteed Maximum Price Addendum).

B. Notice to Proceed. A Notice to Proceed may be given at any time within thirty (30) days after the effective date of the Agreement. Contractor shall start to perform the Work on the date specified in the Notice to Proceed, but no Work shall be done at the site prior to the issuance of the Notice to Proceed.

C. Quality of Work. If at any time the labor used or to be used appears to the Owner as insufficient or improper for securing the quality of Work required or the required rate of progress, the Owner may order the Contractor to increase its efficiency or to improve the character of its Work, and the Contractor shall conform to such an order. Any such order shall not entitle Contractor to any additional compensation or any increase in Contract Time. The failure of the Owner to demand any increase of such efficiency or any improvement shall not release the Contractor from its obligation to secure the quality of Work or the rate of progress necessary to complete the Work within the limits imposed by the Contract Documents. The Owner may require the Contractor to remove such personnel as the Owner deems incompetent, careless, insubordinate or otherwise objectionable, or whose continued employment on the Project is deemed to be contrary to the Owner's interest. The Contractor shall provide good quality workmanship and shall promptly correct construction defects without additional compensation. Acceptance of the Work by the Owner shall not relieve the Contractor of the responsibility for subsequent correction of any construction defects.

D. Materials. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by Architect/Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instruction of the applicable supplier except as otherwise provided in the Contract Documents.

E. Accountability for Work. The Contractor shall be solely accountable for its Work, including plans review and complete submittals. The Contractor shall be solely responsible for means, methods, techniques, sequences and procedures of construction. If a specific means, method, technique, sequence or procedure of construction is required by the Contract Documents, the Contractor may utilize an alternative means, method, technique, sequence or procedure acceptable to the Architect/Engineer if the Contractor submits sufficient information to allow the Architect/Engineer to determine that the alternative is equivalent to that required by the Contract Documents.

F. Contract Sum. The Contractor shall construct the Project so that the Project can be built for a cost not to exceed the Contract Sum.

G. Governing Specifications. The Project shall be constructed in accordance with applicable Owner design standards and guidelines. In the absence of specified Owner design standards or guidelines, the Architect/Engineer shall use, and the Contractor shall comply with, the most recent version of the applicable FDOT or AASHTO design standards. In general, the Project shall be constructed by the Contractor in accordance with applicable industry standards. The Contractor shall be responsible for utilizing and maintaining current knowledge of any laws, ordinances, codes, rules, regulations, standards, guidelines, special conditions, specifications or other mandates relevant to the Project or the services to be performed.

H. Adherence to Project Schedule. The development and equipping of the Project shall be undertaken and completed in accordance with the Project Schedule, and within the Contract

Time described therein.

I. Superintendent. The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project Site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

(1) The Contractor, as soon as practicable after award of the Agreement, shall furnish in writing to the Owner through the Architect/Engineer the name and qualifications of the proposed superintendent. The Architect/Engineer may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect/Engineer has reasonable objection to the proposed superintendent or (2) that the Architect/Engineer requires additional time to review. Failure of the Architect/Engineer to reply within 14 days shall constitute notice of no reasonable objection.

(2) The Contractor shall not employ a proposed superintendent to whom the Owner or Architect/Engineer has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not be unreasonably withheld or delayed.

J. Work Hours. Contractor shall provide competent, suitable qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the site. Except in connection with the safety or protection of persons or the Work or property at the site or adjacent thereto and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during regular working hours, and Contractor shall not permit overtime work or the performance of Work on a Saturday, Sunday or legal holiday without Owner's written consent given after prior notice to Architect/Engineer (at least seventy-two (72) hours in advance).

K. Overtime-Related Costs. Contractor shall pay for all additional Architect/Engineering charges, inspection costs and Owner staff time for any overtime work which may be authorized. Such additional charges shall be a subsidiary obligation of Contractor and no extra payment shall be made by Owner because such overtime work. At Owner's option, such overtime costs may be deducted from Contractor's monthly payment request or Contractor's retainage prior to release of final payment.

L. Insurance, Overhead and Utilities. Unless otherwise specified, Contractor shall furnish and assume full responsibility for all bonds, insurance, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

M. Cleanliness. The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials from and about the Project Site. Contractor shall restore to original conditions all property not designated for alteration by the Contract Documents. If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from Contractor.

N. Loading. Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work

or adjacent property to stresses or pressures that will endanger it.

O. Safety and Protection. Contractor shall comply with the Florida Department of Commerce Safety Regulations and any local safety regulations. Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of and shall provide the necessary protection to prevent damage, injury or loss to:

- (1) All employees on the Work and other persons and organizations who may be affected thereby;
- (2) All the Work and materials and equipment to be incorporated therein, whether in storage on or off the Project Site; and
- (3) Other property at the Project Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities not designated for removal, relocation or replacement during construction.

Contractor shall comply with all applicable laws and regulations of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss, and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall provide and maintain all passageways, guard fences, lights and other facilities for the protection required by public authority or local conditions. Contractor shall provide reasonable maintenance of traffic for the public and preservation of the Owner's business, taking into full consideration all local conditions. Contractor's duties and responsibilities for safety and protection with regard to the Work shall continue until such time as all the Work is completed.

P. Emergencies. In emergencies affecting the safety or protection of persons or the Work or property at the Project Site or adjacent thereto, Contractor, without special instruction or authorization from Architect/Engineer or Owner, shall act to prevent threatened damage, injury or loss. Contractor shall give Owner prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If Owner determines that a change in the Project is required because of the action taken in response to an emergency, a Work Directive Change or Change Order will be issued to document the consequences of the changes or variation.

Q. Substitutes. For Substitutes not included with the Bid (or Guaranteed Maximum Price Addendum), but submitted after the effective date of the Agreement (or Guaranteed Maximum Price Addendum), Contractor shall make written application to Architect/Engineer for acceptance thereof, certifying that the proposed Substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. The application will also contain an itemized estimate of all costs and delays or schedule impacts that will result directly or indirectly from review, acceptance and provision of such Substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which will be considered by the Architect/Engineer in evaluating the proposed Substitute. Architect/Engineer may require Contractor to furnish at Contractor's expense, additional data about the proposed Substitute. In rendering a decision, Owner, Architect/Engineer and Contractor shall have access to any available Float Time in the Project Schedule. If Substitute materials or equipment not included as part of the Bid (or Guaranteed Maximum Price Addendum), but proposed after the effective date of the Agreement, are accepted and are less costly than the originally specified materials or

equipment, then the net difference in cost shall be credited to the Owner and an appropriate Change Order executed to adjust the Contract Sum.

- (1) Architect/Engineer will be allowed a reasonable time within which to evaluate each proposed Substitute. Architect/Engineer will be the sole judge of acceptability and no Substitute will be ordered, installed or utilized without Architect/Engineer's prior written acceptance which will be evidenced by either a Change Order or an approved shop drawing. Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any Substitute.
- (2) Contractor shall reimburse Owner for the charges of Architect/Engineer and Architect/Engineer's Consultants for evaluating each proposed Substitute submitted after the effective date of the Agreement and all costs resulting from any delays in the Work while the Substitute was undergoing review.

R. Surveys and Stakes. The Contractor shall furnish, free of charge, all labor, stakes, surveys, batter boards for structures, grade lines and other materials and supplies and shall set construction stakes and batter boards for establishing lines, position of structures, slopes and other controlling points necessary for the proper prosecution of the Work. Where rights-of-way, easements, property lines or any other conditions which make the lay-out of the Project or parts of the Project critical are involved, the Contractor shall employ a competent surveyor who is registered in the State of Florida for lay-out and staking. These stakes and marks shall constitute the field control by and in accord with which the Contractor shall govern and execute the Work. The Contractor shall be held responsible for the preservation of all stakes and marks and if for any reason any of the stakes or marks or batter boards become destroyed or disturbed, they shall be immediately and accurately replaced by the Contractor.

S. Suitability of Project Site. The Contractor has, by careful examination, satisfied itself as to the nature and location of the Work and all other matters which can in any way affect the Work, including, but not limited to details pertaining to borings, as shown on the drawings. Such boring information is not guaranteed to be more than a general indication of the materials likely to be found adjacent to holes bored at the Project Site, approximately at the locations indicated. The Contractor has examined boring data, where available, made its own interpretation of the subsurface conditions and other preliminary data, and has based its Bid (or Guaranteed Maximum Price Addendum) on its own opinion of the conditions likely to be encountered. Except as specifically provided in Sections 2.4.U., 5.4 and 5.5, no extra compensation or extension of time will be considered for any Project Site conditions that existed at the time of bidding (or at the time of execution of the Guaranteed Maximum Price Addendum). No verbal agreement or conversation with any officer, agent or employee of the Owner, before or after the execution of the Agreement, shall affect or modify any of the terms or obligations herein contained.

T. Project Specification Errors. If the Contractor, during the Work, finds that the drawings, specifications or other Contract Documents cannot be followed, the Contractor shall immediately inform the Owner in writing, and the Owner shall promptly check the accuracy of the information. Any Work done after such discovery, until any necessary changes are authorized, will be done at the Contractor's sole risk of non-payment and delay.

U. Remediation of Contamination: Owner and Contractor recognize that remediation of subsurface conditions may be necessary due to potential hazardous materials contamination. Because the presence or extent of any contamination is not known, Contractor shall

include no cost in the Contract Sum, and no time in the Project Schedule, for cost or delays that might result from any necessary remediation. The Project Schedule will provide a period of time between demolition activities and the start of the next activity to commence any remediation if needed. Contractor shall use all reasonable efforts in scheduling the Project to minimize the likelihood that remediation delays construction. Any hazardous materials remediation Work which Contractor agrees to perform shall be done pursuant to a Change Order or amendment consistent with the following:

- (1) The dates of Substantial Completion shall be equitably adjusted based on delays, if any, incurred in connection with remediation efforts.
- (2) Contractor, and any Subcontractors which have mobilized on the Project Site, shall be paid for demonstrated costs of overhead operations at the Project Site during any period of delay of more than seven (7) days, except to the extent that Work proceeds concurrently with remediation. The categories of costs to be reimbursed are limited to those reasonably incurred at the jobsite during the delay period (such as trailers or offices, telephones, faxes, and the like); equipment dedicated to the Project and located at the Project Site; salaries and associated costs of personnel dedicated to the Project to the extent that they do not perform work on other projects; and other jobsite costs that are reasonable and which are incurred during the delay period. Subcontractors and suppliers which have not mobilized are limited to the costs set forth in Section 2.4.U(3).
- (3) Contractor and any Subcontractor or supplier on the Project who is eligible for compensation shall be paid any demonstrated costs of escalation in materials or labor, and reasonable costs of off-site storage of materials identified to the Project, arising because of any delay of more than seven (7) days. Such Contractor, Subcontractors and suppliers are obligated to take all reasonable steps to mitigate escalation costs, such as through early purchase of materials.
- (4) Contractor, for itself and all Subcontractors and suppliers on the Project, hereby agrees that the extension of time for delays under Section 2.4.U(1), and payment of the costs identified in Sections 2.4.U(2) and/or Section 2.4.U(3), are the sole remedies for costs and delays described in this Section, and waives all claims and demands for extended home office overhead (including, but not limited to, "Eichleay" claims), lost profit or lost opportunities, and any special, indirect, or consequential damages arising as a result of delays described in this Section. The Contract Sum shall be adjusted to reflect payment of allowable costs.
- (5) If any delay described in this section causes the time or cost for the Project to exceed the Contract Time or the Contract Sum, then the Owner may terminate the Agreement pursuant to Section 14.2.
- (6) Contractor and any Subcontractor or supplier seeking additional costs under this Section 2.4.U. shall promptly submit estimates or any costs as requested by Owner, and detailed back-up for all costs when payment is sought or whenever reasonably requested by Owner. All costs are auditable, at Owner's discretion. Bid, estimate and pricing information reasonably related to any request for additional compensation will be provided promptly upon request.

- (7) Contractor shall include provisions in its subcontracts and purchase orders consistent with this Section.

V. Interfacing.

- (1) The Contractor shall take such measures as are necessary to ensure proper construction and delivery of the Project, including but not limited to providing that all procurement of long-lead items, the separate construction Subcontractors, and the general conditions items are performed without duplication or overlap to maintain completion of all Work on schedule. Particular attention shall be given to provide that each Subcontractor bid package clearly identifies the Work included in that particular separate subcontract, its scheduling for start and completion, and its relationship to other separate contractors.
- (2) Without assuming any design responsibilities of the Architect/Engineer, the Contractor shall include in the Progress Reports required under this Section 2.4 comments on overlap with any other separate subcontracts, omissions, lack of correlation between drawings, and any other deficiencies noted, in order that the Architect/Engineer may arrange for necessary corrections.

W. Job Site Facilities. The Contractor shall arrange for all job site facilities required and necessary to enable the Contractor and Architect/Engineer to perform their respective duties and to accommodate any representatives of the Owner which the Owner may choose to have present on the Project Site.

X. Weather Protection. The Contractor shall provide temporary enclosures of building areas to assure orderly progress of the Work during periods when extreme weather conditions are likely to be experienced. The Contractor shall also be responsible for providing weather protection for Work in progress and for materials stored on the Project Site. A contingency plan shall be prepared upon request of the Owner for weather conditions that may affect the construction.

Y. Payment and Performance Bond. Prior to the construction commencement date, the Contractor shall obtain, for the benefit of and directed to the Owner, a Payment and Performance Bond satisfying the requirements of Section 255.05, Florida Statutes, covering the faithful performance by the Contractor of its obligations under the Contract Documents, including but not limited to the construction of the Project on the Project Site and the payment of all obligations arising thereunder, including all payments to Subcontractors, laborers, and materialmen. The surety selected by the Contractor to provide the Payment and Performance Bond shall be approved by the Owner prior to the issuance of such Bond, which approval shall not be unreasonably withheld or delayed provided that the surety is rated A or better by Best's Key Guide, latest edition. For Changes in the Work that result in an increase in the Contract Sum, Owner reserves the right to require the Contractor to secure and deliver additive riders to the Payment and Performance Bond.

Z. Construction Phase; Building Permit; Code Inspections. Unless otherwise provided, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work.

- (1) Building Permit. The Owner and Architect/Engineer shall provide such information to any Permitting Authority as is necessary to obtain approval from

the Permitting Authority to commence construction prior to beginning construction. The Contractor shall pull any required building permit, and shall be responsible for delivering and posting the building permit at the Project Site prior to the commencement of construction. The cost of the building permit is included in the Contract Sum. The Owner and Architect/Engineer shall fully cooperate with the Contractor when and where necessary.

- (2) Code Inspections. The Project requires detailed code compliance inspection during construction in disciplines determined by any Permitting Authority. These disciplines normally include, but are not necessarily limited to, structural, mechanical, electrical, plumbing, general building and fire. The Contractor shall notify the appropriate inspector(s) and the Architect/Engineer, no less than 24 hours in advance, when the Work is ready for inspection and before the Work is covered up. All inspections shall be made for conformance with the applicable ordinances and building codes. Costs for all re-inspections of Work found defective and subsequently repaired shall not be included as Project Costs and shall be borne by the Contractor or as provided in the contract between Contractor and Subcontractor.
- (3) Contractor's Personnel. The Contractor shall maintain sufficient off-site support staff and competent full-time staff at the Project Site authorized to act on behalf of the Contractor to coordinate, inspect, and provide general direction of the Work and progress of the Subcontractors. At all times during the performance of the Work, the Owner shall have the right to demand replacement of Contractor Personnel to whom the Owner has reasonable objection, without liability to the Contractor.
- (4) Lines of Authority. To provide general direction of the Work, the Contractor shall establish and maintain lines of authority for its personnel and shall provide this information to the Owner and all other affected parties, such as the code inspectors of any Permitting Authority, the Subcontractors, and the Architect/Engineer. The Owner and Architect/Engineer may attend meetings between the Contractor and his Subcontractors; however, such attendance is optional and shall not diminish either the authority or responsibility of the Contractor to administer the subcontracts.

AA. Quality Control. The Contractor shall develop and maintain a program, acceptable to the Owner and Architect/Engineer, to assure quality control of the construction. The Contractor shall be responsible for and supervise the Work of all Subcontractors, providing instructions to each when their Work does not conform to the requirements of the Project Plans and Specifications, and the Contractor shall continue to coordinate the Work of each Subcontractor to ensure that corrections are made in a timely manner so as to not affect the efficient progress of the Work. Should a disagreement occur between the Contractor and the Architect/Engineer over the acceptability of the Work, the Owner, at its sole discretion and in addition to any other remedies provided herein, shall have the right to determine the acceptability, provided that such determination is consistent with standards for construction projects of this type and generally accepted industry standards for workmanship in the State of Florida.

BB. Management of Subcontractors. All Subcontractors shall be compensated in accordance with Article IV. The Contractor shall solely control the Subcontractors. The Contractor shall negotiate all Change Orders and Field Orders with all affected Subcontractors and shall review the costs

and advise the Owner and Architect/Engineer of their validity and reasonableness, acting in the Owner's best interest. When there is an imminent threat to health and safety, and Owner's Project Representative concurrence is impractical, the Contractor shall act immediately to remove the threats to health and safety and shall subsequently fully inform Owner of all such action taken. The Contractor shall also carefully review all shop drawings and then forward the same to the Architect/Engineer for review and actions. The Architect/Engineer will transmit them back to the Contractor, who will then issue the shop drawings to the affected Subcontractor for fabrication or revision. The Contractor shall maintain a suspense control system to promote expeditious handling. The Contractor shall request the Architect/Engineer to make interpretations of the drawings or specifications requested of him by the Subcontractors and shall maintain a business system to promote timely response. The Contractor shall inform the Architect/Engineer which shop drawings or requests for clarification have the greatest urgency, to enable the Architect/Engineer to prioritize requests coming from the Contractor. The Contractor shall advise the Owner and Architect/Engineer when timely response is not occurring on any of the above.

CC. Job Requirements.

- (1) The Contractor shall provide each of the following as a part of its services hereunder:
  - (a) Maintain a log of daily activities, including manpower records, equipment on site, weather, delays, major decisions, etc;
  - (b) Maintain a roster of companies on the Project with names and telephone numbers of key personnel;
  - (c) Establish and enforce job rules governing parking, clean-up, use of facilities, and worker discipline;
  - (d) Provide labor relations management and equal opportunity employment for a harmonious, productive Project;
  - (e) Provide and administer a safety program for the Project and monitor for subcontractor compliance without relieving them of responsibilities to perform Work in accordance with best acceptable practice;
  - (f) Provide a quality control program as provided under Section 2.4.C above;
  - (g) Provide miscellaneous office supplies that support the construction efforts which are consumed by its own forces;
  - (h) Provide for travel to and from its home office to the Project Site and to those other places within Manatee County as required by the Project;
  - (i) Verify that tests, equipment, and system start-ups and operating and maintenance instructions are conducted as required and in the presence of the required personnel and provide adequate records of same to the Architect/Engineer;

- (j) Maintain at the job site orderly files for correspondence, reports of job conferences, shop drawings and sample submissions, reproductions of original Contract Documents including all addenda, change orders, field orders, additional drawings issued after execution of the Agreement, Owner/Architect/Engineer's clarifications and interpretations of the Contract Documents, progress reports, as-built drawings, and other project related documents;
  - (k) Keep a diary or log book, recording hours on the job site, weather conditions, data relative to questions of extras or deductions; list of visiting officials and representatives or manufacturers, fabricators, suppliers and distributors; daily activities, decisions, observations in general and specific observations in more detail as in the case of observing test procedures, and provide copies of same to Owner/Architect/Engineer;
  - (l) Record names, addresses and telephone numbers of all Contractors, Subcontractors and major suppliers of materials and equipment;
  - (m) Furnish Owner/Architect/Engineer periodic reports, as required, of progress of the Work and Contractor's compliance with the approved progress schedule and schedule of shop drawing submissions;
  - (n) Consult with Owner/Architect/Engineer in advance of scheduling major tests, inspections or start of important phases of the Work;
  - (o) Verify, during the course of the Work, that certificates, maintenance and operations manuals and other data required to be assembled and furnished are applicable to the items actually installed, and deliver same to Owner/Architect/Engineer for review prior to final Acceptance of the Work; and
  - (p) Cooperate with Owner in the administration of grants.
- (2) The Contractor shall provide personnel and equipment, or shall arrange for separate Subcontractors to provide each of the following as a Project Cost:
- (a) Services of independent testing laboratories, and provide the necessary testing of materials to ensure conformance to contract requirements; and
  - (b) Printing and distribution of all required bidding documents and shop drawings, including the sets required by Permitting Authority inspectors.

DD. As-Built Drawings. The Contractor shall continuously review as-built drawings and mark up progress prints to provide as much accuracy as possible. Prior to, and as a requirement for authorizing final payment to the Contractor due hereunder, the Contractor shall provide to the Owner an original set of marked-up, as-built Project Plans and Specifications and an electronic format of those records showing the location and dimensions of the Project as constructed, which documents shall be certified as being correct by the Contractor and the Architect/Engineer. Final as-built drawings shall be

signed and sealed by a registered Florida surveyor.

EE. Progress Reports. The Contractor shall forward to the Owner, as soon as practicable after the first day of each month, a summary report of the progress of the various parts of the Work, to include those parts of the Work in fabrication and in the field, stating the existing status, estimated time of completion and cause of delay, if any. Together with the summary report, the Contractor shall submit any necessary revisions to the original schedule for the Owner's review and approval. In addition, more detailed schedules may be required by the Owner for daily traffic control.

FF. Contractor's Warranty. The Contractor warrants to the Owner and Architect/Engineer that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements will be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect/Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

- (1) Contractor shall use its best efforts and due diligence to ensure that during the warranty period, those entities or individuals who have provided direct warranties to the Owner as required by the Contract Documents perform all required warranty Work in a timely manner and at the sole cost and expense of such warranty providers. Any such cost or expense not paid by the warranty providers shall be paid by the Contractor, to include any costs and attorney's fees incurred in warranty-related litigation between Contractor and any Subcontractors.
- (2) The Contractor shall secure guarantees and warranties of Subcontractors, equipment suppliers and materialmen, and assemble and deliver same to the Owner in a manner that will facilitate their maximum enforcement and assure their meaningful implementation. The Contractor shall collect and deliver to the Owner any specific written guaranties or warranties given by others as required by subcontracts.
- (3) At the Owner's request, the Contractor shall conduct, jointly with the Owner and the Architect/Engineer, no more than two (2) warranty inspections within three (3) years after the Substantial Completion Date.

GG. Apprentices. If Contractor employs apprentices, their performance of Work shall be governed by and shall comply with the provisions of Chapter 446, Florida Statutes.

HH. Schedule of Values. Unit prices shall be established for this Agreement by the submission of a schedule of values within ten (10) days of receipt of the Notice to Proceed. The schedule shall include quantities and prices of items equaling the Contract Sum and will subdivide the Work into components in sufficient detail to serve as the basis for progress payments during construction. Such prices shall include an appropriate amount of overhead and profit applicable to each item of Work. Upon request of the County, the Contractor shall support the values with data which will substantiate their correctness.

II. Other Contracts. The Owner reserves the right to let other contracts in connection with this Work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and execution of their work, and promptly connect and coordinate the Work with theirs.

### ARTICLE III, COMPENSATION

**3.1 Compensation.** The Contract Sum constitutes the total compensation (subject to authorized adjustments) payable to Contractor for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by Contractor shall be at Contractor's expense without change in the Contract Sum.

A. Adjustments. The Contract Sum may only be changed by Change Order or by a written amendment. Any claim for an increase or decrease in the Contract Sum shall be based on written notice delivered by the party making the claim to the other party. Notice of the amount of the claim with supporting data shall be delivered within fifteen (15) days from the beginning of such occurrence and shall be accompanied by claimant's written statement that the amount claimed covers all amounts to which the claimant is entitled as a result of the occurrence of said event. Failure to deliver a claim within the requisite 15-day period shall constitute a waiver of the right to pursue said claim.

B. Valuation. The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Sum shall be determined in one of the following ways (at Owner's discretion):

- (1) In the case of Unit Price Work, in accordance with Section 3.1.C, below; or
- (2) By mutual acceptance of a lump sum; or
- (3) On the basis of the cost of the Work, plus a negotiated Contractor's fee for overhead and profit. Contractor shall submit an itemized cost breakdown together with supporting data.

C. Unit Price Work. The unit price of an item of Unit Price Work shall be subject to re-evaluation and adjustment pursuant to a requested Change Order under the following conditions:

- (1) If the total cost of a particular item of Unit Price Work amounts to 5% or more of the Contract Sum and the variation in the quantity of the particular item of Unit Price Work performed by Contractor differs by more than 15% from the estimated quantity of such item indicated in the Agreement; and
- (2) If there is no corresponding adjustment with respect to any other item of Work; and
  - (i) If Contractor believes that it has incurred additional expense as a result thereof; or
  - (ii) If Owner believes that the quantity variation entitles it to an adjustment in the unit price; or

- (iii) If the parties are unable to agree as to the effect of any such variations in the quantity of Unit Price Work performed.

**3.2 Schedule of Compensation.** All payments for services and material under the Contract Documents shall be made in accordance with the following provisions.

A. Periodic Payments for Services. The Contractor shall be entitled to receive payment for Construction Services rendered pursuant to Section 2.4 in periodic payments which shall reflect a fair apportionment of cost and schedule of values of services furnished prior to payment, subject to the provisions of this Section.

B. Payment for Materials and Equipment. In addition to the periodic payments authorized hereunder, payments may be made for material and equipment not incorporated in the Work but delivered and suitably stored at the Project Site, or another location, subject to prior approval and acceptance by the Owner on each occasion.

C. Credit toward Contract Sum. All payments for Construction Services made hereunder shall be credited toward the payment of the Contract Sum as Contractor's sole compensation for the construction of the Project.

**3.3 Invoice and Payment.** All payments for services and materials under the Contract Documents shall be invoiced and paid in accordance with the following provisions.

A. Invoices. The Contractor shall submit to the Owner periodic invoices for payment, in a form acceptable to the Owner, which shall include a sworn statement certifying that, to the best of the Contractor's knowledge, information and belief, the construction has progressed to the point indicated, the quality and the Work covered by the invoice is in accord with the Project Plans and Specifications, and the Contractor is entitled to payment in the amount requested, along with the cost reports required pursuant to Article II, showing in detail all monies paid out, Project Costs accumulated, or Project Cost incurred during the previous period. This data shall be attached to the invoice.

B. Additional Information; Processing of Invoices. Should an invoiced amount appear to exceed the Work effort believed to be completed, the Owner may, prior to processing of the invoice for payment, require the Contractor to submit satisfactory evidence to support the invoice. All progress reports and invoices shall be delivered to the attention of the Owner's Project Representative. Invoices not properly prepared (mathematical errors, billing not reflecting actual Work done, no signature, etc.) shall be returned to the Contractor for correction.

C. Architect/Engineer's Approval. Payment for Work completed shall be subject to the Architect/Engineer approving the payment requested by the Contractor and certifying the amount thereof that has been properly incurred and is then due and payable to the Contractor, and identifying with specificity any amount that has not been properly incurred and that should not be paid.

D. Warrants of Contractor with Respect to Payments. The Contractor warrants that (1) upon payment of any retainage, materials and equipment covered by a partial payment request will pass to Owner either by incorporation in construction or upon receipt of payment by the Contractor, whichever occurs first; (2) Work, materials and equipment covered by previous partial payment requests shall be free and clear of liens, claims, security interests, or encumbrances; and (3) no Work, materials or equipment covered by a partial payment request which has been acquired by the Contractor or any other person performing Work at the Project Site, or furnishing materials or equipment for the Project,

shall be subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or any other person.

E. All Compensation Included. Contractor's compensation includes full payment for services set forth in the Contract Documents, including but not limited to overhead, profit, salaries or other compensation of Contractor's officers, partners and/or employees, general operating expenses incurred by Contractor and relating to this Project, including the cost of management, supervision and data processing staff, job office equipment and supplies, and other similar items.

#### **ARTICLE IV, SUBCONTRACTORS**

**4.1 Subcontracts.** At the Owner's request, the Contractor shall provide Owner's Project Representative with copies of all proposed and final subcontracts, including the general and supplementary conditions thereof.

A. Subcontracts Generally. All subcontracts shall: (1) require each Subcontractor to be bound to Contractor to the same extent Contractor is bound to Owner by the terms of the Contract Documents, as those terms may apply to the portion of the Work to be performed by the Subcontractor, (2) provide for the assignment of the subcontracts from Contractor to Owner at the election of Owner, upon termination of Contractor, (3) provide that Owner will be an additional indemnified party of the subcontract, (4) provide that Owner will be an additional insured on all insurance policies required to be provided by the Subcontractor, except workers' compensation, (5) assign all warranties directly to Owner, and (6) identify Owner as an intended third-party beneficiary of the subcontract.

(1) A Subcontractor is a person or entity who has a direct contract with Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

(2) A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

B. No Damages for Delay. Except when otherwise expressly agreed to by Owner in writing, all subcontracts shall provide:

"LIMITATION OF REMEDIES – NO DAMAGES FOR DELAY. The Subcontractor's exclusive remedy for delays in the performance of the contract caused by events beyond its control, including delays claimed to be caused by the Owner or Architect/Engineer or attributable to the Owner or Architect/Engineer and including claims based on breach of contract or negligence, shall be an extension of its contract time and shall in no way involve any monetary claim."

Each subcontract shall require that any claims by the Subcontractor for delay must be submitted to the Contractor within the time and in the manner in which the Contractor must submit such claims to the Owner, and that failure to comply with the conditions for giving notice and submitting claims shall result in the waiver of such claims.

C. Subcontractual Relations. The Contractor shall require each Subcontractor to assume all the obligations and responsibilities which the Contractor owes the Owner pursuant to the Contract Documents, by the parties to the extent of the Work to be performed by the Subcontractor. Said obligations shall be made in writing and shall preserve and protect the rights of the Owner and Architect/Engineer, with respect to the Work to be performed by the Subcontractor, so that the subcontracting thereof will not prejudice such rights. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with its sub-subcontractors.

D. Insurance; Acts and Omissions. Insurance requirements for Subcontractors shall be no more stringent than those requirements imposed on the Contractor by the Owner. The Contractor shall be responsible to the Owner for the acts and omissions of its employees, agents, Subcontractors, their agents and employees, and all other persons performing any of the Work or supplying materials under a contract to the Contractor.

**4.2 Relationship and Responsibilities.** Except as specifically set forth herein with respect to direct materials acquisitions by Owner, nothing contained in the Contract Documents or in any Contract Document does or shall create any contractual relation between the Owner or Architect/Engineer and any Subcontractor. Specifically, the Contractor is not acting as an agent of the Owner with respect to any Subcontractor. The utilization of any Subcontractor shall not relieve Contractor from any liability or responsibility to Owner, or obligate Owner to the payment of any compensation to the Subcontractor or additional compensation to the Contractor.

**4.3 Payments to Subcontractors; Monthly Statements.** The Contractor shall be responsible for paying all Subcontractors from the payments made by the Owner to Contractor pursuant to Article III, subject to the following provisions:

A. Payment. The Contractor shall, no later than ten (10) days after receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's Work, pay to each Subcontractor the amount to which the Subcontractor is entitled in accordance with the terms of the Contractor's contract with such Subcontractor. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to sub-Subcontractors in a similar manner. After receipt of payment from Owner, if the need should arise to withhold payments to Subcontractors for any reason, as solely determined by Contractor, the Contractor shall promptly restore such monies to the Owner, adjusting subsequent pay requests and Project bookkeeping as required.

B. Final Payment of Subcontractors. The final payment of retainage to Subcontractors shall not be made until the Project has been inspected by the Architect/Engineer or other person designated by the Owner for that purpose, and until both the Architect/Engineer and the Contractor have issued a written certificate that the Project has been constructed in accordance with the Project Plans and Specifications and approved Change Orders. Before issuance of final payment to any Subcontractor without any retainage, the Subcontractor shall submit satisfactory evidence that all payrolls, material bills, and other indebtedness connected with the Project have been paid or otherwise satisfied, warranty information is complete, as-built markups have been submitted, and instruction for the Owner's operating and maintenance personnel is complete. Final payment may be made to certain select Subcontractors whose Work is satisfactorily completed prior to the completion of the Project, but only upon approval of the Owner's Project Representative.

**4.4 Responsibility for Subcontractors.** As provided in Section 2.4.BB, Contractor shall be fully responsible to Owner for all acts and omissions of the Subcontractors, suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect Contract with

Contractor just as Contractor is responsible for Contractor's own acts and omissions.

**4.5 Contingent Assignment of Subcontracts.** Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that:

- (1) assignment is effective only after termination of the Contract by the Owner for cause pursuant to Article XIV and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and
- (2) assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Agreement.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract. Upon such assignment, if the Work has been suspended for more than thirty (30) days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension. Upon such assignment to the Owner, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

## **ARTICLE V, CHANGES IN WORK**

**5.1 General.** Changes in the Work may be accomplished after execution of the Agreement, and without invalidating the Agreement, by Change Order, Work Directive Change or order for a minor change in the Work, subject to the limitations stated in this Article V and elsewhere in the Contract Documents. A Change Order shall be based upon agreement among the Owner, Contractor and Architect/Engineer; a Work Directive Change requires agreement by the Owner and Architect/Engineer and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect/Engineer alone. Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Work Directive Change or order for a minor change in the Work.

**5.2 Minor Changes in the Work.** The Owner or Architect/Engineer shall have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such change will be effected by written order signed by the Architect/Engineer and shall be binding on the Owner and Contractor. The Contractor shall abide by and perform such minor changes. Such changes shall be effected by a Field Directive or a Work Directive Change. Documentation of changes shall be determined by the Construction Team, and displayed monthly in the Progress Reports. Because such changes shall not affect the Contract Sum to be paid to the Contractor, they shall not require a Change Order pursuant to Section 5.6.

**5.3 Emergencies.** In any emergency affecting the safety of persons or property, the Contractor shall act at its discretion to prevent threatened damage, injury, or loss. Any increase in the Contract Sum or extension of time claimed by the Contractor because of emergency Work shall be determined as provided in Section 5.6. However, whenever practicable, the Contractor shall obtain verbal concurrence of the Owner's Project Representative and Architect/Engineer where the act will or may affect the Contract Sum or Contract Time.

**5.4 Concealed Conditions.** If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the

Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect/Engineer before conditions are disturbed and in no event later than ten (10) days after first observance of the conditions. The Architect/Engineer will promptly investigate such conditions and, if the Architect/Engineer determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect/Engineer determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect/Engineer shall promptly notify the Owner and Contractor in writing, stating the reasons. If the Contractor disputes the Architect/Engineer's determination or recommendation, the Contractor may proceed as provided in Article VIII. If the Owner disputes the Architect/Engineer's determination or recommendation, the Owner may appeal directly to the Purchasing Official and shall thereafter follow the process set forth in Section 8.5.

**5.5 Hazardous Materials.** In the event the Contractor encounters on the Project Site material reasonably believed to be hazardous, petroleum or petroleum related products, or other hazardous or toxic substances, except as provided in Section 2.4.U, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner and the Architect/Engineer in writing. The Work in the affected area shall not thereafter be resumed except by Change Order or written amendment, if in fact the material or substance has not been rendered harmless. The Work in the affected area shall be resumed when the Project Site has been rendered harmless, in accordance with the final determination by the Architect/Engineer or other appropriate professional employed by Owner. The Contractor shall not be required to perform without its consent any Work relating to hazardous materials, petroleum or petroleum related products, or other hazardous or toxic substances. In the event the Contractor encounters on the Project Site materials believed in good faith to be hazardous or contaminated material, and the presence of such hazardous or contaminated material was not known and planned for at the time the Contractor submitted its Bid (or Guaranteed Maximum Price proposal), and it is necessary for the Contractor to stop Work in the area affected and delays Work for more than a seven (7) day period, adjustments to the Contract Sum and/or Contract Time shall be made in accordance with this Article V.

**5.6 Change Orders; Adjustments to Contract Sum.**

A. Change Orders Generally. The increase or decrease in the Contract Sum resulting from a change authorized pursuant to the Contract Documents shall be determined:

- (1) By mutual acceptance of a lump sum amount properly itemized and supported by sufficient substantiating data, to permit evaluation by the Architect/Engineer and Owner; or
- (2) By unit prices stated in the Agreement or subsequently agreed upon; or
- (3) By any other method mutually agreeable to Owner and Contractor.

If Owner and Contractor are unable to agree upon increases or decreases in the Contract Sum and the Architect/Engineer certifies that the work needs to be commenced prior to any such agreement, the Contractor, provided it receives a written Change Order signed by or on behalf of the Owner, shall promptly proceed with the Work involved. The cost of such Work shall then be determined on the basis of the reasonable expenditures of those performing the Work attributed to the change. However, in the

event a Change Order is issued under these conditions, the Owner, through the Architect/Engineer, will establish an estimated cost of the Work and the Contractor shall not perform any Work whose cost exceeds that estimated without prior written approval by the Owner. In such case, the Contractor shall keep and present in such form as the Owner may prescribe an itemized accounting, together with appropriate supporting data of the increase in overall costs of the Project. The amount of any decrease in the Contract Sum to be allowed by the Contractor to the Owner for any deletion or change which results in a net decrease in costs will be the amount of the actual net decrease.

**5.7 Owner-Initiated Changes.** Without invalidating the Agreement and without notice to any Surety, Owner may, at any time, order additions, deletions or revisions in the Work. These will be authorized by a written amendment, a Field Directive, a Change Order, or a Work Directive Change, as the case may be. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided). A Work Directive Change may not change the Contract Sum or the Contract Time; but is evidence that the parties expect that the change directed or documented by a Work Directive Change will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Sum or Contract Time.

**5.8 Unauthorized Work.** Contractor shall not be entitled to an increase in the Contract Sum or an extension of the Contract Time with respect to any Work performed that is not required by the Contract Documents.

**5.9 Defective Work.** Owner and Contractor shall execute appropriate Change Orders (or written amendments) covering changes in the Work which are ordered by Owner, or which may be required because of acceptance of defective Work, without adjustment to the Contract Sum.

**5.10 Estimates for Changes.** At any time Architect/Engineer may request a quotation from Contractor for a proposed change in the Work. Within twenty-one (21) calendar days after receipt, Contractor shall submit a written and detailed proposal for an increase or decrease in the Contract Sum or Contract Time for the proposed change. Architect/Engineer shall have twenty-one (21) calendar days after receipt of the detailed proposal to respond in writing. The proposal shall include an itemized estimate of all costs and time for performance that will result directly or indirectly from the proposed change. Unless otherwise directed, itemized estimates shall be in sufficient detail to reasonably permit an analysis by Architect/Engineer of all material, labor, equipment, subcontracts, overhead costs and fees, and shall cover all Work involved in the change, whether such Work was deleted, added, changed or impacted. Notwithstanding the request for quotation, Contractor shall carry on the Work and maintain the progress schedule. Delays in the submittal of the written and detailed proposal will be considered non-prejudicial.

**5.11 Form of Proposed Changes.** The form of all submittals, notices, Change Orders and other documents permitted or required to be used or transmitted under the Contract Documents shall be determined by the Owner. Standard Owner forms shall be utilized.

**5.12 Changes to Contract Time.** The Contract Time may only be changed pursuant to a Change Order or a written amendment to the Contract Documents. Any claim for an extension or shortening of the Contract Time shall be based on written notice delivered by the party making the claim to the other party. Notice of the extent of the claim with supporting data shall be delivered within fifteen (15) days from detection or beginning of such occurrence and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled to because of the occurrence of said event. The Contract time will be extended in an amount equal to time lost due to delays beyond the control of Contractor. Such delays

shall include, but not be limited to, acts or neglect by Owner or others performing additional Work; or to fires, floods, epidemics, abnormal weather conditions or acts of God. Failure to deliver a written notice of claim within the requisite 15-day period shall constitute a waiver of the right to pursue said claim.

## **ARTICLE VI, ROLE OF ARCHITECT/ENGINEER**

### **6.1 General.**

A. Retaining. The Owner shall retain an Architect/Engineer (whether an individual or an entity) lawfully licensed to practice in Florida. That person or entity is identified as the Architect/Engineer in the Agreement and is referred to throughout the Contract Documents as if singular in number.

B. Duties. Duties, responsibilities and limitations of authority of the Architect/Engineer as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner and Architect/Engineer. Consent shall not be unreasonably withheld.

C. Termination. If the employment of the Architect/Engineer is terminated, the Owner shall employ a successor Architect/Engineer as to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect/Engineer.

**6.2 Administration.** The Architect/Engineer will provide administration of the Agreement as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect/Engineer approves the final Application for Payment. The Architect/Engineer will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

A. Site Visits. The Architect/Engineer will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work complete, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. Unless specifically instructed by Owner, the Architect/Engineer will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect/Engineer will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

B. Reporting. Based on the site visits, the Architect/Engineer will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect/Engineer will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect/Engineer will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

**6.3 Interpretation of Project Plans and Specifications.** The Architect/Engineer will be the interpreter of the requirements of the Project Plans and Specifications. Upon receipt of comments or objections by Contractor or Owner, the Architect/Engineer will make decisions on all claims, disputes, or

other matters pertaining to the interpretation of the Project Plans and Specifications.

**6.4 Rejection of Non-Conforming Work.** Upon consultation with Owner, the Architect/Engineer shall have the authority to reject Work which does not conform to the Project Plans and Specifications.

**6.5 Correction of Work.** The Contractor shall promptly correct all Work rejected by the Architect/Engineer for being defective or as failing to conform to the Project Plans and Specifications, whether observed before or after the Substantial Completion Date and whether or not fabricated, installed, or completed. The Contractor shall bear all costs of correcting such rejected Work, including compensation for Architect/Engineer's additional services made necessary thereby.

**6.6 Timely Performance of Architect/Engineer.** The Contractor shall identify which requests for information or response from the Architect/Engineer have the greatest urgency and those items which require prioritizing in response by the Architect/Engineer. The Contractor shall also identify the preferred time period for response and shall request a response time which is reasonably and demonstrably related to the needs of the Project and Contractor. If Architect/Engineer claims that Contractor's expectations for a response are unreasonable, Owner shall require Architect/Engineer to communicate such claim to Contractor in writing together with the specific time necessary to respond and the date upon which such response will be made. If Contractor believes that Architect/Engineer is not providing timely services or responses, Contractor shall notify Owner of same in writing not less than two (2) weeks before Contractor believes performance or response time from Architect/Engineer is required without risk of delaying the Project.

## **ARTICLE VII, OWNER'S RIGHTS AND RESPONSIBILITIES**

**7.1 Project Site; Title.** The Owner shall provide the lands upon which the Work under the Contract Documents is to be done, except that the Contractor shall provide all necessary additional land required for the erection of temporary construction facilities and storage of his materials, together with right of access to same. The Owner hereby represents to the Contractor that it currently has and will maintain up through and including the Substantial Completion Date, good title to all of the real property constituting the Project Site. Owner agrees to resolve, at its expense, any disputes relating to the ownership and use of the Project Site which might arise during construction.

**7.2 Project Plans and Specifications; Architect/Engineer.** The parties hereto acknowledge and agree that Owner has previously entered into an agreement with Architect/Engineer. Pursuant to the terms of such agreement, the Architect/Engineer, as an agent and representative of Owner, is responsible for the preparation of Project Plans and Specifications which consist of drawings, specifications, and other documents setting forth in detail the requirements for the construction of the Project. All such Project Plans and Specifications shall be provided either by Owner or the Architect/Engineer, and Contractor shall be under no obligation to provide same and shall be entitled to rely upon the accuracy and completeness of the Project Plans and Specifications provided by the Architect/Engineer and all preliminary drawings prepared in connection therewith. The Contractor will be furnished a reproducible set of all drawings and specifications reasonably necessary for the performance of Contractor's services hereunder and otherwise ready for printing. The Contractor shall be notified of any written modification in the agreement between Owner and Architect/Engineer.

**7.3 Surveys; Soil Tests and Other Project Site Information.** Owner shall be responsible for providing a legal description and certified land survey of the Project Site in a form and content and with such specificity as may be required by the Architect/Engineer and Contractor to perform their services. To the extent deemed necessary by Owner and Architect/Engineer, and solely at Owner's expense,

Owner may engage the services of a geotechnical consultant to perform test borings and other underground soils testing as may be deemed necessary by the Architect/Engineer or the Contractor. Contractor shall not be obligated to provide such surveys or soil tests and shall be entitled to rely upon the accuracy and completeness of the information provided; subject, however, to the provisions of Section 2.4.S hereof. Owner shall provide Contractor, as soon as reasonably possible following the execution of the Contract Documents, all surveys or other survey information in its possession describing the physical characteristics of the Project Site, together with soils reports, subsurface investigations, utility locations, deed restrictions, easements, and legal descriptions then in its possession or control. Upon receipt of all surveys, soils tests, and other Project Site information, Contractor shall promptly advise Owner of any inadequacies in such information and of the need for any additional surveys, soils or subsoil tests. In performing this Work, Contractor shall use the standard of care of experienced contractors and will use its best efforts timely to identify all problems or omissions. Owner shall not be responsible for any delay or damages to the Contractor for any visible or disclosed site conditions or disclosed deficiencies in the Project Site which should have been identified by Contractor and corrected by Owner prior to the execution of the Contract Documents.

**7.4 Information; Communication; Coordination.** The Owner's Project Representative shall examine any documents or requests for information submitted by the Contractor and shall advise Contractor of Owner's decisions pertaining thereto within a reasonable period of time to avoid unreasonable delay in the progress of the Contractor's services. Contractor shall indicate if any such documents or requests warrant priority consideration. However, decisions pertaining to approval of the Project Schedule as it relates to the date of Substantial Completion, the Project Cost, Contractor's compensation, approving or changing the Contract Sum shall only be effective when approved by Owner in the form of a written Change Order or amendment to the Contract Documents. Owner reserves the right to designate a different Owner's Project Representative provided Contractor is notified in writing of any such change. Owner and Architect/Engineer may communicate with Subcontractors, materialmen, laborers, or suppliers engaged to perform services on the Project, but only for informational purposes. Neither the Owner nor the Architect/Engineer shall attempt to direct the Work of or otherwise interfere with any Subcontractor, materialman, laborer, or supplier, or otherwise interfere with the Work of the Contractor. Owner shall furnish the data required of Owner under the Contract Documents promptly.

**7.5 Governmental Body.** The Contractor recognizes that the Owner is a governmental body with certain procedural requirements to be satisfied. The Contractor has and will make reasonable allowance in its performance of services for such additional time as may be required for approvals and decisions by the Owner and any other necessary government agency.

**7.6 Pre-Completion Acceptance.** The Owner shall have the right to take possession of and use any completed portions of the Work, although the time for completing the entire Work or such portions may not have expired, but such taking possession and use shall not be deemed an acceptance of any Work not completed in accordance with the Contract Documents.

**7.7 Ownership and Use of Drawings, Specifications and Other Instruments of Service.**

- (1) The Architect/Engineer and the Architect/Engineer's consultants shall be deemed the authors and owners of their respective instruments of service, including the Project Plans and Specifications, and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the instruments of service. Submittal or distribution to meet official regulatory requirements or for other purposes in

connection with this Project is not to be constructed as publication in derogation of the Architect/Engineer's or Architect/Engineer's consultants' reserved rights.

- (2) The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the drawings and specifications provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Project Plans and Specifications or other instruments of service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the drawings or specifications on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect/Engineer and the Architect/Engineer's consultants.

**7.8 Owner's Project Representative.** Owner's Project Representative is Owner's Agent, who will act as directed by and under the supervision of the Owner, and who will confer with Owner/Architect/Engineer regarding his actions. The Owner's Project Representative's dealings in matters pertaining to the on-site Work shall, in general, be only with the Owner/Architect/Engineer and Contractor and dealings with Subcontractors shall only be through or with the full knowledge of Contractor.

A. Responsibilities. Except as otherwise instructed in writing by Owner, the Owner's Project Representative will:

- (1) Attend preconstruction conferences; arrange a schedule of progress meetings and other job conferences as required in consultation with Owner/Architect/Engineer and notify those expected to attend in advance; and attend meetings and maintain and circulate copies of minutes thereof;
- (2) Serve as Owner/Architect/Engineer's liaison with Contractor, working principally through Contractor's superintendent, to assist in understanding the intent of the Contract Documents. As requested by Owner/Architect/Engineer, assist in obtaining additional details or information when required at the job site for proper execution of the Work;
- (3) Report to Owner/Architect/Engineer whenever he believes that any Work is unsatisfactory, faulty or defective or does not conform to the Contract Documents;
- (4) Accompany visiting inspectors representing public or other agencies having jurisdiction over the project; record the outcome of these inspections and report to Owner/Architect/Engineer;
- (5) Review applications for payment with Contractor for compliance with the established procedure for their submission and forward them with recommendations to Owner/Architect/Engineer; and
- (6) Perform those duties as set forth elsewhere within the Contract Documents.

B. Limitations. Except upon written instructions of Owner, Owner's Project Representative shall not:

- (1) Authorize any deviation from the Contract Documents or approve any substitute materials or equipment;
- (2) Exceed limitations on Owner/Architect/Engineer's authority as set forth in the Contract Documents;
- (3) Undertake any of the responsibilities of Contractor, Subcontractors or Contractor's superintendent, or expedite the Work;
- (4) Advise on or issue directions relative to any aspect of the means, methods, techniques, sequences or procedures of construction unless such is specifically called for in the Contract Documents;
- (5) Advise on or issue directions as to safety precautions and programs in connection with the Work;
- (6) Authorize Owner to occupy the project in whole or in part; or
- (7) Participate in specialized field or laboratory tests.

## **ARTICLE VIII, RESOLUTION OF DISAGREEMENTS; CLAIMS FOR COMPENSATION**

**8.1 Owner to Decide Disputes.** The Owner shall reasonably decide all questions and disputes (with the exception of matters pertaining to the interpretation of the Project Plans and Specifications which shall be resolved by the Architect/Engineer pursuant to Section 6.3) that may arise in the execution and fulfillment of the services provided for under the Contract Documents, in accordance with the Procurement Ordinance.

**8.2 Finality.** The decision of the Owner upon all claims, questions, disputes and conflicts shall be final and conclusive, and shall be binding upon all parties to the Contract Documents, subject to judicial review as provided in Section 8.5 below.

**8.3 No Damages for Delay.** If at any time Contractor is delayed in the performance of Contractor's responsibilities under the Contract Documents as the result of a default or failure to perform in a timely manner by Owner or Owner's agents or employees, Contractor shall not be entitled to any damages except for compensation specifically authorized in Article III. Contractor's sole remedy will be a right to extend the time for performance. Nothing herein shall preclude Contractor from any available remedy against any responsible party other than Owner. Contractor shall be responsible for liquidated damages for delay if otherwise provided for in the Contract Documents.

**8.4 Permitted Claims Procedure.** Where authorized or permitted under the Contract Documents, all claims for additional compensation by Contractor, extensions of time affecting the Substantial Completion Date, for payment by the Owner of costs, damages or losses due to casualty, Force Majeure, Project Site conditions or otherwise, shall be governed by the following:

- (1) All claims must be submitted as a request for Change Order in the manner as provided in Article V.

- (2) The Contractor must submit a notice of claim to Owner's Project Representative and to the Architect/Engineer within fifteen (15) days of when the Contractor was or should have been aware of the fact that an occurrence was likely to cause delay or increased costs. Failure to submit a claim within the requisite 15-day period shall constitute a waiver of the right to pursue said claim.
- (3) Within twenty (20) days of submitting its notice of claim, the Contractor shall submit to the Owner's Project Representative its request for Change Order, which shall include a written statement of all details of the claim, including a description of the Work affected.
- (4) After receipt of a request for Change Order, the Owner's Project Representative, in consultation with the Architect/Engineer, shall deliver to the Contractor, within twenty (20) days after receipt of request, its written response to the claim.
- (5) In the event the Owner and Contractor are unable to agree on the terms of a Change Order, the Owner shall have the option to instruct the Contractor to proceed with the Work. In that event, the Owner shall pay for those parts of the Work, the scope and price of which are not in dispute. The balance of the disputed items in the order to proceed will be resolved after completion of the Work, based upon completed actual cost.
- (6) The rendering of a decision by Owner with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment) will be a condition precedent to any exercise by Owner or Contractor of such right or remedies as either may otherwise have under the Contract Documents or by laws or regulations in respect of any such claim, dispute or other matter.

**8.5 Contract Claims and Disputes.** After completion of the process set forth in Section 8.4 above, any unresolved dispute under this Agreement shall be decided by the Purchasing Official in accordance with Section 2-26-63 of the Manatee County Code of Laws, subject to an administrative hearing process as provided in Section 2-26-64. The decision of the Board of County Commissioners in accordance with Section 2-26-64 of the Manatee County Code of Laws shall be the final and conclusive County decision subject to exclusive judicial review in circuit court by a petition for certiorari.

**8.6 Claims for Consequential Damages.** The Contractor and Owner waive claims against each other for consequential damages arising out of or relating to this Agreement. This mutual waiver includes:

- (1) damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons, unless any of such damages or losses are covered by insurance place by the Contractor; and
- (2) damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article XIV. Nothing contained in this Section 8.6 shall be deemed to preclude assessment of liquidated direct damages, when applicable, in accordance with the requirements of the Contract Documents.

## **ARTICLE IX, INDEMNITY**

### **9.1 Indemnity.**

A. Indemnification Generally. To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect/Engineer, Architect/Engineer's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 9.1.

B. Claims by Employees. In claims against any person or entity indemnified under this Section 9.1 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 9.1.A. shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

**9.2 Duty to Defend.** The Contractor shall defend the Owner in any action, lawsuit mediation or arbitration arising from the alleged negligence, recklessness or intentionally wrongful conduct of the Contractor and other persons employed or utilized by the Contractor in the performance of the Work. So long as Contractor, through its own counsel, performs its obligation to defend the Owner pursuant to this Section, Contractor shall not be required to pay the Owner's costs associated with the Owner's participation in the defense.

## **ARTICLE X, ACCOUNTING RECORDS; OWNERSHIP OF DOCUMENTS**

**10.1 Accounting Records.** Records of expenses pertaining to all services performed shall be kept in accordance with generally accepted accounting principles and procedures.

**10.2 Inspection and Audit.** The Contractor's records shall be open to inspection and subject to examination, audit, and/or reproduction during normal working hours by the Owner's agent or authorized representative to the extent necessary to adequately permit evaluation and verification of any invoices, payments or claims submitted by the Contractor or any of its payees during the performance of the Work. These records shall include, but not be limited to, accounting records, written policies and procedures, Subcontractor files (including proposals of successful and unsuccessful bidders), original estimates, estimating worksheets, correspondence, Change Order files (including documentation covering negotiated settlements), and any other supporting evidence necessary to substantiate charges related to the Contract Documents. They shall also include, but not be limited to, those records necessary to evaluate and verify direct and indirect costs (including overhead allocations)

as they may apply to costs associated with the Contract Documents. For such audits, inspections, examinations and evaluations, the Owner's agent or authorized representative shall have access to said records from the effective date of the Contract Documents, for the duration of Work, and until three (3) years after the date of final payment by the Owner to the Contractor pursuant to the Contract Documents.

**10.3 Access.** The Owner's agent or authorized representative shall have access to the Contractor's facilities and all necessary records to conduct audits in compliance with this Article. The Owner's agent or authorized representative shall give the Contractor reasonable advance notice of intended inspections, examinations, and/or audits.

**10.4 Ownership of Documents.** Upon obtainment of Substantial Completion or termination of the Agreement, all records, documents, tracings, plans, specifications, maps, evaluations, reports, transcripts and other technical data, other than working papers, prepared or developed by the Contractor shall be delivered to and become the property of the Owner. The Contractor at its own expense may retain copies for its files and internal use.

## **ARTICLE XI, PUBLIC CONTRACT LAWS**

### **11.1 Equal Opportunity Employment.**

A. Employment. The Contractor shall not discriminate against any employee or applicant for employment because of race, creed, sex, color, national origin, disability or age, and will take affirmative action to ensure that all employees and applicants are afforded equal employment opportunities without discrimination because of race, creed, sex, color, national origin, disability or age. Such action will be taken with reference to, but shall not be limited to, recruitment, employment, job assignment, promotion, upgrading, demotion, transfer, layoff or termination, rates of training or retraining, including apprenticeship and on-the-job training.

B. Participation. No person shall, on the grounds of race, creed, sex, color, national origin, disability or age, be excluded from participation in, be denied the proceeds of, or be subject to discrimination in the performance of the Agreement.

**11.2 Immigration Reform and Control Act of 1986.** Contractor acknowledges that it is responsible for complying with the provisions of the Immigration Reform and Control Act of 1986, located at 8 U.S.C. Section 1324, et seq., and regulations relating thereto. Failure to comply with the above statutory provisions shall be considered a material breach and shall be grounds for immediate termination of this Agreement.

**11.3 No Conflict of Interest.** The Contractor warrants that it has not employed or retained any company or person, other than a bona fide employee working solely for the Contractor to solicit or secure this Agreement, and that it has not paid or agreed to pay any person, company, corporation, individual, or firm other than a bona fide employee working solely for the Contractor, any fee, commission, percentage, gift or any other consideration, contingent upon or resulting from the award or making of this Agreement.

A. No Interest in Business Activity. By accepting award of this Agreement, the Contractor, which shall include its directors, officers and employees, represents that it presently has no interest in and shall acquire no interest in any business or activity which would conflict in any manner with the performance of services required hereunder, including without limitation as described in the Contractor's own professional ethical requirements. An interest in a business or activity which shall be

deemed a conflict includes but is not limited to direct financial interest in any of the material and equipment manufacturers, suppliers, distributors, or contractors who will be eligible to supply material and equipment for the Project for which the Contractor is furnishing its services required hereunder.

B. No Appearance of Conflict. The Contractor shall not knowingly engage in any contractual or professional obligations that create an appearance of a conflict of interest with respect to the services provided pursuant to the Agreement. The Contractor has provided the Affidavit of No Conflict, incorporated into the Contract Documents as Exhibit "C", as a material inducement for Owner entering the Agreement. If, in the sole discretion of the County Administrator or designee, a conflict of interest is deemed to exist or arise during the term of this Agreement, the County Administrator or designee may cancel this Agreement, effective upon the date so stated in a written notice of cancellation, without penalty to the Owner.

**11.4 Truth in Negotiations.** By execution of the Contract Documents, the Contractor certifies to truth-in-negotiations and that wage rates and other factual unit costs supporting the compensation are accurate, complete and current at the time of contracting. Further, the original Contract Sum and any additions thereto shall be adjusted to exclude any significant sums where the Owner determines the Contract Sum was increased due to inaccurate, incomplete or non-current wage rates and other factual unit costs. Such adjustments must be made within one (1) year after final payment to the Contractor.

**11.5 Public Entity Crimes.** The Contractor is directed to the Florida Public Entity Crimes Act, Section 287.133, Florida Statutes, specifically section 2(a), and the Owner's requirement that the Contractor comply with it in all respects prior to and during the term of the Agreement.

## **ARTICLE XII, FORCE MAJEURE, FIRE OR OTHER CASUALTY**

### **12.1 Force Majeure.**

A. Unavoidable Delays. Delays in any performance by any party contemplated or required hereunder due to fire, flood, sinkhole, earthquake or hurricane, acts of God, unavailability of materials, equipment or fuel, war, declaration of hostilities, revolt, civil strife, altercation or commotion, strike, labor dispute, or epidemic, archaeological excavation, lack of or failure of transportation facilities, or any law, order, proclamation, regulation, or ordinance of any government or any subdivision thereof, or for any other similar cause to those enumerated, beyond the reasonable control and which with due diligence could not have been reasonably anticipated, shall be deemed to be events of Force Majeure and any such delays shall be excused. In the event such party is delayed in the performance of any Work or obligation pursuant to the Contract Documents for any of the events of Force Majeure stated in this Section 12.1, the date for performance required or contemplated by the Contract Documents shall be extended by the number of calendar days such party is actually delayed.

B. Concurrent Contractor Delays. If a delay is caused for any reason provided in 12.1.A. or because of an extension of time provided by Change Order, and during the same time period a delay is caused by Contractor, the date for performance shall be extended as provided in 12.1.A. but only to the extent the time is or was concurrent.

C. Notice; Mitigation. The party seeking excuse for nonperformance based on Force Majeure shall give written notice to the Owner, if with respect to the Contractor, or to the Contractor if with respect to the Owner, specifying its actual or anticipated duration. Each party seeking excuse from nonperformance based on Force Majeure shall use its best efforts to rectify any condition

causing a delay and will cooperate with the other party, except that neither party shall be obligated to incur any unreasonable additional costs and expenses to overcome any loss of time that has resulted.

**12.2 Casualty; Actions by Owner and Contractor.** During the construction period, if the Project or any part thereof shall have been damaged or destroyed, in whole or in part, the Contractor shall promptly make proof of loss; and Owner and Contractor shall proceed promptly to collect, or cause to be collected, all valid claims which may have arisen against insurers or others based upon such damage or destruction. The Contractor shall diligently assess the damages or destruction and shall prepare an estimate of the cost, expenses, and other charges, including normal and ordinary compensation to the Contractor, necessary for reconstruction of the Project substantially in accordance with the Project Plans and Specifications. Within fifteen (15) days following satisfaction of the express conditions described in subsections (1), (2) and (3) below, the Contractor covenants and agrees diligently to commence reconstruction and to complete the reconstruction or repair of any loss or damage by fire or other casualty to the Project to substantially the same size, floor area, cubic content, and general appearance as prior to such loss or damage:

- (1) Receipt by the Owner or the trustee of the proceeds derived from collection of all valid claims against insurers or others based upon such damage or destruction, and receipt of other sums from any source such that the funds necessary to pay the Project Cost and any additions to the Project Cost necessitated for repair or reconstruction are available;
- (2) Written agreement executed by the Contractor and the Owner, by amendment to the Contract Documents or otherwise, authorizing and approving the repair or reconstruction and any additions to the Project Cost necessitated thereby, including any required adjustment to the Contract Sum; and
- (3) Final approval by the Owner of the Project Plans and Specifications for such repair or reconstruction and issuance of any required building permit.

**12.3 Approval of Plans and Specifications.** The Owner agrees to approve the plans and specifications for such reconstruction or repair if the reconstruction or repair contemplated by such plans and specifications is economically feasible, and will restore the Project, or the damaged portion thereof, to substantially the same condition as prior to such loss or damage, and such plans and specifications conform to the applicable laws, ordinances, codes, and regulations. The Owner agrees that all proceeds of any applicable insurance or other proceeds received by the Owner or the Contractor as a result of such loss or damage shall be used for payment of the costs, expenses, and other charges of the reconstruction or repair of the Project.

**12.4 Notice of Loss or Damage.** The Contractor shall promptly give the Owner written notice of any significant damage or destruction to the Project, defined as loss or damage which it is contemplated by Contractor will increase the Contract Sum or extend the Substantial Completion Date, stating the date on which such damage or destruction occurred, the then expectations of Contractor as to the effect of such damage or destruction on the use of the Project, and the then proposed schedule, if any, for repair or reconstruction of the Project. Loss or damage which the Contractor determines will not affect the Contract Sum or Substantial Completion Date will be reported to Owner and Architect/Engineer immediately, and associated corrective actions will be undertaken without delay.

## ARTICLE XIII, REPRESENTATIONS, WARRANTIES AND COVENANTS

**13.1 Representations and Warranties of Contractor.** The Contractor represents and warrants to the Owner each of the following.

A. The Contractor is a construction company, organized under the laws of the State of \_\_\_\_\_, authorized to transact business in the State of Florida, with \_\_\_\_\_ as the primary qualifying agent. Contractor has all requisite power and authority to carry on its business as now conducted, to own or hold its properties, and to enter into and perform its obligations hereunder and under each instrument to which it is or will be a party, and is in good standing in the State of Florida.

B. Each Contract Document to which the Contractor is or will be a party constitutes, or when entered into will constitute, a legal, valid, and binding obligation of the Contractor enforceable against the Contractor in accordance with the terms thereof, except as such enforceability may be limited by applicable bankruptcy, insolvency, or similar laws from time to time in effect which affect creditors' rights generally and subject to usual equitable principles in the event that equitable remedies are involved.

C. There are no pending or, to the knowledge of the Contractor, threatened actions or proceedings before any court or administrative agency, within or without the State of Florida, against the Contractor or any partner, officer, or agent of the Contractor which question the validity of any document contemplated hereunder, or which are likely in any case, or in the aggregate, to materially adversely affect the consummation of the transactions contemplated hereunder, or materially adversely affect the financial condition of the Contractor.

D. The Contractor has filed or caused to be filed all federal, state, local, or foreign tax returns, if any, which were required to be filed by the Contractor, and has paid, or caused to be paid, all taxes shown to be due and payable on such returns or on any assessments levied against the Contractor.

E. Neither Contractor nor any agent or person employed or retained by Contractor has acted fraudulently or in bad faith or in violation of any statute or law in the procurement of this Agreement.

F. The Contractor shall timely fulfill or cause to be fulfilled all of the terms and conditions expressed herein which are within the control of the Contractor or which are the responsibility of the Contractor to fulfill. The Contractor shall be solely responsible for the means and methods of construction.

G. It is recognized that neither the Architect/Engineer, the Contractor, nor the Owner has control over the cost of labor, materials, or equipment, over a Subcontractor's methods of determining bid prices, or over competitive bidding, market, or negotiating conditions.

H. During the term of the Contract Documents, and the period of time that the obligations of the Contractor under the Contract Documents shall be in effect, the Contractor shall cause to occur and to continue to be in effect those instruments, documents, certificates, and events contemplated by the Contract Documents that are applicable to, and the responsibility of, the Contractor.

I. The Contractor shall assist and cooperate with the Owner and shall accomplish the construction of the Project in accordance with the Contract Documents and the Project Plans and Specifications, and will not knowingly violate any laws, ordinances, rules, regulations, or orders that are or will be applicable thereto.

J. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective, and that Owner, representatives of Owner, and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. Contractor shall give Architect/Engineer timely notice of readiness of the Work for all required approvals and shall assume full responsibility, including costs, in obtaining required tests, inspections, and approval certifications and/or acceptance, unless otherwise stated by Owner.

K. If any Work (including Work of others) that is to be inspected, tested, or approved is covered without written concurrence of Architect/Engineer, it must, if requested by Architect/Engineer, be uncovered for observation. Such uncovering shall be at Contractor's expense unless Contractor has given Architect/Engineer timely notice of Contractor's intention to cover the same and Architect/Engineer has not acted with reasonable promptness in response to such notice. Neither observations by Architect/Engineer nor inspections, tests, or approvals by others shall relieve Contractor from Contractor's obligations to perform the Work in accordance with the Contract Documents.

L. If the Work is defective, or Contractor fails to supply sufficient skilled workers, or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof and terminate payments to the Contractor until the cause for such order has been eliminated. Contractor shall bear all direct, indirect and consequential costs for satisfactory reconstruction or removal and replacement with non-defective Work, including, but not limited to fees and charges of Architect/Engineers, attorneys and other professionals and any additional expenses experienced by Owner due to delays to other Contractors performing additional Work and an appropriate deductive change order shall be issued. Contractor shall further bear the responsibility for maintaining the schedule and shall not be entitled to an extension of the Contract Time or the recovery of delay damages due to correcting or removing defective Work.

M. If Contractor fails within seven (7) days after written notice to correct defective Work, or fails to perform the Work in accordance with the Contract Documents, or fails to comply with any other provision of the Contract Documents, Owner may correct and remedy any such deficiency to the extent necessary to complete corrective and remedial action. Owner may exclude Contractor from all or part of the site, take possession of all or part of the Work, Contractor's tools, construction equipment and machinery at the site or for which Owner has paid Contractor but which are stored elsewhere. All direct and indirect costs of Owner in exercising such rights and remedies will be charged against Contractor in an amount approved as to reasonableness by Architect/Engineer and a Change Order will be issued incorporating the necessary revisions.

N. If within three (3) years after the Substantial Completion Date or such longer period of time as may be prescribed by laws or regulations or by the terms of any applicable special guarantee required by the Contract Documents, any Work is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions, either correct such defective Work or if it has been rejected by Owner, remove it from the site and replace it with non-defective Work. If Contractor does not promptly comply with the terms of such instruction, Owner may have the defective Work corrected/removed and all direct, indirect and consequential costs of such

removal and replacement will be paid by Contractor. Failing payment by the Contractor and notwithstanding any other provisions of the Contract Documents to the contrary, Owner shall have the right to bring a direct action in the Circuit Court to recover such costs.

**13.2 Representations of the Owner.** To the extent permitted by law, the Owner represents to the Contractor that each of the following statements is presently true and accurate:

- A. The Owner is a validly existing political subdivision of the State of Florida.
- B. The Owner has all requisite corporate or governmental power and authority to carry on its business as now conducted and to perform its obligations under the Contract Documents and each Contract Document contemplated hereunder to which it is or will be a party.
- C. The Contract Documents and each Contract Document contemplated hereby to which the Owner is or will be a party has been duly authorized by all necessary action on the part of, and has been or will be duly executed and delivered by, the Owner, and neither the execution and delivery thereof nor compliance with the terms and provisions thereof or hereof: (a) requires the approval and consent of any other person or party, except such as have been duly obtained or as are specifically noted herein; (b) contravenes any existing law, judgment, governmental rule, regulation or order applicable to or binding on the Owner; or (c) contravenes or results in any breach of, default under, or result in the creation of any lien or encumbrance upon the Owner under any indenture, mortgage, deed of trust, bank loan, or credit agreement, the charter, ordinances, resolutions, or any other agreement or instrument to which the Owner is a party, specifically including any covenants of any bonds, notes, or other forms of indebtedness of the Owner outstanding on the date of the Contract Documents.
- D. The Contract Documents and each document contemplated hereby to which the Owner is or will be a party constitutes, or when entered into will constitute, a legal, valid, and binding obligation of the Owner enforceable against the Owner in accordance with the terms thereof, except as such enforceability may be limited by applicable bankruptcy, insolvency, or similar laws from time to time in effect which affect creditors' rights generally, and subject to usual equitable principles in the event that equitable remedies are involved.
- E. There are no pending or, to the knowledge of the Owner, threatened actions or proceedings before any court or administrative agency against the Owner which question the validity of the Contract Documents or any document contemplated hereunder, or which are likely in any case or in the aggregate to materially adversely affect the consummation of the transactions contemplated hereunder or the financial or corporate condition of the Owner.
- F. The Owner shall use due diligence to timely fulfill or cause to be fulfilled all of the conditions expressed in the Contract Documents which are within the control of the Owner or which are the responsibility of the Owner to fulfill.
- G. During the pendency of the Work and while the obligations of the Owner under the Contract Documents shall be in effect, the Owner shall cause to occur and to continue to be in effect and take such action as may be necessary to enforce those instruments, documents, certificates and events contemplated by the Contract Documents that are applicable to and the responsibility of the Owner.
- H. The Owner shall assist and cooperate with the Contractor in accomplishing the construction of the Project in accordance with the Contract Documents and the Project Plans and

Specifications, and will not knowingly violate any laws, ordinances, rules, regulations, orders, contracts, or agreements that are or will be applicable thereto or, to the extent permitted by law, enact or adopt any resolution, rule, regulation, or order, or approve or enter into any contract or agreement, including issuing any bonds, notes, or other forms of indebtedness, that will result in the Contract Documents or any part thereof, or any other instrument contemplated by and material to the timely and effective performance of a party's obligations hereunder, to be in violation thereof.

#### **ARTICLE XIV, TERMINATION AND SUSPENSION**

**14.1 Termination for Cause by Owner.** This Agreement may be terminated by Owner upon written notice to the Contractor should Contractor fail substantially to perform a material obligation in accordance with the terms of the Contract Documents through no fault of the Owner. In the event Owner terminates for cause and it is later determined by a court of competent jurisdiction that such termination for cause was not justified, then in such event such termination for cause shall automatically be converted to a termination without cause pursuant to Section 14.2.

A. Nonperformance. If the Contractor fails to timely perform any of its obligations under the Contract Documents, including any obligation the Contractor assumes to perform Work with its own forces, or if it persistently or repeatedly refuses or fails, except in case for which extension of time is provided, to supply enough properly skilled workmen or proper materials, or fails, without being excused, to maintain an established schedule (failure to maintain schedule shall be defined as any activity that falls thirty (30) days or more behind schedule) which has been adopted by the Construction Team, or it fails to make prompt payment to Subcontractors for materials or labor, or disregards laws, rules, ordinances, regulations, or orders of any public authority having jurisdiction, or otherwise is guilty of substantial violations of the Agreement the Owner may, after seven (7) days written notice, during which period the Contractor fails to perform such obligation, make good such deficiencies and perform such actions. The Contract Sum shall be reduced by the cost to the Owner of making good such deficiencies, and the Contractor's compensation shall be reduced by an amount required to manage the making good of such deficiencies. Provided, however, nothing contained herein shall limit or preclude Owner from pursuing additional damages from Contractor because of its breach.

B. Insolvency. If the Contractor is adjudged bankrupt, or if it makes a general assignment for the benefit of its creditors, or if a receiver is appointed because its insolvency, then the Owner may, without prejudice to any other right or remedy, and after giving the Contractor and its surety, if any, fourteen (14) days written notice, and during which period the Contractor fails to cure the violation, terminate the Agreement. In such case, the Contractor shall not be entitled to receive any further payment. Owner shall be entitled to recover all costs and damages arising because of failure of Contractor to perform as provided in the Contract Documents, as well as reasonable termination expenses, and costs and damages incurred by the Owner may be deducted from any payments left owing the Contractor.

C. Illegality. Owner may terminate the Agreement if Contractor disregards laws or regulations of any public body having jurisdiction.

D. Rights of Owner. The Owner may, after giving Contractor (and the Surety, if there is one) seven (7) days written notice, terminate the services of Contractor for cause; exclude Contractor from the Project Site and take possession of the Work and of all Contractor's tools, construction equipment and machinery at the Project Site and use the same to the full extent they could be used (without liability to Contractor for trespass or conversion); incorporate in the Work all materials and equipment stored at the Project Site or for which Owner has paid Contractor but which are stored elsewhere, and finish the Work as Owner may deem expedient. In such case, Contractor shall not be

entitled to receive any further payment beyond an amount equal to the value of material and equipment not incorporated in the Work, but delivered and suitably stored, less the aggregate of payments previously made. If the direct and indirect costs of completing the Work exceed the unpaid balance of the Contract Sum, Contractor shall pay the difference to Owner. Such costs incurred by Owner shall be verified by Owner in writing; but in finishing the Work, Owner shall not be required to obtain the lowest quote for the Work performed. Contractor's obligations to pay the difference between such costs and such unpaid balance shall survive termination of the Agreement. In such event and notwithstanding any other provisions of the Contract Documents to the contrary, Owner shall be entitled to bring a direct action in the Circuit Court to recover such costs.

**14.2 Termination without Cause by Owner.** The Owner, through its County Administrator or designee, shall have the right to terminate the Agreement, in whole or in part, without cause upon sixty (60) calendar days' written notice to the Contractor. In the event of such termination for convenience, the Owner shall compensate Contractor for payments due through the date of termination, and one subsequent payment to cover costs of Work performed through the date of termination, subject to the terms and conditions of Section 3.1. The Contractor shall not be entitled to any other further recovery against the Owner, including, but not limited to, anticipated fees or profit on Work not required to be performed, or consequential damages or costs resulting from such termination.

A. Release of Contractor. As a condition of Owner's termination rights provided for in this subsection, Contractor shall be released and discharged from all obligations arising by, through, or under the terms of the Contract Documents, and the Payment and Performance Bond shall be released. Owner shall assume and become responsible for the reasonable value of Work performed by Subcontractors prior to termination plus reasonable direct close-out costs, but in no event shall Subcontractors be entitled to unabsorbed overhead, anticipatory profits, or damages for early termination.

B. Waiver of Protest. Contractor hereby waives any right to protest the exercise by Owner of its rights under this Section that may apply under the Procurement Ordinance.

**14.3 Suspension without Cause.** Owner may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than ninety (90) days by written notice to Contractor, which will fix the date on which Work will be resumed. Contractor shall be allowed an increase in the Contract Sum or an extension of the Contract Time, or both, directly attributable to any suspension if Contractor makes an approved claim therefor.

**14.4 Termination Based Upon Abandonment, Casualty or Force Majeure.** If, after the construction commencement date (i) Contractor abandons the Project (which for purposes of this paragraph shall mean the cessation of all construction and other activities relating to the Project, excluding those which are necessary to wind down or otherwise terminate all outstanding obligations with respect to the Project, and no recommencement of same within one hundred twenty (120) days following the date of cessation), or (ii) the Project is stopped for a period of thirty (30) consecutive days due to an instance of Force Majeure or the result of a casualty resulting in a loss that cannot be corrected or restored within one hundred twenty (120) days (excluding the time required to assess the damage and complete the steps contemplated under Section 12.2), the Owner shall have the right to terminate the Agreement and pay the Contractor its compensation earned or accrued to date.

**14.5 Vacation of Project Site; Delivery of Documents.** Upon termination by Owner pursuant to Section 14.2 or 14.4, Contractor shall withdraw its employees and its equipment, if any, from the Project Site on the effective date of the termination as specified in the notice of termination (which

effective date shall not be less than two (2) working days after the date of delivery of the notice), regardless of any claim the Contractor may or may not have against the Owner. Upon termination, the Contractor shall deliver to the Owner all original papers, records, documents, drawings, models and other material set forth and described in the Contract Documents.

**14.6 Termination by the Contractor.** If, through no act or fault of Contractor, the Work is suspended for a period of more than ninety (90) consecutive days by Owner or under an order of court or other public authority, or Owner fails to act on any Application for Payment or fails to pay Contractor any sum finally determined to be due; then Contractor may, upon fourteen (14) days written notice to Owner terminate the Agreement and recover from Owner payment for all Work executed, any expense sustained plus reasonable termination expenses. In lieu of terminating the Agreement, if Owner has failed to act on any Application for Payment or Owner has failed to make any payment as aforesaid, Contractor may upon fourteen (14) days written notice to Owner stop the Work until payment of all amounts then due.

END OF GENERAL CONDITIONS

**SECTION D**

**BID ATTACHMENTS**

**Bid Attachment 1****INSURANCE AND BOND REQUIREMENTS**

IFBC No. 19-TA003100SAM

Work under the resulting Agreement cannot commence until all insurance coverages indicated herein have been obtained. The cost for insurance coverages is the sole responsibility of successful Bidder. The successful Bidder shall obtain and submit to the Procurement Division within ten (10) calendar days from the date of notice of intent to award, proof the following minimum amounts of insurance on a standard ACORD form (inclusive of any amounts provided by an umbrella or excess policy):

STANDARD INSURANCES	REQUIRED LIMITS
1. <input checked="" type="checkbox"/> <b>Automobile Liability:</b>	<p>Coverage must be afforded under a per occurrence policy form including coverage for all owned, hired and non-owned vehicles for bodily injury and property damage of not less than:</p> <ul style="list-style-type: none"><li>• \$ <u>1,000,000</u> Combined Single Limit; OR</li><li>• \$ <u>500,000</u> Bodily Injury and \$ <u>500,000</u> Property Damage</li><li>• \$ <u>10,000</u> Personal Injury Protection (No Fault)</li><li>• \$ <u>500,000</u> Hired, Non-Owned Liability</li><li>• \$ <u>10,000</u> Medical Payments</li></ul> <p><i>This policy shall contain severability of interests' provisions.</i></p>
2. <input checked="" type="checkbox"/> <b>Commercial General Liability:</b> (Per Occurrence form only; Claims-Made form is not acceptable)	<p>Coverage shall be afforded under a per occurrence policy form, policy shall be endorsed and name "Manatee County, a political subdivision of the State of Florida" as an Additional Insured, and include limits not less than:</p> <ul style="list-style-type: none"><li>• \$ <u>1,000,000</u> Single Limit Per Occurrence</li><li>• \$ <u>2,000,000</u> Aggregate</li><li>• \$ <u>1,000,000</u> Products/Completed Operations Aggregate</li><li>• \$ 1,000,000 Personal and Advertising Injury Liability</li><li>• \$ 50,000 Fire Damage Liability</li><li>• \$ <u>10,000</u> Medical Expense, and</li><li>• \$ <u>1,000,000</u>, Third Party Property Damage</li><li>• \$ _____ Project Specific Aggregate (Required on projects valued at over \$<u>10,000,000</u>)</li></ul> <p><i>This policy shall contain severability of interests' provisions.</i></p>
3. <input checked="" type="checkbox"/> <b>Employer's Liability</b>	<p>Coverage limits of not less than:</p> <ul style="list-style-type: none"><li>• \$ <u>100,000</u> Each Accident</li><li>• \$ <u>500,000</u> Disease Each Employee</li></ul> <p>\$<u>500,000</u> Disease Policy Limit</p>
4. <input checked="" type="checkbox"/> <b>Worker's Compensation</b>	<p>Coverage limits of not less than:</p> <ul style="list-style-type: none"><li>• Statutory workers' compensation coverage shall apply for all employees in compliance with the laws and statutes of</li></ul>

<input type="checkbox"/> <b>US Longshoremen &amp; Harbor Workers Act coverage</b> <input type="checkbox"/> <b>Jones Act coverage</b>	<p>the State of Florida and the federal government.</p> <ul style="list-style-type: none"> <li>• If any operations are to be undertaken on or about navigable waters, coverage must be included for the US Longshoremen &amp; Harbor Workers Act and Jones Act.</li> </ul> <p>Should 'leased employees' be retained for any part of the project or service, the employee leasing agency shall provide evidence of Workers' Compensation coverage and Employer's Liability coverage for all personnel on the worksite and in compliance with the above Workers' Compensation requirements.</p> <p>NOTE: Workers' Compensation coverage is a firm requirement. Elective exemptions are considered on a case-by-case basis and are approved in a very limited number of instances.</p>
<b>OTHER INSURANCES</b>	<b>REQUIRED LIMITS</b>
5. <input type="checkbox"/> <b>Aircraft Liability</b>	\$ _____ per occurrence Coverage shall be carried in limits of not less than \$5,000,000 each occurrence if applicable to the completion of the services under this Agreement.
6. <input type="checkbox"/> <b>Installation Floater</b>	If the resulting Agreement <b>does not</b> include construction of or additions to above ground building or structures, but does involve the installation of machinery or equipment, successful Bidder shall provide an " <b>Installation Floater</b> " with the minimum amount of insurance to be 100% of the value of such addition(s), building(s), or structure(s).
7. <input type="checkbox"/> <b>Pollution Liability</b>	\$ _____ per occurrence
8. <input type="checkbox"/> <b>Professional Liability and/or Errors and Omissions (E&amp;O) Liability</b>	Professional (E&O) Liability shall be afforded for the Bodily Injury and Property Damage for not less than \$_____ Each Claim, \$1,000,000 Policy Aggregate.
9. <input checked="" type="checkbox"/> <b>Builder's Risk Insurance</b>	When the contract or agreement includes the construction of roadways and/or the addition of a permanent structure or building, including the installation of machinery and/or equipment, Builder's Risk Insurance shall be afforded under a per occurrence policy form, policy shall be endorsed and name "Manatee County, a political subdivision of the State of Florida" as an Additional Insured, and include limits not less than:

	<ul style="list-style-type: none"> <li>• An amount equal to 100% of the completed value of the project, or the value of the equipment to be installed</li> <li>• The policy shall not carry a self-insured retention/deductible greater than \$10,000</li> </ul> <p>Coverage shall be for all risks and include, but not be limited to, storage and transport of materials, equipment, supplies of any kind whatsoever to be used on or incidental to the project, theft coverage, and Waiver of Occupancy Clause Endorsement, where applicable.</p>
10. <input type="checkbox"/> <b>Cyber Liability</b>	<p>Coverage must comply with Florida Statute 501.171 and must be afforded under a per occurrence policy form for limits not less than</p> <p>\$_____ Security Breach Liability</p> <p>\$_____ Security Breach Expense (each occurrence)</p> <p>\$_____ Security Breach Expense (aggregate)</p> <p>\$_____ Replacement or Restoration of Electronic Data</p> <p>\$_____ Extortion Threats</p> <p>\$_____ Business Income and Extra Expense</p> <p>\$_____ Public Relations Expense</p> <p>The policy must not carry a self-insured retention/deductible greater than \$_____.</p>
11. <input type="checkbox"/> <b>Hazardous Materials Insurances (as noted)</b>	<p>Hazardous materials include all materials and substances that are currently designated or defined as hazardous by Florida or Federal law or rules of regulations.</p> <p><input type="checkbox"/> <b><i>Pollution Liability</i></b></p> <p>Coverage must be afforded under a per occurrence policy form for limits not less than the value of the contract, subject to a \$_____ minimum, for Bodily Injury and Property Damage to include sudden and gradual release, each claim and aggregate.</p> <p><input type="checkbox"/> <b><i>Asbestos Liability (If handling within scope of Contract)</i></b></p> <p>Coverage must be afforded under a per occurrence policy form for limits not less than the value of the contract, subject to a \$_____ minimum, for Bodily Injury and Property Damage to include sudden and gradual release, each claim and aggregate.</p>

	<p><input type="checkbox"/> <b>Disposal</b></p> <p>Coverage must be afforded under a per occurrence policy form for limits not less than the value of the contract, subject to a \$_____ minimum, for Liability for Sudden and Accidental Occurrences, each claim and an aggregate and not less than the value of the contract, subject to a \$_____ minimum, for Liability for Non-Sudden Occurrences, each claim and aggregate.</p> <p><input type="checkbox"/> <b>Hazardous Waste Transportation Insurance</b></p> <p>Coverage must be afforded under a per occurrence policy form for limits not less than the value of the contract, subject to a \$_____ minimum, per accident.</p> <p>The successful Bidder shall designate the hauler and have the hauler furnish a Certificate of Insurance for Automobile Liability Insurance with Endorsement MCS-90 for liability arising out of the transportation of hazardous materials.</p> <p>The successful Bidder must also provide the EPA Identification Number.</p>
12. <input type="checkbox"/> <b>Liquor Liability</b>	<p>Coverage must be afforded under a per occurrence policy form for limits not less than</p> <p>\$_____ Each Occurrence and Aggregate.</p>
13. <input type="checkbox"/> <b>Garage Keeper's Liability</b>	<p>Coverage shall be required if the maintenance, servicing, cleaning or repairing of any County motor vehicles is inherent or implied within the provision of the contract.</p> <p>Coverage must be afforded under a per occurrence policy form for limits not less than equal to the full replacement value of the lot or garage</p>
14. <input type="checkbox"/> <b>Bailee's Customer</b>	<p>Coverage must be afforded under a per occurrence policy form for limits not less than equal to the full replacement value of the lot or garage.</p>

15. <input type="checkbox"/> Watercraft	\$_____ per occurrence
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#### BOND REQUIREMENTS

1. <input checked="" type="checkbox"/> Bid Bond	<p>A Bid Bond in the amount of \$_____ or __5__% of the total offer. Bid bond shall be submitted with the sealed response and shall include project name, location, and / or address and project number.</p> <p>In lieu of the bond, the bidder may file an alternative form of security in the amount of \$_____ or _____% of the total offer. in the form of a money order, a certified check, a cashier's check, or an irrevocable letter of credit issued to Manatee County.</p> <p>NOTE: A construction project over \$200,000 requires a Bid Bond in the amount of 5% of the total bid offer.</p>
2. <input checked="" type="checkbox"/> Payment and Performance Bond	<p>A Payment and Performance Bond shall be submitted by successful Bidder for 100% of the award amount and shall be presented to Manatee County within ten (10) calendar days of issuance of the notice of intent to award.</p> <p>NOTE: A construction project over \$200,000 requires a Payment and Performance Bond.</p>
3. <input type="checkbox"/> Construction Bond	<p>For construction projects to protect against an adverse event that causes disruptions, failure to complete the project, or failure to meet the contract specifications in an amount of \$</p>

## **INSURANCE REQUIREMENTS**

### **I. THE POLICIES BELOW ARE TO CONTAIN, OR BE ENDORSED TO CONTAIN, THE FOLLOWING PROVISIONS:**

#### **1. Commercial General Liability and Automobile Liability Coverages**

- a. **“Manatee County, a Political Subdivision of the State of Florida,” is to be named as an Additional Insured in respect to:** Liability arising out of activities performed by or on behalf of the successful Bidder, his agents, representatives, and employees; products and completed operations of the successful Bidder; or automobiles owned, leased, hired or borrowed by the successful Bidder. The coverage shall contain no special limitation(s) on the scope of protection afforded to the County, its officials, employees or volunteers.

In addition to furnishing a Certificate of Insurance, the successful Bidder shall provide the endorsement that evidences Manatee County being listed as an Additional Insured. This can be done in one of two ways: (1) an endorsement can be issued that specifically lists “Manatee County, a Political Subdivision of the State of Florida,” as Additional Insured; or, (2) an endorsement can be issued that states that all Certificate Holders are Additional Insured with respect to the policy.

- b. The successful Bidder's insurance coverage shall be primary insurance with respect to the County, its officials, employees and volunteers. Any insurance or self-insurance maintained by the County, its officials, employees or volunteers shall be excess of successful Bidder's insurance and shall be non-contributory.
- c. The insurance policies must be on an occurrence form.

#### **2. Workers' Compensation and Employers' Liability Coverages**

The insurer shall agree to waive all rights of subrogation against the County, its officials, employees and volunteers for losses arising from work performed by the successful Bidder for the County.

### **II. GENERAL INSURANCE PROVISIONS APPLICABLE TO ALL POLICIES:**

1. Prior to the execution of contract, or issuance of a Purchase Order, and then annually upon the anniversary date(s) of the insurance policy's renewal date(s) for as long as this contract remains in effect, successful Bidder shall furnish the County with a Certificate(s) of Insurance (using an industry accepted certificate form, signed by the Issuer, with applicable endorsements, and containing the solicitation or contract number, and title or description) evidencing the coverage set forth above and naming “Manatee County, a Political Subdivision of the State of Florida” as an Additional Insured on the applicable coverage(s) set forth above.
2. If the policy contains an aggregate limit, confirmation is needed in writing (letter, email, etc.) that the aggregate limit has not been eroded to procurement representative when supplying Certificate of Insurance.

In addition, when requested in writing from the County, successful Bidder will provide the County with a certified copy of all applicable policies. The address where such certificates and certified policies shall be sent or delivered is as follows:

**Manatee County, a Political Subdivision of the State of Florida**  
**Attn: Risk Management Division**  
**1112 Manatee Avenue West, Suite 969**  
**Bradenton, FL 34205**

3. The project's solicitation number and title shall be listed on each certificate.
  4. successful Bidder shall provide thirty (30) days written notice to the Risk Manager of any cancellation, non-renewal, termination, material change, or reduction in coverage of any insurance policies to procurement representative including solicitation number and title with all notices.
  5. successful Bidder agrees that should at any time successful Bidder fail to meet or maintain the required insurance coverage(s) as set forth herein, the County may terminate this contract.
  6. The successful Bidder waives all subrogation rights against Manatee County, a Political Subdivision of the State of Florida, for all losses or damages which occur during the contract and for any events occurring during the contract period, whether the suit is brought during the contract period or not.
  7. The successful Bidder has sole responsibility for all insurance premiums and policy deductibles.
  8. It is the successful Bidder's responsibility to ensure that his agents, representatives and subcontractors comply with the insurance requirements set forth herein. successful Bidder shall include his agents, representatives, and subcontractors working on the project or at the worksite as insured under its policies, or successful Bidder shall furnish separate certificates and endorsements for each agent, representative, and subcontractor working on the project or at the worksite. All coverages for agents, representatives, and subcontractors shall be subject to all of the requirements set forth to the procurement representative.
  9. All required insurance policies must be written with a carrier having a minimum A.M. Best rating of A- FSC VII or better. In addition, the County has the right to review the successful Bidder's deductible or self-insured retention and to require that it be reduced or eliminated.
- III. Successful Bidder understands and agrees that the stipulated limits of coverage listed herein in this insurance section shall not be construed as a limitation of any potential liability to the County, or to others, and the County's failure to request evidence of this insurance coverage shall not be construed as a waiver of successful Bidder's obligation to provide and maintain the insurance coverage specified.
- IV. The enclosed Hold Harmless Agreement shall be signed by the successful Bidder and shall become a part of the contract.

- V.** Successful Bidder understands and agrees that the County does not waive its immunity and nothing herein shall be interpreted as a waiver of the County's rights, including the limitation of waiver of immunity, as set forth in Florida Statutes 768.28, or any other statutes, and the County expressly reserves these rights to the full extent allowed by law.
- VI.** No award shall be made until the Procurement Division has received the Certificate of Insurance and Hold Harmless Agreement in accordance with this section.

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## **Bid Attachment 2 TECHNICAL SPECIFICATIONS**

**SWWRF & SEWRF  
BELT FILTER PRESS REHABILITATION**

**BID SET  
TECHNICAL SPECIFICATIONS  
MAY 2019**

**PREPARED FOR  
BOARD OF COUNTY COMMISSIONERS  
COUNTY OF MANATEE, FLORIDA  
MANATEE COUNTY PROJECT NO: 6091680**



**PREPARED BY  
BROWN AND CALDWELL  
PROJECT NO: 152270**



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# **SWWRF & SEWRF BELT FILTER PRESS REHABILITATION**

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**This specification includes by reference the Manatee County Public Works Standards, Part I Utilities Standards Manual approved June 2015.**

**\*\*END OF SECTION\*\***

## SECTION 01005

### GENERAL REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SCOPE AND INTENT

###### A. Description

The work to be done consists of the furnishing of all labor, materials and equipment, and the performance of all work included in this Contract.

###### B. Work Included

The Contractor shall furnish all labor, superintendence, materials, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, shop drawings, working drawings and other means of construction necessary or proper for performing and completing the work. He shall obtain and pay for all required permits necessary for the work, other than those permits such as the DEP permit and railroad permit, which may have already been obtained. He shall perform and complete the work in the manner best calculated to promote rapid construction consistent with safety of life and property and to the satisfaction of the County, and in strict accordance with the Contract Documents. The Contractor shall clean up the work and maintain it during and after construction, until accepted, and shall do all work and pay all incidental costs. He shall repair or restore all structures and property that may be damaged or disturbed during performance of the work.

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

The Contractor shall be solely responsible for the adequacy of his workmanship, materials and equipment.

###### C. Public Utility Installations and Structures

Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, house service connections, vaults, manholes and all other appurtenances and facilities pertaining thereto.

The Contractor shall protect all installations and structures from damage during the work. Access across any buried public utility installation or structure shall be made only in such locations and by means approved by the County. All required

protective devices and construction shall be provided by the Contractor at his expense. All existing public utilities damaged by the Contractor, which are shown on the Plans or have been located in the field by the utility, shall be repaired by the Contractor, at his expense, as approved by the County. No separate payment shall be made for such protection or repairs to public utility installations or structures.

Public utility installations or structures owned or controlled by the County or other governmental body, which are required by this contract to be removed, relocated, replaced or rebuilt by the Contractor not identified in any separate bid item shall be considered as a part of the general cost of doing the work and shall be included in the prices bid for the various contract items. No separate payment shall be made.

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

The Contractor shall give written notice to County and other governmental utility departments and other owners of public utilities of the location of his proposed construction operations, at least forty-eight hours in advance of breaking ground in any area or on any unit of the work. This can be accomplished by making the appropriate contact with the "Sunshine State One-Call of Florida, Inc. Call Center ("Call Sunshine") and per all requirements provided for in the Florida Underground Facilities Damage Prevention and Safety Act (Florida Statutes, Title XXXIII, Chapter 556).

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

## 1.02 PLANS AND SPECIFICATIONS

### A. Plans

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

### B. Copies Furnished to Contractor

The Contractor shall furnish each of the subcontractors, manufacturers, and material men such copies of the Contract Documents as may be required for their work. Additional copies of the Plans and Specifications, when requested, may be furnished to the Contractor at cost of reproduction.

C. Supplementary Drawings

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

D. Contractor to Check Plans and Data

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

E. Specifications

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

F. Intent

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

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

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

### 1.03 MATERIALS AND EQUIPMENT

#### A. Manufacturer

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

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

#### B. Delivery

The Contractor shall deliver materials in ample quantities to insure the most speedy and uninterrupted progress of the work so as to complete the work within the allotted time. The Contractor shall also coordinate deliveries in order to avoid delay in, or impediment of, the progress of the work of any related Contractor.

#### C. Tools and Accessories

The Contractor shall, unless otherwise stated in the Contract Documents, furnish with each type, kind or size of equipment, one complete set of suitably marked high grade special tools and appliances which may be needed to adjust, operate, maintain or repair the equipment. Such tools and appliances shall be furnished in approved painted steel cases, properly labeled and equipped with good grade cylinder locks and duplicate keys.

Spare parts shall be furnished as specified.

Each piece of equipment shall be provided with a substantial nameplate, securely fastened in place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, weight and principal rating data.

D. Installation of Equipment.

The Contractor shall have on hand sufficient proper equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character.

Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Plans, unless directed otherwise by the County during installation. All equipment shall be correctly aligned, leveled and adjusted for satisfactory operation and shall be installed so that proper and necessary connections can be made readily between the various units.

The Contractor shall furnish, install and protect all necessary anchor and attachment bolts and all other appurtenances needed for the installation of the devices included in the equipment specified. Anchor bolts shall be as approved by the County and made of ample size and strength for the purpose intended. Substantial templates and working drawings for installation shall be furnished.

The Contractor shall furnish all materials and labor for, and shall properly bed in non-shrink grout, each piece of equipment on its supporting base that rests on masonry foundations.

Grout shall completely fill the space between the equipment base and the foundation. All metal surfaces coming in contact with concrete or grout shall receive a coat of coal tar epoxy equal to Koppers 300M or provide a 1/32-inch neoprene gasket between the metal surface and the concrete or grout.

E. Service of Manufacturer's Engineer

The Contract prices for equipment shall include the cost of furnishing (as required by equipment specifications sections) a competent and experienced engineer or superintendent who shall represent the manufacturer and shall assist the Contractor, when required, to install, adjust, test and place in operation the equipment in conformity with the Contract Documents. After the equipment is placed in permanent operation by the County, such engineer or superintendent shall make all adjustments and tests required by the County to prove that such equipment is in proper and satisfactory operating condition and shall instruct such personnel as may be designated by the County in the proper operation and maintenance of such equipment.

1.04 INSPECTION AND TESTING

A. General

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

For tests specified to be made by the Contractor, the testing personnel shall make the necessary inspections and tests and the reports thereof shall be in such form as will facilitate checking to determine compliance with the Contract Documents. Three (3) copies of the reports shall be submitted and authoritative certification thereof must be furnished to the County as a prerequisite for the acceptance of any material or equipment.

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

Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.

The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the County formally takes over the operation thereof.

**B. Costs**

All inspection and testing of materials furnished under this Contract will be performed by the County or duly authorized inspection engineers or inspections bureaus without cost to the Contractor, unless otherwise expressly specified.

The cost of shop and field tests of equipment and of certain other tests specifically called for in the Contract Documents shall be borne by the Contractor and such costs shall be deemed to be included in the Contract price.

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

**C. Inspections of Materials**

The Contractor shall give notice in writing to the County, at least two weeks in advance of his intention to commence the manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. Such notice shall contain a request for inspection, the date of

commencement and the expected date of completion of the manufacture of preparation of materials. Upon receipt of such notice, the County will arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials or he will notify the Contractor that the inspection will be made at a point other than the point of manufacture, or he will notify the Contractor that inspection will be waived. The Contractor must comply with these provisions before shipping any material. Such inspection shall not release the Contractor from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

D. Certificate of Manufacture

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

E. Shop Tests of Operating Equipment

Each piece of equipment for which pressure, duty, capacity, rating, efficiency, performance, function or special requirements are specified shall be tested in the shop of the maker in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents. No such equipment shall be shipped to the work until the County notifies the Contractor, in writing, that the results of such tests are acceptable.

The cost of shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment shall be borne by the Contractor.

F. Preliminary Field Tests

As soon as conditions permit, the Contractor shall furnish all labor, materials, and instruments and shall make preliminary field tests of equipment. If the preliminary field tests disclose any equipment furnished under this Contract which does not comply with the requirements of the Contract Documents, the Contractor shall, prior to the acceptance tests, make all changes, adjustments and replacements required. The furnishing Contractor shall assist in the preliminary field tests as applicable.

G. Final Field Tests

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

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

#### H. Failure of Tests

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

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

#### I. Final Inspection

During such final inspections, the work shall be clean and free from water. In no case will the final pay application be prepared until the Contractor has complied with all requirements set forth and the County has made his final inspection of the entire work and is satisfied that the entire work is properly and satisfactorily constructed in accordance with the requirements of the Contract Document.

### 1.05 TEMPORARY STRUCTURES

#### A. Temporary Fences

If, during the course of the work, it is necessary to remove or disturb any fence or part thereof, the Contractor shall, at his own expense, if so ordered by the County, provide a suitable temporary fence which shall be maintained until the permanent fence is replaced. The County shall be solely responsible for the determination of the necessity for providing a temporary fence and the type of temporary fence to be used.

1.06 TEMPORARY SERVICES

A. First Aid

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

1.07 LINES AND GRADES

A. Grade

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

B. Safeguarding Marks

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

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

C. Datum Plane

All elevations indicated or specified refer to the Mean Sea Level Datum of the NAVD 1988 and/or NGVD 1929.

1.08 ADJACENT STRUCTURES AND LANDSCAPING

A. Responsibility

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

structures of any kind and appurtenances thereto are not shown on the Plans and when, in the opinion of the County, additional work is deemed necessary to avoid interference with the work, payment therefore will be made as provided for in the General Conditions.

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

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

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

B. Protection of Trees

1. All trees and shrubs shall be adequately protected by the Contractor with boxes and otherwise and in accordance with ordinances governing the protection of trees. No excavated materials shall be placed so as to injure such trees or shrubs. Trees or shrubs destroyed by negligence of the Contractor or his employees shall be replaced by him with new stock of similar size and age, at the proper season and at the sole expense of the Contractor.
2. Beneath trees or other surface structures, where possible, pipelines may be built in short tunnels, backfilled with excavated materials, except as otherwise specified, or the trees or structures carefully supported and protected from damage.
3. The County may order the Contractor, for the convenience of the County, to remove trees along the line or trench excavation. If so ordered, the County will obtain any permits required for removal of trees. Such tree removal ordered shall be paid for under the appropriate Contract Items.

C. Lawn Areas

Lawn areas shall be left in as good condition as before the starting of the work. Where sod is to be removed, it shall be carefully removed, and later replaced, or the area where sod has been removed shall be restored with new sod.

D. Restoration of Fences

Any fence, or part thereof, that is damaged or removed during the course of the work shall be replaced or repaired by the Contractor and shall be left in as good a condition as before the starting of the work. The manner in which the fence is repaired or replaced and the materials used in such work shall be subject to the approval of the County. The cost of all labor, materials, equipment, and work for the replacement or repair of any fence shall be deemed included in the appropriate Contract Item or items, or if no specific Item is provided therefore, as part of the overhead cost of the work, and no additional payment will be made therefore.

1.09 PROTECTION OF WORK AND PUBLIC

A. Barriers and Lights

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

B. Smoke Prevention

A strict compliance with ordinances regulating the production and emission of smoke will be required. No open fires will be permitted.

C. Noise

The Contractor shall eliminate noise to as great an extent as practicable at all times. Air compressing plants shall be equipped with silencers and the exhaust of all engines or other power equipment shall be provided with mufflers. In the vicinity of hospitals and schools, special care shall be used to avoid noise or other nuisances. The Contractor shall strictly observe all local regulations and ordinances covering noise control.

D. Access to Public Services

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

E. Dust prevention

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

1.10 CUTTING AND PATCHING

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

1.11 CLEANING

A. During Construction

During construction of the work, the Contractor shall, at all times, keep the site of the work and adjacent premises as free from material, debris and rubbish as is practicable and shall remove the same from any portion of the site if, in the opinion of the County, such material, debris, or rubbish constitutes a nuisance or is objectionable. The Contractor shall remove from the site all of his surplus materials and temporary structures when no further need therefore develops.

B. Final Cleaning

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

The Contractor shall thoroughly clean all equipment and materials installed by him and shall deliver such materials and equipment undamaged in a bright, clean, polished and new operating condition.

1.12 MISCELLANEOUS

A. Protection Against Siltation and Bank Erosion

1. The Contractor shall arrange his operations to minimize siltation and bank erosion on construction sites and on existing or proposed water courses and drainage ditches.
2. The Contractor, at his own expense, shall remove any siltation deposits and correct any erosion problems as directed by the County which results from his construction operations.

B. Protection of Wetland Areas

The Contractor shall properly dispose of all surplus material, including soil, in accordance with Local, State and Federal regulations. Under no circumstances shall surplus material be disposed of in wetland areas as defined by the Florida Department of Environmental Protection or Southwest Florida Water Management District.

C. Existing Facilities

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

D. Use of 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 instructions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

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## SECTION 01010

### SUMMARY OF WORK

#### PART 1 GENERAL

##### 1.01 WORK COVERED BY CONTRACT DOCUMENTS/REQUIREMENTS INCLUDED

A. This Project, SWWRF and SEWRF Belt Filter Press Rehabilitation Design, consists of work at the SWWRF and SEWRF as identified here.

1. The SWWRF is located at 5101 65<sup>th</sup> St. W, Bradenton, FL 34210. In general, the existing treatment facilities at the SWWRF include influent screening; grit removal; activated sludge process and secondary clarification; deep bed filtration; disinfection with sodium hypochlorite; and gravity belt thickeners for waste activated sludge. Coagulant feed is available on a standby status. The plant is permitted for an annual average daily flow of 15.0 MGD.

##### SWWRF Work:

- a. Remove and replace Belt Filter Press #3 and Belt Filter Press #6, including associative washwater booster pump, in-kind.
- b. Remove the existing polymer system and furnish and install specified polymer system.
- c. Remove and replace six (6) existing belt filter press sludge feed pumps and specified piping, valves and appurtenances in-kind.
- d. Remove and replace piping of the six (6) existing belt filter press sludge feed pumps and install new flow meters on the suction piping.
- e. Remove and replace eight (8) existing polymer feed pumps and specified piping, valves and appurtenances in-kind.
- f. Replace electrical including main service switchgear, motor control centers, electrical power feeds, line, loads and control except fiber.
- g. Remove obsolete panels, exposed conduits and conductors with new.
- h. Replace instrumentation and controls on all BFPs to facilitate automatic operation.
- i. Demolition of existing equipment, parts and electrical rooms, structural and HVAC improvements to the electrical rooms.

2. The SEWRF is located at 3331 Lena Rd., Bradenton, FL 34202. In general, the existing treatment facilities at the SWWRF include influent screening; grit removal; activated sludge process and secondary clarification; deep bed filtration; disinfection with sodium hypochlorite; and gravity belt thickeners for waste activated sludge. The plant is permitted for an annual average daily flow of 11.0 MGD.

SEWRF Work:

- a. Replace three existing BFP main control panels and three local control panels with new Main Control Panel (MCP) and Remote Operator Interface (OIT) Control Panel.
  - b. Replace electrical, instrumentation, and controls on three BFPs to facilitate automatic operation
  - c. Demolition of existing equipment and parts.
- B. The Contractor shall furnish all shop drawings, working drawings, labor, materials, equipment, tools, services and incidentals necessary to complete all work required by these Specifications and as shown on the Contract Drawings.
  - C. The Contractor shall perform the work complete, in place and ready for continuous service and shall include any repairs, replacements, and/or restoration required as a result of damages caused prior to acceptance by the County.
  - D. The Contractor shall furnish and install all materials, equipment and labor which is reasonably and properly inferable and necessary for the proper completion of the work, whether specifically indicated in the Contract Documents or not.

1.02           CONTRACTS

Construct all the Work under a single contract.

1.03           WORK SEQUENCE

- A. All work done under this Contract shall be done with a minimum of inconvenience to the users of the system or facility. The Contractor shall coordinate his work with private property owners such that existing utility services are maintained to all users to the maximum extent possible.
- B. The Contractor shall, if necessary and feasible, construct the work in stages to accommodate the County's use of the premises during the construction period; coordinate the construction schedule and operations with the County's Representative.

- C. The Contractor shall, where feasible, construct the Work in stages to provide for public convenience and not close off public use of any facility until completion of construction to provide alternative usage.

#### 1.04 CONSTRUCTION AREAS

- A. The Contractor shall: Limit his use of the construction areas for work and for storage, to allow for:
  - 1. Work by other Contractors.
  - 2. County's Use.
  - 3. Public Use.
- B. Coordinate use of work site under direction of County's Representative.
- C. Assume full responsibility for the protection and safekeeping of products under this Contract, stored on the site.
- D. Move any stored products under the Contractor's control, which interfere with operations of the County or separate contractor.
- E. Obtain and pay for the use of additional storage of work areas needed for Contractor operations.

#### 1.05 COUNTY OCCUPANCY

- A. It is assumed that portions of the Work will be completed prior to completion of the entire Work. Upon completion of construction of each individual facility, including testing, if the County, at its sole discretion, desires to accept the individual facility, the Contractor will be issued a dated certificate of completion and acceptance for each individual facility. The County will assume ownership and begin operation of the individual facility on that date and the three-year guaranty period shall commence on that date. The County has the option of not accepting the entire work as a whole until it is completed, tested and approved by the County.

#### 1.06 PARTIAL COUNTY OCCUPANCY

The Contractor shall schedule his operations for completion of portions of the Work, as designated, for the County's occupancy prior to substantial completion of the entire work.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION

### 3.01 WORK COVERED BY CONTRACT DOCUMENTS

The Contractor shall furnish all labor, materials, equipment, tools, services and incidentals to complete all the work required by the Contract.

The Contractor shall perform the work as specified and shown in Contract Documents in its entirety to be ready for continuous service, and shall include repairs, replacements, and restoration as required, including restoration and repairs not indicated in the Contract Documents that result from damages occurred during this construction.

The work shall be provided complete with all demolition and relocation of existing facilities; all temporary structures, piping, pumping, power and control facilities required to maintain continuous plant operation; all concrete, support piping and equipment, electrical power, control and lighting; instrumentation; and painting as shown and specified and shall include all specified commissioning requirements.

Contractor shall provide all supplies, manufactured articles and transportation and services, including fuel, power, water, and essential communications, costs and operations for permitting, dewatering, storage, temporary fencing and facilities, equipment for demolition, disposal, maintenance of operation during construction, interconnections to existing plant and utility facilities and bypassing, start-up and testing, restoration (normal not just from damages), operation and maintenance manuals, record documents, spare parts, test equipment, and all other appurtenances and miscellaneous required work required for completion of the work in accordance with the Contract Documents.

The Work shall be complete, and all work, materials, and services not expressly shown or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be performed, furnished, and installed by the Contractor as though originally so specified or shown, at no increase in cost to the County.

Prior to construction, the Contractor shall verify existing field conditions, piping, and utilities. The Contractor is required to perform necessary due diligence to determine the amount, quality, accuracy, and specific field reconnaissance required to adequately perform the work specified and shown in the Contract Documents. The Contractor will be responsible for the coordination of this work with the County and permitting agencies having jurisdiction over the specified locations to be verified.

The Work to be done is shown on the Contract Documents entitled SWWRF & SEWRF Belt Filter Rehabilitation Design. The numbers and titles of all Drawings appear on the index sheets of the Drawings. All drawings so enumerated shall be considered an integral part of the Contract Documents as defined herein.

Certain Document Sections refer to Divisions of the Contract Specifications. Sections are each individually numbered portions of the Specifications (numerically) such as 08110,

13182, 15206, etc. The term Division is used as a convenience term meaning all Sections within a numerical grouping. For example, Division 16 would thus include Sections 16000 through 16999 and would mean all electrical specifications.

Drawings indicate the extent and general arrangement of the work. If any departures from the Drawings are deemed necessary by the Contractor to accommodate the materials and equipment that the Contractor proposes to furnish, Contractor shall notify the Engineer immediately. No such departures shall be made without the prior written approval of the County.

The specific equipment proposed for use by the Contractor on the project may require changes in structures, auxiliary equipment, piping, electrical, mechanical, controls or other work to provide a complete satisfactory operating installation. The Contractor shall submit to the County, for approval, all necessary Drawings and details showing such changes to verify conformance with the overall project structural and architectural requirements and overall project operating performance. The Bid Price shall include all costs in connection with the preparation of new drawings and details and all changes to construction work to accommodate the proposed equipment, including increases in the costs of other Contracts.

In the event that the Engineer is required to provide additional engineering services as a result of substitution of materials or equipment which are not "or equal" by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the County.

Structural design shown on the Contract Drawings is based upon typical weights for major items of equipment as indicated on the Contract Drawings and specified. If the equipment furnished differs from that specified in the Contract Documents such that actual weight exceeds the weight of specified equipment, the Contractor shall assume the responsibility for all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's expenses in connection therewith, provided that the original weight assumptions were correct.

In the event that the Engineer is required to provide additional engineering services as a result of Contractor's errors, omissions, or failure to conform to the requirements of the Contract Documents, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the County and shall be deducted from monies due the Contractor.

In the event the Work of this Contract is not completed within the time set forth in the Contract or within the time to which such completion may have been extended in accordance with the Contract Documents, the additional engineering or inspection charges incurred by the County may be charged to the Contractor and deducted from the monies due to the Contractor. Extra work or supplemental Contract work added to the original Contract, as well as extenuating circumstances beyond the control of the Contractor, will be given due consideration by the

County before assessing engineering and inspection charges against the Contractor.

Charges for additional County's expenses shall be independent of any liquidated damages assessed in accordance with the Contract.

Substantial and Final Completion of the overall contract requirements are also subject to Liquidated Damages.

In the event the Work of this Contract is not completed within the time set forth in the Contract or within the time to which such completion may have been extended in accordance with the Contract Documents, the additional Engineering or inspection charges incurred by the County may be charged to the Contractor and deducted from the monies due.

The Contractor shall perform a field location investigation of the existing underground utilities and facilities in accordance with Section 01530 entitled "Protection of Existing Facilities", shall have provided requirements, plans and schedules in accordance with Section 01340 entitled "Submittals" and shall have obtained all required permits, permissions and approvals prior to commencing with the Work.

At no time shall the Contractor undertake to close off any pipelines, or open valves, or take any other action that would affect the operation of the existing systems, except as specifically required by the Contract Documents, until after authorization is granted by the Engineer and Owner and after proper notification and coordination has been provided. Contractor shall provide prior notification to utility customers for any temporary disruption of service in accordance with the Policies and Procedures of Manatee County.

**\*\*END OF SECTION\*\***

## SECTION 01014

### SEQUENCE OF WORK

#### PART 1 – GENERAL

##### 1.01 CONTINUITY OF PLANT OPERATIONS

###### A. GENERAL

The existing SWWRF and SEWRF are currently and continuously receiving and treating sewage, and those functions shall not be interrupted except as specified herein. The Contractor shall coordinate the work to avoid interference with normal operation of SWWRF and SEWRF equipment and processes. Coordination procedures are defined in Section 01040.

###### B. BYPASSING

Bypassing of raw or screened sewage and solids is prohibited. In the event of accidental bypassing, the Contractor shall stop all work and immediately eliminate the bypass and restore proper operation. The County shall have the right to immediately employ any means to stop the bypassing without providing written notification to the Contractor. The Contractor shall not resume work until the bypassing is resolved. These means could include the employment of other outfits and the potential interruption of construction activities.

The Contractor shall review and understand the operating permit for the plants.

- SWWRF FDEP Permit No. FLA 012619
- SEWRF FDEP Permit No. FLA 012618

###### C. SUBMITTALS

In accordance with these Contract Documents, the Contractor shall submit detailed maintenance of plant operations (MOPOs) for all tasks which will make it necessary to remove a pipeline, channel, electrical circuit, equipment or structure from service prior to beginning any related construction activity. Reference Section 01040 and Section 01310.

In addition to the detailed MOPOs required under Section 01040, the Contractor shall provide an overall detailed Project Sequencing Plan submitted in accordance with Section 01300, coordinated with the Project Schedule required under Section 01310, and which meets the requirements of these Contract Documents adjusted as necessary to meet the intent of the final project included in these Contract Documents.

The Project Sequencing Plan shall include:

1. Detailed description of the Contractor's methods and sequencing of operations and work,
2. Length of time required to complete each individual operation,
3. Equipment which the Contractor shall provide,
4. Required resources from the County,
5. List of deviations and/or exceptions from the sequence and schedule presented in the contract documents along with a detailed explanation for why the deviation is required and or justified.

## 1.02 SEQUENCE AND SCHEDULE OF CONSTRUCTION

Paragraph 01014-3.01 and 3.02 provide the Contractor with particular constraints regarding particular process areas. The Contractor shall not be allowed to deviate from the defined constraints in Paragraph 01014-3.01 and 3.02. Beyond these specific constraints, a sequencing plan is not provided and is left to the discretion of the Contractor.

## PART 2 – PRODUCTS (NOT USED)

## PART 3 – EXECUTION

### 3.01 GENERAL

Specific issues that shall be addressed by the Contractor in the execution of the work for individual process areas are summarized here. These do not relieve the Contractor from evaluating each work area in accordance with the complete construction set and determining for themselves specific area issues. The Contractor is entirely responsible for ensuring that these constraints are upheld during the progression of their work.

### 3.02 SPECIFIC PROCESSES

#### A. SWWRF.

1. Only one belt filter press may be taken offline at a time.
2. Polymer system shall have the ability to feed all sludge lines with only one sludge line out-of-service at any time.

#### B. SEWRF

1. Only one belt filter press may be taken offline at a time.

**\*\*END OF SECTION\*\***

## SECTION 01015

### CONTROL OF WORK

#### PART 1 GENERAL

##### 1.01 WORK PROGRESS

The Contractor shall furnish personnel and equipment which will be efficient, appropriate and adequately sized to secure a satisfactory quality of work and a rate of progress which will insure the completion of the work within the time stipulated in the Contract. If at any time such personnel appears to the County to be inefficient, inappropriate, or insufficient for securing the quality of work required for producing the rate of progress aforesaid, he may order the Contractor to increase the efficiency, change the character, or increase the personnel and equipment and the Contractor shall conform to such order. Failure of the County to give such order shall in no way relieve the Contractor of his obligations to secure the quality of the work and rate of progress required.

##### 1.02 PRIVATE LAND

The Contractor shall not enter or occupy private land outside of easements, except by permission of the affected property owner.

##### 1.03 WORK LOCATIONS

Work shall be located substantially as indicated on the drawings, but the County reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons.

##### 1.04 OPEN EXCAVATIONS

- A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access to private property during construction shall be removed when no longer required. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the County may require special construction procedures such as limiting the length of open trench, prohibiting stacking excavated material in the street and requiring that the trench shall not remain open overnight.
- B. The Contractor shall take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles which

could be dangerous to the public shall be barricaded and well lighted at all times when construction is not in progress.

#### 1.05 DISTRIBUTION SYSTEMS AND SERVICES

- A. The Contractor shall avoid interruptions to water, telephone, cable TV, sewer, gas, or other related utility services. He shall notify the County and the appropriate agency well in advance of any requirement for dewatering, isolating, or relocating a section of a utility, so that necessary arrangements may be made.
- B. If it appears that utility service will be interrupted for an extended period, the County may order the Contractor to provide temporary service lines at the Contractor's expense. Inconvenience of the users shall be kept to the minimum, consistent with existing conditions. The safety and integrity of the systems are of prime importance in scheduling work.

#### 1.06 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

- A. The Contractor shall assume full responsibility for the protection of all buildings, structures and utilities, public or private, including poles, signs, services to building utilities, gas pipes, water pipes, hydrants, sewers, drains and electric and telephone cables and other similar facilities, whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the Contractor's operation shall be repaired by the Contractor at his expense.
- B. The Contractor shall bear full responsibility for obtaining locations of all underground structures and utilities (including existing water services, drain lines and sewers). Services to buildings shall be maintained and all costs or charges resulting from damage thereto shall be paid by the Contractor.
- C. Protection and temporary removal and replacement of existing utilities and structures as described in this Section shall be a part of the work under the Contract and all costs in connection therewith shall be included in the unit prices established in the Bid.
- D. If, in the opinion of the County, permanent relocation of a utility owned by the County is required, the County may direct the Contractor, in writing, to perform the work. Work so ordered will be paid for at the Contract unit prices, if applicable, or as extra work as classified in the General Conditions. If relocation of a privately-owned utility is required, the County will notify the utility to perform the work as expeditiously as possible. The Contractor shall fully cooperate with the County and utility and shall have no claim for delay due to such relocation. The Contractor shall notify public utility companies in writing at

least 48 hours (excluding Saturdays, Sundays and legal holidays) before excavating near their utilities.

1.07 TEST PITS

Test pits for the purpose of locating underground pipeline or structures in advance of the construction shall be excavated and backfilled by the Contractor immediately after the utility location and the surface shall be restored in a manner equal or better than the original condition. No separate payment will be made.

1.08 CARE AND PROTECTION OF PROPERTY

- A. The Contractor shall be responsible for the preservation of all public and private property and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition equal or better to that existing before the damage was done, or he shall make good the damage in another manner acceptable to the County.
- B. All sidewalks which are disturbed by the Contractor's operations shall be restored to their original or better condition by the use of similar or comparable materials. All curbing shall be restored in a condition equal to the original construction and in accordance with the best modern practice.
- C. Along the location of this work, all fences, walks, bushes, trees, shrubbery and other physical features shall be protected and restored in a thoroughly workmanlike manner unless otherwise shown on the drawings. Fences and other features removed by the Contractor shall be replaced in the location indicated by the County as soon as conditions permit. All grass areas beyond the limits of construction which have been damaged by the Contractor shall be regraded and sodded to equal or exceed original conditions.
- D. Trees close to the work which drawings do not specify to be removed, shall be boxed or otherwise protected against injury. The Contractor shall trim all branches that are liable to damage because of his operations, but in no case shall any tree be cut or removed without prior notification to the County. All injuries to bark, trunk, limbs and roots of trees shall be repaired by dressing, cutting and painting according to approved methods, using only approved tools and materials.
- E. The protection, removal and replacement of existing physical features along the line of work shall be a part of the work under the Contract and all costs in connection therewith shall be included in the unit and/or lump sum prices established under the items in the Bid.

1.09 MAINTENANCE OF TRAFFIC

- A. Open pits, trenches, unpaved streets, debris, or other obstructions due to construction that will prevent the normal flow of traffic during an extended construction stoppage, for any reason, shall be minimized. In the event an extended construction stoppage is found to be necessary, Contractor shall, at his own expense, provide normal traffic flow during extended construction stoppage. Extended stoppage will be defined by the County.
- B. All excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, he shall repair the road surface, provide temporary roadways, erect wheel guards or fences, or take other safety measures which are satisfactory to the County.
- C. Any changes to the traffic pattern require a Traffic Control Plan as detailed in section 01570 of this Specification.

1.10 WATER FOR CONSTRUCTION PURPOSES

- A. In locations where, public water supply is available, the Contractor may purchase water for all construction purposes.
- B. The Contractor shall be responsible for paying for all water tap fees incurred for the purpose of obtaining a potable water service or temporary use meter.

1.11 MAINTENANCE OF FLOW

The Contractor shall at his own cost, provide for the flow of sewers, drains and water courses interrupted during the progress of the work and shall immediately cart away and remove all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the County well in advance of the interruption of any flow.

1.12 CLEANUP

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

1.13 COOPERATION WITHIN THIS CONTRACT

- A. All firms or person authorized to perform any work under this Contract shall

cooperate with the General Contractor and his subcontractors or trades and shall assist in incorporating the work of other trades where necessary or required.

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

#### 1.14 PROTECTION OF CONSTRUCTION AND EQUIPMENT

- A. All newly constructed work shall be carefully protected from injury in any way. No wheeling or walking or placing of heavy loads on it shall be allowed and all portions injured shall be reconstructed by the Contractor at his own expense.
- B. All structures shall be protected in a manner approved by the County. Should any of the floors or other parts of the structures become heaved, cracked, or otherwise damaged, all such damaged portions of the work shall be completely repaired and made good by the Contractor, at his own expense and to the satisfaction of the County. If, in the final inspection of the work, any defects, faults, or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein, for at least the warranty period described in the Contract.
- C. Further, the Contractor shall take all necessary precautions to prevent damage to any structure due to water pressure during and after construction and until such structure is accepted and taken over by the County.

#### 1.15 CONSTRUCTION WITHIN RIGHT-OF-WAY

Where pipe lines are installed within FDOT right-of-way, all excavation backfill and compaction for the purpose of reconstructing roadways and/or adjacent slopes contiguous thereto shall be in accordance with FDOT or Manatee County Standards and Specifications, whichever is applicable. Contractor shall satisfy the authorized representative of the FDOT with respect to proper safety procedures, construction methods, required permitting, etc., within the FDOT right-of-way.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

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## SECTION 01030

### SPECIAL PROJECT PROCEDURES

#### PART 1 GENERAL

##### 1.01 PERMITS

Upon notice of award, the Contractor shall immediately apply for all applicable permits not previously obtained by the County to do the work from the appropriate governmental agency or agencies. No work shall commence until all applicable permits have been obtained and copies delivered to the County. The costs for obtaining all permits shall be borne by the Contractor.

##### 1.02 CONNECTIONS TO EXISTING SYSTEM

The Contractor shall perform all work necessary to locate, excavate and prepare for connections to the existing systems all as shown on the Drawings or where directed by the County. The cost for this work and for the actual connection shall be included in the price bid for the project and shall not result in any additional cost to the County. The termination point for each contract shall be as shown on the Contract Drawings.

##### 1.03 RELOCATIONS

The Contractor shall be responsible for the coordination of the relocation of structures, including but not limited to light poles, power poles, signs, sign poles, fences, piping, conduits and drains that interfere with the positioning of the work as set out on the Drawings. No relocation of the items under this Contract shall be done without approval from the County.

##### 1.04 EXISTING UNDERGROUND PIPING, STRUCTURES AND UTILITIES

- A. The attention of the Contractor is drawn to the fact that during excavation, the possibility exists of the Contractor encountering various utility lines not shown on the Drawings. The Contractor shall exercise extreme care before and during excavation to locate and flag these lines as to avoid damage to the existing lines.
- B. It is the responsibility of the Contractor to ensure that all utility or other poles, the stability of which may be endangered by the close proximity of excavation, are temporarily stayed in position while work proceeds in the vicinity of the pole and that the utility or other companies concerned be given reasonable advance notice.
- C. The existing utility locations are shown without express or implied representation, assurance, or guarantee that they are complete or correct or that they represent a true picture of underground piping to be encountered. The Contractor shall be

responsible for notifying the various utility companies to locate their respective utilities in advance of construction in conformance with all requirements provided for in the Florida Underground Facilities Damage Prevention and Safety Act (Florida Statutes, Title XXXIII, Chapter 556).

- D. The existing piping and utilities that interfere with new construction shall be rerouted as shown, specified, or required. Before any piping and utilities not shown on the Drawings are disturbed, the Contractor shall notify the County and shall provide suggestions on how best to resolve the issue.
- E. The Contractor shall exercise care in any excavation to locate all existing piping and utilities. All utilities which do not interfere with complete work shall be carefully protected against damage. Any existing utilities damaged in any way by the Contractor shall be restored or replaced by the Contractor at his expense as directed by the County.
- F. It is intended that wherever existing utilities such as water, sewer, gas, telephone, electrical, or other service lines must be crossed, deflection of the pipe within recommended limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated in the Drawings. However, when in the opinion of the County this procedure is not feasible, he may direct the use of fittings for a utilities crossing as detailed on the Drawings. No deflections will be allowed in gravity sanitary sewer lines or in existing storm sewer lines.

#### 1.05 SUSPENSION OF WORK DUE TO WEATHER

Refer to FDOT Standards and Specifications Book, Section 8.

#### 1.06 HURRICANE PREPAREDNESS PLAN

- A. Within 30 days of the date of Notice to Proceed, the Contractor shall submit to the County a Hurricane Preparedness Plan. The plan should outline the necessary measures which the Contractor proposes to perform at no additional cost to the County in case of a hurricane warning.
- B. In the event of inclement weather, or whenever County shall direct, Contractor shall insure that he and his Subcontractors shall carefully protect work and materials against damage or injury from the weather. If, in the opinion of the County, any portion of work or materials is damaged due to the failure on the part of the Contractor or Subcontractors to protect the work, such work and materials shall be removed and replaced at the expense of the Contractor.

#### 1.07 POWER SUPPLY

Electricity as may be required for construction and permanent power supply shall be secured and purchased by the Contractor.

1.08 SALVAGE

Any existing equipment or material, including, but not limited to, valves, pipes, fittings, couplings, etc., which is removed or replaced as a result of construction under this project may be designated as salvage by the County and if so shall be protected for a reasonable time until picked up by the County. Any equipment or material not worthy of salvaging, as directed by the County, shall be disposed of by the Contractor at no additional cost.

1.09 DEWATERING

- A. The Contractor shall do all groundwater pumping necessary to prevent flotation of any part of the work during construction operations with his own equipment.
- B. The Contractor shall pump out water and wastewater which may seep or leak into the excavations for the duration of the Contract and with his own equipment. He shall dispose of this water in an appropriate manner.

1.10 ADDITIONAL PROVISIONS

- A. Before commencing work on any of the existing pipelines, structures or equipment, the Contractor shall notify the County, in writing, at least 10 calendar days in advance of the date he proposes to commence such work.
- B. The Contractor shall provide, at his own expense, all necessary temporary facilities for access to and for protection of, all existing facilities. The County's personnel must have ready access at all times to the existing facilities. The Contractor is responsible for all damage to existing structures, equipment and facilities caused by his construction operations and must repair all such damage when and as ordered by the County.

1.11 CONSTRUCTION CONDITIONS

The Contractor shall strictly adhere to the specific requirements of the governmental unit(s) and/or agency(ies) having jurisdiction over the work. Wherever there is a difference in the requirements of a jurisdictional body and these Specifications, the more stringent shall apply.

1.12 PUBLIC NUISANCE

- A. The Contractor shall not create a public nuisance including but not limited to encroachment on adjacent lands, flooding of adjacent lands, excessive noise or dust.
- B. Sound levels must meet Manatee County Ordinance #87-34, (which amends Ordinance 81-3, The Manatee County Noise Control Ordinance). Sound levels in excess of such ordinance are sufficient cause to have the work halted until equipment can be quieted to these levels. Work stoppage by the County for

excessive noise shall not relieve the Contractor of the other portions of this specification.

- C. No extra charge may be made for time lost due to work stoppage resulting from the creation of a public nuisance.

#### 1.13 WARRANTIES

- A. All material supplied under these Specifications shall be warranted by the Contractor and the manufacturers for a period of three (3) years. Warranty period shall commence on the date of County acceptance.
- B. The material shall be warranted to be free from defects in workmanship, design and materials. If any part of the system should fail during the warranty period, it shall be replaced at no expense to the County. All material and installation costs shall be 100% borne by the Contractor.
- C. The manufacturer's warranty period shall run concurrently with the Contractor's warranty or guarantee period. No exception to this provision shall be allowed. The Contractor shall be responsible for obtaining warranties from each of the respective suppliers or manufacturers for all the material specified under these contract specifications,
- D. In the event that the manufacturer is unwilling to provide a three-year warranty commencing at the time of County acceptance, the Contractor shall obtain from the manufacturer a four (4) year warranty starting at the time of equipment delivery to the job site. This four-year warranty shall not relieve the Contractor of the three-year warranty starting at the time of County acceptance of the equipment.

#### 1.14 FUEL STORAGE & FILLING

- A. If the contractor is storing fuel on site or doing his own fuel filling of portable equipment (other than hand-held equipment), he is responsible for any required response, clean-up or reporting required, at no additional cost to the county.
- B. The Contractor shall prepare and submit a fuel storage / spill abatement plan prior to start of construction if required.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01040

### COORDINATION WITH COUNTY'S OPERATIONS

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

A. Regulatory discharge requirements for the SWWRF and SEWRF effluent requires continuous and adequate treatment and disinfection of wastewater to meet the SWWRF and SEWRF Permit to Operate. At no time shall forward flow into the SWWRF and SEWRF be required to be stopped to perform the Work.

B. Contractor's means and methods shall be implemented such that the existing plant shall remain in continuous satisfactory operation during the entire construction period except as absolutely required for the work. Work shall be so scheduled and conducted by Contractor such that it shall not reduce the quality of the SWWRF and SEWRF effluent or cause odor or other nuisances. In performing the Work shown and specified, Contractor shall plan and schedule the Work to meet both the constraints outlined in this Section and all other sequencing and work requirements specified in these Contract Documents. The Contractor is specifically pointed to Section 01014 – Sequence of Work.

C. Contractor has the option of providing additional temporary facilities that can eliminate a constraint provided it is done without additional cost to the County, presents no safety hazards, and provided that all requirements of these Specifications are fulfilled.

D. Contractor shall be responsible for coordinating all shutdowns with the Engineer and County. Contractor shall, whenever possible, combine discrete shutdown procedures into a single shutdown when the duration of the shutdowns or the Work requirements allow such combining to occur on a unit process or work area. The intent of combining procedures is to minimize the impacts upon SWWRF and SEWRF operations and processes by limiting the number of shutdowns required.

E. Contractor shall not shut-off or disconnect any operating system of the SWWRF and SEWRF, unless approved by the Engineer, in writing. All SWWRF and SEWRF equipment operations and shutdowns shall be executed by the County, unless otherwise noted. Contractor shall seal County operated gates and valves to prevent unnecessary leakage. After Contractor's Work has been completed, Contractor shall remove the seal to the satisfaction of the Engineer.

F. Contractor shall refer to the Drawings and other Sections, for definition of the equipment, piping, material and appurtenances to be removed, turned over to the County and stored on site, or to become the property of Contractor and removed from the site.

G. Contractor shall be responsible for design and supply of all temporary pipelines, valves, pumps, meters, spare parts, electrical, controls, and any other appurtenances required for the

installation and operation of temporary bypass lines, pumping systems, or conveyance systems required to maintain operations of the SWWRF and SEWRF during construction activities. All pumps shall be provided with magnetic flow meters capable of providing a 4-20 mADC output signal. Contractor shall submit to the Engineer, for review and approval, the design for all temporary lines, pumping, or conveyance systems at least thirty days prior to the commencement of the construction of the Work associated with the temporary facilities.

H. Contractor shall stage the work to maintain unobstructed access for emergency vehicles to all buildings, building Siamese connections, and fire hydrants.

I. Except as specifically allowed elsewhere in these Contract Documents or upon approval by the Engineer, outages, when required, shall be performed during low flow periods. Low flows are between 12:01 a.m. and 5:00 a.m. Individual outage durations shall not exceed 4 hours. At no time shall forward flow into the SWWRF and SEWRF be required to be stopped to perform the Work.

## 1.02 GENERAL CONSTRAINTS

A. New units may only be used after the specified testing is completed and the units are accepted for use by the Engineer, in writing.

B. The following constraints shall be applied to all equipment appurtenant utility systems on the SWWRF and SEWRF site.

1. Load limits on Access Roads: Existing and new underground facilities, such as electrical duct banks, pipelines, etc., in, under and crossing SWWRF and SEWRF roads, have been designed for a maximum wheel load of AASHTO H-20. Contractor shall not exceed this weight limit and shall provide means of protecting the underground facilities.
2. Access to the SWWRF and SEWRF sites: An unobstructed traffic route through all SWWRF gates shall be maintained at all times.
3. Safety Barriers: Contractors shall place safety barriers around unsafe areas located around operational areas accessible to SWWRF and SEWRF personnel.
4. Personnel Access: personnel shall have access to all areas which remain in operation throughout the construction period.
5. Potable Water System: The existing potable water system shall be kept in operation at all times except as noted to perform the work specified.
6. Plumbing Facilities: Sanitary facilities in the existing structures shall be operational at all times for SWWRF and SEWRF personnel, unless

otherwise specified. All other building plumbing systems, such as roof and floor drains, pumping, etc., shall be maintained for all structures.

7. Storm drainage: Storm drainage on the site shall be operational at all times, unless otherwise specified.
8. Building Heating and Ventilating: In Contractor's Work areas and areas affected by Contractor's operations, building heating and ventilating shall be both provided and maintained in structures, including pipe galleries. The temperatures to be maintained in any area occupied by SWWRF and SEWRF personnel, such as offices, lunchrooms, locker rooms, toilet rooms, facilities containing computer control equipment, etc., shall be at least 65°F and not greater than 80°F. The temperatures to be maintained in all other interior SWWRF and SEWRF areas, whether new, existing or temporary, shall be maintained at a minimum of 55°F and not greater than 90°F.
9. Power, Light and Communication Systems: Electric power, lighting service and communication systems shall be maintained in uninterrupted operation in all areas.
10. Sump Pumps and Sumps: All existing sumps shall be maintained in an operable condition with either existing pumps or temporary pumps provided by Contractor. Interim piping, power and controls shall be provided by Contractor, as required by the construction sequence and as directed by the Engineer.
11. Seal and Service Water Piping: A supply of service and seal water and the necessary connections to existing equipment shall be maintained during construction, unless otherwise specified. Interim piping shall be provided by Contractor, as required.
12. The County will assist Contractor in dewatering process tanks, wells, basins and other work areas. It is Contractor's responsibility to clean the tanks, wells, basins and work areas, and dispose off-site of the SWWRF and SEWRF site and at their expense any residuals. The Contractor shall to maintain a clean and dry work area by pumping and disposing of all washdown and cleaning water, stormwater, and other liquids that accumulate in the work areas.
13. All shutdowns of existing systems or piping shall be performed by County personnel. All existing valves and gates shall be operated by County personnel unless the Contractor has been provided written authorization by the Engineer to perform such activities.
14. Draining Process Pipes and Conduits:

- a. Unless otherwise specified, the contents of pipes and conduits undergoing modifications shall be transferred to the SWWRF and SEWRF drain system using hoses, piping, or pumps.
  - b. If a drain is not available on the pipe to be drained, then a wet tap shall be made by Contractor using a tapping saddle and valve approved by the Engineer. No uncontrolled spillage of a pipe's contents shall be allowed.
  - c. Any spillage shall be brought to the Engineer's attention immediately. Contractor shall wash down any spillage to floor drains, sumps and sump pump discharge piping and then flush out by the system to prevent clogging and septic odors. In spillage is not suitable for drainage system, Contractor shall remove spillage by other method such as Vactor truck, as approved by the Engineer.
15. Temporary Partitions and Enclosures: Contractor shall provide temporary partitions and enclosures as necessary to maintain dust-free, heated and ventilated spaces in all areas which are adjacent to the Work and which must be kept operational by the SWWRF and SEWRF.
16. Dead End Valves of Pipe: Contractor shall provide blind flanges on all valves or pipes which dead-end a line on a temporary or permanent basis. Blind flanges shall be braced and blocked, as required or as directed by the Engineer in the field.

### 1.03 SHUTDOWNS

#### A. GENERAL

- 1. A shutdown shall be defined as a portion of the normal operation of a plant unit that has to be suspended or taken out of service in order to perform the specified Work. Note that shutdown does not mean a shutdown of the receipt of forward flow into the SWWRF and SEWRF and at no time shall the SWWRF and SEWRF not be allowed to receive forward flow from the collection system.
- 2. For each shutdown, Contractor shall conduct a hazard safety assessment, compile an inventory of labor, tools, safety equipment and materials required to perform the tasks, develop an estimate of the time required to complete each task, and prepare a written description of steps required to complete all task of the shutdown. In addition, the MOPO form provided in Section 01999 shall be completed for each shutdown. Contractor shall also request in writing from the Engineer, approval for each shutdown a minimum of 3 calendar days prior to the proposed shutdown date. No shutdown shall be initiated until the inventory of materials and labor is verified by the Engineer

on site at least one week prior to the proposed start date. All shutdowns of existing systems or piping shall be performed by County personnel and all existing valves and gates shall be operated by County personnel unless the Contractor has been specifically authorized in writing by the Engineer to perform such activities.

3. Contractor shall arrange for a minimum of three meetings with the County and the Engineer for each shutdown. The first shall be a general planning strategy meeting for the shutdown. The second meeting shall review the roles of the Contractor, Engineer and County in the shutdown and shall, in detail, review all aspects of the shutdown. The shutdown plan and MOPO shall be presented and be final for this meeting. The first meeting shall be, at a minimum, 3 days before the desired shutdown and the second meeting shall be no more than 3 days before the shutdown. A final pre-shutdown meeting with the County and Engineer shall also be held immediately before the shutdown for final coordination purposes.
4. The Work required herein and any other Work required by the Engineer which may interrupt the normal plant operations shall be accomplished at such times that will be convenient to the County.
5. Contractor shall also have on hand and located in close proximity to the Work area, all tools, equipment, spare parts and materials, both temporary and permanent, necessary to complete each Work category without interruption. Adequate numbers of personnel shall be scheduled for each shutdown, so that the Work shall be accomplished within the specified time frame. Prefabrication of all piping and other assemblies shall be completed, to the greatest degree possible, prior to any shutdowns. The Engineer shall inspect the work area, tools, equipment, spare parts and materials prior to the shutdown and shall be satisfied that Contractor has complied with these requirements, to the fullest extent possible, before shutdowns will be authorized. This review; however, does not relieve the Contractor from having full responsibility of the shutdown activity for having the appropriate tools, equipment, spare parts and materials, both temporary and permanent, necessary to complete each Work category without interruption.
6. If Contractor's procedures cause an unscheduled shutdown of the facilities, Contractor shall perform Work as necessary to immediately re-establish satisfactory operation. Contractor shall notify the Engineer, in writing, immediately of any unscheduled shutdown. Contractor shall permit County's personnel to work with Contractor's personnel, as required, to maintain the SWWRF and SEWRF in continuous satisfactory operation. Unscheduled shutdown and/or interruptions of continued safe and satisfactory operation of the facilities that result in any fines levied shall be the responsibility of Contractor if it is demonstrated that Contractor was

negligent in his Work or did not exercise proper precautions in the conduct of his Work.

7. All Work requiring a portion of the SWWRF and SEWRF to be out-of-service shall be performed during the scheduled shutdowns shown. It should be noted that SWWRF and SEWRF staff will continue to perform administrative, operation and maintenance functions during shutdowns.

- B. Shutdowns of Electrical Systems: Contractor in conjunction with the County and appropriate SWWRF and SEWRF personnel shall lock out and tag circuit breakers and switches operated by the County and shall check cables and wires to be sure that they are de-energized to ground potential before Work begins. Upon completion of the Work, Contractor shall remove the locks and tags and notify the Engineer that the facilities are available for use.

#### 1.04 OVERTIME

- A. All overtime Work by Contractor necessary to conform to the requirements of this Section and related Sections shall be performed by Contractor, at no cost to the County and shall be performed in accordance with the General Conditions. Contractor shall make no claims for extra compensation as a result thereof.

#### 1.05 MAINTENANCE OF PLANT OPERATIONS SCHEDULE AND NARRATIVE DESCRIPTIONS

- A. In order to maintain a continuous plant operation during construction, a blank and a completed sample Maintenance of Plant Operations (MOPOs) Schedule is included in Section 01999. Within each MOPO item's procedural steps, time and scheduling constraints and milestone dates shall be outlined.

- B. Contractor shall develop a detailed narrative description, in addition to that provided in the MOPO, for all shutdowns. These narrative descriptions shall be catalogued and submitted to the Engineer for review and approval within ninety days following the Notice to Proceed. Contractor shall maintain these narratives in a binder which shall be reviewable at any time by the Engineer. These narratives shall be clearly identifiable on and be able to be cross-referenced with the project schedule maintained by the Contractor. As adjustments are made or made necessary by the progression of the Work, the Contractor shall modify and resubmit these narrative descriptions.

#### PART 2 – PRODUCTS (Not Used)

#### PART 3 – EXECUTION (Not Used)

**\*\*END OF SECTION\*\***

01040-6

## SECTION 01045

### CUTTING AND PATCHING

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. The Contractor shall be responsible for all cutting, fitting and patching, including 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.
  5. Provide penetrations of non-structural surfaces for installation of piping and electrical conduit.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

Comply with specifications and standards for each specific product involved.

#### PART 3 EXECUTION

##### 3.01 INSPECTION

- A. Inspect existing conditions of project, including elements subject to damage or to movement during cutting and patching.
- B. After uncovering work, inspect conditions affecting installation of products, or performance of work.
- C. Report unsatisfactory or questionable conditions to County. Do not proceed with work until County has provided further instructions.

##### 3.02 PREPARATION

- A. Provide adequate temporary support as necessary to assure structural value to integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of project from damage.

- C. Provide protection from elements for that portion of the project which may be exposed by cutting and patching work and maintain excavations free from water.

### 3.03 PERFORMANCE

- A. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
- B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work.
- C. Fit and adjust products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
- D. Restore work which has been cut or removed; install new products to provide completed work in accordance with the requirements of the Contract Documents.
- E. Replace surfaces airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- F. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes.

END OF SECTION

## SECTION 01050

### FIELD ENGINEERING AND SURVEYING

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. The Contractor shall provide and pay for field surveying service required for the project.
- B. The Contractor shall furnish and set all necessary stakes to establish the lines and grades as shown on the Contract Drawings and layout each portion of the Work of the Contract.

##### 1.02 QUALIFICATION OF SURVEYOR AND ENGINEER

All construction staking shall be conducted by or under the supervision of a Florida Registered Professional Surveyor and Mapper. The Contractor shall be responsible for the layout of all such lines and grades, which will be subject to verification by the County.

##### 1.03 SURVEY REFERENCE POINTS

- A. Existing basic horizontal and vertical control points for the Project are designated on the Contract Drawings.
- B. Locate and protect all survey monumentation, property corners and project control points prior to starting work and preserve all permanent reference points during construction. All costs associated with the replacement of all survey monumentation, property corners and project control points shall be borne by the Contractor.

Make no changes or relocations without prior written notice to County.

Report to County when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

Require surveyor to replace project control points which may be lost or destroyed.

Establish replacements based on original survey control.

##### 1.04 PROJECT SURVEY REQUIREMENTS

The Contractor shall establish temporary bench marks as needed, referenced to data established by survey control points.

1.05 RECORDS

The Contractor shall employ a Professional Engineer or Surveyor registered in the State of Florida to verify survey data and properly prepare record drawings per Section 01720.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01090

### REFERENCE STANDARDS

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS

Abbreviations and acronyms used in Contract Documents to identify reference standards.

- A. Application: When a standard is specified by reference, comply with requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents, or applicable codes established stricter standards.
- B. Publication Date: The most recent publication in effect on the date of issue of Contract Documents, except when a specific publication date is specified.

##### 1.02 ABBREVIATIONS, NAMES AND ADDRESSES OR ORGANIZATIONS

Obtain copies of reference standards direct from publication source, when needed for proper performance of work, or when required for submittal by Contract Documents.

AA Aluminum Association  
818 Connecticut Avenue, N.W.  
Washington, DC 20006

AASHTO American Association of State Highway and Transportation  
Officials  
444 North Capital Street, N.W.  
Washington, DC 20001

ACI American Concrete Institute  
Box 19150  
Reford Station  
Detroit, MI 48219

AI Asphalt Institute  
Asphalt Institute Building  
College Park, MD 20740

AISC American Institute of Steel Construction  
1221 Avenue of the Americas

01090-1

New York, NY 10020

AISI American Iron and Steel Institute  
1000 16th Street NW  
Washington, DC 20036

ANSI American National Standards Institute  
1430 Broadway  
New York, NY 10018

ASHRAE American Society of Heating, Refrigerating and Air Conditioning  
Engineers  
1791 Tullie Circle, N.E.  
Atlanta, GA 30329

ASME American Society of Mechanical Engineers  
345 East 47th Street  
New York, NY 10017

ASTM American Society for Testing and Materials  
1916 Race Street  
Philadelphia, PA 19103

AWWA American Water Works Association  
6666 West Quincy Avenue  
Denver, CO 80235

AWS American Welding Society  
2501 N.W. 7th Street  
Miami, FL 33125

CRSI Concrete Reinforcing Steel Institute  
180 North LaSalle Street, Suite 2110  
Chicago, IL 60601

FDEP Florida Department of Environmental Protection  
3900 Commonwealth Blvd.  
Tallahassee, Florida 32399

FDOT Florida Department of Transportation Standards Specifications for Road  
and Bridge Construction  
Maps & Publication Sales - Mail Station 12  
605 Suwannee St.  
Tallahassee, FL 32399-0450

FS Federal Specification

01090-2

General Services Administration Specifications and Consumer  
Information Distribution Section (WFSIS)  
Washington Navy Yard, Bldg. 197  
Washington, DC 20407

MCPW UTIL STD Manatee County Utility Engineering  
4410-B 66th St. W.  
Bradenton, FL 34210

MLSFA Metal Lath/Steel Framing Association  
221 North LaSalle Street  
Chicago, IL 60601

MMA Monorail Manufacturer's Association  
1326 Freeport Road  
Pittsburgh, PA 15238

NAAMM National Association of Architectural Metal Manufacturers  
221 North LaSalle Street  
Chicago, IL 60601

NEMANational Electrical Manufacturer's Assoc.  
2101 L Street N.W.  
Washington, DC 20037

OHSA Occupational Safety and Health Assoc.  
5807 Breckenridge Pkwy., Suite A  
Tampa, FL 33610-4249

PCA Portland Cement Association  
5420 Old Orchard Road  
Skokie, IL 20076

PCI Prestressed Concrete Institute  
20 North Wacker Drive  
Chicago, IL 60606

SDI Steel Door Institute  
712 Lakewood Center North  
Cleveland, OH 44107

SMACNA Sheet Metal and Air Conditioning Contractor's National  
Association  
8224 Old Court House Road  
Vienna, VA 22180

SSPC Steel Structures Painting Council  
402 24<sup>th</sup> Street, Suite 600  
Pittsburgh, PA 15213

SWFWMD Southwest Florida Water Management District  
2379 Broad Street  
Brooksville, FL 34604-6899

UL Underwriter's Laboratories, Inc.  
333 Pfingston Road  
Northbrook, IL 60062

**\*\*END OF SECTION\*\***

## SECTION 01025

### MEASUREMENT AND PAYMENT

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

A. Payment for the various items in the Schedule of Prices Bid, as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, taxes, materials, commissions, transportation and handling, bonds, permit fees, insurance, overhead and profit, and incidentals appurtenant to the items of Work being described, as necessary to complete the various items of the Work all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). Such compensation shall also include payment for any loss or damages arising directly or indirectly from the Work.

B. The Contractor's attention is called to the fact that the quotations for the various items of Work are intended to establish a total price for completing the Work in its entirety. Should the Contractor feel that the cost for any item of Work has not been established by the Schedule of Payment items or this Section, it shall include the cost for that Work in some other applicable bid item, so that its proposal for the project does reflect its total price for completing the Work in its entirety.

C. The following explanation of measurement and payment for the bid form items is made for information and guidance. The omission of reference to any item in this description shall not, however, alter the intent of the bid form or relieve the Contractor of the necessity of furnishing such as part of the contract at no additional costs.

D. All contract prices included in the Bid Form section will be full compensation for all shop drawings, working drawings, labor, materials, tools, equipment and incidentals necessary to complete the construction as shown on the Drawings and/or as specified in the Contract Documents to be performed under this Contract. Actual quantities of each item bid on a unit price basis will be determined upon completion of the construction in the manner set up for each item in this section of the Specifications. Payment for all items listed in the Bid Form will constitute full compensation for all work shown and/or specified to be performed under this Contract.

##### 1.02 ESTIMATED QUANTITIES

A. The quantities shown are approximate and are given only as a basis of calculation upon which the award of the Contract is to be made. The County does not assume any responsibility for the final quantities, nor shall the Contractor claim misunderstanding because of such estimate of quantities. Final payment will be made only for satisfactorily completed quantity of each item.

### 1.03 WORK OUTSIDE AUTHORIZED LIMITS

A. No payment will be made for work constructed outside the authorized limits of work.

### 1.04 SUBMITTALS

A. The following shall be submitted.

1. Schedule of Values: Submit schedule within the time period in accordance with Division 0.
2. Application for Payment in accordance with Division 0.
3. Final Application for Payment in accordance with Division 0.

### 1.05 SCHEDULE OF VALUES

- A. Prepare a schedule of values for the Work. See Section 01370 for details.
- B. Unit Price Work: Reflect unit price, quantity and price breakdown from the Unit Price Sheet.
- C. Summation of the complete schedule of values representing all the Work shall equal the Contract Price.
- D. An unbalanced or front-end loaded schedule will not be acceptable.

### 1.06 APPLICATION FOR PAYMENT

- A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.
- B. Use detailed Application for Payment Form provided by the Engineer or County.
- C. Include accepted schedule of values for each portion of Work and the unit price breakdown for the Work to be paid on unit price basis, and a listing of County-selected equipment, if applicable, and allowances, as appropriate.
- D. Preparation:
1. Round values to nearest dollar.
  2. List each Change Order and Written Amendment executed prior to date of submission as separate line item. Totals to equal those shown on the Transmittal Summary Form.

3. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form, a listing of materials on hand as applicable, and such supporting data as may be requested by Engineer or County.

E. Include partial releases of liens from all subcontractors and material suppliers for work paid for by previous applications for payment. Include invoices and paid invoices for materials paid for by previous applications for payment for materials stored on site.

#### 1.07 MEASUREMENT—GENERAL

- A. Where payment for items is shown to be paid for on a lump sum basis, no separate payment will be made for any item of work required to complete the lump sum items. Lump sum contracts shall be complete, tested and fully operable prior to request for final payment. Contractor may be required to provide a break-down of the lump sum totals.
- B. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and Specifications as specified in National Institute of Standards and Technology, Handbook 44.

C.

Item	Method of Measurement
LS	Lump Sum—Unit is one; no measurement will be made

#### 1.08 PAYMENT

##### A. GENERAL

1. Progress payments will be made monthly in accordance with the Contract Documents.
2. All lump sum items shall be paid on a percent complete basis.
3. The date for Contractor's submission of monthly Application for Payment shall be established at the Project Kickoff Meeting and shall be in accordance with Division 0.

- B. Payment shall be by Contract Item as listed on the Bid Form and Bid Summary Sheet.

- C. No separate payment will be made for the following items and the cost of such work shall be included in the applicable pay items of work. Final payments shall not be requested by the Contractor or made by the County until as-built (record) drawings have been submitted and approved by the County.

1. Shop Drawings, Working Drawings.
2. Clearing, grubbing and grading except as hereinafter specified.
3. Trench excavation, including necessary pavement removal and rock removal, except as otherwise specified.
4. Dewatering and disposal of surplus water.
5. Structural fill, backfill, and grading.
6. Replacement of unpaved roadways, and shrubbery plots.
7. Cleanup and miscellaneous work.
8. Foundation and borrow materials, except as hereinafter specified.
9. Testing and placing system in operation.
10. Any material and equipment required to be installed and utilized for the tests.
11. Pipe, structures, pavement replacement, asphalt and shell driveways and/or appurtenances included within the limits of lump sum work, unless otherwise shown.
12. Maintaining the existing quality of service during construction.
13. Maintaining or detouring of traffic.
14. Appurtenant work as required for a complete and operable system.
15. Seeding and hydromulching.
16. As-built Record Drawings.

1.09 BID FORM ITEM DESCRIPTION

A. **Bid Item No. 1 – SWWRF Mobilization, Demobilization and Site Work (LS).**

Payment for SWWRF improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. Bid Items No. 1 includes but is not limited to mobilization, demobilization and all associated site work (including but not limited to erosion control) and incidentals that is not covered in Bid Items No. 2 thru 7 as shown in Construction Documents and as required for a complete system and project. Partial payments for SWWRF Mobilization, Demobilization and Site Work shall be made on a percent complete basis.

**Bid Item No. 2 – SWWRF Demolition (LS).**

Payment for SWWRF Demolition item will be made at the lump sum price named on the Bid Form and be on a percent complete basis. SWWRF Demolition includes but is not limited to careful removal and disposal of existing sludge transfer pumps, piping, valves, appurtenances, drives, belt filter presses, polymer feed pumps and skids, and the polymer system. Also included is the lump sum price includes all removal, demolition, hauling, shipping, and freight as well as incidentals and other demolition as shown/required to perform work as shown in Construction Documents. Partial payments for SWWRF Demolition shall be made on a percent complete basis.

**Bid Item No. 3 – SWWRF Structural, HVAC and Plumbing Improvements (LS).**

Payment for SWWRF Structural, HVAC and Plumbing Improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. SWWRF Structural, HVAC and Plumbing improvements includes but is not limited to refurbishing/repairing and coating existing pump pads, jet cleaning of drain piping below BFPs, BFP pad repairs and coating, structural, HVAC and Plumbing improvements including incidentals in the Electrical rooms and other improvements shown/required to perform work as shown in Construction Documents. Partial payments for SWWRF Structural, HVAC and Plumbing Improvements shall be made on a percent complete basis.

**Bid Item No. 4 – SWWRF BFP Improvements (LS).**

Payment for SWWRF BFP Improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. Improvements includes but is not limited to furnishing and installing new belt filter presses, associated appurtenances, piping, valves, connecting electrical, and instrumentation. The lump sum price includes all shipping, freight, as well as incidentals (mounting, testing, etc.) and other improvements shown/required to perform work as shown in Construction Documents. Partial payments for SWWRF BFP Improvements shall be made on a percent complete basis.

**Bid Item No. 5 – SWWRF Sludge Feed and Polymer Feed Pumps Improvements (LS).**

Payment for SWWRF Sludge Feed and Polymer Feed Pumps Improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. Improvements includes but is not limited to furnishing and installing new sludge transfer pumps, polymer feed pump system, piping, valves, appurtenances, and drives. The lump sum price includes all shipping, freight, as well as incidentals (mounting, testing, etc.) and other improvements shown/required to perform work as shown in Construction Documents. Partial payments for SWWRF Sludge Feed and Polymer Feed Pumps Improvements shall be made on a percent complete basis.

**Bid Item No. 6 – SWWRF Polymer System Improvements (LS).**

Payment for SWWRF Polymer System Improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. Improvements includes but is not limited to furnishing and installing new Polymer System, piping, valves, appurtenances, and drives. The lump sum price includes all shipping, freight, as well as incidentals (mounting, testing, etc.) and other improvements shown/required to perform work as shown in Construction Documents. Partial payments for SWWRF Polymer System Improvements shall be made on a percent complete basis.

**Bid Item No. 7 – SWWRF Electrical and Instrumentation Improvements (LS).**

Payment for SWWRF Electrical and Instrumentation Improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. Improvements includes but is not limited to removal of existing electrical and instrumentation as shown on the Contract Documents, replacement of main service switchgear, motor control centers, electrical power feeds, line, loads and control except fiber. Removal of obsolete panels, exposed conduits and conductors. Replacement of instrumentation and controls on all BFPs to facilitate automatic operation, which includes furnishing and installation of cameras at the BFP and truck load-out locations and furnishing and installation of televisions in the administration building. The item also includes all SCADA integration of the controls specified and shown in the Contract Documents. The lump sum price includes all removal, demolition, hauling, shipping, freight, as well as incidentals (mounting, testing, etc.) and other improvements shown/required to perform work as shown in Construction Documents. Partial payments for SWWRF Electrical and Instrumentation Improvements shall be made on a percent complete basis.

**Bid Item No. 8 – SEWRF Improvements (LS).**

Payment for SEWRF electrical improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. SEWRF improvements includes but is not limited to mobilization, demobilization, site work, replacement of the three (3) existing belt filter presses main control panels and three (3) local control panels with a new main control panel and remote operator interface terminal control panel. The includes replacement of electrical, instrumentation, and controls on three (3) belt filter presses to facilitate automatic operations. The item also includes all SCADA integration of the controls specified and shown in the Contract Documents. The lump sum price includes all removal, demolition, hauling, shipping, and freight, as well as incidentals (disposal, handling, etc.) and other improvements shown/required to perform work as shown in Construction Documents. Partial payments for SEWRF electrical improvements shall be made on a percent complete basis.

**1.09 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS**

**A. Payment will not be made for following:**

1. Loading, hauling, and disposing of rejected material.
2. Quantities of excavated material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.

4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by County.
6. Material remaining on hand after completion of Work.

#### 1.010 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to Engineer.

B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

#### 1.011 ALLOWANCES

A. The allowances shall be used only at the discretion of and as ordered by the County for such items as unforeseen conditions, unforeseeable conflicts between existing elements of work and the proposed work, unit price items exceed estimated quantities, and any associated work requested by the County including all labor, materials, and services for modifications or extra work to complete the Project that was anticipated, but not specifically included in this Contract.

B. Any portion of these allowances that remain after all authorized payments have been made will be withheld from contract payments and will remain with the County. A deductive change order will be executed at the end of this contract prior to Final Payment to credit County with the remaining portion of the allowances.

#### 1.10 SCHEDULE OF PAYMENT VALUE

A. The Contractor shall submit a Schedule of Payment Values for review within 10 calendar days upon receipt of purchase order and executed contract. The schedule shall contain the installed value of the component parts of Work for the purpose of making progress payments during the construction period and shall be consistent with the Unit Price Sheet.

B. The schedule shall be given in sufficient detail for proper identification of Work accomplished. The Schedule of Payment Values shall directly correlate to each activity outlined in the construction progress schedule and the construction network analysis (specified in the section entitled "Submittals") to accurately relate construction progress to the requested payment. Each item shall include its proportional share of all costs including the Contractor's overhead, contingencies and profit. The sum of all scheduled items shall equal the total value of the Contract.

C. If the Contractor anticipates the need for payment for materials stored on the project site or off-site in bonded warehouse, it shall also submit a separate list covering the cost

of materials, delivered and unloaded with taxes paid. This list shall also include the installed value of the item with coded reference to the Work items in the Schedule of Payment Values.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01152

### REQUESTS FOR PAYMENT

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

Submit Applications for Payment to the Project Manager or as directed at the preconstruction meeting, in accordance with the schedule established by Conditions of the Contract and Agreement between County and Contractor.

##### 1.02 FORMAT AND DATA REQUIRED

- A. Submit payment requests in the form provided by the County with itemized data typed in accordance with the Bid Form.
- B. Provide construction photographs in accordance with Contract Documents.

##### 1.03 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

- A. When the County requires substantiating data, Contractor shall submit suitable information with a cover letter.
- B. Submit one copy of data and cover letter for each copy of application.

##### 1.04 PREPARATION OF APPLICATION FOR FINAL PAYMENT

Fill in application form as specified for progress payments.

##### 1.05 SUBMITTAL PROCEDURE

- A. Submit applications for payment at the times stipulated in the Agreement.
- B. Number: Three (3) copies of each application; all signed and certified by the Contractor.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

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## SECTION 01153

### CHANGE ORDER PROCEDURES

#### PART 1 GENERAL

##### 1.01 DEFINITION

- A. Change Order: A written order signed by the Owner, the Architect/Engineer and the Contractor authorizing a change in the Project Plans and/or Specifications and, if necessary, a corresponding adjustment in the Contract Sum and/or Contract Time, pursuant to Article V of the General Conditions of the Construction Agreement.
- B. Administrative Change Adjustment: Minor change order under 10% of project cost or 20% time, does not have to be Board approved.
- C. Field Directive: A written order issued by Owner which orders minor changes in the Work not involving a change in Contract Time, to be paid from the Owner's contingency funds.
- D. Field Order: Minor change to contract work that does not require adjustment of contract sum or expected date of completion.

##### 1.02 REQUIREMENTS INCLUDED

- A. The Contractor shall promptly implement change order procedures:
  - 1. Provide full written data required to evaluate changes.
  - 2. Maintain detailed records of work done on a time-and-material/force account basis.
  - 3. Provide full documentation to County on request.
- B. The Contractor shall designate a member of the Contractor's organization who:
  - 1. Is authorized to accept changes to the Work.
  - 2. Is responsible for informing others in the Contractor's employ of the authorized changes into the Work.

##### 1.03 PRELIMINARY PROCEDURES

- A. Project Manager may initiate changes by submitting a Request to Contractor. Request will include:

1. Detailed description of the change, products, costs and location of the change in the Project.
  2. Supplementary or revised Drawings and Specifications.
  3. The projected time extension for making the change.
  4. A specified period of time during which the requested price will be considered valid.
  5. Such request is for information only and is not an instruction to execute the changes, nor to stop work in progress.
- B. Contractor may initiate changes by submitting a written notice to the Project Manager, containing:
1. Description of the proposed changes.
  2. Statement of the reason for making the changes.
  3. Statement of the effect on the Contract Sum and the Contract Time.
  4. Statement of the effect on the work of separate contractors.
  5. Documentation supporting any change in Contract Sum or Contract Time, as appropriate.

#### 1.04 FIELD ORDER CHANGE

- A. In lieu of a Change Order, the Project Manager may issue a Field Order for the Contractor to proceed with additional work within the original intent of the Project.
- B. Field Order will describe changes in the work, with attachments of backup information to define details of the change.
- C. Contractor must sign and date the Field Order to indicate agreement with the terms therein.

#### 1.05 DOCUMENTATION OF PROPOSALS AND CLAIMS

- A. Support each quotation for a lump sum proposal and for each unit price which has not previously been established, with sufficient substantiating data to allow the County to evaluate the quotation.
- B. On request, provide additional data to support time and cost computations:
1. Labor required.
  2. Equipment required.
  3. Products required.
    - a. Recommended source of purchase and unit cost.
    - b. Quantities required.
  4. Taxes, insurance and bonds.

5. Credit for work deleted from Contract, similarly documented.
  6. Overhead and profit.
  7. Justification for any change in Contract Time.
- C. Support each claim for additional costs and for work done on a time-and-material/force account basis, with documentation as required for a lump-sum proposal.
1. Name of the County's authorized agent who ordered the work and date of the order.
  2. Date and time work was performed and by whom.
  3. Time record, summary of hours work and hourly rates paid.
  4. Receipts and invoices for:
    - a. Equipment used, listing dates and time of use.
    - b. Products used, listing of quantities.
    - c. Subcontracts.

#### 1.06 PREPARATION OF CHANGE ORDERS

- A. Project Manager will prepare each Change Order.
- B. Change Order will describe changes in the Work, both additions and deletions, with attachments as necessary to define details of the change.
- C. Change Order will provide an accounting of the adjustment in the Contract Sum and in the Contract Time.

#### 1.07 LUMP SUM/FIXED PRICE CHANGE ORDER

- A. Project Manager initiates the form, including a description of the changes involved and attachments based upon documents and proposals submitted by the Contractor, or requests from the County, or both.
- B. Once the form has been completed, all copies should be sent to Contractor for approval. After approval by Contractor, all copies should be sent to County for approval. The County will distribute executed copies after approval by the Board of County Commissioners.

#### 1.08 UNIT PRICE CHANGE ORDER

- A. Contents of Change Orders will be based on, either:
  1. County's definition of the scope of the required changes.
  2. Contractor's Proposal for a change, as approved by the County.
  3. Survey of completed work.

B. The amounts of the unit prices to be:

1. Those stated in the Agreement.
2. Those mutually agreed upon between County and Contractor.

1.09 TIME AND MATERIAL/FORCE ACCOUNT CHANGE ORDER/  
CONSTRUCTION CHANGE AUTHORIZATION

A. Refer to Article V.5.6 of the General Conditions of the Construction Agreement.

1.10 CORRELATION WITH CONTRACTOR'S SUBMITTALS

- A. Periodically revise Schedule of Values and Application for Payment forms to record each change as a separate item of work, and to record the adjusted Contract Sum.
- B. Periodically revise the Construction Schedule to reflect each change in Contract Time. Revise sub schedules to show changes for other items of work affected by the changes.
- C. Upon completion of work under a Change Order, enter pertinent changes in Record Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01200

### PROJECT MEETINGS

#### PART 1 - GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. The County shall schedule the pre-construction meeting, periodic progress meetings and special meetings, if required, throughout progress of work.
- B. Representatives of contractors, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
- C. The Contractor shall attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules.

##### 1.02 PRE-CONSTRUCTION MEETING

- A Attendance:
  - 1. County's Engineer.
  - 2. County's Project Manager
  - 3. Contractor.
  - 4. Resident Project Representative.
  - 5. Related Labor Contractor's Superintendent.
  - 6. Major Subcontractors.
  - 7. Major Suppliers.
  - 8. Others as appropriate.
- B. Suggested Agenda:
  - 1. Distribution and discussion of:
    - a. List of major subcontractors.
    - b. Projected Construction Schedules.
    - c. Coordination of Utilities
  - 2. Critical work sequencing.
  - 3. Project Coordination.
    - a. Designation of responsible personnel.
    - b. Emergency contact persons with phone numbers.
  - 4. Procedures and processing of:
    - a. Field decisions.
    - b. Submittals.
    - c. Change Orders.
    - d. Applications for Payment.
  - 5. Procedures for maintaining Record Documents.
  - 6. Use of premises:
    - a. Office, work and storage areas.

- b. County's Requirements.
- 7. Temporary utilities.
- 8. Housekeeping procedures.
- 9. Liquidated damages.
- 10. Equal Opportunity Requirements.
- 11. Laboratory testing.
- 12. Project / Job meetings: Progress meeting, other special topics as needed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01300

### SUBMITTALS

#### PART 1 – GENERAL

##### 1.01 GENERAL

- A. The Contractor shall submit to the County for review and approval: working drawings, shop drawings, test reports and data on materials and equipment (hereinafter in this section called data), and material samples (hereinafter in this section called samples) as are required for the proper control of work, including, but not limited to those working drawings, shop drawings, data and samples for materials and equipment specified elsewhere in the Specifications and in the Contract Drawings.
- B. The Contractor is to maintain an accurate updated submittal log and will bring this log to each scheduled progress meeting with the County. This log should include the following items:
  - 1. Submittal description and number assigned.
  - 2. Date to County.
  - 3. Date returned to Contractor (from County).
  - 4. Status of Submittal (No exceptions taken, returned for confirmation or resubmittal, rejected).
  - 5. Date of Resubmittal and Return (as applicable).
  - 6. Date material released (for fabrication).
  - 7. Projected date of fabrication.
  - 8. Projected date of delivery to site.
  - 9. Projected date and required lead time so that product installation does not delay contact.
  - 10. Status of O&M manuals submitted.
- C. Submittals covered by these requirements include manufacturers' information, shop drawings, test procedures, test results, samples, requests for substitutions, and miscellaneous work-related submittals. Submittals shall also include, but not be limited to, all mechanical, electrical and electronic equipment and systems, materials, reinforcing steel, fabricated items, and piping and conduit details. The Contractor shall furnish all drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and other instructions as specifically required in the contract documents to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the contract documents.

- D. The contractor shall submit copies of all permit applications, permit submittals, permit comments and permit approvals.
- E. Within 10 calendar days after Notice to Proceed, Contractor shall submit a complete list of all anticipated submittals including shop drawings, submittals, and product data with an anticipated delivery date to the Engineer and review and approval times. This shall be reviewed during the Project Kickoff Meeting and shall be continuously updated and reviewed during Project Progress Meetings.

## 1.02 CONTRACTOR'S RESPONSIBILITIES

The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items, models, or series of equipment, which are being submitted for review. All extraneous materials shall be crossed out or otherwise obliterated. The Contractor shall ensure that there is no conflict with other submittals and notify the Engineer in each case where his submittal may affect the work of another Contractor or the County. The Contractor shall coordinate submittals among his subcontractors and suppliers including those submittals complying with unit responsibility requirements specified in paragraph 11000-1.02 C and applicable technical sections.

The Contractor shall coordinate submittals with the work so that work will not be delayed. Contractor shall coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. The Contractor shall not proceed with work related to a submittal until the submittal process is complete. For the Contractor to proceed a submittal shall be reviewed, commented and shall be returned to the Contractor stamped "No Exceptions Taken" or "Make Corrections Noted."

The Contractor shall certify on each submittal document that the Contractor has reviewed the submittal, verified field conditions, and complied with the contract documents.

The Contractor may authorize in writing a material or equipment supplier to deal directly with the Engineer regarding a submittal. These dealings shall be limited to contract interpretations to clarify and expedite the work.

The Engineer will review each submittal up to two times. The Contractor shall pay directly to the Engineer for all additional reviews on a time and materials basis but not to exceed 24 hours per submittal review.

It is the duty of the Contractor to check all drawings, data and samples prepared by or for him before submitting them to the County for review. Each and every copy of the Drawings and data shall bear Contractor's stamp showing that they have been so checked. Shop drawings submitted to the County without the Contractor's stamp will be returned to the Contractor for

conformance with this requirement. Shop drawings shall indicate any deviations in the submittal from requirements of the contract Documents.

Determine and verify:

1. Field measurements.
2. Field construction criteria.
3. Catalog numbers and similar data.
4. Conformance with Specifications and indicate all variances from the Specifications.

The Contractor shall furnish the County a schedule of Shop Drawing submittals fixing the respective dates for the submission of shop and working drawings, the beginning of manufacture, testing and installation of materials, supplies and equipment. This schedule shall indicate those that are critical to the progress schedule.

The Contractor shall not begin any of the work covered by a drawing, data, or a sample returned for correction until a revision or correction thereof has been reviewed and returned to him, by the County, with No Exceptions Taken or Approved As Noted.

The Contractor shall submit to the County all drawings and schedules sufficiently in advance of construction requirements to provide no less than twenty-one (21) calendar days for checking and appropriate action from the time the County receives them.

All material & product submittals, other than samples, may be transmitted electronically as a pdf file. All returns to the contractor will be as a pdf file only unless specifically requested otherwise.

The Contractor shall be responsible for and bear all cost of damages which may result from the ordering of any material or from proceeding with any part of work prior to the completion of the review by County of the necessary Shop Drawings.

### 1.03 CATEGORIES OF SUBMITTALS

#### A. GENERAL

Submittals fall into two general categories; submittals for review and comment, and submittals which are primarily for information only. Submittals which are for information only are generally specified as PRODUCT DATA in Part 2 of applicable specification sections.

#### B. SUBMITTALS FOR REVIEW AND COMMENT

All submittals except where specified to be submitted as product data for information only shall be submitted by the Contractor to the Engineer for review and comment.

### C. SUBMITTALS (PRODUCT DATA) FOR INFORMATION ONLY

Where specified, the Contractor shall furnish submittals (product data) to the Engineer for Information only. Submittal requirements for operation and maintenance manuals, which are included in this category, are specified in Section 01730.

#### 1.04 TRANSMITTAL PROCEDURE

##### A. GENERAL

Unless otherwise specified, submittals regarding material and equipment shall be accompanied by Transmittal Form 01300-A specified in Section 01999. Submittals for operation and maintenance manuals, information and data shall be accompanied by Transmittal Form 01730-A specified in Section 01999. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Submittal documents common to more than one piece of equipment shall be identified with all the appropriate equipment numbers. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.

A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX"; where "XXX" is the sequential number assigned by the Contractor. Resubmittals shall have the following format: "XXX-Y"; where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25B, for example, is the second resubmittal of submittal 25.

##### B. DEVIATIONS FROM SPECIFICATION AND DRAWING REQUIREMENTS

Each submittal shall be accompanied with a copy of the related specification section, with addendum updates included, and all applicable and referenced paragraphs of other sections, with addendum updates included, with each paragraph check-marked (✓) to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Vendor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Vendor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

If the Contractor proposes to provide material, equipment, or method of work which deviates from the project manual, he shall indicate so under "deviations" on the transmittal form

accompanying the submittal copies. The deviations noted on the form shall summarize major deviations or groups of deviations. Each submittal shall be accompanied with a detailed list of all deviations with an explanation describing the justification for the deviation.

### C. SUBMITTAL COMPLETENESS

Submittals which do not have all the information required to be submitted, including deviations, are not acceptable and will be returned without review.

## 1.05 REVIEW PROCEDURE

### A. GENERAL

Submittals are specified for those features and characteristics of materials, equipment, and methods of operation which can be selected based on the Contractor's judgment of their conformance to the specified requirements. Other features and characteristics are specified in a manner which enables the Contractor to determine acceptable options without submittals. The review procedure is based on the Contractor's guarantee that all features and characteristics not requiring submittals conform as specified. Review shall not extend to means, methods, techniques, sequences or procedures of construction, or to verifying quantities, dimensions, weights or gages, or fabrication processes (except where specifically indicated or required by the project manual) or to safety precautions or programs incident thereto. Review of a separate item, as such, will not indicate approval of the assembly in which the item functions.

When the contract documents require a submittal, the Contractor shall submit the specified information as follows:

1. Submittals and Product Data shall be submitted electronically as a single PDF document.

The following submittals are excluded and require hard copies. A summary of the types of submittals and the number of copies required for review by the Engineer is as follows:

Copies	Type of Submittal
2	Permit Applications, Permits & Permit Submittals
5	General Submittals & Plans of Operation
5	Construction Schedule
5	Schedule of Payment Items/ Values
5	Progress Estimates & Construction Photographs
8	Equipment Submittals and Shop Drawings
2	Certificates of Compliance
2	Product Samples
2	Project Record Documents
5	Technical Manuals, O&M Manuals & Spare Parts List

6	Application for Payment
3	Consent of Sureties, Partial/Final releases of Liens
2	Elevation Certificates

## B. SUBMITTALS FOR REVIEW AND COMMENT

Unless otherwise specified, within 14 calendar days after receipt of a submittal for review and comment, the Engineer shall review and return three marked-up three copies of the submittal. The reproducible original will be retained by the Engineer. The returned submittal shall indicate one of the following actions:

1. If the review indicates that the material, equipment or work method complies with the project manual, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.
2. If the review indicates limited corrections are required, copies will be marked "MAKE CORRECTIONS NOTED." The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in O&M data, a corrected copy shall be provided.
3. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "AMEND AND RESUBMIT." Except at his own risk, the Contractor shall not undertake work covered by this submittal until it has been revised, resubmitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."
4. If the review indicates that the material, equipment, or work method does not comply with the project manual, copies of the submittal will be marked "REJECTED - SEE REMARKS." Submittals with deviations which have not been identified clearly may be rejected. Except at his own risk, the Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

## C. SUBMITTALS (PRODUCT DATA) FOR INFORMATION ONLY

Such information is not subject to submittal review procedures and shall be provided as part of the work under this contract and its acceptability determined under normal inspection procedures.

### 1.06 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS

Review of contract drawings, methods of work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of his responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the County's Representative or the County, or by any officer or employee thereof, and the Contractor shall have no claim under the contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the County has no objection to the Contractor, upon his own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.

#### 1.07 LIST OF SECTIONS REQUIRING SUBMITTALS

The following submittal list is provided as a courtesy to the Contractor and does not relieve the Contractor of analyzing in its entirety the Contract Documents and providing all submittals, shop drawings, product data and all other information specified, inferred or required to meet the intent of the Contract Documents.

1. Section 01014 Sequence of Work
2. Section 01060 Safety and Health
3. Section 01310 Construction Schedule
4. Section 01380 Construction Photographs and Videos
  - a. Preconstruction Photographs and Video
5. Section 01540 Security
  - a. Required documentation to obtain plant access
6. Section 01560 Environmental Controls
7. Section 01570 Traffic Control
8. Section 01590 Field Office, Equipment and Services
9. Section 01660 Commissioning
10. Section 01662 Electrical Acceptance Testing
11. Section 01663 Process Instrumentation and Control System Testing
12. Section 01664 Training
13. Section 01730 Operation and Maintenance Manuals

- |     |               |  |
|-----|---------------|--|
| 14. | Section 01900 | Structural Design and Anchorage Requirements for Nonstructural Components and Nonbuilding Structures |
| 15. | Section 02100 | Site Preparation   |
| 16. | Section 02270 | Erosion, Sedimentation, and Dust Control   |
| 17. | Section 02350 | Sheeting, Shoring, and Bracing   |
| 18. | Section 02500 | Asphaltic Concrete Pavement  |
| 19. | Section 05100 | Structural Metals  |
| 20. | Section 05501 | Anchor Bolts   |
| 21. | Section 09900 | Coating Systems  |
| 22. | Section 11000 | General Requirements for Equipment   |
| 23. | Section 11002 | Rigid Equipment Mounts   |
| 24. | Section 11050 | General Requirements for Pumping Equipment   |
| 25. | Section 11060 | Electric Motors  |
| 26. | Section 11069 | Adjustable Frequency Drives  |
| 27. | Section 11350 | Polymer Blend Feed Equipment and Appurtenances   |
| 28. | Section 11380 | Metering Diaphragm Pumps   |
| 29. | Section 11390 | Progressive Cavity Pumps   |
| 30. | Section 11622 | Belt Filter Press  |
| 31. | Section 14553 | Shaftless Spiral Conveyors   |
| 32. | Section 15050 | Piping Systems   |
| 33. | Section 15062 | Ductile Iron Pipe  |
| 34. | Section 15064 | Plastic Pipe   |
| 35. | Section 15075 | Joint Gaskets  |
| 36. | Section 15085 | Piping Connections   |
| 37. | Section 15095 | Piping Appurtenances   |

- 38. Section 15096 Pipe Hangers and Supports
- 39. Section 15110 Eccentric Plug Valves
- 40. Section 15118 Spring-Loaded Swing Check Valves
- 41. Section 15136 Knife Gate Valves
- 42. Section 15147 Solenoid Valves
- 43. Section 15180 Power Actuated Valve and Gate Schedules
- 44. Section 15184 Manual Valve and Gate Operators and Operator Appurtenances
- 45. Section 15185 Powered Valve and Gate Actuators and Appurtenances
- 46. Section 15995 Pipeline Testing
- 47. Section 16000 General Requirements for Electrical Work
- 48. Section 16110 Raceways, Boxes and Supports
- 49. Section 16120 600 Volt Conductors, Wire, and Cable
- 50. Section 16140 Wiring Devices
- 51. Section 16155 Individual Motor Starters
- 52. Section 16175 Miscellaneous Electrical Devices
- 53. Section 16431 Arc Flash Analysis, Short Circuit Study, and Protective Device Coordination Report
- 54. Section 16440 Instrument Transformers, Meters, Switches and Accessories
- 55. Section 16445 Surge Protective Devices
- 56. Section 16446 Lighting Protection System
- 57. Section 16450 Grounding System
- 58. Section 16460 Dry Type Transformers
- 59. Section 16470 Lighting and Power Distribution Panel Boards
- 60. Section 16500 Luminaires

- 61. Section 16920 600 Volt Motor Control Centers
- 62. Section 17000 General Requirements for Instrumentation and Control
- 63. Section 17110 Instrument and Control Panels
- 64. Section 17211 Process Taps and Primary Elements
- 65. Section 17212 Transmitters
- 66. Section 17215 Process Fluid Analyzers
- 67. Section 17216 Process Switches
- 68. Section 17271 Signal Conditioning Modules
- 69. Section 17275 Miscellaneous Panel Instruments
- 70. Section 17310 Programmable Logic Controller
- 71. Section 17315 Process Control System Development and Programming
- 72. Section 17316 Process Control Software System

#### 1.08 LIST OF SECTIONS REQUIRING PRODUCT DATA

Reference the individual specification sections.

#### 1.09 COUNTY'S REVIEW OF SHOP DRAWINGS AND WORKING DRAWINGS

- A. The County's review of drawings, data and samples submitted by the Contractor shall cover only general conformity to the Specifications, external connections and dimensions which affect the installation.
- B. The review of drawings and schedules shall be general and shall not be construed:
  - 1. As permitting any departure from the Contract requirements.
  - 2. As relieving the Contractor of responsibility for any errors, including details, dimensions and materials.
  - 3. As approving departures from details furnished by the County, except as otherwise provided herein.
- C. If the drawings or schedules as submitted describe variations and show a departure from the Contract requirements which the County finds to be in the interest of the County and to be so minor as not to involve a change in Contract

Price or time for performance, the County may return the reviewed drawings without noting any exception.

- D. When reviewed by the County, each of the Shop and Working Drawings shall be identified as having received such review being so stamped and dated. Shop Drawings stamped "REJECTED" and with required corrections shown shall be returned to the Contractor for correction and resubmittal.
- E. Resubmittals will be handled in the same manner as first submittals. On resubmittals, the Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, to revisions other than the corrections requested by the County on previous submissions. The Contractor shall make any corrections required by the County.
- F. If the Contractor considers any correction indicated on the drawings to constitute a change to the Contract Drawings or Specifications, the Contractor shall give written notice thereof to the County.
- G. The County shall review a submittal/resubmittal a maximum of three (3) times after which cost of review shall be borne by the Contractor. The cost of engineering shall be equal to the County's actual payroll cost.
- H. When the Shop and Working Drawings have been completed to the satisfaction of the County, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the County.
- I. No partial submittals shall be reviewed. Incomplete submittals shall be returned to the Contractor and shall be considered not approved until resubmitted.

#### 1.10 SHOP DRAWINGS

- A. When used in the Contract Documents, the term "Shop Drawings" shall be considered to mean Contractor's plans for material and equipment which become an integral part of the Project. These drawings shall be complete and detailed. Shop Drawings shall consist of fabrication, drawings, setting drawings, schedule drawings, manufacturer's scale drawings and wiring and control diagrams. Cuts, catalogs, pamphlets, descriptive literature and performance and test data, shall be considered only as supportive to required Shop Drawings as defined above.
- B. Drawings and schedules shall be checked and coordinated with the work of all trades involved, before they are submitted for review by the County and shall bear the Contractor's stamp of approval and original signature as evidence of such checking and coordination. Drawings or schedules submitted without this stamp

of approval and original signature shall be returned to the Contractor for resubmission.

- C. Each Shop Drawing shall have a blank area 3-1/2 inches by 3-1/2 inches, located adjacent to the title block. The title block shall display the following:
  - 1. Number and title of the drawing.
  - 2. Date of Drawing or revision.
  - 3. Name of project building or facility.
  - 4. Name of contractor and subcontractor submitting drawing.
  - 5. Clear identification of contents and location of the work.
  - 6. Specification title and number.
- D. If drawings show variations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variations in his letter of transmittal. If acceptable, proper adjustment in the contract shall be implemented where appropriate. If the Contractor fails to describe such variations, he shall not be relieved of the responsibility of executing the work in accordance with the Contract, even though such drawings have been reviewed.
- E. Data on materials and equipment shall include, without limitation, materials and equipment lists, catalog sheets, cuts, performance curves, diagrams, materials of construction and similar descriptive material. Materials and equipment lists shall give, for each item thereon, the name and location of the supplier or manufacturer, trade name, catalog reference, size, finish and all other pertinent data.
- F. For all mechanical and electrical equipment furnished, the Contractor shall provide a list including the equipment name and address and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained.
- G. All manufacturers or equipment suppliers who proposed to furnish equipment or products shall submit an installation list to the County along with the required shop drawings. The installation list shall include at least five installations where identical equipment has been installed and have been in operation for a period of at least one (1) year.
- H. Only the County will utilize the color "red" in marking shop drawing submittals.

#### 1.11 WORKING DRAWINGS

- A. When used in the Contract Documents, the term "working drawings" shall be considered to mean the Contractor's fabrication and erection drawings for structures such as roof trusses, steelwork, precast concrete elements, bulkheads, support of open cut excavation, support of utilities, groundwater control systems,

forming and false work; underpinning; and for such other work as may be required for construction of the project.

- B. Copies of working drawings as noted above, shall be submitted to the County where required by the Contract Documents or requested by the County and shall be submitted at least thirty (30) days (unless otherwise specified by the County) in advance of their being required for work.
- C. Working drawings shall be signed by a registered Professional Engineer, currently licensed to practice in the State of Florida and shall convey, or be accompanied by, calculation or other sufficient information to completely explain the structure, machine, or system described and its intended manner of use. Prior to commencing such work, working drawings must have been reviewed without specific exceptions by the County, which review will be for general conformance and will not relieve the Contractor in any way from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error are assumed by the Contractor; the County and Engineer shall not have responsibility therefor.

#### 1.12 SAMPLES

- A. The Contractor shall furnish, for the review of the County, samples required by the Contract Documents or requested by the County. Samples shall be delivered to the County as specified or directed. The Contractor shall prepay all shipping charges on samples. Materials or equipment for which samples are required shall not be used in work until reviewed by the County.
- B. Samples shall be of sufficient size and quantity to clearly illustrate:
  - 1. Functional characteristics of the product, with integrally related parts and attachment devices.
  - 2. Full range of color, texture and pattern.
  - 3. A minimum of two samples of each item shall be submitted.
- C. Each sample shall have a label indicating:
  - 1. Name of product.
  - 2. Name of Contractor and Subcontractor.
  - 3. Material or equipment represented.
  - 4. Place of origin.
  - 5. Name of Producer and Brand (if any).
  - 6. Location in project.  
(Samples of finished materials shall have additional markings that will identify them under the finished schedules.)
  - 7. Reference specification paragraph.

- D. The Contractor shall prepare a transmittal letter in triplicate for each shipment of samples containing the information required above. He shall enclose a copy of this letter with the shipment and send a copy of this letter to the County. Review of a sample shall be only for the characteristics or use named in such and shall not be construed to change or modify any Contract requirements.
- E. Reviewed samples not destroyed in testing shall be sent to the County or stored at the site of the work. Reviewed samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the reviewed samples. If requested at the time of submission, samples which failed testing or were rejected shall be returned to the Contractor at his expense.

#### PART 2 – PRODUCTS (NOT USED)

#### PART 3 – EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01310

### CONSTRUCTION SCHEDULE & PROJECT RESTRAINTS

#### PART 1 GENERAL

##### 1.01 GENERAL

- A. Construction under this contract must be coordinated with the County and accomplished in a logical order to maintain utilization and flow through existing facilities and public properties and rights-of-way and to allow construction to be completed within the time allowed by Contract Documents and in the manner set forth in the Contract.

##### 1.02 CONSTRUCTION SCHEDULING GENERAL PROVISIONS

- A. No work shall be done between 7:00 p.m. and 7:00 a.m. nor on weekends or legal holidays without written permission of the County. However, emergency work may be done without prior permission.
- B. Night work may be established by the Contractor as regular procedure with the written permission of the County. Such permission, however, may be revoked at any time by the County if the Contractor fails to maintain adequate equipment and supervision for the proper execution and control of the work at night.
- C. Due to potential health hazards and requirements of the State of Florida and the U.S. Environmental Protection Agency, existing facilities must be maintained in operation.
- D. The Contractor shall be fully responsible for providing all temporary piping, plumbing, electrical hook-ups, lighting, temporary structure, or other materials, equipment and systems required to maintain the existing facility's operations. All details of temporary piping and temporary construction are not necessarily shown on the Drawings or covered in the Specifications. However, this does not relieve the Contractor of the responsibility to ensure that construction will not interrupt proper facility operations.
- E. The Contractor shall designate an authorized representative of his firm who shall be responsible for development and maintenance of the schedule and of progress and payment reports. This representative of the Contractor shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the commitments of the Contractor's schedule.

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS

- A. The Contractor shall submit a critical path schedule as described herein.
- B. The planning, scheduling, management and execution of the work is the sole responsibility of the Contractor. The progress schedule requirement is established to allow County to review Contractor's planning, scheduling, management and execution of the work; to assist County in evaluating work progress and make progress payments and to allow other contractors to cooperate and coordinate their activities with those of the Contractor.

### 2.02 FORM OF SCHEDULES

- A. Prepare schedules using the latest version of Microsoft Project, or other County approved software, in the form of a horizontal bar chart diagram. The diagram shall be time-scaled and sequenced by work areas. Horizontal time scale shall identify the first work day of each week.
- B. Activities shall be at least as detailed as the Schedule of Values. Activity durations shall be in whole working days. In addition, man-days shall be shown for each activity or tabulated in an accompanying report.
- C. Diagrams shall be neat and legible and submitted on sheets at least 8-1/2 inches by 11 inches suitable for reproduction. Scale and spacing shall allow space for notations and future revisions.

### 2.03 CONTENT OF SCHEDULES

- A. Each monthly schedule shall be based on data as of the last day of the current pay period.
- B. Description for each activity shall be brief but convey the scope of work described.
- C. Activities shall identify all items of work that must be accomplished to achieve substantial completion, such as items pertaining to Contractor's installation and testing activities; items pertaining to the approval of regulatory agencies; contractor's time required for submittals, fabrication and deliveries; the time required by County to review all submittals as set forth in the Contract Documents; items of work required of County to support pre-operational, startup and final testing; time required for the relocation of utilities. Activities shall also identify interface milestones with the work of other contractors performing work under separate contracts with County.

- D. Schedules shall show the complete sequence of construction by activities. Dates for beginning and completion of each activity shall be indicated as well as projected percentage of completion for each activity as of the first day of each month.
- E. Submittal schedule for shop drawing review, product data, and samples shall show the date of Contractor submittal and the date approved submittals will be required by the County, consistent with the time frames established in the Specifications.
- F. For Contract change orders granting time extensions, the impact on the Contract date(s) shall equal the calendar-day total time extension specified for the applicable work in the Contract change orders.
- G. For actual delays, add activities prior to each delayed activity on the appropriate critical path(s). Data on the added activities of this type shall portray all steps leading to the delay and shall further include the following: separate activity identification, activity description indicating cause of the delay, activity duration consistent with whichever set of dates below applies, the actual start and finish dates of the delay or, if the delay is not finished, the actual start date and estimated completion date.
- H. For potential delays, add an activity prior to each potentially delayed activity on the appropriate critical path(s). Data for added activities of this type shall include alternatives available to mitigate the delay including acceleration alternatives and further show the following: separate activity identification, activity description indicating cause of the potential delay and activity duration equal to zero work days.

## 2.04 SUPPORTING NARRATIVE

- A. Status and scheduling reports identified below shall contain a narrative to document the project status, to explain the basis of Contractor's determination of durations, describe the Contract conditions and restraints incorporated into the schedule and provide an analysis pertaining to potential problems and practical steps to mitigate them.
- B. The narrative shall specifically include:
  - 1. Actual completion dates for activities completed during the monthly report period and actual start dates for activities commenced during the monthly report period.
  - 2. Anticipated start dates for activities scheduled to commence during the following monthly report period.

3. Changes in the duration of any activity and minor logic changes.
4. The progress along the critical path in terms of days ahead or behind the Contract date.
5. If the Monthly Status Report indicates an avoidable delay to the Contract completion date or interim completion dates as specified in the Agreement, Contractor shall identify the problem, cause and the activities affected and provide an explanation of the proposed corrective action to meet the milestone dates involved or to mitigate further delays.
6. If the delay is thought to be unavoidable, the Contractor shall identify the problem, cause, duration, specific activities affected and restraints of each activity.
7. The narrative shall also discuss all change order activities whether included or not in the revised/current schedule of legal status. Newly introduced change order work activities and the CPM path(s) that they affect, must be specifically identified. All change order work activities added to the schedule shall conform with the sequencing and Contract Time requirements of the applicable Change Order.
8. Original Contract date(s) shall not be changed except by Contract change order. A revision need not be submitted when the foregoing situations arise unless required by County. Review of a report containing added activities will not be construed to be concurrence with the duration or restraints for such added activities; instead the corresponding data as ultimately incorporated into the applicable Contract change order shall govern.
9. Should County require additional data, this information shall be supplied by Contractor within 10 calendar days.

## 2.05 SUBMITTALS

- A. Contractor shall submit estimated and preliminary progress schedules (as identified in the Terms and Conditions of the Contract and the General Conditions), monthly status reports, a start-up schedule and an as-built schedule report all as specified herein.
- B. All schedules, including estimated and preliminary schedules, shall be in conformance with the Contract Documents.
- C. The finalized progress schedule discussed in the Contract Documents shall be the first monthly status report and as such shall be in conformance with all applicable specifications contained herein.
- D. Monthly Status Report submittals shall include a time-scaled (days after notice to proceed) diagram showing all contract activities and supporting narrative. The initial detailed schedule shall use the notice to proceed as the start date. The finalized schedule, if concurred with by County, shall be the work plan to be used

by the contractor for planning, scheduling, managing and executing the work.

- E. The schedule diagram shall be formatted as above. The diagram shall include (1) all detailed activities included in the preliminary and estimated schedule submittals, (2) calendar days prior to substantial completion, (3) summary activities for the remaining days. The critical path activities shall be identified, including critical paths for interim dates, if possible.
- F. The Contractor shall submit progress schedules with each application for payment.

## 2.06 MONTHLY STATUS REPORTS

- A. Contractor shall submit detailed schedule status reports on a monthly basis with the Application for Payment. The first such status report shall be submitted with the first Application for Payment and include data as of the last day of the pay period. The Monthly Report shall include a "marked-up" copy of the latest detailed schedule of legal status and a supporting narrative including updated information as described above. The Monthly Report will be reviewed by County and Contractor at a monthly schedule meeting and Contractor will address County's comments on the subsequent monthly report. Monthly status reports shall be the basis for evaluating Contractor's progress.
- B. The "marked-up" diagram shall show, for the latest detailed schedule of legal status, percentages of completion for all activities, actual start and finish dates and remaining durations, as appropriate. Activities not previously included in the latest detailed schedule of legal status shall be added, except that contractual dates will not be changed except by change order. Review of a marked-up diagram by County will not be construed to constitute concurrence with the time frames, duration, or sequencing for such added activities; instead the corresponding data as ultimately incorporated into an appropriate change order shall govern.

## 2.07 STARTUP SCHEDULE

- A. At least 60 calendar days prior to the date of substantial completion, Contractor shall submit a time-scaled (days after notice to proceed) diagram detailing the work to take place in the period between 60 days prior to substantial completion, together with a supporting narrative. County shall have 10 calendar days after receipt of the submittal to respond. Upon receipt of County's comments, Contractor shall make the necessary revisions and submit the revised schedule within 10 calendar days. The resubmittal, if concurred with by County, shall be the Work Plan to be used by Contractor for planning, managing, scheduling and executing the remaining work leading to substantial completion.
- B. The time-scaled diagram shall use the latest schedule of legal status for those

activities completed ahead of the last 60 calendar days prior to substantial completion and detailed activities for the remaining 60-day period within the time frames outlined in the latest schedule of legal status.

- C. Contractor will be required to continue the requirement for monthly reports, as outlined above. In preparing this report, Contractor must assure that the schedule is consistent with the progress noted in the startup schedule.

## 2.08 REVISIONS

- A. All revised Schedule Submittals shall be made in the same form and detail as the initial submittal and shall be accompanied by an explanation of the reasons for such revisions, all of which shall be subject to review and concurrence by County. The revision shall incorporate all previously made changes to reflect current as-built conditions. Minor changes to the approved submittal may be approved at monthly meetings; a minor change is not considered a revision in the context of this paragraph.
- B. A revised schedule submittal shall be submitted for review when required by County.

## PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01370

### SCHEDULE OF VALUES

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. The Contractor shall submit to the County a Schedule of Values allocated to the various portions of the work, within 10 days after date of Notice to Proceed.
- B. Upon request of the County, the Contractor shall support the values with data which will substantiate their correctness.
- C. The Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.

##### 1.02 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Schedule of Values will be considered for approval by County upon Contractor's request. Identify schedule with:
  - 1. Title of Project and location.
  - 2. Project number.
  - 3. Name and address of Contractor.
  - 4. Contract designation.
  - 5. Date of submission.
- B. Schedule of Values shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction.
- C. Follow the table of contents for the Contract Document as the format for listing component items for structures:
  - 1. Identify each line item with the number and title of the respective major section of the specification.
  - 2. For each line item, list sub values of major products or operations under item.
- D. Follow the bid sheets included in this Contract Documents as the format for listing component items for pipe lines.
- E. The sum of all values listed in the schedule shall equal the total Contract sum.

PART 2      PRODUCTS (NOT USED)

PART 3      EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01380

### CONSTRUCTION PHOTOGRAPHS AND VIDEOS

#### PART 1 – GENERAL

##### 1.01 REQUIRMENTS INCLUDED

- A. The Contractor shall employ a competent photographer to take construction record photographs or perform video, recording including furnishing all labor, materials, equipment and incidentals necessary to obtain photographs and/or video recordings of all construction areas.
- B. Preconstruction record information shall consist of video recordings on digital video disks (DVD).
- C. Construction progress information shall consist of photographs and digital photographs on a recordable compact disc (CD-R).

##### 1.02 QUALIFICATIONS

- A. All photography shall be done by a competent camera operator who is fully experienced and qualified with the specified equipment.
- B. For the video recording, the audio portion should be done by a person qualified and knowledgeable in the specifics of the Contract, who shall speak with clarity and diction to be easily understood.

##### 1.03 PROJECT PHOTOGRAPHS

- A. Provide one print of each photograph with each pay application.
- B. Provide one recordable compact disc with digital photographs with each pay application.
- C. Negatives:
  - 1. All negatives shall remain the property of photographer.
  - 2. The Contractor shall require that photographer maintain negatives or protected digital files for a period of two years from date of substantial completion of the project.
  - 3. Photographer shall agree to furnish additional prints to County at commercial rates applicable at time of purchase. Photographer shall also agree to participate as required in any litigation requiring the photographer as an expert witness.

- D. The Contractor shall pay all costs associated with the required photography and prints. Any parties requiring additional photography or prints shall pay the photographer directly.
- E. All project photographs shall be a single weight, color image. All finishes shall be smooth surface and glossy and all prints shall be 8 inches x 10 inches.
- F. Each print shall have clearly marked on the back, the name of the project, the orientation of view, the date and time of exposure, name and address of the photographer and the photographers numbered identification of exposure.
- G. All project photographs shall be taken from locations to adequately illustrate conditions prior to construction, or conditions of construction and state of progress. The Contractor shall consult with the County at each period of photography for instructions concerning views required.

#### 1.04 VIDEO RECORDINGS

- A. Video, recording shall be done along all routes that are scheduled for construction. Video, recording shall include full, recording of both sides of all streets and the entire width of easements plus 10 feet on each side on which construction is to be performed. All video recording shall be in full color.
- B. A complete view, in sufficient detail with audio description of the exact location shall be provided.
- C. The engineering plans shall be used as a reference for stationing in the audio portion of the recordings for easy location identification.
- D. Two complete sets of video recordings shall be delivered to the County on digital video disks (DVD) for the permanent and exclusive use of the County prior to the start of any construction on the project.
- E. All video recordings shall contain the name of the project, the date and time of the video, recording, the name and address of the photographer and any other identifying information required.
- F. Construction shall not start until preconstruction video recordings are completed, submitted and accepted by the County. In addition, no progress payments shall be made until the preconstruction video recordings are accepted by the County.

#### PART 2 – PRODUCTS (NOT USED)

#### PART 3 – EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01410

### TESTING AND TESTING LABORATORY SERVICES

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. County shall employ and pay for the services of an independent testing laboratory to perform testing specifically indicated on the Contract Documents or called out in the Specifications. County may elect to have materials and equipment tested for conformity with the Contract Documents at any time.
  - 1. Contractor shall cooperate fully with the laboratory to facilitate the execution of its required services.
  - 2. Employment of the laboratory shall in no way relieve the Contractor's obligations to perform the work of the Contract.

##### 1.02 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
  - 1. Release, revoke, alter or enlarge on requirements of Contract Documents.
  - 2. Approve or accept any portion of the Work.
  - 3. Perform any duties of the Contractor.

##### 1.03 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel; provide access to Work and/or to Manufacturer's operations.
- B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.
- C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes which require control by the testing laboratory.
- D. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. Standard specifications for quality and workmanship are indicated in the Contract Documents. The County may require the Contractor to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the

Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor and no extra charge to the County shall be allowed on account of such testing and certification.

E. Furnish incidental labor and facilities:

1. To provide access to work to be tested.
2. To obtain and handle samples at the project site or at the source of the product to be tested.
3. To facilitate inspections and tests.
4. For storage and curing of test samples.

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

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

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

H. If the test results indicate the material or equipment complies with the Contract Documents, the County shall pay for the cost of the testing laboratory. If the tests and any subsequent retests indicate the materials and equipment fail to meet the requirements of the Contract Documents, the contractor shall pay for the laboratory costs directly to the testing firm or the total of such costs shall be deducted from any payments due the Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\***

## SECTION 01510

### TEMPORARY AND PERMANENT UTILITIES

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. The Contractor shall be responsible for furnishing all requisite temporary utilities, i.e., power, water, sanitation, etc. The Contractor shall obtain and pay for all permits required as well as pay for all temporary usages. The Contractor shall remove all temporary facilities upon completion of work.

##### 1.02 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with National Electric Code.
- B. Comply with Federal, State and Local codes and regulations and with utility company requirements.
- C. Comply with County Health Department regulations.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS, GENERAL

- A. Materials for temporary utilities may be "used". Materials for electrical utilities shall be adequate in capacity for the required usage, shall not create unsafe conditions and shall not violate requirements of applicable codes and standards.

##### 2.02 TEMPORARY ELECTRICITY AND LIGHTING

- A. Arrange with the applicable utility company for temporary power supply. Provide service required for temporary power and lighting and pay all costs for permits, service and for power used.

##### 2.03 TEMPORARY WATER

- A. The Contractor shall arrange with Manatee County Utilities Customer Service office to provide water for construction purposes, i.e., meter, pay all costs for installation, maintenance and removal, and service charges for water used.

- B. The Contractor shall protect piping and fitting against freezing.

#### 2.04 TEMPORARY SANITARY FACILITIES

- A. The Contractor shall provide sanitary facilities in compliance with all laws and regulations.
- B. The Contractor shall service, clean and maintain facilities and enclosures.

### PART 3 EXECUTION

#### 3.01 GENERAL

- A. The Contractor shall maintain and operate systems to assure continuous service.
- B. The Contractor shall modify and extend systems as work progress requires.

#### 3.02 REMOVAL

- A. The Contractor shall completely remove temporary materials and equipment when their use is no longer required.
- B. The Contractor shall clean, and repair damage caused by temporary installations or use of temporary facilities.

**\*\*END OF SECTION\*\***

## SECTION 01530

### PROTECTION OF EXISTING FACILITIES

#### PART 1 – GENERAL

##### 1.01 THE REQUIREMENT

A. Contractor shall be responsible for the preservation and protection of property adjacent to the work site against damage or injury as a result of their operations under this Contract. Any damage or injury occurring on account of any act, omission or neglect on the part of the Contractor shall be restored in a proper and satisfactory manner or replaced by and at the expense of the Contractor to an equal or superior condition than previously existed.

B. Contractor shall comply promptly with such safety regulations as may be prescribed by the County or the local authorities having jurisdiction and shall, when so directed, properly correct any unsafe conditions created by, or unsafe practices on the part of, his employees. In the event of the Contractor's failure to comply, the County may take the necessary measures to correct the conditions or practices complained of, and all costs thereof will be deducted from any monies due the Contractor. Failure of the County to direct the correction of unsafe conditions or practices shall not relieve the Contractor of their responsibility hereunder.

C. In the event of any claims for damage or alleged damage to property as a result of work under this Contract, the Contractor shall be responsible for all costs in connection with the settlement of or defense against such claims. Prior to commencement of work in the vicinity of property adjacent to the work site, the Contractor, at their own expense, shall take such surveys as may be necessary to establish the existing condition of the property. Before final payment can be made, the Contractor shall furnish satisfactory evidence that all claims for damage have been legally settled or sufficient funds to cover such claims have been placed in escrow, or that an adequate bond to cover such claims has been obtained.

##### 1.02 PROTECTION OF WORK AND MATERIAL

A. During the progress of the work and up to the date of final payment, the Contractor shall be solely responsible for the care and protection of all work and materials covered by the Contract.

B. All work and materials shall be protected against damage, injury or loss from any cause whatsoever, and the Contractor shall make good any such damage or loss at his own expense. Protection measures shall be subject to the approval of the County.

### 1.03 BARRICADES, WARNING SIGNS AND LIGHTS

A. The Contractor shall provide, erect and maintain as necessary, strong and suitable barricades, danger signs and warning lights along all roads accessible to the public, as required by the authority having jurisdiction, to insure safety to the public. All barricades and obstructions along public roads shall be illuminated at night and all lights for this purpose shall be kept burning from sunset to sunrise.

B. The Contractor shall provide and maintain such other warning signs and barricades in areas of and around their respective work as may be required for the safety of all those employed in the work, the County's operating personnel, or those visiting the site.

C. In the case of a conflict between this Specification Section and the Contractor's Safety Plan, the more stringent requirement of the two documents shall govern.

### 1.04 EXISTING UTILITIES AND STRUCTURES

A. The term existing utilities shall be deemed to refer to both publicly-owned and privately-owned utilities such as electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.

B. Where existing utilities and structures are indicated on the Drawings, it shall be understood that all of the existing utilities and structures affecting the work may not be shown and that the locations of those shown are approximate only. It shall be the responsibility of the Contractor to ascertain the actual extent and exact location of existing utilities and structures. In every instance, the Contractor shall notify the proper authority having jurisdiction and obtain all necessary directions and approvals before performing any work in the vicinity of existing utilities.

C. Prior to beginning any excavation work, the Contractor shall, through field investigations, determine any conflicts or interferences between existing utilities and new utilities to be constructed under this project. This determination shall be based on the actual locations, elevations, slopes, etc., of existing utilities as determined in the field investigations, and locations, elevation, slope, etc. of new utilities as shown on the Drawings. If an interference exists, the Contractor shall bring it to the attention of the County as soon as possible. If the County agrees that an interference exists, they shall modify the design as required. Additional costs to the Contractor for this change shall be processed through a Change Order as detailed elsewhere in these Contract Documents.

D. The work shall be carried out in a manner to prevent disruption of existing services and to avoid damage to the existing utilities. Temporary connections shall be provided, as required, to insure uninterrupted of existing services. Any damage resulting from the work of this Contract shall be promptly repaired by the Contractor at their own expense in a manner satisfactory to the County or the respective authority having jurisdiction over such work. Where

it is required by the authority having jurisdiction that they perform their own repairs or have them done by others, the Contractor shall be responsible for all costs thereof.

E. Where excavations by the Contractor require any utility lines or appurtenant structures to be temporarily supported and otherwise protected during the construction work, such support and protection shall be provided by the Contractor. All such work shall be performed in a manner satisfactory to the County or the respective authority having jurisdiction over such work. In the event the Contractor fails to provide proper support or protection to any existing utility, the County may, at his discretion, have the respective authority to provide such support or protection as may be necessary to insure the safety of such utility, and the costs of such measures shall be paid by the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

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## SECTION 01560

### ENVIRONMENTAL CONTROLS

#### PART 1 – GENERAL

##### 1.01 SITE MAINTENANCE

The Contractor shall keep the work site clean and free from rubbish and debris. Materials and equipment shall be removed from the site when they are no longer necessary. Upon completion of the work and before final acceptance, the work site shall be cleared of equipment, unused materials, and rubbish to present a clean and neat appearance.

##### 1.02 TEMPORARY DAMS

Except in time of emergency, earth dams are not acceptable at catch basin openings, local depressions, or elsewhere. Temporary dams of sand bags, asphaltic concrete, or other acceptable material will be permitted to protect the work, provided their use does not create a hazard or nuisance to the public. Such dams shall be removed from the site as soon as they are no longer necessary.

Temporary watertight leak containment filters shall be provided by the contractor for chemical, fuel, material storage, etc. Temporary facilities shall be removed and properly disposed of after construction is completed.

##### 1.03 TEMPORARY DRAINAGE

The Contractor shall control and eliminate the sources of pollutants in stormwater through the development and implementation of a Stormwater Management Plan (SWMP) as required and in accordance with local regulations. The Contractor shall provide the SWMP to the Engineer at least three weeks prior to ground disturbance. The SWMP must detail Best Management Practices (BMPs) that will be implemented during construction, which may include enlarging or supplementing existing stormwater facilities and temporary controls that will protect receiving waters and adjacent properties. BMPs should focus on reducing the source of sediment but may also include sediment removal controls. Existing stormwater facilities shall be protected during construction and all temporary BMPs shall be removed once the site is stabilized. Contractor shall perform inspections as required by the local regulations. Contractor shall keep the SWMP and inspection records on site (in the construction office trailer) at all times.

##### 1.04 AIR POLLUTION CONTROL

The Contractor shall not discharge smoke, dust, and other contaminants into the atmosphere that violate the regulations of any legally constituted authority. He shall also abate dust nuisance by cleaning, sweeping, and sprinkling with water, or other means as necessary. The use of water, in

amounts which result in mud on public streets, is not acceptable as a substitute for sweeping or other methods.

#### 1.05 NOISE CONTROL

Between 7:30 p.m. and 7:00 a.m., noise from Contractor's operations shall not exceed limits established by applicable laws unless a variance is accepted.

#### 1.06 GROUND AND GROUNDWATER CONTAMINATION

The Contractor shall comply with all federal, state and local laws and regulations which apply to water pollution and soil contamination.

In order to minimize the possibility of water or soil contamination due to spills of crankcase oil, gasoline and other fuels, the Contractor shall designate an area for the storage and handling of lubricants, fuels and other supplies which is acceptable to the Engineer. The Contractor shall comply with all applicable federal, state and local rules and regulations related to the storage of fuels and chemicals and the reporting and cleanup of spills.

#### 1.07 FLUORESCENT LIGHT BULBS, HIGH INTENSITY DISCHARGE BULBS AND BALLASTS

Disturbing, removing, replacing, and disposal of fluorescent or High Intensity discharge (HID) lamps or ballasts is authorized under the scope of this project provided the Contractor complies with requirements outlined within this paragraph.

##### A. FLUORESCENT LIGHT BALLASTS

Fluorescent light ballasts manufactured after 1979 that do not contain PCBs are marked by the manufacturer with the words "No PCBs". If a fluorescent light ballast is not marked with the words "No PCBs" it shall be considered to contain PCBs.

Non-PCB ballasts shall be recycled by the contractor. The Contractor shall provide containers for the collection of these ballasts, and the Contractor shall carefully place all ballasts in these containers and close the lid securely. The labels on the containers shall be left intact, unmarked, uncovered, and otherwise completely legible. The labels shall state "Universal Waste Ballasts."

PCB-containing fluorescent light ballasts that are intact and non-leaking shall be recycled by the Contractor. The Contractor shall provide containers for the collection of these recyclable materials. The Contractor shall carefully place these ballasts into the containers provided and shall tightly close the container when it is full. The labels on the containers shall be left intact, unmarked, uncovered, and otherwise completely legible. The labels shall state "Universal Waste Ballasts-PCBs." The Contractor shall manage these materials as if these materials were hazardous waste.

PCB-containing light ballasts that were not previously identified as leaking but are discovered by the Contractor to be leaking prior to removal from fixtures shall cause the Contractor to stop work on the site and immediately notify the Engineer or the County.

PCB-containing fluorescent light ballasts that have been damaged by the Contractor (made to leak) shall cause the Contractor to stop work on the site immediately and notify the Engineer. The Contractor shall carefully place the damaged ballasts into steel UN stamped drums approved by DOT for shipping Hazardous Waste and shall securely close the lids. The ballasts shall then be transported off site by the Contractor and incinerated at an offsite facility by the Contractor in accordance with 40 CFR 761.75.

#### B. FLUORESCENT LIGHT TUBES AND HIGH INTENSITY DISCHARGE (HID) LAMPS

All fluorescent tubes and HID lamps that are removed as part of this work shall be removed intact and recycled by the Contractor to be handled as “universal waste lamps.” The Contractor shall provide containers for the collection of these recyclable materials. The Contractor will carefully place all light tubes and/or lamps in these containers, keep the lid securely closed at all times, and protect the containers from precipitation. Containers shall be labeled in accordance with State Universal Waste requirements for storage and shipping. The labels shall state “Universal Waste Fluorescent Lamps” or “Universal Waste HID Lamps.” These two materials must be collected separately.

It is imperative that the Contractor does not discard fluorescent light tubes or HID lamps on site in dumpsters or other debris collection containers and shall take appropriate actions to manage them properly.

#### C. POLYCHLORINATED BIPHENYLS (PCBs)

If the Contractor believes they have discovered a PCB containing item not specified in the contract or Phase II ESA during the execution of work, the Contractor shall stop work on the site immediately and notify the Engineer. The Contractor shall not use or install any equipment containing PCBs on the plant.

### 1.08 ILLEGAL DISCHARGE

At no time shall the Contractor release or dump solvents, paints, gasoline or other fuels or oils into any portion of the plants sewers or process facilities.

### 1.09 HAZARDOUS WASTES

The Contractor shall comply with all federal, state, and local laws and regulations which apply to the removal and disposal of any and all hazardous wastes encountered during demo of old structures, utilities, and materials required by this project.

**\*\*END OF SECTION\*\***

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## SECTION 01570

### TRAFFIC REGULATION

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. The Contractor shall 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.
- B. The Contractor shall remove temporary equipment and facilities when no longer required, restore grounds to original or to specified conditions.

##### 1.02 TRAFFIC CONTROL

- A. The necessary traffic control shall include, but not be limited to, such items as proper construction warning signs, signals, lighting devices, markings, barricades, channelization and hand signaling devices. The Contractor shall be responsible for installation and maintenance of all devices and detour routes and signage for the duration of the construction period. The Contractor shall utilize the appropriate traffic plan from the FDOT Maintenance of Traffic Standards, Series 600 of the FDOT Roadway & Traffic Design Standards, Latest Edition.
- B. Should there be the necessity to close any portion of a roadway carrying vehicles or pedestrians the Contractor shall submit a Traffic Control Plan (TCP) at least 5 days before a partial or full day closure, and at least 8 days before a multi-day closure. TCP shall be submitted, along with a copy of their accreditation, by a certified IMSA or ATSA Traffic Control Specialist.
  - 1. At no time will more than one (1) lane of a roadway be closed to vehicles and pedestrians without an approved road closure from the County Transportation Department. With any such closings, adequate provision shall be made for the safe expeditious movement of each.
  - 2. All traffic control signs must be in place and inspected at least 1 day in advance of the closure. Multi-day closures notification signs shall be in place at least 3 days in advance of the closure. All signs must be covered when no in effect and checked twice a day by the Worksite Traffic Supervisor when they are in effect.
- C. The Contractor shall be responsible for removal, relocation, or replacement of any traffic control device in the construction area which exists as part of the normal

preconstruction traffic control scheme. Any such actions shall be performed by the Contractor under the supervision and in accordance with the instructions of the applicable highway department unless otherwise specified.

- D. The Contractor will consult with the County immediately on any vehicular or pedestrian safety or efficiency problem incurred as a result of construction of the project.
- E. The Contractor shall provide ready access to businesses and homes in the project area during construction. The Contractor shall be responsible for coordinating this work with affected homeowners.
- F. When conditions require the temporary installation of signs, pavement markings and traffic barriers for the protection of workers and traffic, the entire array of such devices shall be depicted on working drawings for each separate stage of work. These drawings shall be submitted to the County for review and approval prior to commencement of work on the site.
- G. Precast concrete traffic barriers shall be placed adjacent to trenches and other excavations deeper than six inches below the adjacent pavement surface.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\***

## SECTION 01580

### PROJECT IDENTIFICATION AND SIGNS

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. Furnish, install and maintain County project identification signs.
- B. Remove signs on completion of construction.
- C. Allow no other signs to be displayed except for traffic control and safety.

##### 1.02 PROJECT IDENTIFICATION SIGN (COUNTY)

- A. Two painted signs, of not less than 32 square feet (3 square meters) area, with painted graphic content to include:
  - 1. Title of Project.
  - 2. Name of County.
  - 3. Names and titles of authorities as directed by County.
  - 4. Prime Contractor.
- B. Graphic design, style of lettering and colors: As approved by the County.
- C. Erect on the site at a lighted location of high public visibility, adjacent to main entrance to site, as approved by the County

##### 1.03 INFORMATIONAL SIGNS

- A. Painted signs with painted lettering, or standard products.
  - 1. Size of signs and lettering: as required by regulatory agencies, or as appropriate to usage.
  - 2. Colors: as required by regulatory agencies, otherwise of uniform colors throughout project.
- B. Erect at appropriate locations to provide required information.

##### 1.04 QUALITY ASSURANCE

- A. Sign Painter: Professional experience in type of work required.

- B. Finishes, Painting: Adequate to resist weathering and fading for scheduled construction period.

1.05 PUBLIC NOTIFICATION

- A. Door Hangers: The Contractor shall generate and distribute door hangers to all residents who will be impacted by project construction.

1. Residents impacted include anyone who resides inside, or within 500 feet of project limits of construction.

- B. Door Hangers shall be distributed prior to start of construction of the project. Hangers shall be affixed to doors of residents via elastic bands or tape.

EXAMPLE:

PLEASE PARDON THE INCONVENIENCE WHILE THE ROADWAY IS BEING  
RECONSTRUCTED IN YOUR NEIGHBORHOOD

This project consists of belt filter press facility improvements. The project is expected to begin in Fall 2019 and be completed in Winter 2020.

Location Map

WE HOPE TO KEEP ANY INCONVENIENCE TO A MINIMUM.  
HOWEVER, IF YOU HAVE ANY PROBLEMS, PLEASE CONTACT THE  
FOLLOWING:

- |    |                               |                     |
|----|-------------------------------|---------------------|
| A. | Contractor                    | Project Manager     |
|    | Contractor Address            | PM Address          |
|    | Contractor Phone (Site Phone) | PM Phone No. & Ext. |
| B. | Project Inspector             |                     |
|    | Inspector Phone Number        |                     |

AFTER HOURS EMERGENCY NUMBER – (941) 747-HELP  
THANK YOU FOR YOUR UNDERSTANDING AND PATIENCE  
MANATEE COUNTY GOVERNMENT – PROJECT MANAGEMENT DEPT.

## PART 2 PRODUCTS

### 2.01 SIGN MATERIALS

- A. Structure and Framing: May be new or used, wood or metal, in sound condition structurally adequate to work and suitable for specified finish.
- B. Sign Surfaces: Exterior softwood plywood with medium density overlay, standard large sizes to minimize joints.
  - 1. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles.
- C. Rough Hardware: Galvanized.
- D. Paint: Exterior quality, as specified in the Contract Documents.

## PART 3 EXECUTION

### 3.01 PROJECT IDENTIFICATION SIGN

- A. Paint exposed surface or supports, framing and surface material; one coat of primer and one coat of exterior paint.
- B. Paint graphics in styles, size and colors selected.

### 3.02 MAINTENANCE

The Contractor shall maintain signs and supports in a neat, clean condition; repair damages to structures, framing or sign.

### 3.03 REMOVAL

The Contractor shall remove signs, framing, supports and foundations at completion of project.

**\*\*END OF SECTION\*\***

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## SECTION 01590

### COUNTY'S FIELD OFFICE

#### PART 1 – GENERAL

##### 1.01 REQUIRMENTS

Contractor shall furnish, install and maintain one temporary field office during the entire construction period for the sole use of the County.

##### 1.02 OTHER REQUIRMENTS

- A. Prior to installation of the County's field office, the Contractor shall consult with the County on location, access and related facilities.
- B. All site use approvals shall be obtained by the Contractor.
- C. Upon completion of construction. The Contractor shall remove the field office and restore the site to its original condition.

##### 1.03 REQUIRMENTS FOR FACIITIES

- A. Construction:
  - 1. The field office shall be structurally sound, weather tight, with floors raised aboveground.
  - 2. At Contractor's option, portable or mobile buildings may be used.
- B. Office for Field Engineer:
  - 1. A separate office for sole use of the County with secure entrance doors, key and lock shall be provided.
  - 2. Area: 250 sq. ft. minimum, with minimum dimension of 8 feet.
  - 3. Windows:
    - a. Minimum of three (3).
    - b. Operable sash and insect screens.
    - c. Locate field office to provide maximum view of construction areas.
  - 4. Furnishings:
    - a. Two standard size chairs and desks with three drawers each.
    - b. One drafting table: 39"x72"x36" high, with one equipment drawer.
    - c. One metal, double-door storage cabinet with lock and key.
    - d. One plan rack to hold a minimum of six sets of project drawings.
    - e. One standard four-drawer legal-size metal filing cabinet w/ lock and key.
    - f. Six linear feet of bookshelves.
    - g. One swivel arm chair.
    - h. Two straight chairs.

- i. One drafting table stool.
- j. One waste basket.
- k. One tackboard, 36"x30".
- l. One fire extinguisher.
- m. One first aid kit.
- 5. Services:
  - a. Adequate lighting.
  - b. Exterior lighting at entrance door.
  - c. Automatic heating and mechanical cooling equipment to maintain comfort conditions.
  - d. Minimum of four 110-volt duplex electric convenience outlets, at least one on each wall.
  - e. Electric distribution panel: Two circuits minimum 110-volt, 60 hertz service.
  - f. Convenient access to drinking water and toilet facilities.
  - g. Telephone: One private direct line instrument.
  - h. Fax: combination fax/duplicator.

## PART 2 – PRODUCTS

### 2.01 MATERIALS, EQUIPMENT, FURNISHINGS

May be new or used, but must be serviceable, adequate for required purpose and must adhere to all applicable codes or regulations including the Manatee County Building Codes.

## PART 3 – EXECUTION

### 3.01 PREPARATION

Fill and grade site as necessary for temporary structure to provide positive surface drainage.

### 3.02 INSTALLATION

- A. Construct temporary field office on proper foundation and provide connections for all utility services.
  - 1. Secure portable or mobile building when used.
  - 2. Provide steps and landings shall be provided at entrance doors.

**\*\*END OF SECTION\*\***

## SECTION 01600

### MATERIAL AND EQUIPMENT

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. Material and equipment incorporated into the work:
1. Conform to applicable specifications and standards.
  2. Comply with size, make, type and quality specified, or as specifically approved in writing by the County.
  3. Manufactured and Fabricated Products:
    - a. Design, fabricate and assemble in accordance with the best engineering and shop practices.
    - b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
    - c. Two or more items of the same kind shall be identical and manufactured by the same manufacturer.
    - d. Products shall be suitable for service conditions.
    - e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
  4. Do not use material or equipment for any purpose other than that for which it is specified.
  5. All material and equipment incorporated into the project shall be new.

##### 1.02 MANUFACTURER'S INSTRUCTIONS

- A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to County. Maintain one set of complete instructions at the job site during installation and until completion.
- B. Handle, install, connect, clean, condition and adjust products in strict accordance with such instructions and in conformity with specified requirements. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with County prior to proceeding. Do not proceed with work without clear instructions.

1.03           TRANSPORTATION AND HANDLING

- A.    Arrange deliveries of products in accordance with construction schedules, coordinate to avoid conflict with work and conditions at the site.
  - 1.     Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
  - 2.     Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals and that products are properly protected and undamaged.
- B.    Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

1.04           SUBSTITUTIONS AND PRODUCT OPTIONS

Contractor's Options:

- 1.     For products specified only by reference standard, select any product meeting that standard.
- 2.     For products specified by naming one or more products or manufacturers and "or equal", Contractor must submit a request for substitutions of any product or manufacturer not specifically named in a timely manner so as not to adversely affect the construction schedule.

PART 2        PRODUCTS (NOT USED)

PART 3        EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01620

### STORAGE AND PROTECTION

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

Provide secure storage and protection for products to be incorporated into the work and maintenance and protection for products after installation and until completion of Work.

##### 1.02 STORAGE

- A. Store products immediately on delivery and protect until installed in the Work, in accord with manufacturer's instructions, with seals and labels intact and legible.
- B. Exterior Storage
  - 1. Provide substantial platform, blocking or skids to support fabricated products above ground to prevent soiling or staining.
    - a. Cover products, subject to discoloration or deterioration from exposure to the elements, with impervious sheet coverings. Provide adequate ventilation to avoid condensation.
    - b. Prevent mixing of refuse or chemically injurious materials or liquids.
- C. Arrange storage in manner to provide easy access for inspection.

##### 1.03 MAINTENANCE OF STORAGE

- A. Maintain periodic system of inspection of stored products on scheduled basis to assure that:
  - 1. State of storage facilities is adequate to provide required conditions.
  - 2. Required environmental conditions are maintained on continuing basis.
  - 3. Surfaces of products exposed to elements are not adversely affected. Any weathering of products, coatings and finishes is not acceptable under requirements of these Contract Documents.
- B. Mechanical and electrical equipment which requires servicing during long term storage shall have complete manufacturer's instructions for servicing accompanying each item, with notice of enclosed instructions shown on exterior of package.

1. Equipment shall not be shipped until approved by the County. The intent of this requirement is to reduce on-site storage time prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the County.
2. All equipment having moving parts such as gears, electric motors, etc. and/or instruments shall be stored in a temperature and humidity-controlled building approved by the County until such time as the equipment is to be installed.
3. All equipment shall be stored fully lubricated with oil, grease, etc. unless otherwise instructed by the manufacturer.
4. Moving parts shall be rotated a minimum of once weekly to insure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
5. Lubricants shall be changed upon completion of installation and as frequently as required, thereafter during the period between installation and acceptance.
6. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

#### 1.04 PROTECTION AFTER INSTALLATION

- A. Provide protection of installed products to prevent damage from subsequent operations. Remove when no longer needed, prior to completion of work.
- B. Control traffic to prevent damage to equipment and surfaces.
- C. Provide coverings to protect finished surfaces from damage.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION (NOT USED)

\*\* END OF SECTION \*\*

## SECTION 01661

### MECHANICAL TEST STANDARDS

#### 1.0 PURPOSE

This document defines mechanical test standards and pre-testing requirements for new mechanical systems to verify that the installation and equipment comply with specifications and intended use as well as with regulatory and safety requirements and is ready for startup.

#### 2.0 CLEANING TERMS AND DEFINITIONS

##### 2.1 RECIRCULATION FLUSH

Where a single batch of water is recirculated under pressure at a prescribed velocity in a closed path through a strainer, filter, or demineralizer to remove debris and water impurities.

##### 2.2 VELOCITY FLUSH

A cleaning technique that utilizes the capability of a rapid flowing stream of liquid to scrub, sweep, or scour foreign material from the internal walls and surface of the system. Particles picked up by the circulating liquid are flushed to waste or trapped and collected on a fine mesh screen or filter. Effective flushing velocities shall exceed the design flow rate through the equipment.

##### 2.3 BOILER ACID CLEANING (NOT USED)

##### 2.4 PRE-BOILER CHEMICAL CLEANING (NOT USED)

#### 3.0 PRESSURE TESTING TERMS AND DEFINITIONS

##### 3.1 HYDROSTATIC TEST

Controlled injection of high-pressure water to a filled system to demonstrate structural integrity of the associated piping and pressure vessels. A hydraulic test pump is used to produce a selected pressure generally 1.25 to 1.5 times the design pressure. The test will be maintained at least ten minutes, adhering to specified temperature requirements to prevent brittle fracture.

##### 3.2 PNEUMATIC TEST

The pneumatic test pressure shall not be less than or more than 1.1 times the design pressure of the piping system. The test pressure shall not exceed the maximum allowable test of any non-isolated components, such as vessels, pumps, or valves in the system. The test pressure may be applied with an air compressor or with inert gas from pressurized storage and must be maintained for a minimum of ten minutes. Specific requirements shall be verified from applicable codes for each project.

### 3.3 LEAK TESTING

Leak testing is the pressurizing with water or other fluids to demonstrate the tightness of flanges, manholes, and other mechanical closures of piping and equipment. A pressure less than the setting of relief devices is applied from permanently installed pumping equipment at shutoff head or source pressure of system fluid.

### 3.4 STATIC TESTING

Static testing is pressurizing by filling with water or other fluids to demonstrate the tightness of open vessels such as atmospheric tanks, condensers, and associated piping. A head pressure is applied equal to the highest available static head within the system.

## 4.0 PERFORMANCE TESTING TERMS AND DEFINITIONS

### 4.1 TEST SPECIFICATION

An outline of the tests to be performed and the criteria to be satisfied (based on design requirements) for safe and satisfactory performance of the system. It provides necessary design values including operating tolerances, set points, and reference materials for the preparation of detailed pre-operational and/or acceptance test procedures.

## 5.0 REVIEWS AND VERIFICATIONS PRIOR TO EQUIPMENT TESTING

Prior to equipment testing, Contractor shall at a minimum review and verify the following. Contractor shall note any deficiencies by listing them on the corresponding system punch list and they shall be corrected prior to initiation of equipment testing.

### 5.1 SAFE AND CLEAN OPERATING CONDITIONS

Contractor at a minimum shall perform the following to verify safe and clean operating conditions prior to equipment startup.

1. Clean up oil slicks, water puddles, dirty and oily equipment, rags, debris, etc. Flag all protrusions; flag all head and knee breakers.
2. Verify safe access to valves, platforms, and ladders.
3. Verify that there no holes in the platforms and that guardrails installed.
4. Is there fire fighting equipment available when needed?

### 5.2 WORKABLE SYSTEM

Contractor at a minimum shall perform the following to verify a workable system prior to equipment startup.

1. Verify that all necessary equipment is ready for initial operation. Verify that there are no missing pumps, valves, sections of pipe, blind flanges, etc.
2. Verify that any necessary jumpers are installed or other temporary equipment for flushing, etc. is in place.
3. Verify that appropriate flush reports and pressure test reports are complete.

### 5.3 INSTRUMENTATION

Contractor at a minimum shall perform the following to verify that primary instrumentation systems are operable prior to equipment startup.

1. Verify that pressure indicators, temperature indicators, solenoid valves, safety valves, pressure switches, limit switches, etc., needed for equipment operation are installed, calibrated and checked out.
2. Verify with instrumentation discipline lead that the instrumentation is in good working order.
3. Verify that all instrument set points are correct for the process they serve.
4. Verify that construction and start-up loop records, and calibration reports are complete.

### 5.4 POWER SUPPLIES

Contractor at a minimum shall perform the following to verify that power supplies are properly operable prior to equipment startup.

1. Verify that all power sources needed for the system and components are available.
2. Verify that conduit boxes are closed.
3. Verify that breakers are properly tagged and locked where required.
4. Verify that Motor Acceptance, Megger Records, and Ground Resistance Forms are completed.

### 5.5 PIPING

Contractor at a minimum shall perform the following to verify that piping is correctly connected and ready prior to equipment startup.

1. Verify that piping is correctly installed and routed per the Contract Documents and piping submittals.

2. Verify that the piping is correct per the specifications.
3. Verify that there are no open or partially completed welds.
4. Verify that there are no open ends (blind flanges, missing plugs, etc.).
5. Verify that there are no plastic or wooden plugs in the lines.
6. Verify that there are properly functioning vents on all high points and drains on low points.
7. Verify that debris, planking, rags, etc., have been removed from the lines.
8. Verify that no pipe growth interferences have occurred.

## 5.6 PIPE SUPPORTS AND HANGARS

Contractor at a minimum shall perform the following to verify that piping is correctly supported and ready prior to equipment startup.

1. Verify that the supports are they the correct size and type per the pipe support submittals and the Contract Documents.
2. Verify that the supports are they correctly installed per the pipe support submittals and the Contract Documents.
3. Verify that the pipes have the correct amount of supports per the pipe support submittals and the Contract Documents.
4. Verify that no bolts or nuts are missing.
5. Verify that locking nuts are tight.
6. Verify that temporary supports have been removed and replaced with the permanent supports per the pipe support submittals and the Contract Documents.

## 5.7 PIPE CONNECTIONS

Contractor at a minimum shall perform the following to verify that piping is correctly connected and ready prior to equipment startup.

1. Verify that the correct connection type, size and material have been used.
2. Verify that correct gaskets have been used and are in place.
3. Verify that there are no missing or loose bolts and nuts.

4. Verify that mating flanges are tightened evenly.
5. Verify that flange bolts are not too long or too short. (Normal is two threads showing.)
6. Verify that the bolt threads lubricated.
7. Verify that insulating flanges are installed where called for and are they correctly installed.

## 5.8 VALVES

Contractor at a minimum shall perform the following to verify that piping valving is correctly installed and ready prior to equipment startup.

1. Verify correct valve type, size and material.
2. Verify the correct installation of the valves.
3. Verify that the handwheels and locknuts are installed.
4. Verify that the stems are clean and lubricated.
5. Verify that the stem protector is installed.
6. Verify that the gland or packing nuts are tight and installed.
7. Verify that the control valves are checked out and functional.
8. Verify that the motor operators are orientated for manual operation.

## 5.9 PUMPS, FANS AND ALL MOTOR DRIVEN EQUIPMENT

Contractor at a minimum shall perform the following prior to equipment startup.

1. Review and be familiar with the manufacturer's installation instructions.
2. Review and be familiar with the manufacturer's operating instructions.
3. Verify that the equipment foundation is complete per the Contract Documents.
4. Verify that the lubrication system in order, that the correct level of lubrication is in place, and that the lubrication tag is attached.
5. Verify that coupling guards are installed and secured.

6. Verify that the suction and discharge piping flanges and gaskets installed correctly.
7. Verify that equipment connection fittings are correctly installed.
8. Verify that the suction and discharge piping is adequately supported. The equipment shall not support the piping and a stress connection shall be verified.
9. Verify that seal water and other secondary piping is complete.
10. Verify that the Equipment Release, Lubrication Records, Alignment Records and Inspection Reports are complete?
11. Verify that filters and strainers for lube oil and pumps are installed where required.
12. Verify that pump vents and drains are installed.
13. Verify that all necessary instrumentation is installed, calibrated, and adequately mounted.
14. Verify that all safety shutdown/start-up devices have been demonstrated operational by simulation.
15. Verify that there has been no vibration damage.
16. Verify that the installation of insulation complete.
17. Verify that drainage is available and adequate.
18. Verify that there no plugged or clogged drains.
19. Verify that dampers and linkages are freely moving, connected, lubricated, and correctly positioned. Verify that all position indicators are clearly visible and correctly installed.
20. Verify that lift lugs are available and installed.
21. Verify that bearing temperature and vibration sensors are connected to its indicator.
22. Verify that pump or fan isolation systems are correct in order operate in a dual or tandem system as required by the Contract Documents.
23. Verify that temporary suction strainers are installed in the correct orientation and removed when required.

#### 5.10 PRESSURE INDICATORS

Contractor at a minimum shall perform the following to verify that pressure indicators are correctly installed and ready prior to equipment startup.

1. Verify that it has the correct range and is calibrated.
2. Verify that it is correctly mounted and that vibration proofing is included.
3. Verify that the pointer is intact, on zero, and not damaged.
4. Verify that the glass and face are clean and intact.
5. Verify that snubbers are installed if required.

#### 5.11 TEMPERATURE INDICATORS

Contractor at a minimum shall perform the following to verify that temperature indicators are correctly installed and ready prior to equipment startup.

1. Verify that it has the correct range and is calibrated.
2. Verify that the pointer is intact, on zero, and not damaged.
3. Verify that the glass and face are clean and intact.

#### 5.12 THERMO WELLS

Contractor at a minimum shall perform the following to verify that the thermo wells are correctly installed and ready prior to equipment startup.

1. Verify that the material is correct.
2. Verify that the thermo wells are welded in correctly.
3. Verify that the thermo wells are capped with screwed cap and fastened to chain.

#### 5.13 FLOW SIGHT GLASSES

Contractor at a minimum shall perform the following to verify that the flow sight glasses are correctly installed and ready prior to equipment startup.

1. Verify that it is mounted in the correct flow direction.
2. Verify that the glass is clean and intact.

#### 5.14 DRAIN TRAPS

Contractor at a minimum shall perform the following to verify that the flow sight glasses are correctly installed and ready prior to equipment startup.

1. Verify that the drain traps are the correct size and material.
2. Verify that the drain traps are correctly installed for flow direction.

#### 5.15 "Y" STRAINERS

Contractor at a minimum shall perform the following to verify that the Y-strainers are correctly installed and ready prior to equipment startup.

1. Verify correct size and material.
2. Verify that the strainer is correctly installed for flow direction.
3. Verify that the screen is inside, clean and intact.

#### 5.16 COATING, LABELING AND INSULATION

Contractor at a minimum shall perform the following to verify that pipe coating, labeling and insulation is correct prior to equipment startup.

1. Verify that the piping and equipment is correctly coated and labeled with correct nomenclature and flow arrows in accordance with Section 09900.
2. Verify that piping is correctly insulated per the Contract Documents.

#### 5.17 CATHODIC PROTECTION

Contractor at a minimum shall perform the following to verify that the cathodic protection systems are ready prior to equipment startup.

1. Verify that flanges and washers are correctly installed and that no current is passing between two mating flanges.
2. Verify that cathodic protection is correctly located per the Contract Documents.

### 6.0 EQUIPMENT LUBRICATION AND MAINTENANCE

#### 6.1 RESPONSIBILITIES

During startup the equipment and systems are under the control of the Contractor and shall be maintained within the guidelines of this Section and the vendor requirements and recommendations. The startup will be overseen by the County or County's representative; however,

it is entirely the Contractors responsibility to startup and maintain the equipment during startup and testing.

## 6.2 COUNTY INTERFACE

At any time, the County may elect to use its own personnel to assist in performing startup. Contractor shall coordinate with the County to determine when and how the County will assist; however, this assistance shall not be assumed during bidding.

## 6.3 DOCUMENTATION

It is imperative that after performing any routine or special maintenance on equipment, the work must be documented in the following places:

### A. JOBSITE MAINTENANCE LOGBOOK

Contractor shall create and maintain a logbook that is devoted entirely to documenting preventative maintenance and lubrication performed on equipment and/or systems during startup. The logbook shall be completed as the work is performed by the.

### B. LUBRICATION AND MAINTENANCE SCHEDULE STATUS SHEET

Contractor shall prepare for all major mechanical components a Lubrication and Maintenance Schedule (LMS). This schedule shall list all activities that are to be performed on the equipment and the intervals between them. Contractor shall attach to this schedule a log sheet that is to be signed and dated by the technician who performed the work.

## 6.4 INSPECTIONS

Contractor shall perform a complete inspection of the plant daily, to verify that all equipment under its control is in proper working order for it. The daily inspection shall include but not be limited to monitoring for obvious leaks (water and oil), abnormal noises, excessive vibration, unusual rubbing or over-heating. Any problems shall be immediately reported and logged in the Maintenance Logbook.

Equipment inspections required or recommended by the equipment supplier shall be followed by the Contractor while the Contractor has control of the equipment. At a minimum the following shall be checked on a daily, weekly and monthly basis.

### 1. Daily

At a minimum, the following items shall be inspected on a daily walk-down inspection.

#### a. Fuel Handling

- i. Check for oil leaks/spills around conveyors.

- ii. Check belts for tension, wear and tracking.
  - iii. Check all chain driven motors for lubrication.
  - iv. Inspect oil levels in motors and gears.
- b. Compressors
  - i. Check oil levels, observe any leaks.
  - ii. Inspect air filter, clean/replace as required.
  - iii. Drain condensate from air receiver/filters.
  - iv. Check for unusual noises or vibration.
  - v. Verify proper lead/lag switching.
  - vi. Check air dryer performance.
- c. Pumps
  - i. Inspect flanges for leaks.
  - ii. Check level of drip oilers.
  - iii. Note any water or oil leaks.
  - iv. Check bearings for high temperature/vibration.
- d. Motors
  - i. Check oil level.
  - ii. Check bearing temperatures.
  - iii. Check for unusual vibrations.
- e. Fans
  - i. Check bearing oil levels.
  - ii. Check bearing temperatures.
  - iii. Check for unusual vibrations.
- f. Screw Conveyors

- i. Inspect chain drives.
  - ii. Check bearing temperatures.
  - iii. Check gear oil levels.
- g. Rotating Machinery
  - i. Check chain drives.
  - ii. Check shear pins.
  - iii. Check bearing temperatures.
  - iv. Check gear oil levels.

## 2. Weekly

The following items shall be inspected on a weekly basis.

- a. Fuel Handling
  - i. Check rotary valves.
  - ii. Inspect all chain driven equipment for looseness of chain.
  - iii. Listen for abnormal noises and/or vibrations.
- b. Compressors
  - i. Check oil levels.
  - ii. Inspect for loose fittings/foundation bolts.
  - iii. Check I/C for obvious problems.
- c. Pumps
  - i. Check oil levels, add as required.
  - ii. Check vibration.
  - iii. Inspect for loose fittings/foundation bolts.
  - iv. Inspect I/C for obvious problems.

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- v. Perform test of diesel fire pump.
- d. Motors
  - i. Clean off inlet screen to motor cooling.
  - ii. Check coupling and foundation bolts.
- e. Fans
  - i. Check oil levels and temperatures.
  - ii. Inspect for loose fittings/foundation bolts.
  - iii. Check vibration.
- f. Screw Conveyors
  - i. Lubricate chain drives.
  - ii. Check bearing temperatures.
- g. Electrical
  - i. Check water levels in all batteries.
  - ii. Check charging current/voltage of UPS system.
  - iii. Perform walk down of generator(s).
  - iv. Check emergency diesel.
  - v. Check oil levels in transformers.
  - vi. Check nitrogen pressure in transformers.
  - vii. Check temperature of transformers.
  - viii. Walk-down switchgear rooms.
  - ix. Visually check switchyard.
- h. Turbines
  - i. Add oil as required.
  - ii. Check movement of trip and non-return valves.

- iii. Check for loose fittings/foundation bolts.

### 3. Monthly

The following items shall be inspected on a monthly basis.

#### a. Fuel Handling

- i. Grease all idlers on belts.
- ii. Inspect and change oil on gear boxes.
- iii. Check all belts for proper tension.
- iv. Check all belts/chains for wear points.
- v. Check shear pins.
- vi. Re-torque bolts tightened to a specification.

#### b. Compressors

- i. Re-torque bolts tightened to a specification.
- ii. Perform a complete vibration check.
- iii. Draw an oil sample and inspect.
- iv. Wipe off equipment and clean surrounding area.

#### c. Pumps

- i. Grease all bearings.
- ii. Perform a complete vibration check.
- iii. Wipe off equipment and clean surrounding area.
- iv. Rotate redundant pumps.

#### d. Motors

- i. Perform a complete vibration check.
- ii. Wipe off equipment and clean surrounding area.

#### e. Electrical

- i. Perform test of UPS system.
  - ii. Perform test of emergency diesel generator.
  - iii. Check pressure of transformer nitrogen cylinder.
- f. Instrumentation and Controls
  - i. Begin routine calibration of I/C per schedule.
  - ii. Check pressures in CEMS gas cylinders weekly.

## 7.0 CLEANING AND FLUSHING

All piping shall be thoroughly cleaned of debris and scale. Generally fluid handling lines shall be flushed with water, thoroughly drained, and where critical air blown.

Gas handling piping may be water flushed, gas blown or air blown. Water shall be blown from the gas lines upon completion. Gas piping to the compressors or turbines shall be free of all water. All low temperature lines and cryogenic equipment shall be blown clear with oil free and moisture free gas. Air utility piping may be cleaned with their normal media.

### 7.1 CLEANING METHODS

The types of cleaning methods that may be used for pipe cleaning are as follows:

- a. Velocity flushes.
- b. Re-circulation flushes.
- c. Gas or Air blows.
- d. Manual cleaning.

#### 1. Velocity Flushes

Velocity flushes shall consist of single pass flushes through piping from a suitable water supply. This type of flush is normally used on piping where an adequate supply of water combined with pumping capacity is available to maintain acceptable water velocities for a duration long enough for acceptable cleaning.

The cleaning shall be performed as follows:

- a. The highest attainable water velocity shall be used for this flush. A minimum velocity of 1.2 times the normal service velocity shall be used.
- b. A flush shall be completed when the effluent water and piping internal surfaces meet the acceptance criteria established for that system.

## 2. Recirculation Flushes

Recirculation flushes shall consist of flushes in a closed loop in any given system. This type of flush could be a lube oil flush or one in a closed cooling system.

When possible, the following steps shall be followed when cleaning a water system:

- a. Where possible, flush downwards or horizontally.
- b. There must be no risk of carrying debris into complicated or inaccessible equipment.
- c. No debris shall be allowed to collect at 'pockets' in the system.
- d. Where practical, use vessels as reservoirs and flush away from the vessel.
- e. There must be no chance of debris being flushed back into a section that has already been cleared.
- f. Flush only one route at a time so that there is no doubt as to the direction of flow.
- g. Flush through open lines. Do not restrict flow.
- h. Flush through all drains and vents.
- i. Flush main headers first and then laterals working systematically, outwards from the water source.

Remove all flow restrictors, i.e. meters and orifices. Remove all non-return valve flappers, relief valves, micro strainers, pressure reducers and control valves before flushing to avoid fouling or damage. Close all instrument taps, including level gauge cocks. Install spool pieces with strainer baskets on pump suctions or in locations predetermined during flush preparation.

Fill the system completely with the flushing medium. Vent where possible.

Operate the system pumps monitoring pump discharge pressure and motor amperages. Monitor the differential pressure across the strainer.

### 3. Gas and Air Blows

Gas and air blows shall consist of blowing the service medium through the system piping to atmosphere. This method of cleaning shall normally be used on systems such as instrument and service air, and gas systems.

Always avoid blowing dirty piping into cleaned piping.

All piping shall be thoroughly cleaned of debris and scale. It is preferred that interconnecting pipe work be blown clear on completion of hydrostatic testing. Once the pipe has been checked for cleanliness and dryness it can be mounted in position. All low temperature and cryogenic equipment must be blown clear with oil-free and moisture-free gas.

Air utility piping may be cleaned by blowing with their normal media.

#### a. Air Blows

The air shall be oil-free and moisture-free.

The velocity of air shall be at least 30 ft/s in order to remove debris. In order to achieve the air velocities necessary for effective cleaning out of equipment it is preferable to fill vessels with air up to normal working pressure, and then to depressurize rapidly through the equipment to be cleaned.

Where possible, blow downwards or horizontally.

There must be no risk of carrying debris into complicated or inaccessible equipment.

No debris shall be allowed to collect at “pockets” in the system.

There must be no chance of debris being blown back into a section that has already been cleared.

Where practical, use vessels as reservoirs and blow away from the vessel.

All orifices plates, non-return valve flappers, relief valves, micro strainers, pressure reducers and control valves must be removed before blowing to avoid fouling or damage.

Close all instrument taps, including level gauge cocks.

Blow only one route at a time so that there is no doubt as to the direction of flow.

Blow through open lines. Do not restrict flow.

Blow through all drains and vents.

Blow main headers first and then laterals, working systematically outwards from the air source.

b. Gas Blows

Gas handling piping may be water flushed, pigged or air blown and in some cases gas blown. Water shall be blown from the gas lines upon completion. Gas piping to the compressors or turbines must be free of all water. All low temperature lines and cryogenic equipment must be blown clear with oil free and moisture free gas. Air utility piping may be cleaned with their normal media.

4. Manual Cleaning

In the case of rework or when removing temporary equipment, manual cleaning may be utilized on components and large piping which permit personnel access for cleaning. The four allowed methods of manual cleaning are:

a. Grinding and Polishing

To remove scale or smooth surface irregularities, austenitic stainless steels and carbon steel surfaces may be ground or polished with aluminum oxide or silicon carbide impregnated fabric wheels, or with grinding wheels with resin or rubber bonded grit.

Grinding or polishing on stainless steels shall only be done with wheels, which have been used exclusively on stainless steel.

b. Wire Brushing

Wire brushing may be used on class B, C, and D surfaces, to remove paint, coatings, or loosely adherent oxides. Wire brushing

of stainless steel or nickel alloy made surfaces shall be performed with stainless steel wire brushes, which have been used exclusively on stainless steel or nickel alloy surfaces. Particulate contaminants resulting from wire brushing must be removed.

c. Solvent Degreasing

Solvent degreasing may be performed on any metallic surface using the appropriate solvent as shown in Tables 4.1 and 4.2. The surface may be cleaned by wiping, immersion, or filling the vessel or surface with solvent. Chlorinated solvents shall not be used on stainless steel surfaces; these solvents decompose in the presence of moisture forming hydrochloric acid. In addition, kerosene and other similar solvents, which leave a greasy non-volatile residue, shall not be used.

Acetone, alcohol, and similar hazardous solvents must be used with great caution in order to prevent fires, skin burns, or toxic effects when inhaled.

The following preventive measures shall be applied:

- i. All personnel must review the MSDS sheets on all solvents being used at your site.
- ii. Adequate ventilation must be provided to protect personnel from solvent vapors. Safety cans or polyethylene squeeze bottles must be used to prevent excessive concentrations of vapors in working areas.
- iii. Cloths soaked in solvent shall be rinsed in water to minimize hazards.
- iv. Explosion-proof lights must be used while working with solvents.
- v. When solvents are used in enclosed or semi-enclosed areas, the “buddy system” shall be in effect.
- vi. Solvent cleaning will be followed by service (or better) quality water washing in order to remove all solvent residue. Approved solvents and/or service water will be used with lint-free rags only.
- vii. Take count of rags being used. Make sure to dispose of used rags properly.

- viii. Cleaning of equipment such as large piping, pump casings, and valves shall be considered complete when it meets the acceptance criteria for the cleanliness class designated for the system.

d. Alkaline Degreasing

Stainless steel and carbon steel surfaces (with exception of cleanliness Class A surfaces), may be degreased with a non-toxic wetting agent combined with mild alkaline-phosphate based cleaning compounds.

For small areas, Turco 4215, for example, is commercially available. For large scale flushing, a solution may be prepared using the following:

- i. Demineralized water.
- ii. Trisodium phosphate ( $\text{Na}_3\text{PO}_4$ ); 0.5 to 0.75% by weight.
- iii. Disodium phosphate ( $\text{Na}_2\text{HPO}_4$  with a ratio of  $\text{Na}_2\text{HPO}_4$  to  $\text{Na}_3\text{HPO}_4$  between 1:4 and 1:1).
- iv. The solution and metal temperatures must not exceed 150°F during degreasing. Thorough rinsing, using service or better quality water must immediately follow cleaning before the alkaline solution dries out on the component surfaces.

e. Cleaning Solvents

Solvents used for cleaning shall be of quality equal to or greater than the grades specified in the tables below. Solvents may be new or redistilled. Redistilled solvents shall be of quality equal to or greater than the new solvent. Ten (10) gallons per product is the maximum allowable for external cleaning without proper review from the Safety Department. In all applications insure proper protective clothing and equipment is used, adequate ventilation and boundaries roped off with No Smoking/No Hot Work signs attached and clearly visible.

Chemicals acceptable in solvent cleaning operations on any surface:

SOLVENT	GRADE FED. SPEC. NO.	
Ethyl Alcohol	95% - USP	-----
Methyl Alcohol	Technical	O-M-232-E
Naptha	Technical	TT-N-95B
Acetone	Technical	O-A-51F
Isopropyl Alcohol	A or B	TT-I-735a

Chemicals acceptable for use on crevice free, open, freely evaporative surfaces, provided that solvent is removed by evaporation, drying, or similar method before any subsequent fabrication or cleaning operations are performed:

SOLVENT	GRADE FED. SPEC. NO.	
Trichloroethylene	Technical	O-T-634B
Perchloroethylene	Technical	O-P-191
Trichloroethane	Technical	O-T-620

f. Wipe Cleaning

Accessible surfaces may be wiped clean with a lint-free cloth moistened with inhibited water, an approved solvent, or alkaline solution.

## 7.2 DOCUMENTATION

Contractor shall complete and maintain accurate records to provide adequate documentation showing which section of a system was flushed and to what extent. These records shall include:

1. Flushing Procedure

Indicating the cleaning method and acceptance criteria in systematic details. Each step is signed off indicating its completion.

2. Mark- up Piping and Instrument Diagram (P&ID)

Mark- up Piping and Instrument Diagram (P&ID) showing the flow path for each flush. Also show the boundary of the flush and temporary piping required to perform this flush.

3. System Flush Report providing the results of the flush and certifying that the flush has been adequately completed.

### 7.3 PRECAUTIONS

The following general precautions shall be taken during all flushing:

1. Conduct system flushes within the limits and restrictions of pump, NPSH, motor current, motor consecutive starts, pump curve, strainer differential pressure, and vibration limits on rotating equipment.
2. Where possible, pump suction piping shall be flushed to waste before the pump is started.
3. All flushing shall progress in a logical sequence so that no "dirty" system is flushed into a clean one. For example, main headers shall be flushed first with the branch lines closed. After that all branch lines, vents, drains and trap lines, instrument lines, etc., are flushed in sequence.
4. Pressurize temporary piping slowly to verify leak tightness.
5. Temporary piping shall be routed to avoid splashing, spraying, or flooding. Added precautions shall be taken against inadvertent wetting of electrical equipment.
6. Sump pumps shall be in service prior to the start of the flush.
7. Flushing of long risers shall be done if possible in the direction of gravity.
8. All flow elements or other devices, which could be damaged by debris during flushing, shall be removed, identified, and carefully stored.
9. Only instruments required for safe operation of the equipment shall be in service during the initial flush. Instrument lines shall be flushed only after the process lines are thoroughly flushed.
10. Control valves shall not be used for throttling or flow control during flushing operations if any other practical alternative is available.

## 7.4 LAY-UP

If the system is not put into operation immediately after cleaning and flushing, it shall be placed in lay-up status to prevent contamination.

## 8.0 PIPE SYSTEM CLEANLINESS

### 8.1 CLEANLINESS CLASSIFICATION AND ENDPOINTS

There are four cleanliness classifications ranging from Class "A" through Class "D". Class "A" is a very high level of cleanliness and applies to such items as delicate instruments. Class "B" is a high level of cleanliness, usually specified for stainless steel systems, since carbon steel and low alloy steel surfaces will rapidly rust upon exposure to even atmospheric moisture. Class "C" is an intermediate level of cleanliness, generally applicable to condensate and feedwater systems, and closed cooling water systems. Class "D" is a lower level of cleanliness and is applicable to fire protection, open service water, and other systems that require a nominal degree of cleanliness. Prior to testing, Contractor shall clean the pipelines to levels of cleanliness indicated herein.

### 8.2 CLEANLINESS ENDPOINTS

#### 1. Class "A" Cleanliness

A very high level of cleanliness in which there is no evidence of contamination of a surface either under visual examination, with or without magnification, or with the aide of sensitive detection methods. Class "A" cleanliness applies to special items such as delicate instruments, and other close tolerances or carefully controlled surfaces or assemblies. Such items shall receive their required level of cleanliness at the point of manufacture and cleanliness must be maintained at the construction site. Normally, any required site cleanliness inspection and/or re-cleaning should only be performed by the vendor's representative or under their direction.

#### 2. Class "B" Cleanliness

The surface shall appear "metal clean" when examined without magnification under a lighting level (background plus supplementary lighting) of at least 100 foot candles.

The surface shall be free of particulate contaminants such as sand, metal chips, weld slag, etc.

The surface shall be free of organic films and contaminants such as oils, paint, and preservatives as determined by a visual examination or an organic solvent dampened white cloth or an equivalent alternate method.

3. Class "C" Cleanliness

Surfaces shall meet the requirements for class "B" cleanliness with the exception of the following:

Thin uniform rust films which can be removed by hand brushing or wiping are acceptable on carbon steel surfaces but hard rust which forms in a crusty film and tends to break off in pieces or flakes and/or heavy rusting such as a continuous film of appreciable thickness which forms due to lengthy exposure to aerated water or condensed moisture is not acceptable for carbon steel and must be removed.

4. Class "D" Cleanliness

Tightly adherent mill scale on carbon steel surfaces is acceptable. Paint or preservative coatings on carbon steel surfaces that will not peel or flake when exposed to cold water flushing, or air flowing are acceptable.

### 8.3 PIPING CLEANLINESS CLASSIFICATION

The following identifies the piping cleanliness requirements based on the pipe service.

Symbol	Service	Cleanliness Classification
ABE	Aeration Basin Effluent	C
CD	Chemical Drain	C
CHEM	Chemical	B
CS	Chemical System	B
CW	Cold Water	B
DSL	Digested Sludge	B
FA	Foul Air	B
FECL	Ferric Chloride	B
HW	Hot Water	C
IA	Instrument Air	B
NIT	Nitrogen	B
OF	Overflow	C
PD	(Gravity) Process Drain	C
PE	Primary Effluent	C
PLW	Chlorinated Plant Water	C
PW	Potable Water	C
RS	Raw Sewage	C

Symbol	Service	Cleanliness Classification
SRS	Screened Raw Sewage	C
THS	Thickened Sludge	C
D	Drain	C
V	Vent	C

## 9.0 ROTATING EQUIPMENT VIBRATION TESTING

### 9.1 ACCEPTANCE CRITERIA

All rotating equipment shall be vibration testing in accordance with the requirements herein and as otherwise indicated in these Contract Documents. Vibration acceptance is based upon vibration displacement and vibration velocity measurements. Unacceptability of either displacement or velocity measurement shall render the status of the equipment as unacceptable.

Vibration levels as a function of rpm shall not fall above the fair line as shown on the general machinery vibration severity chart.

#### 1. Electrical Motors

The maximum allowable vibration displacement standards for electric motors operating at the indicated speeds are:

Peak to Peak

Speed (rpm)	Vibration Displacement (mils)
3000 and greater	1.0
1500 – 2999	2.0
1000 – 1499	2.5
999 and under	3.0

The vibration velocity shall not exceed 0.34 inches per second.

#### 2. Centrifugal Pumps

Centrifugal pumps operating between 60 and 8000 rpm and within 10% of rated capacity shall not exceed the vibration displacement level indicated on the chart. The vibration velocity shall not exceed 0.34 inches per second.

### 3. Axial and Centrifugal Fans

For axial and centrifugal fans operating between 400 and 8000 rpm and as near to normal operating conditions as feasible, vibration displacement shall not exceed the fair line as shown on the severity chart, nor shall the vibration velocity exceed 0.10 inches per second.

## 9.2 PROCEDURE

Vibration measurements shall be made with broadband test instruments. Filters shall not be used for purposes of this procedure.

Test instruments shall include a tachometer for measuring the actual rotating speed of equipment. Selection shall be based on the range of speeds to be measured.

By visual and hand contact methods, Contractor shall observe vibration conditions on all horizontal and vertical rotating equipment. Unless requested by the Engineer in instances where the machine is obviously unacceptably vibrating, the Contractor does not need to record actual vibration readings on motor driven equipment with motors less than 10 HP motors.

Contractor shall take initial displacement and velocity vibration readings on all large horsepower (100 HP and over) motors and turbines with the motor/turbine uncoupled from its driven equipment, and repeat the procedure with the equipment coupled.

When taking readings, the vibration velocity and the vibration displacement shall be recorded. In initial testing, if either displacement or velocity of vibration is found in excess of acceptable criteria, equipment alignment shall be rechecked. If alignment is determined not to be the cause of vibration, then more sophisticated monitoring equipment and specialist personnel shall be employed to determine the frequency of vibration and to help ascertain the problem. In any case, the engineering specialist shall be notified as well as the equipment vendor if the frequency of vibration is determined not to correspond to the rotation speed.

### 1. Horizontal Equipment

Horizontal equipment vibration readings shall be taken with hand-held or magnetic vibration pickups on or as near as possible to each accessible bearing housing and always on a solid surface. Measurement positions shall include the following:

- a. Horizontal and vertical readings that are perpendicular (or radial) to the rotating shaft.
- b. Axial readings that are parallel to the rotating shaft.
- c. When friction type sleeve bearings are encountered, horizontal and vertical shaft readings shall be taken with a magnetic type pickups attached to the bearing housing.

## 2. Vertical Equipment

Vertical equipment vibration readings shall be taken with hand-held or magnetic vibration pickups on or as near as possible to the top motor bearing and always on a solid surface. Many times this bearing will be covered by a plastic cap, thus measurements must be made on the adjacent casing. Vibration measurements on this bearing shall be performed and recorded in both the coupled and uncoupled modes. Measurement positions shall include the following.

- a. Horizontal readings that are perpendicular (or radial) to the rotating shaft, and perpendicular to each other.
- b. Axial readings that are parallel to the shaft.

Vibration reading locations shall be selected to conform with specific reference points such as pump suction or discharge, as applicable, and are taken consistently with these reference points to facilitate future reproduction of the test.

## 10.0 PLANT LAY-UP

Laying up plant equipment is usually required when the system or component is going to be taken out of operation for a length of time. The length of time governs the method of lay-up.

### 10.1 SHORT TERM LAY-UP

#### 1. General

Short term lay-up is required when a system or component is taken out of service for up to one (1) month. The lay-up usually entails leaving the system with the fluid inside and adding a chemical to prevent oxygen corrosion. In some cases it may be necessary to circulate and periodically test the fluid to ensure proper lay-up conditions are maintained.

#### 2. Specific Instructions

When it is determined that a short-term lay-up is required, Contractor shall review the vendor instructions and submit a plan in accordance with Section 01300 to the Engineer for the lay-up. This plan shall include the following:

- a. Estimated duration of lay-up.
- b. Type and quantity of chemical required.
- c. List of any temporary equipment required.

- d. Freeze potential.
- e. Any special items that shall be noted i.e., system configuration, safety, etc.

## 10.2 LONG TERM LAY-UP

### 1. General

Long term lay-up is required when a system or component is taken out of service for longer than one (1) month. The lay-up generally entails leaving the system with the fluid inside and adding a chemical to prevent oxygen corrosion, or dry with either a desiccant inside or open with air circulation. In some cases it may be necessary to circulate and periodically test the fluid to ensure proper lay-up conditions are maintained.

### 2. Specific Instructions

When it is determined that a long-term lay-up is required, the Contractor shall review the vendor instructions and submit a long-term lay-up plan to the Engineer in accordance with Section 01300. This plan shall include the following:

- a. Estimated duration of lay-up.
- b. Type and quantity of chemical required.
- c. List of any temporary equipment required.
- d. Ambient conditions surrounding the lay-up.
- e. Any special items that shall be noted.

**\*\*END OF SECTION\*\***

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## SECTION 01664

### TRAINING

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

This section contains requirements for training the Manatee County's (referred to as County or Owner) personnel, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract.

The basic elements of the training are the vendors (equipment) training and the design engineers (process) training. A plan for coordination and completion of the training will be developed during the construction phase in concert with the Contractor and submitted to the County for review.

The training will begin with many of the routine and non-complicated equipment items and continue in the following weeks while the commissioning staff is available. The later training will incorporate the more complex equipment and systems, and those elements which are unique to SWWRF and SEWRF.

##### 1.02 QUALITY ASSURANCE

Where required by the detailed specifications, the Contractor shall provide on-the-job training of the County's personnel. The training sessions shall be conducted by qualified, experienced, factory-trained representatives of the various equipment manufacturers. Training shall include instruction in both operation and maintenance of the subject equipment.

##### 1.03 SUBMITTALS

The following information shall be submitted to the Engineer in accordance with the provisions of Section 01300. The material shall be reviewed and accepted by the Engineer as a condition precedent to receiving progress payments in excess of 50 percent of the contract amount and not less than three (3) weeks prior to the provision of training.

1. An overall Training Plan encompassing all aspects of the Work in accordance with intent of this Section. Training plan shall discuss general approach for each training session and general scheduling of these training sessions. Plan shall be adjusted monthly once training has been initiated and resubmitted as the Work progresses.
2. Lessons plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included

3. Subject of each training session, identity and qualifications of individuals to be conducting the training, and tentative date and time of each training session.

## PART 2 – PRODUCTS

### 2.01 GENERAL

Where specified, the Contractor shall conduct training sessions for the County's personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work and under the conditions specified in the following paragraphs. Approved operation and maintenance manuals shall be available prior to the date scheduled for the individual training session.

### 2.02 LOCATION

Training sessions shall take place at the site of the work or as identified by the County and Engineer. Training may take place at the SWWRF training conference room.

### 2.03 LESSON PLANS

Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan shall contain a time allocation for each subject.

One complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material shall be the property of the County and shall be suitably bound for proper organization and easy reproduction. The Contractor shall furnish ten copies of necessary training manuals, handouts, visual aids and reference materials at least one (1) week prior to each training session.

### 2.04 FORMAT AND CONTENT

Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:

1. Familiarization
  - a. Review catalog, parts lists, drawings, etc., which have been previously provided for the SWWRF and SEWRF files and operation and maintenance manuals.
  - b. Check out the installation of the specific equipment items.

- c. Demonstrate the unit and indicate how all parts of the specifications are met.
  - d. Answer questions.
- 2. Safety
  - a. Using material previously provided, review safety references.
  - b. Discuss proper precautions around equipment.
- 3. Operation
  - a. Using material previously provided, review reference literature.
  - b. Explain all modes of operation (including emergency).
  - c. Check out County's personnel on proper use of the equipment.
- 4. Preventive Maintenance
  - a. Using material previously provided, review preventive maintenance (PM) lists including:
    - i. Reference material.
    - ii. Daily, weekly, monthly, quarterly, semiannual, and annual jobs.
  - b. Show how to perform PM jobs.
  - c. Show County's personnel what to look for as indicators of equipment problems.
- 5. Corrective Maintenance
  - a. List possible problems.
  - b. Discuss repairs--point out special problems.
  - c. Open equipment and demonstrate procedures, where practical.
- 6. Parts
  - a. Show how to use previously provided parts list and order parts.

- b. Check over spare parts on hand. Make recommendations regarding additional parts that should be available.
- 7. Local Representatives
  - a. Where to order parts: name, address, telephone.
  - b. Service problems:
    - i. Who to call.
    - ii. How to get emergency help.
- 8. Operation and Maintenance Manuals
  - a. Review any other material submitted.
  - b. Update material, as required.

## 2.05 VIDEO RECORDING:

The County will retain the services of a commercial video taping service to record each training session. After taping, the material will be edited and supplemented with professionally produced graphics to provide a permanent record. The Contractor shall advise all manufacturers providing training sessions that the material will be video taped and shall make available to the County's videotaping contractor such utility services and accommodation as may be required to facilitate the production of the video tape record.

## PART 3 – EXECUTION

Training shall be conducted in conjunction with the operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The Contractor shall arrange to have the training conducted on consecutive days, with no more than 6 hours of classes scheduled for any one day. Concurrent classes shall not be allowed. Training shall be certified on Form 11000-B specified in Section 01999.

Acceptable operation and maintenance manuals for the specific equipment shall be provided to the County prior to the start of any training. Video taping shall take place concurrently with all training sessions.

The following services shall be provided for each item of equipment or system as required in individual specification sections. Additional services shall be provided, where specifically required in individual specification sections.

1. As a minimum classroom equipment training for operations personnel will include:
  - a. Using slides and drawings, discuss the equipment's specific location in the SWWRF and an operational overview.
  - b. Purpose and plant function of the equipment.
  - c. A working knowledge of the operating theory of the equipment.
  - d. Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.
  - e. Identify and discuss safety items and procedures.
  - f. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.
  - g. Operator detection, without test instruments, of specific equipment trouble symptoms.
  - h. Required equipment exercise procedures and intervals.
  - i. Routine disassembly and assembly of equipment if applicable (as judged by the County on a case-by-case basis) for purposes such as operator inspection of equipment.
2. As a minimum, hands-on equipment training for operations personnel will include:
  - a. Identify location of equipment and review the purpose.
  - b. Identifying piping and flow options.
  - c. Identifying valves and their purpose.
  - d. Identifying instrumentation:
    - i. Location of primary element.
    - ii. Location of instrument readout.

- iii. Discuss purpose, basic operation, and information interpretation.
  - e. Discuss, demonstrate, and perform standard operating procedures and round checks.
  - f. Discuss and perform the preventative maintenance activities.
  - g. Discuss and perform start-up and shutdown procedures.
  - h. Perform the required equipment exercise procedures.
  - i. Perform routine disassembly and assembly of equipment if applicable.
  - j. Identify and review safety items and perform safety procedures, if feasible.
3. Classroom equipment training for the maintenance and repair personnel will include:
- a. Theory of operation.
  - b. Description and function of equipment.
  - c. Start-up and shutdown procedures.
  - d. Normal and major repair procedures.
  - e. Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.
  - f. Routine and long-term calibration procedures.
  - g. Safety procedures.
  - h. Preventative maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.
4. Hands-on equipment training for maintenance and repair personnel shall include:
- a. Locate and identify equipment components.

- b. Review the equipment function and theory of operation.
- c. Review normal repair procedures.
- d. Perform start-up and shutdown procedures.
- e. Review and perform the safety procedures.
- f. Perform County approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

#### PART 4 – DEVELOPMENT OF TRAINING SCHEDULE

The Contractor along with the County will develop a training syllabus and schedule which will include development time for all vendor specific training documentation and the duration of each training activity. The training schedule will utilize the overall project schedule to establish training dates based on equipment receipt and required project needs.

**\*\*END OF SECTION\*\***

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## SECTION 01700

### CONTRACT CLOSEOUT

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the work.

##### 1.02 SUBSTANTIAL COMPLETION

- A. The Contractor shall submit the following items when the Contractor considers the work to be substantially complete:
  - 1. A written notice that the work, or designated portion thereof, is substantially complete.
  - 2. A list of items to be completed or corrected.
- B. Within a reasonable time after receipt of such notice, the County shall make an inspection to determine the status of completion.
- C. Project record documents and operations and maintenance manuals must be submitted before the project shall be considered substantially complete.
- D. If the County determines that the work is not substantially complete:
  - 1. The County shall notify the Contractor in writing, stating the reasons.
  - 2. The Contractor shall remedy the deficiencies in the work and send a second written notice of substantial completion to the County.
  - 3. The County shall reinspect the work.
- E. When the County finds that the work is substantially complete:
  - 1. The Engineer shall prepare and deliver to the County a tentative Certificate of Substantial Completion (Manatee County Project Management Form PMD-8) with a tentative list of the items to be completed or corrected before final payment.
  - 2. The Engineer shall consider any objections made by the County as provided in Conditions of the Contract. When the Engineer considers the work substantially complete, he will execute and deliver to the County a definite Certificate of Substantial Completion (Manatee County Project Management Form PMD-8) with a revised tentative list of items to be

completed or corrected.

#### 1.03 FINAL INSPECTION

- A. When the Contractor considered the work to be complete, he shall submit written certification stating that:
  - 1. The Contract Documents have been reviewed.
  - 2. The work has been inspected for compliance with Contract Documents.
  - 3. The work has been completed in accordance with Contract Documents.
  - 4. The equipment and systems have been tested in the presence of the County's representative and are operational.
  - 5. The work is completed and ready for final inspection.
- B. The County shall make an inspection to verify the status of completion after receipt of such certification.
- C. If the County determines that the work is incomplete or defective:
  - 1. The County shall promptly notify the Contractor in writing, listing the incomplete or defective work.
  - 2. The Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to County that the work is complete.
  - 3. The County shall reinspect the work.
- D. Upon finding the work to be acceptable under the Contract Documents, the County shall request the Contractor to make closeout submittals.
- E. For each additional inspection beyond a total of three (3) inspections for substantial and final completion due to the incompleteness of the work, the Contractor shall reimburse the County's fees.

#### 1.04 CONTRACTOR'S CLOSEOUT SUBMITTALS TO COUNTY

- A. Project Record Documents (prior to substantial completion).
- B. Operation and maintenance manuals (prior to substantial completion).
- C. Warranties and Bonds.
- D. Evidence of Payment and Release of Liens: In accordance with requirements of General and Supplementary Conditions.
- E. Certification letter from Florida Department of Transportation and Manatee County Department of Transportation, as applicable.

- F. Certificate of Insurance for Products and Completed Operations.
- G. Final Reconciliation, Warranty Period Declaration, and Contractor's Affidavit (Manatee County Project Management Form PMD-9).

1.05 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit a final statement of accounting to the County.
- B. Statement shall reflect all adjustments to the Contract Sum:
  - 1. The original Contract Sum.
  - 2. Additions and deductions resulting from:
    - a. Previous Change Orders
    - b. Unit Prices
    - c. Penalties and Bonuses
    - d. Deductions for Liquidated Damages
    - e. Other Adjustments
  - 3. Total Contract Sum, as adjusted.
  - 4. Previous payments.
  - 5. Sum remaining due.
- C. Project Management shall prepare a final Change Order, reflecting approved adjustments to the Contract Sum which were not previously made by Change Orders.

1.06 FINAL APPLICATION FOR PAYMENT

Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

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## SECTION 01710

### CLEANING

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

Execute cleaning during progress of the work and at completion of the work, as required by the General Conditions.

##### 1.02 DISPOSAL REQUIREMENTS

Conduct cleaning and disposal operations to comply with all Federal, State and Local codes, ordinances, regulations and anti-pollution laws.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

#### PART 3 EXECUTION

##### 3.01 DURING CONSTRUCTION

- A. Execute periodic cleaning to keep the work, the site and adjacent properties free from accumulation of waste materials, rubbish and wind-blown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish.
- C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

##### 3.02 DUST CONTROL

- A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

- A. Employ skilled workmen for final cleaning.
- B. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- C. Prior to final completion or County occupancy, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces and all work areas to verify that the entire work is clean.

**\*\*END OF SECTION\*\***

## SECTION 01720

### PROJECT RECORD DOCUMENTS

#### PART 1 STANDARDS

##### 1.01 MINIMUM RECORD DRAWING STANDARDS FOR ALL RECORD DRAWINGS SUBMITTED TO MANATEE COUNTY

- A. Record drawings shall be submitted to at least the level of detail in the contract documents. It is anticipated that the original contract documents shall serve as at least a background for all record information. Original drawings in CAD format may be requested of the County.
- B. Drawings shall meet the criteria of paragraph 2.04 D above and as mentioned in Section 1.14 Record Drawings in the Manatee County Public Works Standards, Part I Utilities Standards Manual approved June 2015.

#### PART 2 STANDARDS

##### 2.01 REQUIRMENTS INCLUDED

- A. Contractor shall maintain at the site for the County one record copy of:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. County's field orders or written instructions.
  - 6. Approved shop drawings, working drawings and samples.
  - 7. Field test records.
  - 8. Construction photographs.

##### 2.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
  - 1. Provide files and racks for storage of documents.
  - 2. Provide locked cabinet or secure storage space for storage of samples.
- B. File documents and samples in accordance with CSI format.
- C. Maintain documents in a clean, dry, legible, condition and in good order. Do not

use record documents for construction purposes.

- D. Make documents and samples available at all times for inspection by the County.

## 2.03 MARKING DEVICES

- A. Provide felt tip marking pens for recording information in the color code designated by the County.

## 2.04 DRAWING PREPERATION

- A. Record information concurrently with construction progress.
- B. Do not conceal any work until required information is recorded.
- C. Drawings; Legibly mark to record actual construction:
  - 1. All underground piping with elevations and dimensions. Changes to piping location. Horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements. Actual installed pipe material, class, etc. Locations of drainage ditches, swales, water lines and force mains shall be shown every 200 feet (measured along the centerline) or alternate lot lines, whichever is closer. Dimensions at these locations shall indicate distance from centerline of right-of-way to the facility.
  - 2. Field changes of dimension and detail.
  - 3. Changes made by Field Order or by Change Order.
  - 4. Details not on original contract drawings.
  - 5. Equipment and piping relocations.
  - 6. Locations of all valves, fire hydrants, manholes, water and sewer services, water and force main fittings, underdrain cleanouts, catch basins, junction boxes and any other structures located in the right-of-way or easement, shall be located by elevation and by station and offset based on intersection P.I.'s and centerline of right-of-way. For facilities located on private roads, the dimensioning shall be from centerline of paving or another readily visible baseline.
  - 7. Elevations shall be provided for all manhole rim and inverts; junction box rim and inverts; catch basin rim and inverts; and baffle, weir and invert elevations in control structures. Elevations shall also be provided at the PVI's and at every other lot line or 200 feet, whichever is less, of drainage swales and ditches. Bench marks and elevation datum shall be indicated.
  - 8. Slopes for pipes and ditches shall be recalculated, based on actual field measured distances, elevations, pipe sizes, and type shown. Cross section of drainage ditches and swales shall be verified.
  - 9. Centerline of roads shall be tied to right-of-way lines. Elevation of roadway centerline shall be given at PVI's and at all intersections.

10. Record drawings shall show bearings and distances for all right-of-way and easement lines, and property corners.
11. Sidewalks, fences and walls, if installed at the time of initial record drawing submittal, shall be located every 200 feet or alternate lot lines, whichever is closer. Dimensions shall include distance from the right-of-way line and the back of curb and lot line or easement line.
12. Sanitary sewer mainline wyes shall be located from the downstream manhole. These dimensions shall be provided by on-site inspections or tele viewing of the sewer following installation.
13. Elevations shall be provided on the top of operating nuts for all water and force main valves.
14. Allowable tolerance shall be  $\pm 6.0$  inches for horizontal dimensions. Vertical dimensions such as the difference in elevations between manhole inverts shall have an allowable tolerance of  $\pm 1/8$  inch per 50 feet (or part thereof) of horizontal distance up to a maximum tolerance of  $\pm 2$  inch.
15. Properly prepared record drawings on mylar, together with two copies, shall be certified by a design professional (Engineer and/or Surveyor registered in the State of Florida), employed by the Contractor, and submitted to the County.

D. Specifications and Addenda; Legibly mark each Section to record:

1. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed.
2. Changes made by field order or by change order.

E. Shop Drawings (after final review and approval):

1. Five sets of record drawings for each process equipment, piping, electrical system and instrumentation system.

2.05 SUBMITTAL

- A. Prior to substantial completion and prior to starting the bacteria testing of water lines, deliver signed and sealed Record Documents and Record Drawings to the County. These will be reviewed and verified by the inspector. If there are any required changes or additions, these shall be completed and the entire signed and sealed set resubmitted prior to final pay application.
- B. The Contractor shall employ a Professional Engineer or Surveyor registered in the State of Florida to verify survey data and properly prepare record drawings. Record drawings shall be certified by the professional(s) (Engineer or Surveyor licensed in Florida), as stipulated by the Land Development Ordinance and submitted on signed and sealed paper drawings, signed and dated mylar drawings together with an AutoCAD version on a recordable compact disk (CD).

- C. The CD shall contain media in AutoCAD Version 2017 or later, or in any other CAD program compatible with AutoCAD in DWG or DXF form. All fonts, line types, shape files, external references, or other pertinent information used in the drawing and not normally included in AutoCAD shall be included on the media with a text file or attached noted as to its relevance and use.
- D. Accompany submittal with transmittal letter, containing:
1. Date.
  2. Project title and number.
  3. Contractor's name and address.
  4. Title and number of each Record Document.
  5. Signature of Contractor or his authorized representative.

Note: The data required to properly prepare these record drawings shall be obtained at the site, at no cost to the County by the responsible design professional or his/her duly appointed representative. The appointed representative shall be a qualified employee of the responsible design professional or a qualified inspector retained by the responsible design professional on a project-by-project basis.

### PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01730

### OPERATING AND MAINTENANCE DATA

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. Compile product data and related information appropriate for County's maintenance and operation of products furnished under Contract.

Prepare operating and maintenance data as specified in this and as referenced in other pertinent sections of Specifications.

- B. Instruct County's personnel in maintenance of products and equipment and systems.
- C. Provide three (3) sets of operating and maintenance manuals for each piece of equipment provided within this Contract.

##### 1.02 FORM OF SUBMITTALS

- A. Prepare data in form of an instructional manual for use by County's personnel.

- B. Format:

1. Size: 8-1/2-inch x 11 inch
2. Paper: 20 pound minimum, white, for typed pages
3. Text: Manufacturer's printed data or neatly typewritten
4. Drawings:
  - a. Provide reinforced punched binder tab, bind in with text.
  - b. Fold larger drawings to size of text pages.
5. Provide fly-leaf for each separate product or each piece of operating equipment.
  - a. Provide typed description of product and major component parts of equipment.
  - b. Provide indexed tabs.
6. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
  - a. Title of Project.
  - b. Identity of separate structures as applicable.
  - c. Identity of general subject matter covered in the manual.

- C. Binders:

1. Commercial quality three-ring binders with durable and cleanable plastic covers.
2. Maximum ring size: 1 inch.
3. When multiple binders are used, correlate the data into related consistent groupings.

1.03 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit three copies of complete manual in final form.
- B. Content for each unit of equipment and system, as appropriate:
  1. Description of unit and component parts.
    - a. Function, normal operating characteristics and limiting conditions.
    - b. Performance curves, engineering data and tests.
    - c. Complete nomenclature and commercial number of replaceable parts.
  2. Operating Procedures:
    - a. Start-up, break-in, routine and normal operating instructions.
    - b. Regulation, control, stopping, shut-down and emergency instructions.
    - c. Summer and winter operating instructions.
    - d. Special operating instructions.
  3. Maintenance Procedures:
    - a. Routine operations.
    - b. Guide to "trouble-shooting".
    - c. Disassembly, repair and reassembly.
    - d. Alignment, adjusting and checking.
  4. Servicing and lubricating schedule.
    - a. List of lubricants required.
  5. Manufacturer's printed operating and maintenance instructions.
  6. Description of sequence of operation by control manufacturer.
  7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
    - a. List of predicted parts subject to wear.
    - b. Items recommended to be stocked as spare parts.
  8. As installed control diagrams by controls manufacturer.
  9. Each contractor's coordination drawings.
    - a. As installed color-coded piping diagrams.
  10. Charts of valve tag numbers, with location and function of each valve.
  11. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.
  12. Other data as required under pertinent sections of specifications.
- C. Content, for each electric and electronic system, as appropriate:

1. Description of system and component parts.
    - a. Function, normal operating characteristics and limiting conditions.
    - b. Performance curves, engineering data and tests.
    - c. Complete nomenclature and commercial number of replaceable parts.
  2. Circuit directories of panelboards.
    - a. Electrical service.
    - b. Controls.
    - c. Communications.
  3. As-installed color-coded wiring diagrams.
  4. Operating procedures:
    - a. Routine and normal operating instructions.
    - b. Sequences required.
    - c. Special operating instructions.
  5. Maintenance procedures:
    - a. Routine operations.
    - b. Guide to "trouble-shooting".
    - c. Disassembly, repair and reassembly.
    - d. Adjustment and checking.
  6. Manufacturer's printed operating and maintenance instructions.
  7. List of original manufacture's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.
  8. Prepare and include additional data when the need for such data becomes apparent during instruction of County's personnel.
- D. Prepare and include additional data when the need for such data becomes apparent during instruction on County's personnel.
- E. Additional requirements for operating and maintenance data: Respective sections of Specifications.

#### 1.04 SUBMITTAL SCHEDULE

- A. Submit one copy of completed data in final form fifteen days prior to substantial completion.
  1. Copy will be returned after substantial completion, with comments (if any).
- B. Submit two copies of approved data in final form. Final acceptance will not be provided until the completed manual is received and approved.

#### 1.05 INSTRUCTION OF COUNTY'S PERSONNEL

- A. Prior to final inspection or acceptance, fully instruct County's designated operating and maintenance personnel in operation, adjustment and maintenance of

products, equipment and systems.

B. Operating and maintenance manual shall constitute the basis of instruction.

1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

PART 2 – PRODUCTS (NOT Used)

PART 3 – EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01740

### WARRANTIES AND BONDS

#### PART 1 GENERAL

##### 1.01 REQUIREMENTS INCLUDED

- A. Compile specified warranties and bonds.
- B. Compile specified service and maintenance contracts.
- C. Co-execute submittals when so specified.
- D. Review submittals to verify compliance with Contract Documents.
- E. Submit to County for review and transmittal.

##### 1.02 SUBMITTAL REQUIREMENTS

- A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers and subcontractors.
- B. Number of original signed copies required: Two each.
- C. Table of Contents: Neatly typed, in orderly sequence. Provide complete information for each item.
  - 1. Product or work item.
  - 2. Firm, with name of principal, address and telephone number.
  - 3. Scope.
  - 4. Date of beginning of warranty, bond or service and maintenance contract.
  - 5. Duration of warranty, bond or service maintenance contract.
  - 6. Provide information for County's personnel:
    - a. Proper procedure in case of failure.
    - b. Instances which might affect the validity of warranty or bond.
  - 7. Contractor, name of responsible principal, address and telephone number.

##### 1.03 FORM OF SUBMITTALS

- A. Prepare in duplicate packets.
- B. Format:

1. Size 8-1/2 inch x 11 inch punched sheets for standard 3-ring binder. Fold larger sheets to fit into binders.
  2. Cover: Identify each packet with typed or printed title "WARRANTIES AND BONDS". List:
    - a. Title of Project.
    - b. Name of Contractor.
- C. Binders: Commercial quality, three-ring, with durable and cleanable plastic covers.

#### 1.04 TIME OF SUBMITTALS

- A. Make submittals within ten days after date of substantial completion and prior to final request for payment.
- B. For items of work, where acceptance is delayed materially beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

#### 1.05 SUBMITTALS REQUIRED

- A. Submit warranties, bonds, service and maintenance contracts as specified in respective sections of Specifications.
- B. Approval by the County of all documents required under this section is a prerequisite to requesting a final inspection and final payment

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION (NOT USED)

**\*\*END OF SECTION\*\***

## SECTION 01900

### STRUCTURAL DESIGN AND ANCHORAGE REQUIREMENTS FOR NONSTRUCTURAL COMPONENTS AND NONBUILDING STRUCTURES

#### PART 1 – GENERAL

##### 1.01 SUMMARY

###### A. SCOPE

This section specifies the minimum structural requirements for the design, anchorage and bracing of architectural/mechanical/HVAC/electrical components, equipment, and systems, and non-building structures. Design of supports, attachments and bracing for all parts or elements of the architectural, mechanical, HVAC and electrical systems shall be provided in accordance with this section. The requirements of this section shall apply to the design of the structural elements and features of equipment and to platforms/walkways that are provided with equipment or non-building structures.

This section applies to nonstructural components that are permanently attached to structures, and non-building structures as defined below in paragraph 1.01-B and ASCE 7-10. Note that equipment is defined as a non-structural component and tanks are defined as a non-building structure.

Design shall be in accordance with the criteria listed within this section and shall conform to the provisions of the design codes listed within this section. Engineering design is not required for attachments, anchorage, or bracing detailed on the drawings or where the size of attachments, anchorage, or bracing is defined in the technical specification sections.

###### B. DEFINITIONS:

1. **STRUCTURES:** The structural elements of a building that resist gravity, wind, and other types of loads. Structural components include columns, posts, beams, girders, joists, bracing, floor or roof sheathing, slabs or decking, load-bearing walls, and foundations.
2. **NONSTRUCTURAL COMPONENTS:** The nonstructural portions of a building include every part of the building and all its contents, except the structural portions, that carry gravity loads and that may also be required to resist the effects of wind, impact, and temperature loads. Nonstructural components include, but are not limited to, ceilings, partitions, windows, equipment, piping, ductwork, furnishings, lights, etc.
3. **NONBUILDING STRUCTURES:** All self-supporting structures that carry gravity loads and that may also be required to resist the effects of

wind, impact, and temperature loads. No building structures include, but are not limited to, pipe racks, storage racks, stacks, tanks, vessels and structural towers that support tanks and vessels.

## 1.02 QUALITY ASSURANCE

### A. QUALITY CONTROL BY THE COUNTY:

Special Inspection of nonstructural components and non-building structures, and their anchorages shall be performed by the Special Inspector under contract with the County and in conformance with the 2014 Florida Building Code. Special Inspector(s) and laboratory shall be acceptable to the County in their sole discretion. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.

### B. REFERENCES:

Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization, or if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced. When conflicting requirements occur, the most stringent requirements will govern the design.

Reference	Title
AAMA	American Architectural Manufacturer's Association
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 360	Specification for Structural Steel Buildings
ASCE 7	Minimum Design Loads for Buildings and Other Structures
ASTM C635	Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

Reference	Title
ASTM C636	Standard Practice for Installation for Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.2	Structural Welding Code – Stainless Steel
FBC	Florida Building Code with local amendments
NFPA-13	Standard for the Installation of Sprinkler Systems
OSHA	U.S. Dept. of Labor, Occupational Safety and Health Administration

### 1.03 SUBMITTALS

For structural elements of nonstructural components and non-building structures required to be designed per this specification section, drawings and design calculations shall be stamped by a Florida licensed professional engineer qualified to perform structural engineering.

Submit drawings and calculations no less than four weeks in advance of the installation of any component to be anchored to the structure or installation of any structural member to which the component will be attached.

A. The following submittals shall be provided in accordance with Section 01300:

1. List of all nonstructural components and non-building structures requiring wind design and anchorage.
2. Shop drawings showing details of complete wind bracing and anchorage attachment assemblies including connection hardware, and embedment into concrete.
3. Shop drawings showing plans, elevations, sections and details of equipment support structures and non-building structures, including anchor bolts, structural members, platforms, stairs, ladders, and related attachments.
4. Identify all interface points with supporting structures or foundations, as well as the size, location, and grip of all required attachments and anchor bolts. Clearly indicate who will be providing each type of attachment/anchor bolt. Equipment vendor shall design anchor bolts, including embedment into concrete, and submit stamped calculations.
5. Calculations for all supports, bracing, and attachments shall clearly indicate the design criteria applied in the design calculations. Concrete embedment calculations shall be coordinated with thickness and strength of concrete members. Submit a tabulation of the magnitude of unfactored (service level)

equipment loads at each support point, broken down by type of loading (dead, live, wind, etc.). Indicate impact factors applied to these loads in the design calculations.

6. Product Data: Manufacturer's certificates of compliance with the loading requirements of this section.

#### 1.04 DESIGN CODES

The following standard codes have application at this site for:

Buildings/Structures:	Florida Building Code 2014 and ASCE 7-10
Reinforced concrete:	ACI 350-06 for Concrete Liquid Containing Tanks, ACI 318-11 for all other reinforced concrete
Structural steel:	AISC 360-10
Welding:	AWS Welding Codes, Latest Edition
Occupational health and safety requirements:	U.S. Dept. of Labor, Occupational Safety and Health Administration (OSHA)

When conflicting requirements occur, the most stringent requirements will govern the design.

#### 1.05 DESIGN LOADS

All nonstructural components and non-building structures shall be designed for the following loads. Wind and snow loads shall not be applied to nonstructural components and non-building structures that are located inside buildings.

##### A. DEAD LOADS:

An additional allowance will also be added for piping and conduit when supported and hung from the underside of equipment and platforms.

Typical allowance for piping and conduit unless noted otherwise: 20 psf

##### B. UNIFORM LIVE LOADS:

Elevated grating floors:	100 psf
Columns:	No column live load reduction allowed
Stairs and landings:	100 psf
Equipment platforms, walkways/catwalks (other than exitways):	100 psf

Utility bridges:	75 psf per level minimum
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C. WIND LOADS:

Code:	FBC 2014 & ASCE 7-10
Ultimate Wind Speed (3-second gust):	160mph
Exposure:	C
Topographic Factor ( $K_{zt}$ )	1.0

All exterior non-structural components and non-building structures, unless located in a pit or basin, shall be designed to withstand the design wind loads without consideration of shielding effects by other structures.

D. IMPACT LOADS:

Impact loads shall be considered in the design of support systems.

The following impact load factors shall be used unless recommendations of the equipment manufacturer will cause a more severe load case.

Rotating machinery:	20% of moving load
Reciprocating machinery:	50% of moving load
Monorail Hoists:	
Vertical	25% of lifted load
Longitudinal	10% of lifted load
Hangers supporting floors and platforms:	33% of live and dead load

E. TEMPERATURE:

The effects of temperature shall be included in design where nonstructural components and non-building structures are exposed to differential climatic conditions. See Section 1.07 for temperature extremes.

## 1.06 LOAD COMBINATIONS

All nonstructural components and non-building structures shall be designed to withstand the load combinations as specified in the governing building code. Where the exclusion of live load or impact load would cause a more severe load condition for the member under investigation, then the load shall be ignored when evaluating that member.

## 1.07 DESIGN CONSIDERATIONS

All nonstructural components and non-building structures shall be designed for the following conditions:

### A. CLIMATIC CONDITIONS:

Maximum design temperature:	100	degrees Fahrenheit
Minimum design temperature:	15	degrees Fahrenheit

### B. FOUNDATIONS:

Foundations supporting nonstructural components and non-building structures shall extend below grade a minimum of 12”.

Consult project geotechnical report for allowable soil bearing recommendations at location of structure.

## 1.08 COLUMN BASE FIXITY

Column bases shall be designed as pinned connections. No moments shall be assumed to be transferred to the foundations.

Where significant shear loads (greater than 5,000 lb. per anchor bolt) are transferred at column base plates, the equipment vendor shall provide a shear key.

## 1.09 DEFLECTIONS

Maximum beam deflections as a fraction of span for walkways and platforms shall be L/240 for total load and L/360 for live load. Maximum total load deflection for equipment supports shall be L/450.

## PART 2 – PRODUCTS

### 2.01 GENERAL

Materials shall be in conformance with information shown on the drawings and in other technical specification sections. See individual component and equipment specifications for additional requirements.

## PART 3 – EXECUTION

### 3.01 GENERAL

- A. Attachments and braces shall be made in such a manner that the component force is transferred to the lateral force-resisting system of the structure. Attachment requirements and size and number of braces shall be based on the calculations submitted by the Contractor.
- B. All anchorage of equipment is specified to be made by cast-in anchor bolts in concrete elements unless specifically noted otherwise on the drawings or other specification Sections. Contractor shall be responsible for any remedial work or strengthening of concrete elements because of superimposed loading if anchor bolts are improperly installed or omitted due to lack of submittal review or improper placement for any reason, at no additional cost to the County.
- C. Anchor bolts shall be provided and installed by the Contractor in accordance with Section 05501. Size of anchor bolts and embedment of anchor bolts shall be based on the calculations submitted by the Contractor.
- D. Details of and calculations for all anchorages shall be submitted and accepted in accordance with paragraph 1.03 prior to placement of concrete or erection of other structural supporting members. Submittals received after structural supports are in place will be rejected if proposed anchorage method would create an overstressed condition of the supporting member. The Contractor shall be responsible for revisions to the anchorages and/or strengthening of the structural support so that there is no overstressed condition at no additional cost to the County.

**\*\*END OF SECTION\*\***

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## SECTION 01999

### REFERENCE FORMS

The forms listed below and included in this section are referenced from other sections of the project manual:

Form No.	Title
01040-A	Maintenance of Plant Operations (MOPO) Form
01300-A	Submittal Transmittal Form
01660-A	Equipment Test Report Form
01730-A	Operation and Maintenance Transmittal Form
01730-B	Equipment Record Form
01730-C	Equipment Record Form
09900-A	Coating System Inspection Checklist
11000-A	Manufacturer's Installation Certification Form
11000-B	Manufacturer's Instruction Certification Form
11000-C	Unit Responsibility Certification Form
11002-A	Rigid Equipment Mount Installation Inspection Checklist
11060-A	Motor Data Form
15000-A	Lubrication Record
15000-B	Alignment Record
15000-C	Inspection Report Fan/Blower
15000-D	Mechanical Equipment Data Record
15000-E	Final Tank and Vessel Inspection
15000-F	Piping Inspection Report
15000-G	Pressure Test Report
15000-H	Heat Trace Record
15000-I	System Flush Record
16000-A	Wire and Cable Resistance Test Data Form
16000-B	Installed Motor Test Data Form
16000-C	Dry Transformer Test Data Form
16000-D	Motor Control Center Test Form
16000-E	Medium Voltage Motor Starter Test Form
16000-F	Medium Voltage Switchgear Test Form
16000-G	Protective Relay Test Form
16000-H	Low Voltage Switchgear Test Form
16000-I	Medium Voltage Load Interrupter Switch Test Form
16000-J	Liquid-Filled Transformer Test Form
16000-K	Automatic Transfer Switch Test Form
16000-L	Neutral Grounding Resistor Test

Form No.	Title
17000-A	Loop Wiring and Insulation Resistance Test Data Form
17000-B	Control Circuit Piping Leak Test Form
17000-C	Controller Calibration Test Data Form
17000-D	Panel Indicator Calibration Test Data Form
17000-E	Recorder Calibration Test Data Form
17000-F	Signal Trip Calibration Test Data Form
17000-G	Field Switch Calibration Test Data Form
17000-H	Transmitter Calibration Test Data Form
17000-I	Miscellaneous Instrument Calibration Test Data Form
17000-J	Individual Loop Test Data Form
17000-K	Loop Commissioning Test Data Form

**01040 – A – MAINTENANCE OF PLANT OPERATIONS**

MOPO Title: \_\_\_\_\_

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN

# 01040 – A – MAINTENANCE OF PLANT OPERATIONS – COMPLETED SAMPLE

MOPO Title: CENTRATE PUMP STATION

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.01	Construct New 30" DAF Pipe, 4" SPD Pipe, and 2" HPA Pipe  Demolish unused 18" WAS pipe from WAS splitter box	- WAS Splitter Box  - DAFT 5, DAFT 6, DAFT 7, and/or DAFT 8  - Secondary Sedimentation Basins  - Thickener Effluent Wet Well	- WAS Splitter Box  - DAFT 5 and/or DAFT 6  - Secondary Sedimentation Basins  - Thickener Effluent Wet Well	- DAFT 7 and DAFT 8	- None	<u>CITY shall:</u>  - Take DAFT 7 and DAFT 8 out of service  - Shut down sump pumps at DAFT 7 and DAFT 8  <u>CONTRACTOR shall:</u>  - Dewater 4" SPD and 30" DAF pipe from DAFT 7 and DAFT 8 to Thickener Effluent Wet Well  - Construct new 30" DAF, 4" SPD, and 2" HPA pipes as shown on drawings  - Tie-in new 30" DAF pipe to existing 30" DAF pipe  - Install temporary plugs in each end of 30" DAF pipe during tie-in. Remove before tie-in is completed.	Reference sheets: <b>G42:</b> Index areas F/G/H-3 <b>G43:</b> Index areas F/G/H-11 <b>G64:</b> F/G/H-3 <b>G65:</b> F/G/H-11  Contractor shall be responsible for maintaining proper working conditions and safety personnel during the MOPO as identified in specifications  Contractor shall provide spill mitigation during tie-in of 30" DAF pipe  2" AR pipe shall be out of service for no more than 30 minutes	48 hours

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.01 cont'd						<p>- Tie-in new 4" SPD to existing 4" SPD</p> <p>- Tie-in new 2" HPA to existing 2" HPA</p> <p>- Cut, drain, and cap unused 18" WAS pipe from WAS splitter box as shown on drawings.</p> <p><u>CITY shall:</u></p> <p>- Return DAFT 7 and DAFT 8 to service</p>		

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.02	Centrate Pump Station Chemical Resistant Coating Application	<ul style="list-style-type: none"> <li>- DAFT 5</li> <li>- DAFT 6</li> <li>- DAFT 7</li> <li>- DAFT 8</li> <li>- WAS Splitter Box</li> </ul>	<ul style="list-style-type: none"> <li>- DAFT 5</li> <li>- DAFT 6</li> <li>- WAS Splitter Box</li> </ul>	<ul style="list-style-type: none"> <li>- DAFT 7</li> <li>- DAFT 8</li> <li>- <u>On a limited basis:</u> WAS Splitter Box, DAFT 5 and DAFT 6</li> </ul>	- None	<p><u>CITY shall:</u></p> <ul style="list-style-type: none"> <li>- Shut off plant wasting pumps</li> <li>- Pump down Centrate Pump Station level as much as possible until level stops increasing</li> <li>- Shut off Centrate Pump Station Pumps 1, 2, and 3</li> <li>- Close butterfly valves at discharges of Centrate Pump Station Pumps 1, 2, and 3</li> <li>- Shut off storm water pump east of Digester Cleaning Bed 99</li> <li>- Verify butterfly valve on spare tee on Centrate Pump Station discharge header is closed</li> </ul> <p><u>CONTRACTOR shall:</u></p> <ul style="list-style-type: none"> <li>- Install temporary pumps in DAFT 5 and DAFT 6 effluent wet well south of Centrate Pump Station</li> </ul>	<p>Reference sheets: M501, M502</p> <p>Contractor is cautioned that the existing valves may not provide a liquid-tight shutoff</p> <p>Contractor will be responsible for maintaining proper working conditions and safety personnel during the MOPO as identified in specifications</p> <p>Contractor is advised that storm water diversion may be completed prior to start of MOPO</p>	8 days – 24 hours/day including holidays and weekends (if necessary)

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.02 cont'd						<ul style="list-style-type: none"> <li>- Remove blind flange from the spare tee in the Centrate Pump Station discharge header</li> <li>- Install temporary piping from the temporary pumps to the spare tee in the Centrate Pump Station discharge header</li> <li>- Install blind flanges in discharges of Centrate Pump Station Pumps 1, 2, and 3</li> <li>- Complete dewatering of pump station with portable pump(s).</li> <li>- Install a tee, valves, and temporary piping in the storm water pump discharge line to divert flow to Digester Cleaning Bed 99</li> <li><u>CITY will:</u></li> <li>- Open butterfly valve between temporary piping and spare tee</li> <li>- Return plant wasting pumps to normal operation</li> </ul>	<p>Contractor will be responsible for routing the discharge from the storm water pump to one of the drainage gates on the West side of Digester Cleaning Bed 99 in the event it is not possible or recommended to pump the storm water directly into Digester Cleaning Bed 99</p> <p>Contractor shall schedule shutdown during April to September to take advantage of lower effluent flows</p>	

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.02 cont'd						<ul style="list-style-type: none"> <li>- Start temporary pumps at DAFT 5 and DAFT 6 effluent wet well</li> <li>- Return storm water pump to normal operation</li> </ul> <p><u>CONTRACTOR shall:</u></p> <ul style="list-style-type: none"> <li>- Install temporary plugs in both ends of 24" pipe between DAFT 5 and 6 effluent wet well and Centrate Pump Station</li> <li>- Modify Centrate Pump Station discharge piping as indicated in drawings and specifications</li> <li>- Apply chemical resistant coating to Centrate Pump Station as indicated in drawings and specifications</li> </ul> <p><u>CITY will:</u></p> <ul style="list-style-type: none"> <li>- Shut off plant wasting pumps</li> <li>- Shut off temporary pumps</li> </ul>		

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.02 cont'd						<ul style="list-style-type: none"> <li>- Close butterfly valve between temporary piping and spare tee</li>   <li>- Shut off storm water pump</li>   <li>CONTRACTOR shall:</li>   <li>- Remove blind flanges from discharges of Centrate Pump Station pumps 1, 2, and 3</li>   <li>- Remove temporary pumps</li>   <li>- Remove temporary plugs</li>   <li>- Remove temporary piping</li>   <li>- Reinstall blind flange on spare tee</li>   <li>- Remove temporary piping from storm water pump discharge to Digester Cleaning Bed 99</li> </ul>		

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.02 cont'd						<u>CITY shall:</u>  - Open butterfly valves at discharges of Centrate Pump Station pumps 1, 2, and 3.  - Return Centrate Pump Station pumps to normal operation  - Return storm water pump to normal operation  - Return plant wasting pumps to normal operation		

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.03	Demolition of DAF Piping and Installation of Centrate Flow Meter and CEN Piping at Tunnel 2.	<ul style="list-style-type: none"> <li>- DAFT 5, DAFT 6, DAFT 7 and/or DAFT 8</li> <li>- Thickener Effluent Wet Well</li> <li>- Decant Pump Station</li> <li>- Headworks Centrate/DAF Splitter Structure</li> </ul>	<ul style="list-style-type: none"> <li>- DAFT 5, DAFT 6, DAFT 7 and/or DAFT 8</li> <li>- Thickener Effluent Wet Well</li> </ul>	<ul style="list-style-type: none"> <li>- Decant Pump Station</li> <li>- Headworks Centrate/DAF Splitter Structure</li> </ul>	- None	<p><u>CITY will:</u></p> <ul style="list-style-type: none"> <li>- Shut down Decant Pump Station pumps</li> <li>- Close two 8" CEN plug valves east of Grit Basin No. 4</li> <li>- Open 20" butterfly valve and close 30" butterfly valve to divert Thickener Effluent Wet Well flow from Headworks to Plant 1A Aeration Basin No. 1</li> </ul> <p><u>CONTRACTOR shall:</u></p> <ul style="list-style-type: none"> <li>- Dewater Headworks Centrate/DAF Splitter Structure as needed</li> <li>- Install temporary plugs in twelve 30" DAF inlets to Headworks Centrate/DAF Splitter Structure.</li> </ul> <p><u>CITY will:</u></p> <ul style="list-style-type: none"> <li>- Open two 8" CEN plug valves east of Grit Basin No. 4</li> <li>- Start Decant Pump Station pumps</li> </ul> <p><u>CONTRACTOR shall:</u></p> <ul style="list-style-type: none"> <li>- Cut and drain existing</li> </ul>	<p>Reference sheets: G41, G61, M103</p> <p>Contractor shall be responsible for maintaining proper working conditions and safety personnel during the MOPO as identified in specifications</p> <p>Contractor shall provide spill mitigation during cutting and draining of existing DAF piping at Tunnel 2</p> <p>MOPO may require that feed to SHF centrifuges be temporarily stopped to prevent Decant Pump Station level from increasing</p>	Duration of each Decant Pump Station shut down to install/remove plugs – 2 hours

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.03 cont'd						<p>DAF piping</p> <ul style="list-style-type: none"> <li>- Demolish DAF piping in and adjacent to Tunnel 2 as shown on drawings.</li> <li>- Install CEN piping and flow meter as shown on drawings.</li> <li>- Clean, disinfect and test piping in accordance with specifications</li> </ul> <p><u>CITY will:</u></p> <p>Shut down Decant Pump Station pumps</p> <ul style="list-style-type: none"> <li>- Close two 8" CEN plug valves east of Grit Basin No. 4</li> </ul> <p><u>CONTRACTOR shall:</u></p> <ul style="list-style-type: none"> <li>- Dewater Headworks Centrate/DAF Splitter Structure as required</li> <li>- Remove 12 temporary plugs from 30" DAF inlets to Headworks Centrate/DAF Splitter Structure</li> </ul> <p><u>CITY will:</u></p> <p>Open two 8" CEN plug valves east of Grit Basin No. 4</p> <p>- Start Decant Pump</p>		

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.03 cont'd						Station pumps  - Open 30" butterfly valve and close 20" butterfly valve to divert Thickener Effluent Wet Well flow to Headworks		

Submittal Description: \_\_\_\_\_ Submittal No:<sup>1</sup> \_\_\_\_\_

Spec Section: \_\_\_\_\_

	Routing	Sent	Received
CITY:	Contractor/CM		
PROJECT:	CM/Engineer		
	Engineer/CM		
CONTRACTOR:	CM/Contractor		

We are sending you ☐ Attached ☐ Under separate cover via \_\_\_\_\_  
☐ Submittals for review and comment ☐ Product data for information only

Remarks: \_\_\_\_\_

Item	Copies	Date	Section No.	Description	Review action <sup>a</sup>	Reviewer initials	Review comments attached

<sup>a</sup>Note: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected Attach additional sheets if necessary.**Contractor**

Certify either A or B:

- ☐ A. We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).
- ☐ B. We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.	Deviation

Certified by: \_\_\_\_\_

Contractor's Signature

<sup>1</sup>See paragraph 01300-4.0 A, Transmittal Procedure.

## 01660-A. EQUIPMENT TEST REPORT FORM

NOTE: This example equipment test report is provided for the benefit of the Contractor and is not specific to any piece of equipment to be installed as a part of this project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test report forms for this project.

## CITY OF SAMPLE

**EXAMPLE WATER TREATMENT PLANT  
STAGE IV EXPANSION PROJECT**

ABC Construction Company, Inc., General Contractor  
XYZ Engineering, Inc., Engineer

## EQUIPMENT TEST REPORT

Equipment Name: Sludge Pump 2  
 Equipment Number: P25202  
 Specification Ref: 11390  
 Location: East Sedimentation Basin Gallery

	Contractor		Engineer	
	Verified	Date	Verified	Date
<b>PREOPERATIONAL CHECKLIST</b>				
<u>Mechanical</u>				
Lubrication				
Alignment				
Anchor bolts				
Seal water system operational				
Equipment rotates freely				
Safety guards				
Valves operational				
Hopper purge systems operational				
Sedimentation tank/hopper clean				
O&M manual information complete				
Manufacturer's installation certificate complete				
<u>Electrical</u> (circuit ring-out and high-pot tests)				
Circuits:				
Power to MCC 5				
Control to HOA				

	Contractor		Engineer	
	Verified	Date	Verified	Date
Indicators at MCC:				
Red (running)				
Green (power)				
Amber (auto)				
Indicators at local control panel				
Wiring labels complete				
Nameplates:				
MCC				
Control station				
Control panel				
Equipment bumped for rotation				
<u>Piping Systems</u>				
Cleaned and flushed:				
Suction				
Discharge				
Pressure tests				
Temporary piping screens in place				
<u>Instrumentation and Controls</u>				
Flowmeter FE2502F calibration				
Calibration Report No.				
Flow recorder FR2502G calibrated against transmitter				
VFD speed indicator calibrated against independent reference				
Discharge overpressure shutdown switch calibration				
Simulate discharge overpressure Shutdown				
<b>FUNCTIONAL TESTS</b>				
<u>Mechanical</u>				
Motor operation temperature satisfactory				
Pump operating temperature satisfactory				
Unusual noise, etc.?				
Pump operation: 75 gpm/50 psig				
Measurement:				
Flow:				
Pressure:		Test gage number:		
Alignment hot				
Dowelled in				
Remarks:				

	Contractor		Engineer	
	Verified	Date	Verified	Date
<u>Electrical</u>				
Local switch function:				
Runs in <i>HAND</i>				
No control power in <i>OFF</i>				
Timer control in <i>AUTO</i>				
Overpressure protection switch PS2502C functional in both <i>HAND</i> and <i>AUTO</i>				
Overpressure protection switch PS2502C set at 75 psig				
PLC 2500 set at 24-hour cycle, 25 min <i>ON</i>				
<b>OPERATIONAL TEST</b>				
48-hour continuous test. Pump cycles as specified, indicators functional, controls functional, pump maintains capacity, overpressure protection remains functional, hour meter functional				

RECOMMENDED FOR BENEFICIAL OCCUPANCY

\_\_\_\_\_

Engineer \_\_\_\_\_ Date \_\_\_\_\_

ACCEPTED FOR BENEFICIAL OCCUPANCY

\_\_\_\_\_

City's Representative \_\_\_\_\_ Date \_\_\_\_\_

# 01730-A. OPERATION AND MAINTENANCE TRANSMITTAL FORM

Date: \_\_\_\_\_ Submittal No.:<sup>2</sup> \_\_\_\_\_  
 To: \_\_\_\_\_ Contract No: \_\_\_\_\_  
 \_\_\_\_\_ Spec. Section: \_\_\_\_\_  
 \_\_\_\_\_ Submittal Description: \_\_\_\_\_  
 \_\_\_\_\_ From: \_\_\_\_\_  
 Attention: \_\_\_\_\_

Checklist	Contractor		Engineer	
	Satisfactory	N/A	Accept	Deficient
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and post shutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks: \_\_\_\_\_

\_\_\_\_\_  
Contractor's Signature

<sup>2</sup>See paragraph 01300-4.0 A, Transmittal Procedure.

## 01730-B. EQUIPMENT RECORD FORM

EQUIP DESCRIP		EQUIP LOC	
EQUIP NO.	SHOP DWG NO.	DATE INST	COST
MFGR		MFGR CONTACT	
MFGR ADDRESS			PHONE
VENDOR		VENDOR CONTACT	
VENDOR ADDRESS			PHONE

MAINTENANCE REQUIREMENTS	D	W	M	Q	S	A	Hours
LUBRICANTS: RECOMMENDED:							
ALTERNATIVE:							
MISC. NOTES:							

RECOMMENDED SPARE PARTS			
PART NO	QUAN	PART NAME	COST

ELECTRICAL NAMEPLATE DATA			
EQUIP			
MAKE			
SERIAL NO.		ID NO.	
MODEL NO.		FRAME NO.	
HP	V	AMP	HZ
PH	RPM	SF	DUTY
CODE	INSL. CL	DES	TYPE
NEMA DES	C AMB	TEMP RISE	RATING
MISC.			
MECHANICAL NAMEPLATE DATA			
EQUIP			
MAKE			
SERIAL NO.		ID NO.	
MODEL NO.		FRAME NO.	
HP	RPM	CAP	SIZE
TDH	IMP SZ	BELT NO.	CFM
PSI	ASSY NO.	CASE NO.	
MISC			

EQUIP DESCRIP		EQUIP LOC	
EQUIP NO.	SHOP DWG NO.	DATE INST	COST
MFGR		MFGR CONTACT	
MFGR ADDRESS			PHONE
VENDOR		VENDOR CONTACT	
VENDOR ADDRESS			PHONE

Reference Forms  
SWWRF & SEWRF Belt Filter Rehabilitation Design

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# 09900-A COATING SYSTEM INSPECTION CHECKLIST

09900-A Coating System Inspection Checklist			
Project Name			
City		Coating System Manufacturer (CSM)	
General Contractor (GC)		Coating System Applicator (CSA)	
Area or Structure		Location within Structure	
Coating System (e.g. E-1)		Coating Type (e.g. Epoxy, etc.)	

Step	Description		Name	Signature	Date
1	Completion of cleaning and substrate decontamination prior to abrasive blast cleaning.	GC QC			
		CSM QC			
		CSA QC			
2	Installation of protective enclosure of structure or area and protection of adjacent surfaces or structures that are not to be coated.	GC QC			
		CSM QC			
		CSA QC			
3	Completion of ambient condition control in structure or building area and acceptance of ventilation methods in structure or Area.	GC QC			
		CSM QC			
		CSA QC			
4	Completion of Surface Preparation for Substrates to Be Coated.	GC QC			
		CSM QC			
		CSA QC			
5	Completion of Primer Application.	GC QC			
		CSM QC			
		CSA QC			
6	Completion of Concrete Repairs If Required and Related Surface Preparation Rework Prior to Coating System Application.	GC QC			
		CSM QC			
		CSA QC			

Step	Description		Name	Signature	Date
7	Completion of Concrete Filler/ Surface Application to Concrete.	GC QC			
		CSM QC			
		CSA QC			
8	Completion of First Finish Coat Application and of Detail Treatment at Transitions or Terminations.	GC QC			
		CSM QC			
		CSA QC			
9	Completion of Second Finish Coat Application and of Detail Treatment at Transitions and Terminations.	GC QC			
		CSM QC			
		CSA QC			
10	Completion of Full and Proper Cure of Coating System.	GC QC			
		CSM QC			
		CSA QC			
11	Completion of Testing of Cured Coating System including Adhesion, Holiday (Continuity) Testing and Dry Film Thickness.	GC QC			
		CSM QC			
		CSA QC			
12	Completion of Localized Repairs to Coating System Following Testing.	GC QC			
		CSM QC			
		CSA QC			
13	Final Acceptance of Coating System Installation Including Final Clean-Up Complying with Specification Requirements and the CSM's Quality Requirements.	GC QC			
		CSM QC			
		CSA QC			

11000-A. MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No: \_\_\_\_\_ Specification section: \_\_\_\_\_

Equipment name: \_\_\_\_\_

Contractor: \_\_\_\_\_

Manufacturer of equipment item: \_\_\_\_\_

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Date

\_\_\_\_\_  
Manufacturer

\_\_\_\_\_  
Signature of Authorized Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Signature of Authorized Representative

# 11000-B. MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No: \_\_\_\_\_ Specification section: \_\_\_\_\_

Equipment name: \_\_\_\_\_

Contractor: \_\_\_\_\_

Manufacturer of equipment item: \_\_\_\_\_

The undersigned manufacturer certifies that a service engineer has instructed the wastewater treatment plant operating personnel in the proper maintenance and operation of the equipment designated herein.

<u>Operations Check List</u> (check appropriate spaces)	
Start-up procedure reviewed	
Shutdown procedure reviewed	
Normal operation procedure reviewed	
Others:	
<u>Maintenance Check List</u> (check appropriate spaces)	
Described normal oil changes (frequency)	
Described special tools required	
Described normal items to be reviewed for wear	
Described preventive maintenance instructions	
Described greasing frequency	
Others:	

\_\_\_\_\_  
Date

\_\_\_\_\_  
Manufacturer

\_\_\_\_\_  
Signature of Authorized Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of City's Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Contractor's Representative

(Project Title)

**CERTIFICATE OF UNIT RESPONSIBILITY**

for Specification Section \_\_\_\_\_

(Section title)

***In accordance with paragraph 11000-1.02 C of the contract documents, the undersigned manufacturer of driven equipment ("manufacturer") accepts unit responsibility for all components of equipment furnished to the Project under specification Section \_\_\_\_\_, and for related equipment manufactured under Sections \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.***

*We have reviewed the requirements for Sections 11000 (and 11050 where applicable) and all sections referencing this (these) section(s), including but not limited to drivers, supports for driving and driven equipment and all other specified appurtenances to be furnished to the Project by manufacturer. And, we have further reviewed, and modified as necessary, the requirements for associated variable speed drives and motor control centers. We hereby certify that all specified components are compatible and comprise a functional unit suitable for the specified performance and design requirements whether or not the equipment was furnished by us. We will make no claim nor establish any condition that problems in operation for the product provided under this specification Section \_\_\_\_\_ are due to incompatibility of any components covered by this Certificate of Unit Responsibility. Nor will we condition or void any warranty for the performance of the product of this specification Section \_\_\_\_\_ due to incompatibility of any components covered under this Certificate of Unit Responsibility.*

*Our signature on this Certificate of Unit Responsibility does not obligate us to take responsibility for, nor to warrant the workmanship, quality, or performance of related equipment provided by others under specification Sections \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_. Our obligation to warranty all equipment provided by us shall remain unaffected.*

\_\_\_\_\_  
Notary Public\_\_\_\_\_  
Name of Corporation\_\_\_\_\_  
Commission expiration date\_\_\_\_\_  
Address

Seal:

By: \_\_\_\_\_  
Duly Authorized Official\_\_\_\_\_  
Legal Title of Official

Date: \_\_\_\_\_

# 11002-A. RIGID EQUIPMENT MOUNT INSTALLATION CHECKLIST

(CLIENT, PROJECT NAME)

Equipment Tag No.: \_\_\_\_\_ Date: \_\_\_\_\_

Grout Product Name and Type: \_\_\_\_\_

Grouting System Manufacturer: \_\_\_\_\_

Grouting Application Contractor: \_\_\_\_\_

General Contractor: \_\_\_\_\_

## **Step 1: Verify Equipment Anchor Installation Conformance to Equipment Pad Details**

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Contractor Rep.

Name: \_\_\_\_\_ Name: \_\_\_\_\_  
Engineer Millwright

## **Step 2: Completion of Cleaning and Concrete Substrate Preparation Prior to Grouting**

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Contractor Rep.

Name: \_\_\_\_\_ Name: \_\_\_\_\_  
Engineer Grouting Contractor Rep.

Name: \_\_\_\_\_  
Grout Manufacturer's Technical Rep.

## **Step 3: Equipment Leveling**

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Contractor Rep.

Name: \_\_\_\_\_ Name: \_\_\_\_\_  
Engineer Millwright

Name: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_  
Contractor Rep.

Name: \_\_\_\_\_ Name: \_\_\_\_\_  
Engineer Grouting Contractor Rep.

Name: \_\_\_\_\_  
Grout Manufacturer's Technical Rep.

Name: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_  
Contractor Rep.

Name: \_\_\_\_\_ Name: \_\_\_\_\_  
Engineer Grouting Contractor Rep.

Name: \_\_\_\_\_  
Grout Manufacturer's Technical Rep.

Name: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_  
Contractor Rep.

Name: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_  
Grouting Contractor Rep.

Name: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_  
Grout Manufacturer's Technical Rep.

Name: \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_  
Engineer

### Step 7: Epoxy Grout Installation

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Contractor Rep.

Name: \_\_\_\_\_ Name: \_\_\_\_\_  
Engineer Grouting Contractor Rep.

Name: \_\_\_\_\_  
Grout Manufacturer's Technical Rep.

### Step 8: Completion of Full and Proper Cure of Epoxy Grout

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Contractor Rep.

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Grouting Contractor Rep.

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Grout Manufacturer's Technical Rep.

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Engineer

### Step 9: Completion of Localized Repair of Grout Voids

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Contractor Rep.

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Grouting Contractor Rep.

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Grout Manufacturer's Technical Rep.

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Engineer

**Step 10: Final Acceptance of Grouting System Installation Including Final Clean-Up of the Work Site Complying with All Specification Requirements and the GSM's Quality Requirements**

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Contractor Rep.

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Grouting Contractor Rep.

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Grout Manufacturer's Technical Rep.

Name: \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
Engineer

# 11060-A. MOTOR DATA FORM

Equipment Name: \_\_\_\_\_ Equipment No(s): \_\_\_\_\_

Project Site Location: \_\_\_\_\_

## Nameplate Markings

Mfr:		Mfr Model:		Frame:		Horsepower:	
Volts:		Phase:		RPM:		Service Factor:	
FLA:		LRA:		Frequency:		Amb Temp Rating:	°C
Time rating:				Design Letter:			
	(NEMA MG1-10.35)				(NEMA MG-1.16)		
KVA Code Letter:				Insulation Class:			

The following information is required for explosion-proof motors only:

- A. Approved by UL for installation in Class \_\_\_\_\_, Div \_\_\_\_\_, Group \_\_\_\_\_
- B. UL frame temperature code \_\_\_\_\_ (NEC Tables 500-8B)

The following information is required for all motors 1/2 horsepower and larger:

- A. Guaranteed minimum efficiency \_\_\_\_\_  
(Paragraph 11060-2.04 G)
- B. Nameplate or nominal efficiency \_\_\_\_\_

## Data Not Necessarily Marked on Nameplate

Type of Enclosure:				Enclosure Material:			
Temp Rise:	°C (NEMA MG1-12.41,42)						
Space Heater included?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If Yes:	Watts	Volts		
Type of motor winding over-temperature protection, if specified:							

Provide information on other motor features specified:

\_\_\_\_\_

# 15000-A. LUBRICATION RECORD

Description:		TAG:	
System:		P&ID:	
	<b>Driven Equipment</b>	<b>_____Coupling _____Chain</b>	<b>Driver Equipment</b>
Grease Manufacturer			
Grease Type			
Oil Manufacturer			
Factory Lube (Inspected)			
Date Lubricated			
Tag Installed			
Lube Quantity			
<b>Additional Checks and Remarks as Required</b> (Inspection frequencies and items which require special maintenance)			
Approved by: _____ Dept: _____ Date: _____			
Performed by: _____ Dept: _____ Date: _____			

15000-B. ALIGNMENT RECORD

Description:		TAG:
System:		P&ID:
<b>Equipment Data</b>	<b>Driven</b>	<b>Driver</b>
Manufacturer		
Serial Number		
Tag Number		
Sheave Alignment (Belt or chain driven)		
Pipe Strain Values (If applicable)		
<div style="display: flex; justify-content: space-between; margin-bottom: 10px;"> <span><b>FACE</b></span> <span><b>OUTSIDE DIAMETER</b></span> </div>		
<b>Viewed from Driver End</b>		
<b>Manufacturer's Tolerance:</b> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <span>FACE: _____</span> <span>CD: _____</span> <span>GAP: _____</span> </div>		
<b>Remarks:</b> <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div> <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div>		
Performed by: _____ Dept: _____ Date: _____		
Approved by: _____ Dept: _____ Date: _____		

## 15000-C. INSPECTION REPORT FAN/BLOWER

Description:			TAG:			
System:			P&ID:			
Manufacturer			S/N			
Type			Model			
Size			Capacity			
RPM						
<b>Equipment Test Data</b>						
Bearing Temperatures:			Measured RPM			
Inboard: _____		Outboard: _____				
Rotation Viewed from Motor End			Motor AMPS (At Test Condition) CW			
CCW						
<b>Vibration Data (Draw arrows where taken)</b>						
Points	A	B	C	D	E	
Horiz.						
Vert.						
Axial						
Units of Measure: _____			<b>Sketch of Equipment</b>			
<b>Fan Data:</b>						
MFG.	Fan Size		Blade Pitch Angle			
S/N	Fan Type		Motor HP			
M/N						
<b>Completeness Checklist:</b>						
Alignment		Date:		Initials:		
Drive Guard		Date:		Initials:		
Shaft Free to Rotate		Date:		Initials:		
Blower Lobe Clearance		Date:		Initials:		
Balance		Date:		Initials:		
<b>Remarks:</b>						
Approved by: _____ Dept: _____ Date: _____						
Performed by: _____ Dept: _____ Date: _____						

01999-35

# 15000-D. MECHANICAL EQUIPMENT DATA RECORD

Description:		TAG:			
System:		P&ID:			
<b>Name Plate Data: (Driven equipment)</b> see motor acceptance for motor information.					
Manufacturer		S/N			
Type		Model			
Size		Capacity			
RPM					
<b>Equipment Test Data</b>					
Suction Pressure		Suction Temperature			
Discharge Pressure		Discharge Temperature			
Bearing Temperatures: Inboard: _____ Outboard: _____		Measured RPM			
Rotation Viewed from Motor End CW                      CCW		Motor AMPS (At Test Condition)			
<b>Vibration Data (Draw arrows where taken)</b>					
Points	A	B	C	D	E
Horiz.					
Vert.					
Axial					
Units of Measure: _____			<b>Sketch of Equipment</b> <div style="border: 1px solid black; height: 100px; width: 100%;"></div>		
<b>Remarks:</b> <div style="border: 1px solid black; height: 40px; width: 100%;"></div>					
<b>Performed by:</b> _____ <b>Date</b> _____					
<b>Approved by:</b> _____ <b>Date</b> _____					

15000-E. FINAL TANK AND VESSEL INSPECTION

Description:		TAG:
System:		P&ID:
<b>Tank Name Plate Data</b>		
Manufacturer		
Type		
Size/Capacity		
Design Pressure		
<b>Inspection Items</b>		
	<b>Verified By</b>	<b>Date</b>
Clean		
Dry		
Grounding		
Coating		
Pipe Connections		
Cathodic Protection		
<b>Heater Checkout</b>		
Equipment Number		
Heater Coil Resistance	OHMS	
Thermostat Setting	Degrees	
Amperage in Service	Amps	
<b>Remarks:</b>		
Performed by: _____ Dept: _____ Date: _____		
Approved by: _____ Dept: _____ Date: _____		

# 15000-F. PIPING INSPECTION REPORT

Description:	Tag:	
System:	P&ID:	
<b>READY FOR FINAL INSPECTION</b>  Approved by: _____ Dept: _____ Date: _____  Verify the following as meeting the drawings and applicable piping specification. (Verification to be 100% unless otherwise noted) [R] = Random (Approx. 10% of installed quantities)		
Item	Initials	Remarks
[R] Material check (pipe and fittings)		
[R] Studs / Bolts (material and type) 1-1 1/2 thread minimum protrusion from both nuts		
[R] Gaskets (type & rating)		
[R] Valves / in line components (Tag & Rating)		
Welding visual		
Nondestructive testing		
Post weld heat treatment		
Supports (attach verification sheets)		
<b>Note: 100% verification required for studs, gaskets, and valves for HPS and HP feedwater systems.</b>		
<b>Comments / Exceptions:</b>  <div style="border: 1px solid black; height: 20px; margin-top: 5px;"></div>		
<b>Released for pressure test or system turnover:</b>  Performed by: _____ Dept: _____ Date: _____		
Approved by: _____ Dept: _____ Date: _____		

# 15000-G. PRESSURE TEST REPORT

Description:		Tag:	
System:		P&ID:	
Applicable Code/Section			
Above Ground			
Design Pressure:			
Test Method:	Hydrostatic	Pneumatic	In Service
Required Test Pressure:			
Inspection Test Pressure:			
Required Time Pressure Test Held:			
Time Test Started:		Time Test Completed:	
<b>Remarks:</b>			
<b>Calibration Data</b>			
Gauge No: _____ Calibration Date: _____			
Performed by: _____ Dept.: _____ Date: _____			
Approved by: _____ Dept.: _____ Date: _____			

15000-H. HEAT TRACE RECORD

System:							
Heat Trace Circuit No.	Power Supply Panel No.	Ring Out	Hook Up	Amps	Thermostat Setpoint	Post Insul. Megger Readings	In-Service Initials/Date
Performed by: _____ Dept.: _____ Date: _____							
Approved by: _____ Dept.: _____ Date: _____							

15000-I. SYSTEM FLUSH REPORT

System:	P&ID:
Flushing Fluid:	
<b>Description of Flush:</b>	
<b>Note: Verify that all critical piping not flushed is acceptably clear.</b>	
Performed by: _____ Dept.: _____ Date: _____	
Approved by: _____ Dept.: _____ Date: _____	

16000-A. WIRE AND CABLE RESISTANCE TEST DATA FORM

Wire or Cable No.: \_\_\_\_\_ Temperature, °F: \_\_\_\_\_

Location of Test	Insulation resistance, megohms
1.	
2.	
3.	
4.	
5.	
6.	
7	

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

# 16000-B. INSTALLED MOTOR TEST FORM

Motor Equipment Number: \_\_\_\_\_ Date of test: \_\_\_\_\_

Equipment Driven: \_\_\_\_\_

MCC Location: \_\_\_\_\_

				Ambient temp	°F
Resistance:					
Insulation resistance phase-to-ground megohms:					
Phase A		Phase B		Phase C	
Current at Full Load:					
Phase		Current, amps			
Phase		Current, amps			
Phase		Current, amps			
Thermal Overload Device:	Manufacturer/catalog #			Amperes	
Circuit breaker (MCP) setting:					

Motor Nameplate Markings:

Mfr		Mfr Model		Frame		HP	
Volts		Phase		RPM		Service factor**	
Amps		Freq		Ambient temp rating		°C	
Time rating				Design letter**			
	(NEMA 1-10.35)				(NEMA MG-1.16)		
Code letter				Insulation class			

\*\*Required for 3-phase squirrel cage induction motors only.

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

# 16000-C. DRY TRANSFORMER TEST DATA FORM

(Note: Use Data Form for dry type transformers with voltage rating of 600 Vac or less and sizes to 167 kVA single phase and 500 kVA three phase. Use NETA Test Forms and Test Procedures for higher voltages and larger transformers.)

Equipment Tag No.: \_\_\_\_\_ Temperature Rating: \_\_\_\_\_

Description/Location: \_\_\_\_\_ Feeder size/Source: \_\_\_\_\_

Primary Voltage: \_\_\_\_\_ Secondary Voltage: \_\_\_\_\_ Winding Connection: \_\_\_\_\_

## A. VISUAL INSPECTION

Transformer Inspection	Pass	Fail	Note
1. Nameplate data as specified			
2. Mechanical condition			
a. Free of dents and scratches			
b. Anchored properly			
c. Shipping brackets removed			
d. Spacing from wall per nameplate			
3. Grounding *			
a. Equipment grounding			
b. System grounding			

## B. INSULATION-RESISTANCE TESTS:

Perform tests with calibrated megohmmeter. Apply 1000 Vdc test voltage for 60 seconds and record readings in megohms at 30-seconds and 60-seconds intervals.

Test Group	Resistance between		30-second reading	60-second reading	Absorption Ratio Index 60-sec. / 30-sec.
Primary Winding to ground	A	GRD			
	B	GRD			
	C	GRD			
Secondary Winding to ground with * N-G Bond removed	a	GRD			
	b	GRD			
	c	GRD			
Primary Winding to Secondary Winding	A	a			
	B	b			
	C	c			

Submit resistance readings to the Engineer immediately after the tests that are less than the manufacturer's recommended value or less than 10-megohms. Record the Absorption Ratio Index values for future reference. Ratio must be 1.0 or greater, with infinity ( $\infty$ ) equal to 1.0.

Contractor Representative Certified: \_\_\_\_\_ Date \_\_\_\_\_

City Representative Witnessed: \_\_\_\_\_ Date \_\_\_\_\_

# 16000-D. MOTOR CONTROL CENTER TEST FORM

Equipment No.: \_\_\_\_\_ Ambient room temperature: \_\_\_\_\_

Location: \_\_\_\_\_

## A. MECHANICAL CHECK:

All bolted connections either bus to bus or cable to bus shall be torqued to the manufacturer's recommendations.

## B. ELECTRICAL TESTS:

1. Measure insulation resistance of each bus section phase to phase and phase to ground for 1 minute using a megohmmeter at 1000 volts.

Test results (megohms)			
Phase		Phase	
A-GRD		A-B	
B-GRD		B-C	
C-GRD		C-A	

2. Set the circuit breaker in the starter unit to comply with the requirements of NEC, Article 430-52 and Table 430-152.
3. Motor overload heater elements shall be sized and installed based on the actual nameplate full load amperes of the motor connected to the starter.

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

# 16000-E. MEDIUM VOLTAGE MOTOR STARTER TEST FORM

Equipment No.: \_\_\_\_\_

Location: \_\_\_\_\_

Room Temperature: \_\_\_\_\_

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms)

Phase:	A		B		C	
--------	---	--	---	--	---	--

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

3. Perform minimum pickup voltage tests on trip and close coils.
4. Motor RTDs shall be tested by using a hot oil bath. The temperature at which the sensor trips shall be recorded for each RTD.
5. The Contactor shall be tripped by operation of each protective device.

# 16000-F. MEDIUM VOLTAGE SWITCHGEAR TEST FORM

Equipment No.: \_\_\_\_\_

Location: \_\_\_\_\_

Room Temperature: \_\_\_\_\_

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms).

Phase:	A		B		C	
--------	---	--	---	--	---	--

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

3. Perform minimum pickup voltage tests on trip and close coils.
4. Verify the instrument transformer ratios. Check the transformer's polarity electrically.
5. The Contactor shall be tripped by operation of each protective device.

## 16000-G. PROTECTIVE RELAY TEST FORM

Location: \_\_\_\_\_

Switchgear Breaker No.: \_\_\_\_\_

Protective Relay Description: \_\_\_\_\_

The protective relays shall be tested in the following manner:

1. Each protective relay circuit shall have its insulation resistance tested to ground.
2. Perform the following tests on the specified relay setting:
  - a. Pickup parameters on each operating element.
  - b. Timing test shall be performed at three points on the time dial curve.
  - c. Pickup target and seal-in units.

The results shall be recorded and signed. A copy shall be given to the Engineer in accordance with paragraph 16000-1.05 B.

# 16000-H. LOW VOLTAGE SWITCHGEAR TEST FORM

Equipment No.: \_\_\_\_\_

Location: \_\_\_\_\_

Room Temperature: \_\_\_\_\_

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms).

Phase:	A		B		C	
--------	---	--	---	--	---	--

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

3. Minimum pickup current shall be determined by primary current injection.
4. Long time delay shall be determined by primary injection at three hundred percent (300%) pickup current.
5. Short time pickup and time delay shall be determined by primary injection of current.
6. Instantaneous pickup current shall be determined by primary injection.
7. Trip unit reset characteristics shall be verified.
8. Auxiliary protective devices, such as ground fault or under voltage relays, shall be activated to ensure operation of shunt trip devices.

# 16000-I. MEDIUM VOLTAGE LOAD INTERRUPTER SWITCH TEST FORM

Equipment Number: \_\_\_\_\_

Location: \_\_\_\_\_

Date: \_\_\_\_\_

1. Measure switch blade resistance (micro-ohms).

Phase:	A		B		C	
--------	---	--	---	--	---	--

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

The results shall be recorded and signed. A copy shall be given to the Engineer in accordance with paragraph 16000-2.06 B.

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

## 16000-J. LIQUID-FILLED TRANSFORMER TEST FORM

Equipment Number: \_\_\_\_\_

Location: \_\_\_\_\_

Date/Weather Conditions: \_\_\_\_\_

- A. Perform the "Insulation-Resistance Test" and "Dielectric Absorption Test" using Form 16000-C, Dry Transformer Test Data Form.
- B. Perform an applied voltage (low frequency dielectric) test in accordance with ANSI C57.12.90, paragraph 10.5, Applied Voltage Test. Applied voltage levels shall be 75 percent of recommended factory test levels or recommended test levels of ANSI C57.12.00, Table 5.
- C. Insulating oil shall be sampled and shall be laboratory tested for the following:
  - 1. Dielectric strength.
  - 2. Acid neutralization.
  - 3. Interfacial tension.
  - 4. Color.
  - 5. Power factor.
- D. Perform a turns ratio test between the windings for all tap positions.
- E. The temperature and pressure switches shall be tested using a hot oil bath and air pump.
- F. The results shall be recorded and signed by the Contractor and Engineer. A copy shall be given to the Engineer in accordance with paragraph 16000-2.06 D. Any readings which are abnormal to ANSI industry standards shall be reported to the Engineer.

# 16000-K. AUTOMATIC TRANSFER SWITCH TEST FORM

Equipment Number: \_\_\_\_\_

Location: \_\_\_\_\_

Date: \_\_\_\_\_

1. Perform an insulation resistance test (1000 volts DC for 1 minute):

Phase	A		B		C		
Pole to ground							megohms
Pole to pole	AB		BC		CA		megohms

2. Perform the following operations and initial:

- a. Manual transfer \_\_\_\_\_
- b. Loss of normal power; \_\_\_\_\_sec delay
- c. Return to normal power; \_\_\_\_\_sec delay

The results shall be recorded and signed. A copy shall be given to the Engineer in accordance with paragraph 16000-2.06 B.

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

## 16000-L. NEUTRAL GROUNDING RESISTOR TEST

Equipment No.: \_\_\_\_\_

Location: \_\_\_\_\_

The pickup and time delay setting on the ground fault relay shall be set in accordance with Section 16431.

1. The transformer neutral insulation resistance shall be measured with and without the grounding resistor connected to insure no parallel ground paths exist.
2. The protective relay pickup current shall be determined by injecting test current into the current sensor. The pickup current should be within 10 percent of the dial setting. Record the dial setting and actual pickup tie.
3. The relay timing shall be tested by injecting 150 and 300 percent of pickup current into the current sensor. The relay timing shall be in accordance with the manufacturer's published time-current characteristic curves. Record the relay timing at 150 and 300 percent of pickup current.
4. The circuit interrupting device shall be operated by operating the relay.

The results shall be recorded and signed by the Contractor and Engineer. A copy shall be given to the Engineer in accordance with paragraph 16000-2.06 B.

# 17000-A. LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM

Loop No.: \_\_\_\_\_

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

Wire No.	Panel Tie	Field TB	Continuity Resistance <sup>a</sup>		Insulation Resistance <sup>b</sup>			
			Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A			--	(A/SH)				
B			(A/B)	--				
C			(A/C)	--				
D			(A/D)	--				
etc.								

## NOTES:

- Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of  $\pm 2$  ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.
- Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

## 17000-B. CONTROL CIRCUIT PIPING LEAK TEST FORM

Loop No.: \_\_\_\_\_

List tubing associated with loop in table below. Make applicable measurements after isolating any air consuming pilots from circuit.

Tube No.	Tubing Equivalent Length of 1/4-Inch Copper <sup>a</sup>	Test Period (seconds)	Permitted Pressure Drop (psi) <sup>b</sup>	Measured Pressure Drop (psi)
A				
B				
C				
D				
etc.				

### NOTES:

- a. Convert actual tubing and air motor volume to equivalent 1/4-inch copper tubing.
- b. Pressure drop shall not exceed 1 psi per hundred feet 1/4-inch tubing per 5 seconds.

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

# 17000-C. CONTROLLER CALIBRATION TEST DATA FORM

Tag No. and Description: \_\_\_\_\_

Make & Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Input: \_\_\_\_\_ Process Variable (PV) Scale: \_\_\_\_\_

Output: \_\_\_\_\_ Output Scale: \_\_\_\_\_

## PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
% Deviation Allowed:				

Connect output to PV for following tests:

Set Point (SP) Indicator Accuracy			Output Meter Accuracy			Controller Accuracy		
SP	PV Reading	Expected % Dev.	Actual Reading	Expected Reading	Actual % Dev.	Output	Output	% Dev.
(0%)								
(50%)								
(100%)								
% Deviation Allowed:			% Deviation Allowed:			% Deviation Allowed:		

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

# 17000-D. PANEL INDICATOR CALIBRATION TEST DATA FORM

Tag No. and Description: \_\_\_\_\_

Make & Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Input: \_\_\_\_\_

Scale: \_\_\_\_\_ Range: \_\_\_\_\_

## PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
% Deviation Allowed:				

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

17000-E. RECORDER CALIBRATION TEST DATA FORM

Tag No. and Description: \_\_\_\_\_

Make & Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Input: \_\_\_\_\_ Chart: \_\_\_\_\_

Scale: \_\_\_\_\_ Range: \_\_\_\_\_

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
% Deviation Allowed:				

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

# 17000-F. SIGNAL TRIP CALIBRATION TEST DATA FORM

Tag No. and Description: \_\_\_\_\_

Make & Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Input: \_\_\_\_\_

Scale: \_\_\_\_\_ Range: \_\_\_\_\_

Set Point(s): \_\_\_\_\_

After setting set point(s), run signal input through entire range and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

# 17000-G. FIELD SWITCH CALIBRATION TEST DATA FORM

Tag No. and Description: \_\_\_\_\_

Make & Model No.: \_\_\_\_\_ Serial No: \_\_\_\_\_

Input: \_\_\_\_\_

Range: \_\_\_\_\_

Set Point(s): \_\_\_\_\_

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

# 17000-H. TRANSMITTER CALIBRATION TEST DATA FORM

Tag No. and Description: \_\_\_\_\_

Make & Model No.: \_\_\_\_\_ Serial No.: \_\_\_\_\_

Input: \_\_\_\_\_

Output: \_\_\_\_\_

Range: \_\_\_\_\_ Scale: \_\_\_\_\_

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
% Deviation Allowed:				

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

# 17000-I. MISCELLANEOUS INSTRUMENT CALIBRATION TEST DATA FORM

(For instruments not covered by any of the preceding test forms, the Contractor shall create a form containing all necessary information and calibration procedures.)

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

## 17000-J. INDIVIDUAL LOOP TEST DATA FORM

Loop No.: \_\_\_\_\_

Description: (Give complete description of loop's function using tag numbers where appropriate.)

P&ID No.: (Attach copy of P&ID.)

- a.     Wiring tested:  
       (Attach test form 17000-A)
- b.     Instrumentation tubing/piping tested:  
       (Attach test form 17000-B)
- c.     Instruments calibrated:  
       (Attach test forms 17000-C through I)
- d.     List step-by-step procedures for testing loop parameters. Test loop with instruments, including transmitters and control valves, connected and functioning. If it is not possible to produce a real process variable, then a simulated signal may be used with the Engineer's approval.

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

# 17000-K. LOOP COMMISSIONING TEST DATA FORM

Loop No.: \_\_\_\_\_

- a. Loop tested:  
(Attach test form 17000-J)
- b. Controlled or connected equipment tests confirmed:
- c. Give complete description of loop's interface with process.
- d. With associated equipment and process in operation, provide annotated chart trace of loop response to changes in set points for verification of performance. This chart should demonstrate 1/4-amplitude damping as output adjusts to set point change. Show set points, starting and finishing times on chart, as well as any other pertinent data.

Connect 2-pen recorder to process variable (PV) and to controller output. Use 1 inch/second chart speed.

Pen 1 - PV - Connections:

Pen 2 - Output - Connections:

CERTIFIED \_\_\_\_\_ Date \_\_\_\_\_  
Contractor's Representative

WITNESSED \_\_\_\_\_ Date \_\_\_\_\_  
City's Representative

**\*\*END OF SECTION\*\***

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## SECTION 02064

### MODIFICATIONS TO EXISTING STRUCTURES, PIPING AND EQUIPMENT

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to modify, alter and/or convert existing structures as shown or specified and as required for the installation of piping, mechanical equipment and appurtenances. Existing piping and equipment shall be removed and dismantled as necessary for the performance of facility alterations in accordance with the requirements herein specified.

#### PART 2 PRODUCTS

- A. Epoxy mortar shall be fiberglass fiber mixed with an epoxy filler.
- B. Non-shrink grout shall be a sand-cement, non-metallic formulation, having a 28-day strength of 4,000 psi and 0.0 percent shrinkage per ASTM C1090.
- C. Liners to be installed in existing manholes and wetwells shall be spray-applied, monolithic, reinforced urethane resin. Urethane resin-based manhole liner material shall be resistant to hydrogen sulfide gas, and other common contents found in a sanitary sewer environment.
- D. Approved manhole and wet well liner products are Raven 405, SprayWall, Green Monster, or SpectraShield.

#### PART 3 EXECUTION

##### 3.01 GENERAL

- A. Cut, repair, reuse, excavate, demolish or otherwise remove parts of the existing structures or appurtenances, as indicated on the contract drawings, or as necessary to complete the work as required. Dispose of surplus materials resulting from the above work in an approved manner. The work shall include all necessary cutting and bending of reinforcing steel, structural steel, or miscellaneous metal work found embedded in the existing structures.
- B. Dismantle and remove all existing equipment, piping, and other appurtenances required for the completion of the work. Where called for or required, cut existing pipelines for the purpose of making connections thereto

- C. Anchor bolts for equipment and structural steel to be removed shall be cut off one inch below the concrete surface. Surfaces shall then be refinished using non-shrink grout or epoxy mortar or as indicated on the construction drawings. Repairs to the interior surfaces of existing concrete structures in sanitary sewers shall be made with epoxy mortar. Repairs to be made on other existing concrete surfaces using non-shrink grout shall be made using a bonding agent such as Acrylbond by Concrete Producers Solutions or an equal approved by the County. Remove all dirt, curing compounds, sealers, paint, rust or other foreign material, and etch with muriatic acid solution. Flush with clean water and while still damp, apply a coating of the bonding agent. Place the new grout patch onto the treated area immediately.
- D. At the time that a new connection is made to an existing pipeline, additional new piping, extending to and including a new valve, shall be installed. Pipe restraint devices, if required, shall also be installed as required. At the time when a new potable or reclaim water service is installed, a pipe locator tracer wire shall be installed and connected to the tracer wire at the main.
- E. No existing structure, equipment, or appurtenance shall be shifted, cut, removed, or otherwise altered except with the express approval of and only to the extent approved by the County. All existing valve boxes, fire hydrants, air release valve cabinets, and manholes shall be relocated to meet the new finished grade elevations after construction.
- F. When removing materials or portions of existing utility pipelines and/or structures or when making openings in walls and partitions, take all precautions and use all necessary barriers and other protective devices so as not to damage the structures beyond the limits necessary for the new work, and not to damage the structures or contents by falling or flying debris. Unless otherwise approved by the County, saw-cutting, rotary core-boring, or line drilling will be required in removing material from existing concrete structures or pipes.
- G. Materials and equipment removed in the course of making alterations and additions shall remain the property of the County, except that items not salvageable, as determined by the County, shall be disposed of off work site.
- H. All alterations to existing utility pipes and structures shall be done at such time and in such manner as to comply with the approved time schedule. Before any part of the work is started, all tools, equipment, and materials shall be assembled and made ready so that the work can be completed without delays.
- I. All cutting of existing concrete or other material to provide suitable bonding to new work shall be done in a manner to meet the requirements of the respective section of these Standards covering the new work. When not covered, the work shall be carried on in the manner and to the extent directed by the County or per the

construction drawings.

- J. Surfaces of seals visible in the completed work shall be made to match as nearly as possible the adjacent surfaces.
- K. Non-shrink cementitious grout shall be used for setting wall castings, sleeves, leveling pump bases, doweling anchors into existing concrete and elsewhere as shown on the construction drawings. The surface to which grout is to be applied shall be wetted to facilitate good bonding.
- L. Where necessary or required for the purpose of making connections; cut existing pipelines in a manner to provide an approved joint. Where required, use flanges, couplings, or adapters, all as required.
- M. Provide flumes, hoses, piping, pipes and well points, and other related items to divert or provide suitable plugs, bulkheads, or other means to hold back the flow of water or other liquids, all as required in the performance of the work.
- N. Care shall be taken not to damage any part of existing buildings or foundations or outside structures.
- O. Prior to entering confined spaces in sanitary sewer structures, conduct an evaluation of the atmosphere within, in accordance with local, state, and federal regulations. Provide ventilation equipment and other equipment as required to assure safe working conditions.

### 3.02 CONNECTING TO EXISTING PIPING AND EQUIPMENT

The Contractor shall verify exact location, material, alignment, joint, etc. of existing piping and equipment prior to making the connections called out in the Drawings. The verifications shall be performed with adequate time to correct any potential alignment or other problems prior to the actual time of connection. A County inspector must be present for all tie-ins for a visual inspection.

### 3.03 REMOVAL AND ABANDONMENT OF ASBESTOS CEMENT PIPE AND APPURTENANCES

- A. All work associated with the removal or abandonment of existing asbestos cement pipe and appurtenances shall be performed by a licensed asbestos removal Contractor registered in the State of Florida.
- B. The asbestos Contractor shall contact the appropriate regulatory agencies prior to removal or abandonment of any asbestos material and shall obtain all required permits and licenses and issue all required notices. The cost for all fees associated with permits, licenses and notices to the governing regulatory agencies shall be

borne by the asbestos Contractor.

- C. All work associated with removal or abandonment of asbestos cement pipe and appurtenances shall be performed in accordance with the standards listed below and all other applicable local, State, or Federal standards.
  - 1. Florida Administrative Code, Chapter 62-257, ASBESTOS PROGRAM
  - 2. Title 40 CFR, Part 61, Subpart M, NATIONAL EMISSION STANDARD FOR ASBESTOS
  - 3. Occupational Safety and Health Act, Title 29 CFR
  - 4. Title 40 CFR, Part 763, ASBESTOS
  - 5. Florida Statute Title XXXII, Chapter 469, ASBESTOS ABATEMENT
- D. All asbestos cement pipe sections indicated on the construction drawings to be removed, and all related tees, valves, fittings and appurtenances shall be removed in their entirety and disposed of by the asbestos Contractor in accordance with this Section. Asbestos cement nipples between tees and valves shall be replaced. After removal of the pipelines, all excavations shall be backfilled in accordance with the applicable provisions of the Trenching and Excavation Section of these Standards. The cost of disposing of the removed materials shall be borne by the asbestos Contractor.
- E. The cutting of existing asbestos-cement (A/C, a.k.a. "Transite") pipe shall be by hand tools only. No powered machine cutting is allowed. Removal of all fragments of pipe shall be double bagged prior to shipment. Longer sections of pipe removed may be shipped without double bagging. An asbestos manifest form must accompany each shipment of such pipe or pipe material waste to the Manatee County Lena Road Landfill. Prior to each shipment, a minimum of 24 hours' notice to the Landfill field office (telephone (941) 748-5543) is required.

### 3.04 IN-PLACE GROUTING OF EXISTING PIPE

- A. Where water and wastewater utility pipes are to be abandoned in place, they shall be filled with a non-shrinking sand-cement grout. When such pipes are made of asbestos-cement materials, the abandonment activities shall be performed by a licensed asbestos Contractor. It is completely the Contractor's responsibility to obtain all regulatory clearances and provide documentation in cases where they have determined that an asbestos-cement pipe abandonment activity by in-place grouting does not require a licensed asbestos Contractor.
- B. The ends of the pipe sections to be grout-filled shall be capped or plugged with suitable pipe fittings. The grout material shall be of suitable properties and the pumping pressure shall be such that the pipe sections are filled completely with grout. All above ground features shall be removed: hydrants, meters, valve & meter boxes, pads, vaults, etc. Existing tees, crosses, and valves left in service shall be plugged and restrained.

- C. The pump used for grouting should be a continuous flow, positive displacement model with a pugmill type mixing vat having a minimum shaft speed of 60 rpm and incorporated as an integral part of the equipment. Alternate equipment may be used subject to the approval of the County. The rate of pumping shall not exceed six (6) cubic feet per minute. The pumping pressures shall be in the range of 100 to 150 psi. The County shall be given timely notice so that the County's representative may be present to monitor all pipe grouting operations. Provide standpipes and/or additional means of visual inspection as required to determine if adequate grout material has filled the entire pipe sections.
- D. All tees, crosses, and valves left in service shall be plugged and restrained.

### 3.05 SPRAY-APPLIED LINERS

- A. Use a high-pressure water spray to remove all foreign material from the walls and bench of the structure. Loose or protruding masonry materials shall be removed using a hammer and chisel. Fill any voids, holes or cracks using a hand trowel with epoxy mortar to form a uniform surface. Place covers over all pipe openings to prevent extraneous material from entering the pipes. Block or divert sewer flow from entering the structure. Any infiltration leaks shall be stopped by using such methods as approved by the County.
- B. The liner material shall be sprayed onto the invert, bench and wall areas. The sprayed-on material shall be applied such that the entire structure is lined with a structurally enhanced monolithic liner. The thickness of the wall liner material shall be such that it will withstand the hydraulic load generated by the surrounding groundwater table, using a factor of safety of two, and using the assumption that the groundwater table is at the level of the top of the structure. The invert and bench liner material shall be the same thickness as that required for the base of the wall.
- C. Special care shall be used to provide a smooth transition between the intersecting pipelines and the manhole inverts such that flow is not impaired. Remove concrete material from the existing manhole base channel in depth to the required thickness of the new liner material.
- D. No active sewer flow shall be allowed in the newly lined structure, nor shall any vacuum tests be performed, until the liner material has had adequate time to cure, as recommended by the liner material manufacturer.
- E. Install the coating systems per manufacturer's recommendation and completely protect the structure from corrosion. The liner or coating systems must extend and seal onto manhole ring, onto and around pipe openings and any other protrusions, and completely cover the bench and flow invert. Provide a five (5)-year unlimited warranty on all workmanship and products. The work includes the surface

preparation and application of the coating or liner system and shall protect the structure for at least five (5) years from all leaks and from failure due to corrosion from exposure to corrosive gases such as hydrogen sulfide.

### 3.06 CONNECTION TO EXSTING MANHOLE

- A. Where required or as indicated on the construction drawings, make connection of new pipelines to existing manhole structures. If pipe stub-outs of the correct size and position are not available, make connections by removing a portion of the manhole wall by mechanical rotary core boring. The connection between pipe and concrete manhole shall be complete with resilient seals meeting the requirements of ASTM C923.
- B. A new channel shall be formed in the manhole base by removing and reforming or by providing new concrete to convey the new flow into the existing channel in accordance with the standard requirements for new sewer manhole structures. Flow direction shall not change by more than 90 degrees within the manhole base.
- C. Repair internal coating of existing manholes cored during connection of new sewers by applying approved coating material as listed above in accordance with the manufacturer's recommendations. If existing manhole has an internal coating other than that listed above, sandblast the interior of the existing manhole and apply an approved coating in accordance with the manufacturer's recommendations.
- D. When connecting a force main to an existing manhole, the force main termination manhole and the next two manholes downstream shall be rehabilitated and lined with a currently approved liner. If the existing manholes are lined with a non-conforming liner according to Part 2.D above, the existing liner shall be removed and replaced, unless otherwise noted on the plans or with written approval by the County.

**\*\*END OF SECTION\*\***

## SECTION 02100

### SITE PREPARATION

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. This Section covers clearing, grubbing and stripping of the project site and/or along the pipeline route.
- B. The Contractor shall clear and grub all of the area within the limits of construction or as required, which includes, but is not limited to utility easements. The width of the area to be cleared shall be reviewed by the County prior to the beginning of any clearing.
- C. The Contractor's attention is directed to any Soil Erosion and Sediment Control Ordinances in force in Manatee County. The Contractor shall comply with all applicable sections of these ordinances.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 EXECUTION

##### 3.01 CLEARING

The surface of the ground, for the area to be cleared and grubbed shall be completely cleared of all timber, brush, stumps, roots, grass, weeds, rubbish and all other objectionable obstructions resting on or protruding through the surface of the ground. However, trees shall be preserved as hereinafter specified unless otherwise designated by the County. Clearing operations shall be conducted so as to prevent damage to existing structures and installations and to those under construction, so as to provide for the safety of employees and others. Soil erosion control devices such as hay bales and silt fences shall be installed to satisfy all Federal, State and County requirements.

##### 3.02 GRUBBING

Grubbing shall consist of the complete removal of all stumps, roots larger than 1-1/2 inches in diameter, matted roots, brush, timber, logs and any other organic or metallic debris not suitable for foundation purposes, resting on, under or protruding through the surface of the ground to a depth of 18 inches below the subgrade. All depressions excavated below the original ground surface for or by

the removal of such objects, shall be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.

### 3.03 STRIPPING

In areas so designated, topsoil shall be stockpiled. Topsoil so stockpiled shall be protected until it is placed as specified. The County shall have the option to receive all excess topsoil materials. The Contractor shall pay all equipment and labor cost to deliver excess top soil material to a remote site chosen by the County within a five mile radius of the construction site. Should County not choose to receive any or all excess topsoil materials, the Contractor shall dispose of said material at no additional cost to County.

### 3.04 DISPOSAL OF CLEARED AND GRUBBED MATERIAL

The Contractor shall dispose of all material and debris from the clearing and grubbing operation by hauling such material and debris off site. The cost of disposal (including hauling) of cleared and grubbed material and debris shall be considered a subsidiary obligation of the Contractor; the cost of which shall be included in the prices bid for the various classes of work.

### 3.05 PRESERVATION OF TREES

Those trees which are not designated for removal by the County shall be carefully protected from damage. The Contractor shall erect such barricades, guards and enclosures as may be considered necessary by him for the protection of the trees during all construction operation.

### 3.06 PRESERVATION OF DEVELOPED PRIVATE PROPERTY

- A. The Contractor shall exercise extreme care to avoid unnecessary disturbance of developed private property adjacent to proposed project site. Trees, shrubbery, gardens, lawns and other landscaping, which are not designated by the County to be removed, shall be replaced and replanted to restore the construction easement to the condition existing prior to construction.
- B. All soil preservation procedures and replanting operations shall be under the supervision of a nursery representative experienced in such operations.
- C. Improvements to the land such as fences, walls, outbuildings and other structures which of necessity must be removed, shall be replaced with equal quality materials and workmanship.
- D. The Contractor shall clean up the construction site across developed private property directly after construction is completed upon approval of the County.

3.07

## PRESERVATION OF PUBLIC PROPERTY

The appropriate paragraphs of these Specifications shall apply to the preservation and restoration of public lands, parks, rights-of-way, easements and all other damaged areas. This includes, but is not limited to the trimming of trees damaged by contractor's equipment.

**\*\*END OF SECTION\*\***

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SECTION 02220  
EXCAVATION, BACKFILL, FILL AND GRADING FOR STRUCTURES

PART 1      GENERAL

1.01      SCOPE OF WORK

- A.      Structural excavation shall consist of the removal of material for the construction of foundations for structures and other excavation designated on the drawings or in these specifications.
- B.      Structural excavation and backfill shall consist of furnishing material, if necessary and placing and compacting backfill material around structures to the lines and grades designated on the drawings, as specified or directed by the County.
- C.      Structural excavation and backfill shall include the furnishing of all materials, equipment and other facilities which may be necessary to perform the excavations, place and compact the backfill, install sheeting and bracing, and carry out any necessary dewatering. It shall also include the wasting or disposal of surplus excavated material in a manner and in locations approved by the County.
- D.      The Contractor is responsible for the protection of every tree which is scheduled to remain in the project area. This includes trees which may or may not be shown on the plans. Every tree shall be adequately protected in place at no additional cost to the County. This includes, but is not limited to, protecting the root systems and adjusting grades as necessary for tree/root protection.

1.02      QUALITY ASSURANCE

- A.      Testing Agency:
  - 1.      In place soil compaction tests shall be performed by a qualified testing laboratory.
  - 2.      Compaction tests shall be taken every 500 feet, except in the road crossings or road shoulders. Tests are to be taken according to current FDOT Standards.
- B.      Reference Standards:

1. American Society for Testing and Materials (ASTM):
  - a. ASTM D1557, Moisture-Density Relations of Soils Using 10-lb. (4.5-kg) Rammer and 18-in. (457-mm) Drop.

## 1.03 JOB CONDITIONS

- A. The Contractor shall provide, operate and maintain all necessary pumps, discharge lines, well points, etc., in sufficient number and capacity to keep all excavation, bases, pits, etc., free from seepage, standing or running water at all times throughout the period of construction.
- B. The Contractor shall assume all responsibility for the security of the excavation required, employing bracing, lining or other accepted means necessary to accomplish same.
- C. Excavated areas shall be cleared of all debris, water, slush, muck, clay and soft or loose earth and shall be conditioned to the entire satisfaction of the County.
- D. All excavated material unsuitable for use or which will not be used shall be disposed of in a manner consistent with State and County regulation.
- E. All unsuitable organic materials, roots, logs, etc., found during excavation shall be removed by the Contractor and the trench shall be refilled with suitable material.

## PART 2 PRODUCTS

### 2.01 MATERIAL FOR CONTROLLED FILL

- A. Composition: Only approved material free from organic matter and lumps of clay, shall be used for backfill. Excavated earth free from debris or organic material may be used for backfilling foundations or fill.
- B. Crushed stone and shell shall meet or exceed current FDOT Standards.

### 2.02 UNSUITABLE MATERIAL

Unsuitable material shall be defined as highly organic soil per ASTM D2487 Group PT. This includes, but is not limited to, such items as topsoil, roots, vegetable matter, trash, debris, and clays that cannot be dried sufficiently to obtain specified compaction.

## PART 3 EXECUTION

### 3.01 INSPECTION

- A. The Contractor shall verify that work preceding the affected work of this Section has been satisfactorily completed.
- B. Conditions adversely affecting the work of this Section shall be corrected to the satisfaction of the County.

### 3.02 REMOVAL OF UNSUITABLE MATERIALS

- A. The Contractor shall remove unsuitable material from within the limits of the Work.
- B. Materials meeting requirements for controlled fill shall be stockpiled as necessary and in such a manner satisfactory to the County.
- C. All material excavated shall be placed so as to minimize interference with public travel and to permit proper access for inspection of the work.

### 3.03 EXCAVATION

- A. When concrete or shell subbase footing is to rest on an excavated surface, care shall be taken not to disturb the natural soil. Final removal and replacement of the foundation material and subbase compaction to grade shall not be made until just before the concrete or masonry is placed.
- B. When any structural excavation is completed, the Contractor shall notify the County who will make an inspection of the excavation. No concrete or masonry shall be placed until the excavation has been approved by the County.
- C. The elevations of the footing bottom and the base slab as shown on the Drawings, shall be considered as approximate and the County may order in writing, such changes in dimensions or elevations of the footings and slab base as necessary to secure satisfactory foundations.
- D. All excavation shall be made within an area bounded by lines five feet outside and parallel to the exterior walls of the structure to allow for correct forming, shoring and inspection of foundation work. Pouring of concrete against earth side walls shall not be permitted.
- E. If the ground is excavated below the grade called for by the Drawings or becomes unstable due to the Contractor's carelessness or operations, the ground shall be excavated to undisturbed native soil before continuing concreting operations.
- F. If in the opinion of the County, the material at or below the normal grade of the bottom of the trench is unsuitable for pipe or structure foundation, it shall be removed to the depth directed by the County and if so directed, replaced by crushed stone or washed shell.

### 3.04 STRUCTURAL BACKFILL

- A. Structural backfill shall not be placed until the footings or other portions of the structure or facility have been inspected by the County and approved for backfilling.
- B. A minimum of 1-1/2" layer of lean concrete shall be placed as a working mat for the concrete base slabs and footings if required by the County.
- C. Fill shall be placed in uniform layers not more than 12" thick and compacted to a minimum of 98 percent of the maximum density determined by ASTM D1557, Method A or C, or as directed by the County. The Contractor shall securely tamp the backfill with pneumatic rammer around all wall foundations. The method of compaction shall be satisfactory to the County.
- D. Compaction of structural backfill by ponding and jetting may be permitted when, as determined by the County: the backfill material is of such character that it will be self-draining when compacted; foundation materials will not soften or be otherwise damaged by the applied water; no damage from hydrostatic pressure will result to the structure. Ponding and jetting within two feet below finished subgrade shall not be permitted in roadway areas. At the discretion of the County, ponding and jetting may be permitted with compaction layers not to exceed four feet.
- E. Surplus material not used on-site shall be removed and disposed of off-site by the Contractor. In no case shall surplus material be deposited on adjacent lands. Fill used for grading shall be placed in layers not to exceed 12 inches in thickness and shall be compacted to a density equal or greater to that of the surrounding natural ground.

### 3.05 BACKFILLING AROUND STRUCTURES

- A. Common fill and structural fill are specified for use as backfill against the exterior walls of the structures. Fill shall be placed in layers having a maximum thickness of eight (8) inches in loose state and shall be compacted sufficiently to prevent settlement. If compaction is by rolling or ramming, material shall be wetted down as required. Where material can be suitably compacted by jetting or puddling, the Contractor may use one of these methods. No boulders shall be allowed to roll down the slopes and hit the walls.
- B. Backfilling shall be carried up evenly on all walls of an individual structure simultaneously. A variation of two (2) feet in elevation will be the maximum allowable. No backfill shall be allowed against walls until the walls and their supporting slabs, if applicable, have attained sufficient strength. Backfilling shall be subjected to approval by the County.

- C. In locations where pipes pass through building walls, the Contractor shall take the following precautions to consolidate the refill up to an elevation of at least one foot above the bottom of the pipes:
  - 1. Place structural fill in such areas for a distance of not less than three feet either side of the center line of the pipe in level layers not exceeding 6-inches in depth.
  - 2. Wet each layer to the extent directed and thoroughly compact each layer with a power tamper to the satisfaction of the County.
  - 3. Structural fill shall be of the quality specified under Part 2 of this Section.
- D. The surface of filled areas shall be graded to smooth true lines, strictly conforming to grades indicated on the grading plan. No soft spots or uncompacted areas shall be allowed in the work.
- E. Temporary bracing shall be provided as required during construction of all structures to protect partially completed structures against all construction loads, hydraulic pressure and earth pressure. The bracing shall be capable of resisting all loads applied to the walls as a result of backfilling.

3.06 FIELD QUALITY CONTROL

- A. The density of soil in place shall be a minimum of 95 percent in accordance with ASTM test 1557-70T, Method A or C.

**\*\*END OF SECTION\*\***

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SECTION 02221  
TRENCHING, BEDDING AND BACKFILL FOR PIPE

PART 1      GENERAL

1.01      SCOPE OF WORK

- A.      The Contractor shall furnish all labor, materials, equipment and incidentals necessary to perform all dewatering, excavation, backfill, fill, grading, trench protection or other related work required to complete the piping work shown on the Drawings and specified herein. The work shall include, but not be limited to: vaults; duct conduit; pipe; roadways and paving; backfilling; required fill or borrow operations; grading; disposal of surplus and unsuitable materials; and all related work such as sheeting, bracing and dewatering.
- B.      Prior to commencing work, the Contractor shall examine the site and review test borings if available, or undertake his own subsurface investigations and take into consideration all conditions that may affect his work.
- C.      The Contractor is responsible for the protection of every tree which is scheduled to remain in the project area. This includes trees which may or may not be shown on the plans. Every tree shall be adequately protected in place at no additional cost to the County. This includes, but is not limited to protecting the root systems and adjusting grades as necessary for tree/root protection.

1.02      PROTECTION

- A.      Sheeting and Bracing in Excavations:
  - 1.      In connection with construction of underground structures, the Contractor shall properly construct and maintain cofferdams. These shall consist of: sheeting and bracing as required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction and to protect adjacent structures, existing yard pipe and/or foundation material from disturbance, undermining, or other damage. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
  - 2.      Trench sheeting for pipes: no sheeting is to be withdrawn if driven below, mid-diameter of any pipe and no wood sheeting shall be cut off at a level lower than one foot above the top of any pipe unless otherwise directed by the County. During the progress of the work, the County may direct the Contractor in writing to leave additional wood sheeting in place. If steel

sheeting is used for trench sheeting, removal shall be as specified above, unless written approval is given for an alternate method of removal.

3. All sheeting and bracing not left in place shall be carefully removed in such a manner as not to endanger the construction or other structures, utilities, existing piping, or property. Unless otherwise approved or indicated on the Drawings or in the Specification, all sheeting and bracing shall be removed after completion of the piping or structure, care being taken not to disturb or otherwise injure the pipeline or finished masonry. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools specifically made for that purpose, by watering, or as may otherwise be directed.
4. The Contractor shall construct, to the extent he deems it desirable for his method of operation, the cofferdams and sheeting outside the neat lines of the pipeline trench or foundation unless otherwise indicated on the Drawings or directed by the County. Sheeting shall be plumb and securely braced and tied in position. Sheeting, bracing and cofferdams shall be adequate to withstand all pressures to which the pipeline or structure will be subjected. Pumping, bracing and other work within the cofferdam shall be done in a manner to avoid disturbing any construction of the pipeline or the enclosed masonry. Any movement or bulging which may occur shall be corrected by the Contractor at his own expense so as to provide the necessary clearances and dimensions.
5. Drawings of the cofferdams and design computations shall be submitted to the County and approved prior to any construction. However, approval of these drawings shall not relieve the Contractor of the responsibility for the cofferdams. The drawings and computations shall be prepared and stamped by a Registered Professional Engineer in the State of Florida and shall be in sufficient detail to disclose the method of operation for each of the various stages of construction, if required, for the completion of the pipeline and substructures.

**B. Dewatering, Drainage and Flotation**

1. The Contractor shall construct and place all pipelines, concrete work, structural fill, bedding rock and limerock base course, in-the-dry. In addition, the Contractor shall make the final 24" of excavation for this work in-the-dry and not until the water level is a minimum of 18 below proposed bottom of excavation.
2. The Contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavation and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fill,

structure, or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations. At all times during the construction operations, the groundwater levels shall be maintained at an elevation 18 inches below the lowest level where structures are being installed.

3. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
4. Wellpoints may be required for dewatering the soil prior to final excavation for deeper in-ground structures or piping and for maintaining the lowered groundwater level until construction has been completed to avoid the structure, pipeline, or fill from becoming floated or otherwise damaged. Wellpoints shall be surrounded by suitable filter sand and no fines shall be removed by pumping. Pumping from wellpoints shall be continuous and standby pumps shall be provided.
5. The Contractor shall furnish all materials and equipment to perform all work required to install and maintain the proposed drainage systems for handling groundwater and surface water encountered during construction of structures, pipelines and compacted fills.
6. Where required, the Contractor shall provide a minimum of two operating groundwater observation wells at each structure to determine the water level during construction of the pipeline or structure. Locations of the observation wells shall be at structures and along pipelines as approved by the County prior to their installation. The observation wells shall be extended to 6 inches above finished grade, capped with screw-on caps protected by 24" x 24" wide concrete base and left in place at the completion of this Project.
7. Prior to excavation, the Contractor shall submit his proposed method of dewatering and maintaining dry conditions to the County for approval. Such approval shall not relieve the Contractor of the responsibility for the satisfactory performance of the system. The Contractor shall be responsible for correcting any disturbance of natural bearing soils for damage to pipeline or structures caused by an inadequate dewatering system or by interruption of the continuous operation of the system as specified.
8. As part of his request for approval of a dewatering system, the Contractor shall demonstrate the adequacy of the proposed system and wellpoint filter sand by means of a test installation. Discharge water shall be clear, with no visible soil particles in a one quart sample. Discharge water shall not flow directly into wetlands or Waters of the State as defined by FDEP and SWFWMD.

9. During backfilling and construction, water levels shall be measured in observation wells located as directed by the County.
10. Continuous pumping will be required as long as water levels are required to be below natural levels.

## PART 2 PRODUCTS

### 2.01 MATERIALS

#### A. General

1. Materials for use as fill and backfill shall be described below and shall be from an FDOT certified pit. For each material, the Contractor shall notify the County of the source of the material and shall furnish the County, for approval, a representative sample weighing approximately 50 pounds, at least ten calendar days prior to the date of anticipated use of such material.
2. Additional materials shall be furnished as required from off-site sources and hauled to the site.

#### B. Bedding - shall conform to FDOT Standard Specifications for Road and Bridge Construction, Section 901 Coarse Aggregate, and shall be either coarse aggregate of Size No. 57 or coarse sand of Size No. 9. Washed shell size No.57 may be used as an alternate bedding material.

#### C. Structural Fill

1. Structural fill in trenches shall be used below spread footing foundations, slab-on-grade floors and other structures as backfill within three feet of the below grade portions of structures.
2. Shall be either soil classification A-1, A-2 or A-3, per AASHTO M-145, and shall be free of organic matter, lumps of clay or marl, muck, compressible materials, and rock exceeding 2.5 inches in diameter. Broken concrete, masonry, rubble or other similar materials shall not be used as backfill. Minimum acceptable density shall be 98 percent of the maximum density as determined by AASHTO T-180.

#### D. Selected Common Fill - shall have the same material classification and requirements as Structural Fill, as described above.

#### E. Common Fill

1. Shall be either soil classification A-1, A-2, A-3, A-4, A-5 or A-6, per AASHTO M-145, and shall be free of organic matter, lumps of clay or marl, muck, compressible materials and rock exceeding 2.5 inches in diameter. Broken concrete, masonry, rubble or other similar materials shall not be used as backfill.
  2. Material falling within the above specification, encountered during the excavation, may be stored in segregated stockpiles for reuse. All material which, in the opinion of the County, is not suitable for reuse shall be spoiled as specified herein for disposal of unsuitable materials by the Contractor.
- E. Unsuitable Material - soil classification A-7 and A-8, per AASHTO M-145, shall not be used as backfill material.

## PART 3 EXECUTION

### 3.01 EXCAVATION

- A. Excavate trenches and pits for structures to the elevations indicated on the construction drawings. Take special care to avoid over-excavating or disturbing the bottom of the trench or pit, so that the soil at the bottom of the hole remains in a naturally compacted condition. Excavate to widths sufficient to provide adequate working room to install the required structures. Do not excavate the final layer of soil to the designed grade until just before placing the bedding, foundation, pipe, structure, or masonry work required. Remove boulders, rocks, logs or any unforeseen obstacles encountered.
- B. In case the foundation soil found at the bottom of the trench or pit is soft, plastic or mucky, or does not conform to the soils classification specified as suitable foundation material, over-excavation to a greater depth will be required. Soils not meeting the classification required for foundation material shall be removed to a depth at least four inches below the bottom of the pipe, bedding or structure bottom elevation. Rock, boulders or other hard or lumpy material shall be removed to a depth 12 inches below the bottom of the pipe, bedding or structure bottom elevation. Remove muck, clay or other soft material to a depth as needed to establish a firm foundation.
- C. Where possible, the sides of trenches should be vertical up to at least the spring line of the installed pipe.
- D. Trench excavation shall be performed in accordance with Florida Statute Title XXXIII, Chapter 553, Part III, Trench Safety Act.

### 3.02 BACKFILLING

- A. Backfill materials shall be placed on solid, firm, naturally compacted or compacted to 98 percent of the maximum dry density of the material as determined by AASHTO T-180, dry or dewatered in place soil foundations.
- B. Where over-excavation is required due to nonconforming soil classification or rocky, unstable, or otherwise undesirable soil conditions, place Structural Fill or Selected Common Fill in the over-excavated zone up to the base of the bedding material layer. Compact the over-excavated zone to 98 percent of the maximum dry density of the material as determined by AASHTO T-180.
- C. When backfilling in an over-excavated zone where moist or watery conditions exist, backfill shall be coarse No. 9 sand or a mixture of No. 57 coarse aggregate with either No. 9 coarse sand, A-1, or A-3 material.
- D. After compaction, backfill material in the over-excavation zone shall form a solid and firm foundation on which to build up successive layers of backfill and structures.
- E. Bedding materials shall be placed on solid, firm soil foundations and shall be compacted to 98 percent of the maximum dry density of the material as determined by AASHTO T-180.
- F. Concrete and masonry structures shall be backfilled using Structural Fill. Backfilling and compaction shall be underneath the structure and carried up evenly on all walls of an individual structure simultaneously. The maximum allowable difference in backfill elevations shall be two feet. No backfilling shall be allowed against concrete or masonry walls until the walls and their supporting slabs have been in place at least seven days or until the specified 28-day strength has been attained. Compaction of Structural Fill underneath the base and along the walls shall be 98 percent of the maximum dry density of the material as determined by AASHTO T-180. The Structural Fill shall be either dried or shall have water added so that the moisture content of the material is within a range that will allow the required density to be achieved.
- G. Trenching backfill for pipe installation shall be Selected Common Fill for the pipe bedding zone. The pipe bedding envelope shall begin at the level four inches, six inches, or nine inches, depending on pipe diameter, below the bottom of the pipe, and shall extend vertically up to a level 12 inches above the top of the pipe. Where the in-place soil material within the four inch, six inch, or nine inch pipe bedding zone beneath the bottom of the pipe meets the soil classification for Selected Common Fill, undercutting of the trench below the bottom of the pipe will not be required. In this case, loosen the soil in the bottom of the trench immediately below the middle third of the pipe diameter, and place the pipe upon it. Where the in-place soil material within the pipe bedding zone does not meet the soil classification for Selected Common Fill, undercutting shall be required, and the bedding zone shall be backfilled with Selected Common Fill. In this case, place the pipe bedding

material and leave it in a moderately firm uncompacted condition under the middle third of the pipe diameter, and compact the outer portions of the trench bottom to 98 percent of the maximum dry density. Soils that were over-excavated due to rocky, soft or otherwise unsuitable soil foundation conditions shall also be replaced with Selected Common Fill. Compaction of Selected Common Fill shall be 98 percent of the maximum dry density as determined by AASHTO T-180. Such backfill material shall have an optimized moisture content that will allow the required density to be achieved.

- H. Pipe sections for gravity flow systems shall be laid with spigots downstream and bells upstream. Excavate for pipe bells before laying pipe. Lay pipe true to the lines and grades indicated on the construction plans. Place backfill material on both sides of the pipe and compact to 98 percent of the maximum dry density of the material as determined by AASHTO T-180. Take special care to effectively fill and compact the material in the haunch areas under the sides of the pipe.
- I. For pipes that are not installed under roadways or driveways, trenching backfill for pipe installation shall be Common Fill above the pipe envelope zone, and shall be compacted to 95 percent of the maximum dry density of the material as determined by AASHTO T-180, and shall have moisture content optimized to allow the required density. For pipes that are installed under roadways or driveways, trenching backfill for pipe installation shall be Selected Common Fill above the pipe envelope zone, and shall be compacted to 98 percent of the maximum dry density of the material as determined by AASHTO T-180, and shall have moisture content optimized to allow the required density. Selected Common Backfill shall be placed in layers not to exceed 6 inches. Common Backfill shall be placed in layers not to exceed 12 inches.
- J. Backfill compaction tests shall be performed every 500 feet in pipe line trenches and for every utility structure. Test reports shall be presented to the County Inspector.

### 3.03 GRADING AND CLEAN UP

- A. Surplus and unsuitable soil materials not used on-site shall be removed and disposed of off-site in a manner that is consistent with state and local regulations. In no case shall surplus or unsuitable material be deposited on-site or on adjacent lands.
- B. The surface of backfilled areas shall be graded smooth and true to the lines and grades indicated on the construction plans. No soft spots or uncompacted areas shall be allowed in the work.
- C. Upon completion of the work, leave the work areas and all adjacent areas in a neat and presentable condition, clear of all temporary structures, rubbish and surplus

materials. Pile any salvageable materials that have been removed in neat piles for pickup by County crews, unless otherwise directed.

**\*\*END OF SECTION\*\***

## SECTION 02223

### EXCAVATION BELOW GRADE AND CRUSHED STONE OR SHELL REFILL

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. If in the opinion of the County, the material at or below the normal grade of the bottom of the trench is unsuitable for pipe or structure foundation, it shall be removed to the depth directed by the County and replaced by crushed stone or washed shell.

#### PART 2 PRODUCTS (NOT USED)

#### PART 3 MATERIALS

##### 3.01 EXCAVATION AND DRAINAGE

- A. Whatever the nature of unstable material encountered or the groundwater conditions, trench stabilization shall be complete and effective.
- B. Should the Contractor excavate below the grade shown on the Contract drawings because of negligence or for his own convenience; due to failure in properly dewatering the trench; disturbs the subgrade before dewatering is sufficiently complete; he shall be directed by the County to excavate below grade. The work of excavating below grade and furnishing and placing the approved refill material shall be performed at the Contractor's expense.

##### 3.02 REFILL

- A. Soils not meeting the classification required for foundation material shall be removed to a depth at least four inches below the bottom of the pipe, bedding or structure bottom elevation. Rock, boulders or other hard or lumpy material shall be removed to a depth 12 inches below the bottom of the pipe, bedding or structure bottom elevation. Remove muck, clay or other soft material to a depth as needed to establish a firm foundation.

**\*\*END OF SECTION\*\***

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## SECTION 02260

### FINISH GRADING

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. The Contractor shall finish grade sub-soil.
- B. The Contractor shall cut out areas to receive stabilizing base course materials for paving and sidewalks.
- C. The Contractor shall place, finish grade and compact top soil.

##### 1.02 PROTECTION

The Contractor shall prevent damage to existing fencing, trees, landscaping, natural features, bench marks, pavement and utility lines. Damage shall be corrected at no cost to the County.

#### PART 2 PRODUCTS

- A. Topsoil: Shall be friable loam free from subsoil, roots, grass, excessive amount of weeds or other organics, stones, and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4 percent and a maximum of 25 percent organic matter. The Contractor may use topsoil stockpiles on site if they conform to these requirements.

#### PART 3 EXECUTION

##### 3.01 SUB-SOIL PREPARATION

- A. The Contractor shall rough grade sub-soil systematically to allow for a maximum amount of natural settlement and compaction. Uneven areas and low spots shall be eliminated. Debris, roots, branches or other organics, stones, and sub-soil shall be removed by the Contractor and disposed of in a manner consistent with the latest Manatee County Standards as well as any affected regulatory agency. Should contaminated soil be found, the Contractor shall notify the County.
- B. The Contractor shall cut out areas to sub-grade elevation to stabilize base material for paving and sidewalks and shall be compacted to 98 percent of the maximum dry

density of the material as determined by AASHTO T-180, and shall have moisture content optimized to allow the required density.

- C. The Contractor shall bring sub-soil to required profiles and contour grades gradually; and blend slopes into level areas.
- D. The Contractor shall slope the structure grade a minimum of two (2) inches in ten (10) feet unless indicated otherwise on the Drawings.
- E. The Contractor shall cultivate sub-grade to a depth of 3 inches where the topsoil is to be placed. He shall repeat cultivation in areas where equipment use has compacted sub-soil.
- F. The Contractor shall not make grade changes which causes water to flow onto adjacent lands.

### 3.02 PLACING TOPSOIL

- A. The Contractor shall place topsoil in areas where seeding, sodding and planting is to be performed. He shall place from the following minimum depths, up to finished grade elevations:
  - 1. 6 inches for seeded areas
  - 2. 4-1/2 inches for sodded areas
  - 3. 24 inches for shrub beds
  - 4. 18 inches for flower beds
- B. The Contractor shall use topsoil in a dry state as determined by the County. He shall place the material during dry weather.
- C. The Contractor shall use fine grade topsoil eliminating rough and low areas to ensure positive drainage. He shall maintain levels, profiles and contours of the sub-grades.
- D. The Contractor shall remove stone, roots, grass, weeds, debris, and other organics or foreign material while spreading the material.
- E. The Contractor shall manually spread topsoil around trees, plants and structures to prevent damage which may be caused by grading equipment.
- F. The Contractor shall lightly compact and place the topsoil.

### 3.03 SURPLUS MATERIAL

- A. The Contractor shall remove surplus sub-soil and topsoil from site at his expense.

- B. The Contractor shall leave stockpile areas and entire job site clean and raked, ready for landscaping operations.

**\*\*END OF SECTION\*\***

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SECTION 02270  
EROSION, SEDIMENTATION, AND DUST CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

A. WORK INCLUDED

Provide all material, equipment and labor necessary to install erosion and sediment control elements in accordance with this Specification. All costs for permit application shall be borne by the Contractor. Any permits required by the Contractor shall be available at the site at all times.

The specification sections listed below may be related to the project work.

1. SECTION 02050 - Demolition
2. SECTION 02100 – Site Preparation

B. Provide erosion control measures so as to prevent pollution of water, detrimental effects to public or private property adjacent to the project, and damage to work on the project. Construct and maintain temporary erosion control features or, where practical, construct and maintain permanent erosion control features as shown in the Plans or as may be directed by the Engineer.

C. Coordinate the installation of temporary erosion control features with the construction of the permanent erosion control features to the extent necessary to ensure economical, effective, and continuous control of erosion and water pollution throughout the life of the Contract.

D. Do not disturb lands or waters outside the limits of construction.

PART 2 – PRODUCTS

2.1 SUBMITTALS

Prior to commencing work, the Contractor shall submit to the Engineer for approval the Contractor's plans for Erosion, Sedimentation and Dust Control. The Erosion Sedimentation and Dust Control Plan shall be in conformance with the overall construction plan and in accordance with Section 01300.

2.2 SOD

The sod type shall be Bahia sod. All sod and mulch shall be free of noxious weeds and exotic pest plants, plant parts or seed listed in the current Category I “List of Invasive Species” from the Florida Exotic Pest Plant Council (FLEPPC). It shall be well matted with roots. The sod shall be taken up in commercial-size rectangles or rolls preferably 12 inches by 24 inches or larger, except where 6-inch strip sodding is called for, or as rolled sod at least 12 inches in width and length consistent with the equipment and methods used to handle the rolls and place the sod. Sod shall be a minimum of 1-1/4 inches thick including a 3/4-inch-thick layer of roots and topsoil.

The sod shall be sufficiently thick to secure a dense stand of live turf. The sod shall be live, fresh and uninjured, at the time of planting. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. It shall be planted within 48 hours after being cut and kept moist from the time it is cut until it is planted.

## 2.3 FERTILIZERS

Fertilizers shall comply with the State fertilizer laws. Fertilizers shall meet the requirements of the FDOT Standard Specifications for Road and Bridge Construction SECTION 982.

## 2.4 SILT FENCING

A. Geotextiles shall be woven or nonwoven fabrics that will allow the passage of water. Geotextiles shall be packaged in a protective covering sufficient to protect it from sunlight, dirt, and other debris during shipment and storage, upon which the manufacturer’s name, product name, style number, roll dimensions and LOT numbers are clearly labeled.

B. Posts: Posts for silt fences shall as shown in the drawings and be either wooden stakes or metal stakes with a minimum length of 3 feet. Steel posts shall have projections for fastening wire to them.

C. Silt Fence shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by manufacturer or supplier as conforming to the following requirements:

Physical Property	Test Requirements
Permittivity	ASTM-D-4491 .05 SEC <sup>-1</sup>
Grab tensile	ASTM-D-4632 90 lbs. (min. warp)
Grab Sewn Strength	ASTM-D-4884 2.1 lb/in (min)
Trapezoidal Tear	ASTM-D-4533 35 lbs. (min)
UV Resistance	ASTM-D-4355 80% (500 hrs)

Filtration Efficiency

ASTM-D-5141 75% (min)

Flow Rate

ASTM-D-5141 .3 gal (min)

The base plastic shall contain stabilizers and/or inhibitors to make the filaments resistant to deterioration due to ultraviolet light, heat exposure and potential chemically damaging environment. The fabric shall be free of any treatment which may significantly alter its physical properties. The edges of the fabric shall be selvaged or otherwise finished to prevent the outer yarn from pulling away from the fabric.

D. Other materials: Select all other materials not specifically described but required for compliance with the erosion and sediment control plan, subject to approval by the Engineer.

## 2.5 FILTER FABRIC

Filter Fabric for inlet protection shall be Type D-3 per FDOT Index 199.

## 2.6 AGGREGATES

Aggregate for Truck Wash Out area shall be as described in Section 901 excluding 901-2.3 of the FDOT Standard Specifications for Road and Bridge Construction. Aggregates shall be FDOT size No 1. If this size is not available, the next available smaller size aggregate may be substituted with the approval of the Engineer. Sizes containing small aggregate will track off the project and are unsuitable.

# PART 3 – EXECUTION

## 3.1 GENERAL

A. Contractor shall familiarize himself with all the stipulations and requirements of the erosion and sediment control plan. Contractor shall be held responsible for strict adherence to the FDEP generic permit. Contractor shall be deemed liable for any negligence or infringement, which results in non-compliance with this permit.

B. The location of all sediment and erosion control measures shall be left to the Contractor's discretion unless otherwise shown on the Drawings or required by the permit. Should there be no requirement of an erosion control plan, then Contractor shall be required to provide such measures necessary to prevent the formation of gullies or the spread of mud and debris across roads, into waterways or other areas where it may be considered a nuisance.

## 3.2 PLANNING OF CONSTRUCTION

A. Planning and coordination of the construction is needed to minimize sediment pollution. Clearing shall be kept to shortest distance possible ahead of construction. Cleared areas shall be kept to minimum required to facilitate construction.

B. Restoration work shall be performed as the Project progresses and not be left until the end of the Project. No areas shall be left unprotected for longer than 10 days without some form of temporary seeding or, if during a non-growing season, some other form of stabilization, such as mulch.

### 3.3 EXCAVATION AND BACKFILL

Excavation shall be closely controlled. The material removed from the excavation shall be selectively stockpiled in areas where a minimum of sediment will be generated and where other damage will not result from piled earth. Drainage swales and ponds shall be protected at all times and the piling of soil in drainageways shall not be allowed. Repaving shall be placed promptly following completion of backfilling and compaction in improved areas.

### 3.4 STOCKPILES

A. Stockpile areas shall be selected and maintained by on-site personnel. Site selection and stockpile design shall incorporate sediment and erosion control considerations to prevent the potential direct production and delivery of sediment to waterways, and damage to vegetation. Temporary stabilization of stockpiles shall be promptly instituted. The existence of critical slopes on stockpiles shall be avoided. Stockpiling in or immediately adjacent to diversion channels shall not be allowed. If a stockpile is to remain for over sixty (60) days, it shall be stabilized by soil stabilizing chemicals, temporary vegetation, interim structures or other approved practices.

B. Temporary vegetative measures planned for implementation on stockpiles shall be established immediately after stockpile completion. Proper mulching and soil stabilization in conjunction with these seeding operations shall also be carried out.

### 3.5 SILT FENCES

Place silt fences in a continuous row, parallel to the slope, waterway, roadway or other area being protected. Anchor the silt fence fabric to posts set at a minimum of 10 ft. apart. Embed the bottom of the fabric a minimum of 4" deep and backfill and compact soil over the embedded portion. Replace or repair any sections of fence, which collapse or are washed out during the construction period as soon as reasonably possible.

Inspect all silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies. In addition, make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences as directed by the Engineer.

Remove sediment deposits when the deposit reaches approximately 1/2 of the volume capacity of the silt fence or as directed by the Engineer. Dress any sediment deposits remaining in place after the silt fence is no longer required to conform to the finished grade and prepare and sod them in accordance with the requirements of this section.

### 3.6 SODDING

Place the sod on the prepared surface, with edges in close contact. Do not use sod which has been cut for more than 48 hours. Monitor placed sod for growth of pest plants and noxious weeds. If pest plants and/or noxious weeds manifest themselves within 30 days of placement of the sod during the months April through October, within 60 days of placement of the sod during the months of November through March treat affected areas by means acceptable to the City at no expense to the City. If pest plants and/or noxious weeds manifest themselves after the time frames described above from date of placement of sod, the Engineer, at his sole option, will determine if treatment is required and whether or not the Contractor will be compensated for such treatment.

### 3.7 DUST CONTROL

It shall be the Contractor's responsibility to control dust by watering and sweeping at the end of each and every workday or as directed by the Engineer.

### 3.8 INLET PROTECTION

The Contractor shall protect from sediment and debris any existing catch basin with filter fabric while work is in progress. Filter fabric shall be removed after completion of work or sod has established. Filter fabric must be cleaned periodically to avoid excessive accumulation of sediment and debris. Extreme care shall be taken when removing filter fabric to avoid sediments and debris entering catch basin. Any sediments falling inside the drainage system shall be removed.

### 4.0 CLEAN UP

A. A spill kit must be provided during the entire duration of the project. The spill kit is to be used in the immediate response and clean-up of spills, leaks or other discharges of hazardous wastes or other hazardous materials (chemical spills). Spill kits shall be maintained in close proximity to areas where chemicals are managed or stored to enable prompt response and clean-up of spills. The contents of a spill kit shall be tailored to the types and quantities of chemicals that can potentially spill. As a minimum granular absorbent or oil-specific absorbent pads shall be kept on site.

B. Upon project completion, remove all temporary erosion and sediment control devices. Remove from job site all excess materials, debris, surplus tools and equipment. Leave site in a neat and orderly condition acceptable to the Engineer.

C. Upon removal of temporary erosion and sediment control devices, perform all required finish grading, seeding, and mulching as specified under Section 02200.

**\*\*END OF SECTION\*\***

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## SECTION 02485

### SEEDING AND SODDING

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials and equipment necessary to satisfactorily return all construction areas to their original conditions or better.
- B. Work shall include furnishing and placing seed or sod, fertilizing, planting, watering and maintenance until acceptance by County.

##### 1.02 RELATED WORK NOT INCLUDED

Excavation, filling and grading required to establish elevation shown on the Drawings are included under other sections of these Specifications.

##### 1.03 QUALITY ASSURANCE

- A. It is the intent of this Specification that the Contractor is obliged to deliver a satisfactory stand of grass as specified. If necessary, the Contractor shall repeat any or all of the work, including grading, fertilizing, watering and seeding or sodding at no additional cost to the County until a satisfactory stand is obtained. For purposes of grassing, a satisfactory stand of grass is herein defined as a full lawn cover over areas to be sodded or seeded, with grass free of weeds, alive and growing, leaving no bare spots larger than 3/4 square yard within a radius of 8 feet.
- B. All previously grassed areas where pipelines are laid shall be sodded. All sodding and grassing shall be installed in accordance with these Specifications or as directed by the County.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Fertilizer: The fertilizer shall be of the slow-release type meeting the following minimum requirements: 12 percent nitrogen, 8 percent phosphorus, 8 percent potassium; 40 percent other available materials derived from organic sources. At least 50 percent of the phosphoric acid shall be from normal super phosphate or an equivalent source which will provide a minimum of two units of sulfur. The amount of sulfur shall be indicated on the quantitative analysis card attached to each bag or other container. Fertilizer shall be uniform in composition, dry and free

flowing delivered to sites in original unopened containers bearing manufacturer's statement or guarantee.

- B. Seeding/Grassing: The Contractor shall grass all unpaved areas disturbed during construction which do not require sod. All grassing shall be completed in conformance with FDOT Specifications, Sections 570 and 981. The grassed areas shall be mulched and fertilized in accordance with FDOT Specifications, except that no additional payment will be made for mulching, fertilizing and/or watering.
- C. Sodding: Sod shall be provided as required on the construction drawings or at locations as directed by the County in accordance with Florida Department of Transportation, Specifications Section 575 and 981. The Contractor shall furnish bahia grass sod or match existing sod. Placement and watering requirements shall be in accordance with FDOT Specifications Section 575, except that no additional payment will be made for placement and/or watering. This cost shall be included in the Contract price bid for sodding.
- D. Topsoil: Topsoil stockpiled during excavation may be used as necessary. 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.
- E. Water: 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. The Contractor shall make whatever arrangements that may be necessary to ensure an adequate supply of water to meet the needs for his work. He shall also 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.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. When the trench backfill has stabilized sufficiently, the Contractor shall commence work on lawns and grassed areas, including fine grading as necessary and as directed by the County.
- B. Finish Grading: Areas to be seeded or sodded shall be finish graded, raked, and debris removed. Soft spots and uneven grades shall be eliminated. The County shall approve the finish grade of all areas to be seeded or sodded prior to seed or sod application.

- C. Areas to be sodded shall be excavated or cut-down to accept the approximate 2" thick sod, so finish grade matches existing. Sod shall not be thrown over top of existing sod or debris.
- D. Protection: Seeded and sodded areas shall be protected against traffic or other use by placing warning signs or erecting barricades as necessary. Any areas damaged prior to acceptance by the County shall be repaired by the Contractor as directed by the County.

### 3.02 CLEANUP

Soil or similar materials spilled onto paved areas shall be removed promptly, keeping those areas as clean as possible at all times. Upon completion of seeding and sodding operations, all excess soil, stones and debris remaining shall be removed from the construction areas.

### 3.03 LANDSCAPE MAINTENANCE

- A. Any existing landscape items damaged or altered during construction by the Contractor shall be restored or replaced as directed by the County.
- B. Maintain landscape work for a period of 90 days immediately following complete installation of work or until County accepts project. Watering, weeding, cultivating, restoration of grade, mowing and trimming, protection from insects and diseases, fertilizing and similar operations as needed to ensure normal growth and good health for live plant material shall be included at no additional cost to the County.

### 3.04 REPAIRS TO LAWN AREAS DISTURBED BY CONTRACTOR'S OPERATORS

Lawn areas planted under this Contract and all lawn areas damaged by the Contractor's operation shall be repaired at once by proper soil preparation, fertilizing and sodding, in accordance with these Specifications.

**\*\*END OF SECTION\*\***

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## SECTION 02513

### ASPHALT CONCRETE PAVING

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials and equipment necessary to complete all milling asphalt pavement and asphalt concrete paving (including restoration of driveways) as called out on the Contract Documents or as shown on the Drawings.

##### 1.02 QUALITY ASSURANCE

- A. Qualifications of Asphalt Concrete Producer: The only materials permitted shall be furnished by a bulk asphalt concrete producer exclusively engaged in the production of hot-mix, hot-laid asphalt concrete.
- B. Qualification of Testing Agency: The County may employ a commercial testing laboratory to conduct tests and evaluations of asphalt concrete materials and design. The Contractor shall:
  - 1. Provide asphalt concrete testing and inspection service acceptable to County.
  - 2. Include sampling and testing asphalt concrete materials proposed, and tests and calculations for asphalt concrete mixtures.
  - 3. Provide field testing facilities for quality control testing during paving operations.
- C. Requirements of Regulatory Agencies: The Contractor shall comply with the applicable requirements of:
  - 1. Manatee County Utility Operations Department
  - 2. Manatee County Transportation Department
  - 3. State of Florida Dept. of Transportation

##### 1.03 PAVING QUALITY REQUIREMENTS

- A. General: In addition to other specified conditions, the Contractor shall comply with the following minimum requirements:
  - 1. In-place asphalt concrete course shall be tested for compliance with requirements for density, thickness and surface smoothness.
  - 2. Final surface shall be provided of uniform texture, conforming to required grades and cross sections.

3. A minimum of four inch diameter pavement specimens for each completed course shall be taken from locations as directed by the County.
4. Holes from test specimens shall be repaved as specified for patching defective work.

B. Density:

1. When subjected to 50 blows of standard Marshall hammer on each side of an in place material specimen, densities shall be comparable to a laboratory specimen of same asphalt concrete mixture.
2. The minimum acceptable density of in-place course material shall be 98% of the recorded laboratory specimen density.

C. Thickness: In-place compacted thicknesses shall not be acceptable if less than the minimum thicknesses shown on the Drawings.

D. Surface Smoothness:

1. Finished surface of each asphalt concrete course shall be tested for smoothness, using a 10 ft. straightedge applied parallel to and at right angles to centerline of paved areas.
2. Surface areas shall be checked at intervals directed by County.
3. Surfaces shall not be acceptable if they exceed the following:
  - a. Base Course: 1/4 in. in 10 ft.
  - b. Surface Course: 3/16 in. in 10 ft.
  - c. Crowned Surfaces:
    - 1) Test crowned surfaces with a crown template, centered and at right angles to the crown.
    - 2) Surfaces will not be acceptable if varying more than 1/4 in. from the template.

1.04 SUBMITTALS

A. Samples: The Contractor may be required to provide samples of materials for laboratory testing and job-mix design.

B. Test Reports: The Contractor shall submit laboratory reports for following materials tests:

1. Coarse and fine aggregates from each material source and each required grading:
  - a. Sieve Analysis: ASTM C 136 (AASHTO T 27).
  - b. Unit Weight of Slag: ASTM C29 (AASHTO T 19).
  - c. Soundness: ASTM C 88 (AASHTO T 104) for surface course aggregates only.
  - d. Sand Equivalent: ASTM D 2419 (AASHTO T 176).

- e. Abrasion of Coarse Aggregate: ASTM C131 (AASHTO T 96), for surface course aggregates only.
- 2. Asphalt cement for each penetration grade:
  - a. Penetration: ASTM D5 (AASHTO T49).
  - b. Viscosity (Kinematic): ASTM D2170 (AASHTO T 201).
  - c. Flash Point: ASTM D92 (AASHTO T 48).
  - d. Ductility: ASTM D 113 (AASHTO T 51).
  - e. Solubility: ASTM D 4 (AASHTO T 44).
  - f. Specific Gravity: ASTM D 70 (AASHTO T 43).
- 3. Job-mix design mixtures for each material or grade:
  - a. Bulk Specific Gravity for Coarse Aggregate: ASTM C 117(AASHTO T 85).
  - b. Bulk Specific Gravity for Fine Aggregate: ASTM C 128(AASHTO T 84).
- 4. Uncompacted asphalt concrete mix: Maximum Specific Gravity: ASTM D 2041 (AASHTO T 209).
- 5. Compacted asphalt concrete mix:
  - a. Bulk Density: ASTM D 1188 (AASHTO T 166).
  - b. Marshall Stability and Flow: ASTM D 1559.
- 6. Density and voids analysis:
  - a. Provide each series of asphalt concrete mixture test specimens, in accordance with A.I. MS-2 "Mix Design Methods for Asphalt Concrete".
  - b. Use Marshall method of mix design unless otherwise directed or acceptable to the County.
  - c. Report the quantity of absorbed asphalt cement in pounds of dry aggregate, percent air voids, and percent voids in mineral aggregate.
- 7. Sampling and testing of asphalt concrete mixtures for quality control during paving operations:
  - a. Uncompacted asphalt concrete mix.
    - 1) Asphalt Cement Content: ASTM D 2172 (AASHTO T 164).
    - 2) Penetration of Recovered Asphalt Cement: ASTM D 5(AASHTO T 49).
    - 3) Ductibility of Recovered Asphalt Cement: ASTM D 113(AASHTO T 51).
  - b. Compacted asphalt concrete mix:
    - 1) Bulk Density: ASTM D 1188 (AASHTO T 166).
    - 2) Marshall Stability and Flow: ASTM D1559).
  - c. Perform at least one test for each day's paving.
- 8. Asphalt plant inspection: ASTM D 290.
- 9. Additional testing:
  - a. Retesting shall be required if previous tests indicate insufficient values, or if directed by the County.
  - b. Testing shall continue until specified values have been attained.
- 10. Asphalt concrete materials which do not comply with specified requirements shall not be permitted in the work.

## 1.05 JOB CONDITIONS

### A. Weather Limitations:

1. Apply bituminous prime and tack coats only when the ambient temperature in the shade is 50 degrees F. and when the temperature has not been below 35 degrees F. for 12 hours immediately prior to application.
2. Do not apply when the base surface is wet or contains an excess of moisture which would prevent uniform distribution and the required penetration.
3. Construct asphalt concrete surface course only when atmospheric temperature is above 40 degrees F., when the underlying base is dry, and when weather is not rainy.
4. Base course may be placed when air temperature is not below 30 degrees F. and rising, when acceptable to the County.

### B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

### C. Traffic Control: Maintain vehicular and pedestrian traffic during paving operations, as required for other construction activities.

## PART 2 PRODUCTS

### 2.01 MATERIALS

#### A. Soil Cement or Shell Base Course: as specified in FDOT Section 270, "Material for Base and Stabilized Base", and as called for in the Contract Documents.

#### B. Aggregate for Asphalt Concrete, General:

1. Sound, angular crushed stone, crushed gravel, or crushed slag: ASTM D 692.
2. Sand, stone, or slag screening: ASTM D 1073.
3. Provide aggregate in gradations for various courses to comply with local highway standards.

#### C. Surface Course Aggregates:

1. Provide natural sand, unless sand prepared from stone, slag, or gravel or combinations are required to suit local conditions.

#### D. Asphalt Cement: Comply with ASTM D 946 for 85-100 penetration grade.

#### E. Prime Coat:

1. Cut-back liquid asphalt.
2. Medium-Curing type: ASTM D 2027, Grade MC-70.

## 2.02 ASPHALT-AGGREGATE MIXTURES

### A. Job-mix criteria:

1. Provide job-mix formulas for each required asphalt-aggregate mixture.
2. Establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt cement to be added to aggregate, and a single temperature at which asphalt concrete is to be produced.
3. Comply with the mix requirements of local governing highway standards.
4. Maintain material quantities within allowable tolerances of the governing standards.

## 2.03 TRAFFIC AND PARKING MARKING MATERIALS

- A. Traffic lane marking paint with chlorinated rubber base.
- B. Factory mixed, quick drying and non bleeding, FS TT-P-115C, Type III.
- C. Color: Driving Lane Dividers - White  
No Parking Zone - Yellow  
Parking Dividers - White

## PART 3 EXECUTION

### 3.01 SURFACE PREPARATION

#### A. Subbase Preparation:

1. The Contractor shall remove from the area all organic substance encountered to a depth of six or eight inches (6" or 8"), or to such depth and width as directed by the County. The entire area shall be plowed and dragged prior to placing a stabilizing additive, if required to meet minimum bearing value.
2. Subbase shall be compacted to a minimum density of 98 percent of the maximum as determined by the Modified Proctor Density AASHTO T180, and shall have a minimum bearing value of 40 pounds per square inch as determined by the Florida Bearing Test.

#### B. Base Course:

1. Check subgrade for conformity with elevations and section immediately before placing base material.

2. Place base material in compacted layers not more than 6 inches thick, unless continuing tests indicate the required results are being obtained with thicker layers.
3. In no case will more than 8-inches of compacted base be placed in one lift.
4. Spread, shape, and compact all base material deposited on the subgrade during the same day.
5. Compact base course material to be not less than 98% of maximum density: ASTM D 1557, Method D (98 percent maximum density: AASHTO T-180).
6. Test density of compacted base course: ASTM D 2167.
7. Conduct one test for each 250 sq. yds. of in-place material, but in no case not less than one daily for each layer.

C. Loose and Foreign Material:

1. Remove loose and foreign material from compacted subbase surface immediately before application of paving.
2. Use power brooms or blowers, and brooming as required.
3. Do not displace subbase material.

D. Prime Coat:

1. Uniformly apply at rate of 0.20 to 0.5 gal. per sq. yd. over compacted and cleaned subbase surface.
2. Apply enough material to penetrate and seal, but not flood the surface.
3. Allow to cure and dry as long as required to attain penetration and evaporation of volatile, and in no case less than 24 hours unless otherwise acceptable to the County.
4. Blot excess asphalt with just enough sand to prevent pick-up under traffic.
5. Remove loose sand before paving.

E. Tack Coat:

1. Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphalt concrete or portland cement concrete and similar surfaces.
2. Apply at rate of 0.05 to 0.15 gal. per sq. yd. of surface.
3. Apply tack coat by brush to contact surfaces of structures projecting into or abutting asphalt concrete pavement.
4. Allow surfaces to dry until material is at condition of tackiness to receive pavement.

### 3.02 MANHOLE FRAME / VALVE BOX ADJUSTMENTS (IF APPLICABLE)

A. Placing Manhole frames:

1. Surround manhole frames set to elevation with a ring of compacted asphalt concrete base prior to paving.
  2. Place asphalt concrete mixture up to 1 in. below top of frame, slope to grade, and compact by hand tamping.
- B. Adjust manhole frames to proper position to meet paving.
- C. If permanent covers are not in place, provide temporary covers over openings until completion of rolling operations.
- D. Set cover manhole frames to grade, flush with surface of adjacent pavement.

### 3.03 PREPARING THE MIXTURE

- A. Comply with ASTM D 995 for material storage, control, and mixing, and for plant equipment and operation.
- B. Stockpiles:
1. Keep each component of the various-sized combined aggregates in separate stockpiles.
  2. Maintain stockpiles so that separate aggregate sizes shall not be intermixed.
- C. Heating:
1. Heat the asphalt cement at the mixing plant to viscosity at which it can be uniformly distributed throughout mixture
  2. Use lowest possible temperature to suit temperature-viscosity characteristics of asphalt.
  3. Do not exceed 350 degrees F. (176.6 degrees C.).
- D. Aggregate:
1. Heat-dry aggregates to reduce moisture content to not more than 2.0%.
  2. Deliver dry aggregate to mixer at recommended temperature to suit penetration grade and viscosity characteristics of asphalt cement, ambient temperature, and workability of mixture.
  3. Accurately weigh or measure dry aggregates and weigh or meter asphalt cement to comply with job-mix formula requirements.
- E. Mix aggregate and asphalt cement to achieve 90-95% of coated particles for base mixtures and 85-90% of coated particles for surface mixture, when tested in accordance with ASTM D 2489.
- F. Transporting:

1. Transport asphalt concrete mixtures from mixing site in trucks having tight, clean compartments.
2. Coat hauling compartments with a lime-water mixture to prevent asphalt concrete mixture from sticking.
3. Elevate and drain compartment of excess solution before loading mix.
4. Provide covers over asphalt concrete mixture when transporting to protect from weather and to prevent loss of heat.
5. During periods of cold weather or for long-distance deliveries, provide insulation around entire truck bed surfaces.

### 3.04 EQUIPMENT

- A. Provide size and quantity of equipment to complete the work specified within project time schedule.
- B. Bituminous Pavers: Self-propelled that spread hot asphalt concrete mixtures without tearing, shoving or gouging surfaces, and control pavement edges to true lines without use of stationary forms.
- C. Rolling Equipment:
  1. Self-propelled, steel-wheeled and pneumatic-tired rollers that can reverse direction without backlash.
  2. Other type rollers may be used if acceptable to the County.
- D. Hand Tools: Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools to complete the work specified.

### 3.05 PLACING THE MIX

- A. Place asphalt concrete mixture on prepared surface, spread and strike-off using paving machine.
- B. Spread mixture at a minimum temperature of 225 degrees F. (107.2 degrees C.).
- C. Inaccessible and small areas may be placed by hand.
- D. Place each course at thickness so that when compacted, it will conform to the indicated grade, cross-section, finish thickness, and density indicated.
- E. Paver Placing:
  1. Unless otherwise directed, begin placing along centerline of areas to be paved on crowned section, and at high side of sections on one-way slope, and in direction of traffic flow.

2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.
3. Complete base courses for a section before placing surface courses.
4. Place mixture in continuous operation as practicable.

F. Hand Placing:

1. Spread, tamp, and finish mixture using hand tools in areas where machine spreading is not possible, as acceptable to County.
2. Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperature.

G. Joints:

1. Carefully make joints between old and new pavements, or between successive days' work, to ensure a continuous bond between adjoining work.
2. Construct joints to have same texture, density and smoothness as adjacent sections of asphalt concrete course.
3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat.
4. Offset transverse joints in succeeding courses not less than 24 inches.
5. Cut back edge of previously placed course to expose an even, vertical surface for full course thickness.
6. Offset longitudinal joints in succeeding courses not less than 6 inches.
7. When the edges of longitudinal joints are irregular, honeycombed, or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness.

### 3.06 COMPACTING THE MIX

- A. Provide sufficient rollers to obtain the required pavement density.
- B. Begin rolling operations as soon after placing when the mixture will bear weight of roller without excessive displacement.
- C. Do not permit heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set.
- D. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- E. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs.
- F. Do not roll centers of sections first under any circumstances.

G. Breakdown Rolling:

1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge.
2. Operate rollers as close as possible to paver without causing pavement displacement.
3. Check crown, grade, and smoothness after breakdown rolling.
4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling.

H. Second Rolling:

1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction.
2. Continue second rolling until mixture has been thoroughly compacted.

I. Finish Rolling:

1. Perform finish rolling while mixture is still warm enough for removal of roller marks.
2. Continue rolling until roller marks are eliminated and course has attained specified density.

J. Patching:

1. Remove and replace defective areas.
2. Cut-out and fill with fresh, hot asphalt concrete.
3. Compact by rolling to specified surface density and smoothness.
4. Remove deficient areas for full depth of course.
5. Cut sides perpendicular and parallel to direction of traffic with edges vertical.
6. Apply tack coat to exposed surfaces before placing new asphalt concrete mixture.

3.07 MARKING ASPHALT CONCRETE PAVEMENT

A. Cleaning:

1. Sweep surface with power broom supplemented by hand brooms to remove loose material and dirt.
2. Do not begin marking asphalt concrete pavement until acceptable to the County.

B. Apply paint with mechanical equipment.

1. Provide uniform straight edges.
2. Not less than two separate coats in accordance with manufacturer's recommended rates.

3.08 CLEANING AND PROTECTION

- A. Cleaning: After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of the County.
- B. Protection:
  1. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened, and in no case sooner than 6 hours.
  2. Provide barricades and warning devices as required to protect pavement.
  3. Cover openings of structures in the area of paving until permanent coverings are placed (if applicable).

**\*\*END OF SECTION\*\***

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## SECTION 02575

### PAVEMENT REPAIR AND RESTORATION

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment, obtain County or State right-of-way permits and incidentals required and remove and replace pavements over trenches excavated for installation of water or sewer lines and appurtenances as shown on the Contract Drawings.

##### 1.02 GENERAL

- A. The Contractor shall take before and after photographs.
- B. The Contractor shall repair in a manner satisfactory to the County or State, all damage done to existing structures, pavement, driveways, paved areas, curbs and gutters, sidewalks, shrubbery, grass, trees, utility poles, utility pipe lines, conduits, drains, catch basin, flagstones, or stabilized areas or driveways and including all obstructions not specifically named herein, which results from this Project.
- C. The Contractor shall keep the surface of the backfilled area of excavation in a safe traffic bearing condition and firm 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. The repair shall conform to applicable requirements of Manatee County Transportation Department requirements for pavement repair and as described herein, including all base, subbase and asphalt replacement.
- D. All materials and workmanship shall meet or exceed the County requirements and as called for in the Contract Documents and nothing herein shall be construed as to relieve the Contractor from this responsibility.
- E. All street, road and highway repair shall be made in accordance with the FDOT and County details indicated on the Drawings and in accordance with the applicable requirements and approval of affected County and State agencies.

#### PART 2 PRODUCTS

##### 2.01 PAVEMENT SECTION

- A. Asphaltic concrete shall consist of asphalt cement, coarse aggregate, fine aggregate and mineral filler conforming to FDOT Type S-III Asphalt. Pavement

replacement thickness shall match that removed but in no case shall be less than 1-1/2" compacted thickness. All asphalt concrete pavement shall be furnished, installed and tested in accordance with FDOT Specifications for Road and Bridge Construction.

- B. Asphalt or crushed concrete or approved equal base material shall be furnished and installed under all pavement sections restored under this Contract. Asphalt base shall have a minimum 6" compacted thickness, meet requirements for FDOT ABC III (Minimum Marshall Stability of 1000) and be furnished, installed and tested in accordance with the requirements of the FDOT Standards. Crushed concrete base shall be 10" minimum compacted thickness. Crushed concrete aggregate material shall have a minimum LBR of 140 compacted to 98% T-180 AASHTO density. Asphalt base and crushed concrete base are acceptable. Other bases shall be submitted for approval.
- C. Prime and tack will be required and applied in accordance with Section 300 - FDOT Specifications: Prime and Tack Coat for Base Courses.

## PART 3 EXECUTION

### 3.01 CUTTING PAVEMENT

- A. The Contractor shall saw cut in straight lines and remove pavement as necessary to install the new pipelines and appurtenances and for making connections to existing pipelines.
- B. Prior to pavement removal, the Contractor shall mark the pavement for cuts nearly paralleling pipe lines and existing street lines. Asphalt pavement shall be cut along the markings with a rotary saw or other suitable tool. Concrete pavement shall be scored to a depth of approximately two (2) inches below the surface of the concrete along the marked cuts. Scoring shall be done by use of a rotary saw, after which the pavement may be broken below the scoring with a jackhammer or other suitable equipment.
- C. The Contractor shall not machine pull the pavement until it is completely broken and separated along the marked cuts.
- D. The pavement adjacent to pipe line trenches shall neither be disturbed nor damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, the Contractor shall remove and replace the pavement. In addition, the base and sub-base shall be restored in accordance with these Specifications, Florida Dept. of Transportation Standard Specifications and as directed by the County.

### 3.02 PAVEMENT REPAIR AND REPLACEMENT

- A. The Contractor shall repair, to meet or exceed original surface material, all existing concrete or asphaltic pavement, driveways, or sidewalks cut or damaged by construction under this Contract. He shall match the original grade unless otherwise specified or shown on the Drawings. Materials and construction procedures for base course and pavement repair shall conform to those of the Florida Dept. of Transportation.
- B. The Contractor's repair shall include the preparation of the subbase and base, place and maintain the roadway surface, any special requirements whether specifically called for or implied and all work necessary for a satisfactory completion of this work. Stabilized roads and drives shall be finished to match the existing grade. Dirt roads and drives shall have the required depth of backfill material as shown on the Contract Drawings.
- C. The asphaltic concrete repairs shall be in accordance with the Manatee County Public Works Standards, Part I Utilities Standards Manual, Detail UG-12. The asphaltic concrete repairs shall extend the full width and length of the excavation or to the limits of any damaged section. The edge of the pavement to be left in place shall be cut to a true edge with a saw or other approved method so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities. The existing asphalt beyond the excavation or damaged section shall be milled 25' back from the saw cut. Final overlay shall match existing with no discernable "bump" at joint.

### 3.03 MISCELLANEOUS RESTORATION

Sidewalks or driveways cut or damaged by construction shall be restored in full sections or blocks to a minimum thickness of four inches. Concrete curb or curb and gutter shall be restored to the existing height and cross section in full sections or lengths between joints. RCP pipe shall be repaired or installed in accordance with manufacturer's specifications. Grassed yards, shoulders and parkways shall be restored to match the existing sections with grass sod of a type matching the existing grass.

### 3.04 SPECIAL REQUIREMENTS

The restoration of all surfaces, as described herein, disturbed by the installation of pipelines shall be completed as soon as is reasonable and practical. The complete and final restoration of both paved and shell stabilized roads within a reasonable time frame is of paramount importance. To this end, the Contractor shall, as part of his work schedule, complete the restoration of any area of road within five weeks after removing the original surface. Successful leak testing shall be performed prior to restoring any area of road. All restoration and replacement or repairs are the responsibility of the Contractor.

3.05 CLEANUP

After all repair and restoration or paving has been completed, all excess asphalt, dirt and other debris shall be removed from the roadways. All existing storm sewers and inlets shall be checked and cleaned of any construction debris.

3.06 MAINTENANCE OR REPAIR

All wearing surfaces shall be maintained by the Contractor in good order suitable for traffic prior to completion and acceptance of the work.

**\*\*END OF SECTION\*\***

## SECTION 02614

### STEEL PIPE AND FITTINGS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and install, complete, ready for operation and field test all steel pipe as shown on the drawings and specified herein.
- B. Steel pipe shall include black steel, galvanized steel, and stainless steel pipe and fittings.
- C. Provide steel pipe only where specifically called out on the drawings.

##### 1.02 DESCRIPTION OF SYSTEM

- A. All of the equipment specified herein is intended to be standard steel pipe for use in transporting certain chemicals and liquids as shown on the drawings and specified herein.

##### 1.03 QUALIFICATIONS

- A. All steel pipe shall be furnished by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the steel pipe to be furnished. The equipment shall be designed, constructed, installed in accordance with the best practices and methods and shall comply with all these specifications.
- B. Steel pipe and fittings shall conform to all applicable standards of ASTM, ANSI and AWWA.

##### 1.04 SUBMITTALS

- A. Submit to the County for approval in accordance with the General Conditions and Section 01340, shop drawings to include dimensioning and technical specifications for all pipe to be furnished.

#### PART 2 MATERIALS

##### 2.01 STEEL PIPE AND FITTINGS FOR PIPING

- A. Black Steel Pipe: All black steel pipe shall be seamless, Grade B and in conformance with ASTM Designation A-53 and ANSI B36.10.

B. Galvanized Steel Pipe:

1. Galvanized steel pipe for plant and potable water service shall be hot-dipped, zinc coated galvanized, Grade A, electric resistance welded, Schedule 40 conforming to ASTM Designation A120. All joints shall be threaded joints. Threaded joints shall be made up with a stiff mixture of graphite and mineral oil, or an approved, nontoxic, nonhardening, pipe joint compound applied to the male thread only. After having been set up, a joint shall not be backed off unless the joint is completely broken, the threads cleaned and new compound applied. All joints shall be airtight. A sufficient number of unions shall be provided to allow for convenient removal of piping. Fittings for galvanized steel pipe shall be galvanized malleable iron, 150 psi service rating.
2. Where flanged connections are indicated or otherwise required for connection to flanged valves, fittings, and appurtenances, they shall be made up using companion type flanges. Where flanged fittings are indicated or otherwise required, they shall be made up using thread galvanized steel nipples and steel companion type flanges. Companion flanges shall be steel, 150-psi ANSI Standard flat face flanges of the threaded type. Flanges shall be spot-faced on the back around each bolt hole.
3. All exposed threads, wrench marks, or other damage to the zinc coating, shall be protected by the application of two coats of a heavy consistency, bituminous paint, or with two wraps of an approved vinyl or polyvinyl pressure sensitive tape. Bituminous paint shall be equal to Koppers Bitumastic No. 50, brush applied. Tape shall be equal to 3M Company Scotchrap No. 50, 0.010-inch thick, installed as recommended by 3M Company over a primer.

C. Stainless Steel Pipe:

Stainless steel pipe shall be provided as shown on the drawings. Pipe shall be Schedule 40S, Type 316L, annealed, white pickle finish and shall be in accordance with ASTM Specification A312 and ANSI B36.19. Where indicated on the Drawings, holes shall be drilled in the pipe at the factory by the manufacture.

D. Steel Pipe Sleeves:

Sleeves for pipe that passes through floors and walls shall be galvanized Schedule 40 steel pipe conforming to ASTM Designation A120. Sleeve dimensions shall conform to the details shown on the drawings. Sleeve ends shall be cut and ground smooth. Sleeves shall be flush with walls and ceilings, but shall extend above the floor as shown on the drawings. Sleeves for use with mechanical type seals shall be sized in conformance with the seal manufacturer's requirements.

## 2.02 STEEL PIPE FOUR (4) INCHES AND LARGER

- A. Except as modified or supplemented herein, all steel pipe, fittings and specials shall conform to the applicable requirements of the following standard specifications latest editions:

### AWWA Standards

C200 Steel Water Pipe 6 Inches and Larger

C203 Coal-Tar Protecting Coatings and Linings for Steel Water Pipelines - Enamel and Tape-Hot-Applied.

C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 inches and larger - Shop Applied.

C206 Field Welding of Steel Water Pipe

C207 Steel Pipe Flanges for Waterworks Service - Sizes 4 inches through 144 inches, Class D.

C208 Dimensions for Steel Water Pipe Fittings

- B. All steel pipe shall be manufactured and tested in accordance with the standards set forth in AWWA C200 latest edition for fabricated or mill type water pipe. The pipe shall be made from sheet or plate rolled into sections having longitudinal or spirally formed butt-welded seams. Girth seams shall be butt welded and shall be at least 8 feet apart except in specials and fittings. The steel shall conform to the standards established in Section 2 and Section 3 AWWA C200.

#### 1. Minimum Physical Properties of Steel Plate or Sheet:

- a. All steel pipe, specials and fittings shall be manufactured from steel plate or sheet having a specified minimum yield of 35,000 psi and specified minimum tensile of 60,000 psi. Test reports verifying the actual physical and chemical properties of the piping must be submitted to the County as soon as possible after manufacturing and fabrication. The test reports shall state the hydrotest pressure applied to all sections of straight pipe and to straight pipe used in fabrication of specials and fittings.
- b. All steel pipe, specials and fittings shall be manufactured or fabricated to the diameter as shown on the drawings. The normal size shall be the outside diameter of 14 inches and larger. For sizes less than 14 inches, the pipe shall be the normal steel pipe dimensions as listed in ASTM A53 specification. All diameters of

steel pipe, specials and fittings shall have minimum nominal wall thicknesses as stated herein below:

<u>Diameter</u>	<u>Minimum Wall Thickness</u>
54"	.375
48"	.375
42"	.375
36"	.375
30"	.375
24" & smaller	.250

- C. All fittings and specials shall be provided with ends as required for installation and shall be fabricated to the dimensions as shown on the drawings. All fittings shall be fabricated in accordance with the standards set forth in AWWA C208 latest edition. Fittings and specials shall be fabricated from hydrostatically tested pipe meeting AWWA C200 and will not require any further hydrostatic test in the shop. In reducing sections, the wall thickness will be governed by the largest end. Elimination of joints shown on the drawings must be approved by the County prior to the fabrication process.
- D. Flanged and Coupling Standards:
1. All flanges, bolts, nuts and gaskets shall meet standards established in AWWA C207. Flanges shall be Class D suitable for pressure up to and including 150 psi with facing and drilling as stated in Section 3 of C207. Procedure for attachment of flanges shall be in accordance with Section 10 of AWWA C207. Blind flanges shall conform in diameter drilling and thickness to the flanges to which they attach and shall produce a watertight joint under the specified test pressure.
  2. Mechanical couplings shall be Dresser Style 38, Rockwell Style 411 or equal. The middle ring of each coupling shall have a minimum thickness at least equal to that specified for the size of pipe on which the coupling is to be used and shall be 7 inches long for pipe 30 inches and smaller, 10 inches long for pipe 36 inches and larger. The pipe stop shall be omitted from the inner surface of the middle rings and the couplings shall be cleaned and shop primed with the manufacturer's standard rust inhibitive primer. The filter backwash header and where shown on the drawings shall the mechanically coupled joints be restrained with harness bolts and lugs. Joint harnesses, where applicable, shall conform to the details on the drawings. Lugs shall be attached to the pipe in the shop and coated as specified for the adjacent pipe. The dimensions shall be stated in AWWA M011 19.8.
- E. Pipe supports, anchors, blocking and hangers shall be fabricated in accordance with the details shown on the drawings and shall be installed complete with all accessories required for proper operation of the system. Should it be necessary to

modify the details for proper installation, all such modifications shall be subject to approval by the County. Lugs required for anchorage of the piping system shall be attached in the shop and coated as the adjacent pipe.

- F. All steel pipe, fittings, specials and appurtenances shall be prepared, primed, coated and lined as specified herein below:
1. Exterior surfaces of all steel pipe, fittings, specials, flanges, anchors and pipe supports exposed in above ground or interior locations shall be thoroughly cleaned in the shop by blasting with grit, shot or sand to SSPC SP6. One coat of primer shall be applied to the cleaned dry surface in a proper workmanship like manner and as recommended by the primer manufacturer. The primer shall be subject to approval of the County and compatible to the finish coat as specified in the paid section of the specifications. Field painting of the installed system shall be as specified in the painting section.
  2. Interior surfaces of all steel pipe, fittings, and specials, which are to be installed exposed aboveground or in interior locations shall be thoroughly cleaned in the shop by blasting with grit, shot or sand to SSPC SP6. Two coats of paint shall be applied to the interior of the pipe at the shop. The paint coats shall be Koppers Bitumastic Super Tank Solution applied at a minimum of 8 mils D.F.T. per coat.
  3. Exterior surfaces of all steel pipe, fittings and specials which are to be installed underground and in manholes which will not be encased in concrete shall be coated in the shop with coal tar enamel in accordance with the standards established in AWWA C203-78, except as modified or supplemented herein.
  4. The exterior coating system for below ground steel pipe shall consist of coal tar enamel, fibrous glass mat, asbestos pipelines felt wrap and finally wrapped with kraft paper and shall be applied by the procedure described in AWWA C203. The coating shall be held back 12 inches from ends to be mechanically coupled with uncoated areas primed with coal tar primer. The coating system must be done in the shop by an established pipe coating applicator acceptable to the coating materials manufacture and the County. Repairs of the any damage to the coating system incurred during the shipment and the field coating of couplings and ends where coatings have held back for joints shall be done by experienced and qualified personnel approved by the County. Procedure for such field coating shall be as described in AWWA C203.
  5. The interior surfaces of all steel pipe, fittings, and specials which are to be installed below ground shall be cleaned and lined with cement mortar conforming to the standards set forth in AWWA C205-80. All work performed in the lining process shall be done in a thorough and workmanship like manner by trained personnel under the supervision of experienced men skilled in the operations they supervise. The lining thickness shall be as follows:

Pipe Size (Inches)	Coating Thickness (Inches)	Tolerance (Inches)
4-10	1/4	-1/32 + 1/32
11-23	5/16	-1/16 + 1/8
24-36	3/8	-1/16 + 1/8
over 36	1/2	-1/16 + 1/8

Handling and transporting of cement mortar lined pipe shall be in accordance with Section 6 of AWWA C205 and Section 2.14 of AWWA C203.

6. The interior surface of all steel air piping shall be coated with a two part epoxy coating system equivalent to 7.0 mils DFT of Mobil Chemical 78-D-7 followed by 7.0 mils DFT of Mobil Chemical 78-W-3 or equal.

## 2.03 STEEL PIPE AND FITTING AND CHLORINE GAS PIPING

- A. If steel pipes are used for chlorine gas lines, they shall be Schedule 80 seamless steel pipe conforming to ASTM A120. All joints shall be threaded. Threaded joints shall be made up with a cement prepared from litharge and glycerin, or teflon tape. The cement shall be applied to the male thread only. Fitting except unions, shall be carbon steel 2,000 pounds CWP. Unions shall be of the flanged, ammonia type, either two-bolt or four-bolt square.

## PART 3 EXECUTION

### 3.01 INSTALLATION AND TESTING

- A. Steel pipe shall be installed true to alignment and rigidly supported anchors shall be provided where indicated.

After installation, the piping shall be tested by undergoing a four-hour pressure test at 20 percent above the designed operating pressure plant water supply lines. If any joint or pipe proves to be defective, it shall be repaired to the satisfaction of the County.

- B. Screwed joints shall be made up with good quality thread compound and applied to the male thread only. After having been set up, a joint must not be backed off unless the joint is completely broken, the threads cleaned and new compound applied. All joints shall be air tight.

- C. Stainless steel pipe shall have threaded joints or otherwise as required and shall be installed as shown on the Drawings.
- D. Sleeves of the proper size shall be installed for pipes passing through floors and walls as indicated on the drawings. Sleeves shall be given a prime coat of rust inhibitive primer such as Koppers No. 621, or equal.
- E. When cutting of pipe is required, the cutting shall be done by machine in a neat workmanlike manner without damage to the pipe. Cut ends shall be smooth and at right angles to the axis of the pipe.
- F. All field welding shall be in accordance with the American Welding Society Standards. The strength of the field weld shall develop the strength of the pipe. Welds shall receive a field coating of paint as specified in Section 09900 and as approved by the County.
- G. All galvanized steel pipe thread shall be clean, machine cut, and all pipe shall be reamed before erection. Each length of pipe as erected shall be up-ended and rapped to dislodge dirt and scale.
- H. All galvanized steel piping shall have a sufficient number of unions to allow convenient removal of piping. Unions shall be compatible with pipe.

### 3.02 PAINTING

- A. Pipe and fittings exposed to view, except stainless steel, shall receive a prime coating of rust inhibitive primer such as Koppers 621 or equal. Prior to prime coating, all surfaces shall be cleaned of all mill scale, rust, dirt, grease and other foreign matter.
- B. All piping and fittings exposed to view except stainless steel pipe shall be painted as specified.

**\*\*END OF SECTION\*\***

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## SECTION 02615

### DUCTILE IRON PIPE AND FITTINGS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required to install ductile iron pipe and restrained joint ductile iron pipe and cast iron or ductile iron restrained joint fittings, complete, as shown on the Drawings and specified in these Standards.
- B. Fittings are noted on the drawings for the Contractor's convenience and do not relieve him from laying and jointing different or additional items where required.
- C. The Contractor shall furnish all labor, materials, equipment and incidentals required to install push-on joint or restrained joint ductile iron pipe, complete as shown on the Drawings and Specifications.
- D. Newly installed pipe shall be kept clean and free of all foreign matter. All DI pipe installed underground shall be poly wrapped unless noted otherwise on the plans.

##### 1.02 SUBMITTALS

- A. The Contractor shall submit to the County, within ten days after receipt of Notice to Proceed, a list of materials to be furnished, the names of the suppliers and the appropriate shop drawings for all ductile iron pipe and fittings.
- B. The Contractor shall submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Ductile iron pipe shall conform to AWWA C150 and AWWA C151. Pipe shall be Pressure Class 350. All ductile iron pipe used in above ground applications shall be Special Thickness Class 53. All pipe materials used in potable water systems shall comply with NSF Standard 61.
- B. Unrestrained joint pipe shall be supplied in lengths not to exceed 21 ft. and shall be either the rubber-ring compression-type push-on joint or standard mechanical joint pipe as manufactured by the American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, or an approved equal.

- C. All mechanical joint fittings shall be pressure rated for 350 psi for sizes 4-24 inches and 250 psi for sizes 30 inches and larger. All flanged fittings shall be pressure rated for 250 psi for all sizes. All fittings shall meet the requirements of AWWA C110 or AWWA C153.
- D. Rubber gaskets shall conform to AWWA C111 for mechanical and push-on type joints and shall be Ethylene Propylene Diene Monomer (EPDM) rubber for potable water and reclaimed water pipelines. Standard gaskets shall be such as Fastite as manufactured by American Cast Iron Pipe Company, or an approved equal. Acrylonitrile butadiene (NBR) gaskets shall be used for potable water mains that are located in soil that is contaminated with low molecular-weight petroleum products or non-chlorinated organic solvents or non-aromatic organic solvents. Fluorocarbon (FKM) gaskets shall be used for potable water mains that are located in soil that is contaminated with aromatic hydrocarbons or chlorinated hydrocarbons. Fluorocarbon (FKM) gaskets shall be used where both classes of contaminants are found.
- E. Water Main and Reclaimed Water Main Coatings: All ductile iron pipe used in water and reclaimed water systems shall have a standard thickness cement lining on the inside in accordance with AWWA C104 and a standard 1-mil asphaltic exterior coating per AWWA C151. All ductile iron or gray iron fittings used in water and reclaimed water systems shall have standard thickness cement linings on the inside per AWWA C104 and an asphaltic exterior coating or they shall have factory-applied fusion bonded epoxy coatings both inside and outside in accordance with AWWA C550.
- F. Wastewater Main Coatings: All ductile iron pipe and fittings used in wastewater sewer systems shall have a factory applied dry film thickness 40-mil Protecto 401 or 40-mil Novocoat SP2000W amine cured novalac ceramic epoxy lining on the inside. The interior lining application is to be based on the manufacturer's recommendation for long-term exposure to raw sewage. To ensure a holiday-free lining, documentation must be provided, prior to shipment, showing each section of lined pipe has passed holiday testing at the time of production per ASTM G62. The lining shall have a minimum one year warranty covering failure of the lining and bond failure between liner and pipe.

Exterior coatings for ductile iron pipe and fittings used in wastewater systems shall be either an asphaltic coating per AWWA C151 or a factory-applied epoxy coating per AWWA C550.
- G. Thrust restraint devices shall be provided at all horizontal and vertical bends and fittings, in casings under roads and railroads and at other locations specifically indicated on the construction drawings. Thrust restraint devices shall be either concrete thrust blocks or restraining glands as manufactured by Star Pipe Products, Stargrip 3000 and 3100, Allgrip 3600, or as manufactured by EBAA Iron Sales,

Megaflange, 2000 PV, or other approved equal restraining gland products. Restrained joints, where used, shall be installed at bend and fitting locations and at pipe joint locations both upstream and downstream from the bends or fittings at distances as required by these Standards. Restrained joint pipe fittings shall be designed and rated for the following pressures:

350 psi for pipe sizes up to and including 24" diameter  
250 psi for pipe sizes 30" diameter and above

## 2.02 DETECTION

- A. Pipe shall have a 3-inch wide warning tape of the proper color placed directly above the pipe 12 inches below finished grade or a 6-inch warning tape between 12 inches and 24 inches below finished grade.
- B. Pipe shall have a solid, 10 gauge, high strength, copper clad steel wire with a polyethylene jacket of appropriate color installed along the pipe alignment as detailed in these standards. Tracer wire shall be manufactured by Copperhead Industries or Manatee County approved equal.

## 2.03 IDENTIFICATION

- A. Each length of pipe and each fitting shall be marked with the name of the manufacturer, size and class, lining type, and shall be clearly identified as ductile iron pipe. All gaskets shall be marked with the name of the manufacturer, size and proper insertion direction.
- B. All ductile iron pipe 12 inches and smaller shall be entirely polyethylene-wrapped blue for water mains, purple (Pantone 522 C) for reclaimed water mains and green for sewer mains, per AWWA C105.
- C. All ductile iron pipe greater than 12 inches shall be spiral wrapped with color coded polyethylene at a six-inch minimum spacing. If soil testing, in accordance with AWWA C105, indicates that the soil at the site is corrosive, the ductile iron pipe shall be entirely polyethylene-wrapped with color coded polyethylene.
- D. Poly-wrap shall be by V-Bio™ Enhanced Polyethylene Encasement (or equivalent).
- E. All above ground potable water mains and appurtenances shall be painted safety blue.

## PART 3 (NOT USED)

**\*\*END OF SECTION\*\***

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## SECTION 02618

### PIPELINE CLEANING

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment and incidentals required to clean all new lines 4" and larger, and existing pipelines as specified in this specification and as indicated on the Drawings.
- B. This work shall include the furnishing and installation of all pig launching and retrieval devices and the appropriate pigs for the cleaning procedure, and all necessary excavations, shutdowns, fittings and valves required.

##### 1.02 RELATED WORK

- A. The contractor is responsible for all necessary supply water.
- B. The contractor is responsible for all necessary bypass pumping.
- C. The contractor is responsible for the proper disposal of any materials removed from the pipe lines as a result of the cleaning procedure.

##### 1.03 SUBMITTALS

- A. The Contractor shall submit prior to construction, a cleaning plan, Shop Drawings, and layout diagram for approval to the County.
- B. The Contractor shall submit to the County a list of materials to be furnished, and the names of suppliers.

##### 1.04 QUALIFICATIONS

- A. The Contractor performing this work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner.
- B. The Contractor shall also be capable of providing crews as needed to complete this work without undue delay.
- C. The County reserves the right to approve or disapprove the Contractor, based on the submitted qualifications.

#### PART 2 PRODUCTS

02618-1

## 2.01 GENERAL

- A. The contractor shall be responsible for furnishing pigs in sufficient numbers and sizes, of appropriate densities, coatings and configurations to properly clean the piping systems.
- B. All pigs used for the cleaning of sewer or reclaimed water lines shall not be used in the cleaning of potable water lines.

## 2.02 MATERIALS

- A. The pig launching and retrieval equipment shall be of the latest design and construction and shall include the means to maintain constant monitoring of the in-line flows and pressures of the system being cleaned and the constant location of the cleaning pigs in the system. Launching and retrieval systems shall be fabricated, designed and manufactured according to ANSI standards and capable of withstanding working pressures of 150 psi. Launching and receiving devices shall be sized one diameter larger than the system to which it will be attached with a minimum length of 2.5 times the diameter.
- B. The contractor shall have available for immediate use an electronic pig detector for use in the system being cleaned to provide a means of tracking the passage of the pig in the system to locate areas of potential or suspected blockage and other disparities in the system.
- C. The pig shall be constructed of elastomer polyurethane with an open cell construction and a density equal to or suitable for use in the piping system being cleaned. Pig configuration shall consist of a parabolic nose with a concave base and coated with a resilient surface material that will maintain a peripheral seal and will effectively clean the piping system without over abrading the interior pipe wall. Pig characteristics shall include the ability to navigate through 90 degree bends, 180 degree turns, bi-directional fittings, full port valves, reduce its cross sectional area and return to its original design configuration and be propelled by hydraulic pressure.

## PART 3 EXECUTION

### 3.01 PIPELINE CLEANING

- A. The cleaning of the pipe line shall be done by the controlled and pressurized passage of a polyurethane pig of varying dimensions, coatings and densities as determined by the County through the piping system.
- B. A series of pigs shall be entered into the system at a point as near to the beginning as is logistically and mechanically feasible.

- C. A launching assembly shall be used as the entrance point for the pig. This assembly shall allow for the following:
  - 1. The entering of pigs into the system by providing the means to induce flow from an external source, independent of the flows and pressures immediately available from the system, on the back of the pig to develop sufficient pressure to force the pig through the system.
  - 2. A means to control and regulate the flow.
  - 3. A means to monitor the flows and pressures.
  - 4. A means to connect and disconnect from the system without any disruption to the operation of the system.
- D. The pig shall be removed or discharged from the system at a point as near to the end as is logistically and mechanically feasible.
- E. The contractor shall be responsible for the retrieval of the pig at the discharge point. This may include setting a trap that will not disrupt normal flow and operations but will capture the pig and any debris. A retrieval assembly may also be used but said assembly shall be able to connect and disconnect from the system without any disruption to the operation of the system.
- F. Alternative launching and retrieval methods shall be done with the prior approval of the County.
- G. Any pig that cannot progress through the piping system shall be located by the contractor and removed by excavation of the pipe in order to remove the blockage. All pipe repairs shall be the responsibility of the contractor and shall be performed with as little disruption to the system as possible.
- H. Any increase in pressure that cannot be accounted for, i.e. fittings or valves or additional cleaning runs, shall be investigated, per the Engineers' approval, by locating the pig at the beginning of the increased pressure and excavating to determine the cause of the pressure increase. All pipe repairs shall be the responsibility of the contractor and shall be performed with as little disruption to the system as possible.
- I. Final flushing of the cleansed lines shall be performed after the last successful run of the pig as determined by the County. The contractor shall be responsible for all applicable flushing and disinfection requirements for potable water lines.

### 3.02 ACCEPTANCE

- A. The contractor shall maintain and provide a report at the end of the cleaning procedure containing the following:

1. The pressures in the pipe during the pigging procedure.
2. Any inline problems encountered during the procedure including all excavations with detailed locations, reason for the excavation and any corrective measures taken to the pipeline.
3. A record of the pigs used, their sizes, styles and other pertinent information regarding what materials were used during the cleaning.
4. An analysis of the condition of the pipeline before and after the cleaning procedure.

**\*\*END OF SECTION\*\***

## SECTION 02640

### VALVES AND APPURTENANCES

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. The Contractor shall 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.
- B. All of the types of valves and appurtenances shall be products of well-established reputable firms who are fully experienced and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these standards as applicable. Valves used in waterworks applications shall comply with Section 8 of NSF Standard 61 for mechanical devices.
- C. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of potable water, reclaimed water, wastewater, etc., depending on the applications.
- D. All valves and appurtenances shall be of the size shown on the drawings and, to the extent possible, all equipment of the same type on the project shall be from a single manufacturer.
- E. All valves and appurtenances shall have the name of the manufacturer, year of the valve and the working pressure for which they are designed cast in raised letters upon some visible part of the body.
- F. Special tools, if required for the normal operation or maintenance, shall be supplied with the equipment.
- G. All hand actuated buried valves shall have three-piece adjustable valve boxes and 2-inch square AWWA operating nuts. Provide stainless steel extension stems and alignment rings where needed to bring the operating nut to within 4 feet below the box lid.
- H. Water and reclaimed water system isolation valves shall be gate valves for sizes 2-inch through 12-inch and shall be butterfly valves for sizes 16-inch and larger.
- I. Isolation valves for sewer force main pipelines shall be gate valves, unless otherwise noted on the plans. Tapping valves shall be used for tapping force mains.

Plug valves shall be full port, have a 100% circular cross section, and must have prior written authorization from the County for use.

- J. Valves shall open when turning the operating nut or wheel counterclockwise and shall close when turning clockwise.
- K. All bonnet bolts, gland bolts, flange connection bolts, nuts, washers, and other trim hardware exposed to the outside environment shall be stainless steel. Thrust collar tie-rod bolts shall be stainless steel. All MJ-type underground bolts, nuts, and washers shall be COR-TEN or stainless steel.
- L. All valves shall have a factory applied, holiday free, fusion bonded epoxy coating on the interior and exterior unless otherwise noted in the plans or the following specification. All other painted items exposed to sunlight, including field painted box lids, etc., shall be painted the appropriate color with an epoxy type paint.
- M. No valves with a break-way stem shall be allowed.
- N. The equipment shall include, but not be limited to, the following:
  - 1. Gate valves (Sec. 2.01)
  - 2. Combination Pressure Reducing and Pressure Sustaining with Check Valves Option (Sec. 2.02)
  - 3. Ball Valves (Sec. 2.03)
  - 4. Butterfly Valves (Sec. 2.04)
  - 5. Plug Valves (Sec. 2.05)
  - 6. Valve Actuators (Sec. 2.06)
  - 7. Air Release Valves (Sec. 2.07)
  - 8. Valves Boxes (Sec. 2.08)
  - 9. Corporation Stops and Saddles (Sec. 2.09)
  - 10. Flange Adapter and Plain End Couplings (Sec. 2.10)
  - 11. Hose Bibs (Sec. 2.11)
  - 12. Swing Check Values (Sec. 2.12)
  - 13. Hydrants (Sec. 2.13)
  - 14. Restraint Joints (Sec. 2.14)
  - 15. Tapping Sleeves and Tapping Valves (Sec. 2.15)
  - 16. Tracer Wire Boxes (Sec. 2.16)

## 1.02 SUBMITTALS

- A. Submit to the County within 30 days after execution of the contract a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.
- B. Complete shop drawings of all valves and appurtenances shall be submitted to the

County for approval in accordance with the Specifications.

1.03 TOOLS

Special tools, if required for normal operation and maintenance shall be supplied with the equipment.

PART 2 PRODUCTS

2.01 GATE VALVES

- A. Gate valves installed underground shall be provided with a box cast in a concrete pad and a box cover. Stainless steel or equivalent valve extension stems shall be provided to place the valve operating nut no more than 4 feet deep. One valve wrench, 6 feet in length, shall be provided for every 15 valves installed.
- C. Gate valves 2 inches to 14 inches in diameter shall be resilient seated, manufactured to meet or exceed the requirements of AWWA C509 or AWWA C515 and shall be UL listed and FM approved where applicable. Valves shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve.
- D. The valves shall have a non-rising stainless-steel stem to eliminate lead content. All bolts, nuts and washers shall be stainless steel to eliminate exterior corrosion and maintain fastener strength. Manufacturer shall use Never-Seez or equivalent during assembly of bolt and nut sets to prevent galling of similar metals. Stem seals shall be provided and shall be of the O-ring type, two above and one below the thrust collar. Valves that are located above grade and located in valve vaults shall be OS&Y with flanged joints.
- E. The wedge shall be ductile iron fully encapsulated with an EPDM rubber. The Elastomer type shall be permanently indicated on the disc or body of the valve. The resilient sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction.
- F. The valve body, bonnet, and bonnet cover shall meet or exceed all the requirements of AWWA C515.
- G. Valves meeting AWWA C515 requirements shall be rated for an operating pressure of 250 psi and shall be tested in accordance with AWWA C515.
- H. The valves are to have 2-inch cast or ductile iron AWWA operating nuts and shall open left or counterclockwise.
- I. The valves shall be covered by a Manufacturer's 10 year warranty on manufacturer's defects and reasonable labor costs for replacement. Warranty shall

become effective from the date of purchase by the end user and delivered within 30 days from the receipt of the purchase order. For publicly owned and maintained utilities, the end user is Manatee County Government.

- J. Gate valves shall be assembled and tested in a certified ISO 9001:2000 manufacturing facility within the United States and provide their certification of meeting internationally recognized quality control procedures.

## 2.02 COMBINATION PRESSURE REDUCING & PRESSURE SUSTAINING WITH CHECK VALVE OPTION

- A. Pressure sustaining, and check valve shall be pilot operated diaphragm actuated valve with cast iron body, bronze trim, and 125-pound flanged ends. The valve shall be hydraulically operated, diaphragm type globe valve. The main valve shall have a single removable seat and a resilient disc, of rectangular cross section, surrounded on three and a half sides. No external packing glands are permitted and there shall be no pistons operating the main valve or any controls. The valve shall be equipped with isolation valves to service the pilot system while permitting flow if necessary. Main valve and all pilot controls shall be manufactured in the United States of America. Valve shall be single chamber type, with stainless steel stem.
- B. Valve shall automatically reduce pressure for the downstream distribution network and sustain a minimum pressure in the high pressure main regardless of distribution demand, and as an option, shall also close when a pressure reversal occurs for check valve operations. The pilot system shall consist of two direct acting, adjustable, spring loaded diaphragm valves.
- C. Valve shall be cast iron or ductile iron with main valve trim of brass and bronze. The pilot control valves shall be cast brass with 303 stainless steel trim. Valve shall be similar in all respects to Cla-Val Company, Model 92-01 or a similar control valve such as Bermad Model 723, GA Industries Model 4700 or an approved equal.

## 2.03 BALL VALVES

- A. Ball valves for water and reclaimed water, in sizes 3/4-inch through 2-inch, shall be brass body, stem and ball per ASTM B 62, alloy 85-5-5-5, full port, full flow, 1/4-turn check, ball curb valves, rated for 300 psi, Mueller 300 (as specified in the table below), Ford B-Series, or approved equal, with compression, pack joint, flare, threaded or flanged ends as required. Ball valves for wastewater, 2-inch through 3-inch, shall be 316 stainless steel body, cap, stem and ball per ASTM A351, full port, full flow, 1/4-turn check, ball valves, steam rated for 150 psi, pressure rating 1,000 psi CWT, Apollo 76F or approved equal, with threaded or flanged ends as required.

## Curb Stops for Water and Reclaimed Water

Pipe Material	Type of Connection	Model
HDPE	Compression x FIP	B-25170 *
HDPE	Pack Joint x FIP	P-25170 *
Copper	Compression x FIP	B-25170
Copper	Flare x FIP	B-25166
Stainless Steel	FIP x FIP Thread	B-20200
* Insert required, part number per manufacturer product information		

- B. All valves shall be mounted in such a position that valve position indicators are plainly visible. Above grade ball valves shall have a vinyl coated lever handle. Lever handle, handle nut, and lever packing gland shall be 304 or 316 stainless steel.
- C. Potable plastic service pipe material and compression and pack joint connectors shall not be used in soil that is contaminated with low molecular-weight petroleum products, aromatic hydrocarbons, chlorinated hydrocarbons or organic solvents. Appropriate service tubing shall apply.

## 2.04 BUTTERFLY VALVES

- A. Butterfly valves shall conform to AWWA C504, Class 250 B, Mueller Lineseal XPII, DeZurik AWWA, Pratt HP-250II, or an approved equal.
- B. Valve seats shall be an EPDM elastomer. Valve seats 24 inches and larger shall be field adjustable and replaceable without dismounting operator disc or shaft and without removing the valve from the line. Valves 20 inches and smaller shall have bonded or mechanically restrained seats as outlined in AWWA C504.
- C. All valves shall be subject to hydrostatic and leakage tests at the point of manufacture. The hydrostatic test for Class 250 valves shall be performed with an internal hydrostatic pressure equal to 500 psi applied to the inside of the valve body of each valve. During the hydrostatic test, there shall be no leakage through the metal, the end joints or the valve shaft seal. The leakage test for the Class 250 valves shall be performed at a differential pressure of 250 psi and against both sides of the valve. No adjustment of the valve disc shall be necessary after pressure test for normal operation of valve. All valves shall be leak tight in both directions.
- D. Butterfly valve actuators shall conform to AWWA C504. Gearing for the actuators shall be totally enclosed in a gear case. Actuators shall be capable of seating and unseating the disc against the full design pressure and shall transmit a minimum torque to the valve. Actuators shall be rigidly attached to the valve body. E. The valve shaft shall be constructed of 18-8, ASTM A-276, Type 304 stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque. Shaft shall be of either a one piece unit

extending full size through the valve disc and valve bearing or it may be of a stub shaft design. Shaft bearings shall be teflon or nylon, self-lubricated type.

- F. Gearing for the operators shall be totally enclosed in a gear case in accordance with paragraph 3.8.3 of the above mentioned AWWA Standard Specification.
- G. Operators shall be capable of seating and unseating the disc against the full design pressure of velocity, as specified for each class, into a dry system downstream and shall transmit a minimum torque to the valve. Operators shall be rigidly attached to the valve body.
- H. The manufacturer shall certify that the required tests on the various materials and on the completed valves have been satisfactory and that the valves conform with all requirements of this Specification and the AWWA standard.
- I. Where indicated on the Drawings, extension stems, floor stands, couplings, stem guides, and floor boxes as required shall be furnished and installed..

## 2.05 PLUG VALVES

- A. Plug valves shall be eccentric, non-lubricating type with integral plug and shafts and shall be furnished with end connections and with actuating mechanisms as called for on the construction plans or as otherwise required. Valves shall seal bubble-tight or water drop-tight in both directions when tested according to the Leakage Test method of AWWA C504 with a hydrostatic pressure of 150 psi.
- B. Plug valves shall also be subjected to the internal, full body Hydrostatic Test of AWWA C504 at a pressure two times the rated pressure or a minimum pressure of 300 psi, whichever is greater. During the test, there shall be no leakage through the metal, or through the end joints or shaft seal, nor shall any part of the valve be deformed. Plug valves shall be Kennedy or Dezurik.
- C. Flanged valve ends shall be faced and drilled according to ANSI B 16.1, Class 125. Mechanical joint valve ends shall conform to AWWA C111. Threaded ends shall conform to the NPT requirements of ANSI B1.20.1.
- D. The plug valve body, bonnet and gland shall be ductile iron per ASTM A 126, Class B. The integral plug and shafts shall be cast iron ASTM A 126, Class B, or 316 stainless steel. The entire plug, except for the shafts, shall be covered with nitrile (Buna N) rubber. The rubber compound shall have been vulcanized to the metal plug and shall have a peel strength of not less than 75 pounds per inch when tested according to ASTM D 429, method B. The valve seat shall be at least 90 percent pure nickel, welded-in overlay into the cast iron body. The top and bottom bearings shall be 316 stainless steel.

- E. Plug valves shall have a full port area of 100 percent of the nominal pipe size area.
- F. Valves shall have worm gear type actuators with 2-inch square operating nuts.
- G. Plug valves shall be installed side-ways with plug shaft horizontal so that the plug rotates upward when it opens, with the flow entering the seat end of the valve.
- H. Plug valves shall be coated inside with Protecto 401 or amine-cured novolac ceramic epoxy or another two-part epoxy suitable for sanitary sewer service which has been approved by Manatee County.

## 2.06 VALVE ACTUATORS

- A. Butterfly valve and plug valve actuators.

Butterfly valve and plug valve actuators shall conform to the requirements for actuators presented in AWWA C 504 and shall be either manual or motor operated. Actuators shall be capable of seating and unseating the disc against the full design pressure and velocity, as specified for each class, into a dry system downstream, and shall transmit a minimum torque to the valve. Actuators shall be rigidly attached to the valve body.

- B. Manual Actuators

Manual actuators shall have permanently lubricated, totally enclosed gearing with handwheel and gear ratio sized on the basis of actual line pressure and velocities. Actuators shall be equipped with handwheel, position indicator, and mechanical stop-limiting locking devices to prevent over travel of the disc in the open and closed positions. They shall turn counter-clockwise to open valves. Manual actuators shall be of the traveling nut, self-locking type or of worm gear type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Valves located above grade shall have handwheel and position indicator, and valves located below grade shall be equipped with a 2-inch square AWWA operating nut located at ground level and cast iron extension type valve box.

- C. Motor Actuators (Modulating)

- 1. The motor actuated valve controller shall include the motor, actuator unit gearing, limit switch gearing, limit switches, position transmitter which shall transmit a 4-20 mA DC signal, control power transformer, electronic controller which will position the valve based on a remote 4-20 milliamp signal, torque switches, bored and key-wayed drive sleeve for non-rising stem valves, declutch lever and auxiliary handwheel as a self-contained

- unit.
2. The motor shall be specifically designed for valve actuator service using 480 volt, 60 Hertz, three phase power as shown, on the electrical drawings. The motor shall be sized to provide an output torque and shall be the totally enclosed, non-ventilated type. The power gearing shall consist of helical gears fabricated from heat treated alloy steel forming the first stage of reduction. The second reduction stage shall be a single stage worm gear. The worm shall be of alloy steel with carburized threads hardened and ground for high efficiency. The worm gear shall be of high tensile strength bronze with hobbled teeth. All power gearing shall be grease lubricated. Ball or roller bearings shall be used throughout. Preference will be given to units having a minimum number of gears and moving parts. Spur gear reduction shall be provided as required.
  3. Limit switches and gearing shall be an integral part of the valve control. The limit switch gearing shall be made of bronze and shall be grease lubricated, intermittent type and totally enclosed to prevent dirt and foreign matter from entering the gear train. Limit switches shall be of the adjustable type capable of being adjusted to trip at any point between fully opened valve and fully closed valve.
  4. The speed of the actuator shall be the responsibility of the system supplier with regard to hydraulic requirements and response compatibility with other components within the control loop. Each valve controller shall be provided with a minimum of two rotor type gear limit switches, one for opening and one for closing. The rotor type gear limit switch shall have two normally open and two normally closed contacts per rotor. Gear limit switches must be geared to the driving mechanism and in step at all times whether in motor or manual operation. Provision shall be made for two additional rotors as described above, each to have two normally open and two normally closed contacts. Each valve controller shall be equipped with a double torque switch. The torque switch shall be adjustable and will be responsive to load encountered in either direction of travel. It shall operate during the complete cycle without auxiliary relays or devices to protect the valve, should excessive load be met by obstructions in either direction of travel. The torque switch shall be provided with double-pole contacts.
  5. A permanently mounted handwheel shall be provided for manual operation. The handwheel shall not rotate during electric operations but must be responsive to manual operation at all times except when being electrically operated. The motor shall not rotate during hand operation nor shall a fused motor prevent manual operation. When in manual operating position, the unit will remain in this position until motor is energized at which time the valve operator will automatically return to electric operation and shall remain in motor position until handwheel operation is desired. This movement from motor operation to handwheel operation shall be accomplished by a positive declutching lever which will disengage the motor and motor gearing mechanically, but not electrically. Hand operation

must be reasonably fast. It shall be impossible to place the unit in manual operation when the motor is running. The gear limit switches and torque switches shall be housed in a single easily accessible compartment integral with the power compartment of the valve control. All wiring shall be accessible through this compartment. Stepping motor drives will not be acceptable.

6. The motor with its control module must be capable of continuously modulating over its entire range without interruption by heat protection devices. The system, including the operator and control module must be able to function, without override protection of any kind, down to zero dead zone.
7. All units shall have strip heaters in both the motor and limit switch compartments.
8. The actuator shall be equipped with open-stop-close push buttons, an auto-manual selector switch, and indicating lights, all mounted on the actuator or on a separate locally mounted power control station.
9. The electronics for the electric operator shall be protected against temporary submergence.
10. Actuators shall be Limitorque L120 with Modutronic Control System containing a position transmitter with a 4-20MA output signal or equal.

#### D. Motor Actuators (Open-Close)

1. The electronic motor-driven valve actuator shall include the motor, actuator gearing, limit switch gearing, limit switches, torque switches, fully machined drive sleeve, declutch lever, and auxiliary handwheel as a self-contained unit.
2. The motor shall be specifically designed for valve actuator service and shall be of high torque totally enclosed, nonventilated construction, with motor leads brought into the limit switch compartment without having external piping or conduit box.
  - (a) The motor shall be of sufficient size to open or close the valve against maximum differential pressure when voltage to motor terminals is 10% above or below nominal voltage.
  - (b) The motor shall be prelubricated and all bearings shall be of the anti-friction type.
3. The power gearing shall consist of helical gears fabricated from heat treated steel and worm gearing. The worm shall be carburized and hardened alloy steel with the threads ground after heat treating. The worm gear shall be of alloy bronze accurately cut with a hobbing machine. All power gearing shall be grease lubricated. Ball or roller bearings shall be used throughout.
4. Limit switches and gearing shall be an integral part of the valve actuator. The switches shall be of the adjustable rotor type capable of being adjusted to trip at any point between fully opened valve and fully closed valve. Each valve controller shall be provided with a minimum of two rotor type gear

limit switches, one for opening and one for closing (influent valves require additional contacts to allow stopping at an intermediate position). The rotor type gear limit switch shall have two normally open and two normally closed contacts per toro. Additional switches shall be provided if shown on the control and/or instrumentation diagrams. Limit switches shall be geared to the driving mechanism and in step at all times whether in motor or manual operation. Each valve actuator shall be equipped with a double torque switch. The torque switch shall be adjustable and will be responsive to load encountered in either direction of travel. It shall operate during the complete cycle without auxiliary relays or devices to protect the valve should excessive load be met by obstructions in either direction of travel. Travel and thrusts shall be independent of wear in valve disc or seat rings.

5. A permanently mounted handwheel shall be provided for manual operation. The handwheel shall not rotate during electric operation except when being electrically operated. The motor shall not rotate during hand operation, nor shall a fused motor prevent manual operation. When in manual operating position, the unit will remain in this position until motor is energized at which time the valve actuator will automatically return to electric operation and shall remain in motor position until handwheel operation is desired. Movement from motor operation to handwheel operation shall be accomplished by a positive declutching lever which will disengage the motor and motor gearing mechanically, but not electrically. Hand operation must be reasonably fast. It shall be impossible to place the unit in manual operation when the motor is running.
6. Valve actuators shall be equipped with an integral reversing controller and three phase overload relays, Open-Stop-Close push buttons, local-remote-manual selector switch, control circuit transformer, three-phase thermal overload relays and two pilot lights in a NEMA 4X enclosure. In addition to the above, a close coupled air circuit breaker or disconnect switch shall be mounted and wired to the valve input power terminals for the purpose of disconnecting all underground phase conductors.
7. The valve actuator shall be capable of being controlled locally or remotely via a selector switch integral with the actuator. In addition, an auxiliary dry contact shall be provided for remote position feedback.
8. Valve A.C. motors shall be designed for operation on a 480 volt, 3-phase service. Valve control circuit shall operate from a fuse protected 120 volt power supply.
9. Motor operators shall be as manufactured by Limitorque Corporation, Type L120 or approved equal.

## 2.07

### AIR RELEASE VALVES

- A. Air release valves shall be automatic float operated, GA Industries fig-929 for sewer applications, Fig-920 for water and reclaimed water application, or an approved equal, with inlet size and working pressure ratings as

required and NPT connections.

B. Valve bodies shall be ductile iron per ASTM A 126, Class B. The orifice, float and linkage shall be stainless steel. The seat shall be (Buna N) nitrile elastomer.

## 2.08 VALVE BOXES

- A. Buried valves shall have adjustable cast iron or HDPE valve boxes. Lids shall be cast iron drop type, and shall have "WATER", "SEWER", or "RECLAIM", as applicable, cast into the top. Lids will be painted "safety" blue for potable, purple for reclaimed, and green for sanitary sewer.
- B. Cast iron boxes shall be two-piece, or three-piece, as required, screw type, Tyler Pipe, 6850 Series, Box 461-S through 668-S, with extensions, as required to make the desired box length, or an approved equal. Bottom barrel shall be 5-1/4 inches inside diameter, with a flanged bottom with sufficient bearing area to prevent settling.
- C. HDPE boxes shall be two-piece, adjustable, 1/4-inch thick minimum heavy wall, high-density polyethylene, with cast iron top and stainless-steel adjustable stem, Trench Adapter, as manufactured by American Flow Control, or an approved equal. Bottom barrel shall have flanged bottom to prevent settling. All bolts, screws and pins shall be stainless steel.
- D. Reclaimed Valve Boxes shall be square 9-inch x 9-inch load bearing marked "Reclaimed Water" and painted Pantone 522C purple.
- E. All valves shall either have operating nuts within 4 feet below the top of the lid or shall have extension stems with centering guides to provide an extended operating nut within 4 feet below the lid. Extension stems shall be fixed to the valve operating nut with a stainless-steel fastener.
- F. All potable water, sewer, and reclaimed water grade-adjustment risers shall be cast iron material just like the valve box. No plastic or steel risers shall be allowed.
- G. A centering device BoxLokor equal shall be installed in the valve box.
- H. Stand pipe shall match color code of the system being installed, (blue for potable, Pantone purple 522 C for reclaimed, and green for sanitary sewer).

## 2.09 CORPORATION STOPS

- A. Corporation stops for connections to ductile iron and PVC water and reclaimed water mains shall be all red brass, alloy 85-5-5-5, per ASTM B 62, and shall conform to AWWA C800. 1-inch through 2-inch corporation stops shall be ball type, 300 psi working pressure rated, with AWWA MIP threaded inlets and compression, pack joint, flare, or FIP threaded joint outlets, Mueller as shown in the table below, or an approved equal. All joints made to CTS size HDPE tubing shall use stainless steel insert stiffeners.

Corporation Stops

Pipe Material	Type of Connection	Mueller 300 Model
HDPE	Compression x AWWA IP Thread	B-25028 (Saddle) *
HDPE	Compression x AWWA Taper Thread	B-25008 (Direct Tap) *
HDPE	Pack Joint x AWWA IP Thread	P-25028 (Saddle) *
HDPE	Pack Joint x AWWA Taper Thread	P-25008 (Direct Tap) *
Copper	Compression x AWWA IP Thread	B-25028 (Saddle)
Copper	Pack Joint x AWWA Taper Thread	B-25008 (Direct Tap)
Copper	Pack Joint x AWWA IP Thread	P-25028 (Saddle)
Copper	Pack Joint x AWWA Taper Thread	P-25008 (Direct Tap)
Copper	Flare x AWWA IP Thread	B-25028 (Saddle)
Copper	Flare x AWWA Taper Thread	B-25008 (Direct Tap)
Stainless Steel	FIP Thread x AWWA IP Thread	B-20046 (Saddle)
Stainless Steel	FIP Thread x AWWA Taper Thread	B-20045 (Direct Tap)

\* Insert required, part number per manufacturer product information

- B. Potable plastic service pipe material and compression and pack joint connectors shall not be used in soil that is contaminated with low molecular-weight petroleum products, aromatic hydrocarbons, chlorinated hydrocarbons or organic solvents. Appropriate service tubing shall apply.
- C. Water and reclaimed water service connections to PVC and DIP mains shall be made using red brass saddles, alloy 85-5-5-5, per ASTM B 62. Straps, washers and nuts shall be brass or stainless steel. No ductile iron, cast iron or steel saddles will be allowed. Saddles shall be Smith Blair 325 Bronze saddles with Stainless Steel or brass extra wide strap or equivalent.
- D. Connections to PVC sanitary force mains for services up to 2 inches shall be made using Romac Style 306 double bolt stainless steel service saddles or equivalent.
- E. Service and air release valve (ARV) connections to HDPE water, reclaimed water and sewer mains may be made using Romac Style 306H saddle or approved equal. All saddles shall be properly sized per the manufacturer product information and be installed according to the manufacturer's written instructions. Connections to HDPE mains shall not be made using narrower saddles similar to the Smith-Blair 325.

## 2.10 FLANGE ADAPTER AND PLAIN END COUPLINGS

Plain end couplings and adapters shall be fusion-bonded epoxy coated carbon steel with Ethylene Propylene Diene Monomer (EPDM) rubber gaskets and stainless steel nuts, bolts and spacers. Acrylonitrile butadiene (NBR) gaskets shall be used for potable water mains that are located in soil that is contaminated with low molecular-weight petroleum products or non-chlorinated organic solvents or non-aromatic organic solvents. Fluorocarbon (FKM) gaskets shall be used for potable water mains that are located in soil that is contaminated with aromatic hydrocarbons or chlorinated hydrocarbons. Fluorocarbon (FKM) gaskets shall be used for potable water mains if the soil is contaminated with aromatic hydrocarbons or chlorinated hydrocarbons, and is also contaminated with low molecular-weight petroleum products or organic solvents. Couplings shall be Dresser Style 38, or another approved equal. Flange adapters shall have a plain end compression seal similar to the style 38, with an ANSI 125 Class flange on the opposite end, and shall be Dresser Style 128W or an approved equal. Stainless steel backup rings shall be used for force mains that are located in corrosive environments including wetwells and valve vaults.

## 2.11 HOSE BIBS

Hose bibs shall be 3/4" or 1" brass, polished chromium plated brass, with vacuum breaker as noted on the drawings.

## 2.12 SWING CHECK VALVES

- A. Check valves shall be swing type, weighted lever, conforming to AWWA C508. Valves shall be iron-body, bronze-mounted, single disk, 175 psi working pressure for 2- through 12-inch, 150 psi for 14- through 30-inch, with ANSI B16.1 Class 125 flanged ends, by Mueller; No. A-2600-6-01 (sewer), No. A-2602-6-01 (water), or AVK Series 41, or an approved equal.
- B. When there is no flow through the line, the disc shall hang lightly against its seat in practically a vertical position. When open, the disc shall swing clear of the waterway.
- C. Check valves shall have bronze seat and body rings, extended bronze or stainless steel hinge pins and stainless steel nuts and bolts on bolted covers
- D. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and weight.

## 2.13 HYDRANTS

Hydrants shall be dry barrel, nostalgic style, and shall be AVK Series 2780,

American Darling B-84-B , Mueller Super Centurian 250, or approved equal and shall conform to AWWA C502, and UL/FM certified, and shall in addition meet the specific requirements and exceptions which follow:

- A. Hydrants shall be according to manufacturer's standard pattern or nostalgic style and of standard size, and shall have one 5-inch Storz connection or equivalent with two 2½- inch hose nozzles.
- B. Hydrant inlet connections shall have mechanical joints for 6-inch pipe.
- C. Hydrant valve opening shall have an area at least equal to that area of a 5 1/4-inch minimum diameter circle and be obstructed only by the valve rod. Each hydrant shall be able to deliver 500 gpm minimum through its two 2 1/2 -inch hose nozzles when opened together with a loss of not more than 2 psi in the hydrant per AWWA C502.
- D. The upper and lower stem rod shall be stainless steel and shall have a breakable stem-rod coupling of stainless steel, or cast iron or ductile iron with a fusion bonded epoxy coating, with stainless steel pins and clips.
- E. Hydrants shall be hydrostatically tested as specified in AWWA C502 and shall be rated at 250 psi minimum.
- F. The operating nut shall be 1 ½ -inch pentagon shaped with a protective weather cover, and open counter clockwise.
- G. All nozzle threads shall be American National Standard.
- H. Each nozzle cap shall be provided with a Buna N rubber washer.
- I. All hydrants shall be traffic break away type and allow for 360 degree rotation to position the Storz connection/nozzle in the desired direction after installation.
- J. Hydrants must be capable of being extended without removing any operating parts.
- K. Hydrant extensions shall be fusion bonded epoxy coated inside and outside with a stainless steel stem. The breakaway coupling can be fusion bonded epoxy coated or stainless steel. Only one hydrant extension is allowed per hydrant.
- L. Weepholes shall be excluded from fire hydrants.

- M. Hydrant main valve closure shall be of the compression type opening against the pressure and closing with the pressure. The main valve shall be faced or covered with EPDM elastomer, which shall seat on a bronze ring.
- N. Hydrant bonnets, weather cover, nozzle section, caps and shoe shall be cast iron or ductile iron, and shall be holiday free fusion-bonded epoxy coated at the factory, per AWWA C550, inside and outside. Lower barrel shall be fusion bonded epoxy coated inside and outside. Aboveground parts shall also have a top coat of Sherwin-Williams Acrolon 218 HS acrylic polyurethane or approved equal; color Safety Yellow for fire hydrants that are connected to the potable water system or Pantone 522C purple for fire hydrants that are connected to the reclaimed water system.
- O. Exterior nuts, bolts and washers shall be stainless steel. Bronze nuts may be used below grade.
- P. All internal operating parts shall be removable without requiring excavation.

## 2.14 RESTRAINED JOINTS

- A. Pipe joints shall be restrained by poured-in-place concrete thrust blocks or by other mechanical methods, including tie rods, Stargrip and Allgrip, as manufactured by Star Pipe Products or Megaflange and 2000 PV, as manufactured by EBAA Iron Sales. Flanged joints may be used above ground.
- B. All T-bolts, bolts, nuts, washers, and all thread rods shall meet ASTM A-588 requirements (Cor-ten or equivalent) "weathering steel" or be 316 stainless steel. The use of rebar with welded thread is prohibited.

A certification from the supplier shall be provided to the County during the shop drawing review process ensuring all T-bolts, bolts, nuts, washers, and all thread rods meet the A-588 requirements and shall state the project name and contractor in the certification letter. If stainless steel is to be used, no certification letter is required.

- C. Restrained joints may also be Lok-Ring, as manufactured by American Cast Iron Pipe Company, or an approved equal.
- D. Restrained joint designs which require wedges and/or shims to be driven into the joints in order to disassemble the pipe shall not be allowed.

## 2.15 TAPPING SLEEVES AND VALVES

- A. Tapping valves shall meet the requirements of AWWA C509/C515 with ductile iron body and shall be rated for a pressure of 250 psi. The valves shall be flanged with alignment ring by mechanical joint with a non-rising stainless steel stem. All bolts, nuts and washers shall be stainless steel. Manufacturer shall use Never-Seez or equivalent during assembly of bolt and nut sets to prevent galling of similar metals. Stem seals shall be provided and shall be of the O-ring type, two above and one below the valve's thrust collar. Valve shall be designed for vertical burial and shall open counterclockwise. Operating nut shall be AWWA standard 2-inch square for valves 2 inches and up. Valves shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve to accommodate full size shell cutter. Gaskets shall cover the entire area of the flange surface and be 1/8-inch minimal thickness of red rubber. The wedge shall be ductile iron fully encapsulated with EPDM rubber. All bolts, nuts and washers between the sleeve and valve shall be stainless steel.
- B. Tapping sleeves and saddles shall be stainless steel, seal to the pipe by the use of a gasket compounded for water or sewer, and shall be able to withstand a pressure test of 180 psi for water lines or 150 psi for sewer force mains for one hour with no leakage in accordance with AWWA C110. A stainless steel 3/4-inch NPT test plug shall be provided for pressure testing. All bolts joining the two halves shall be stainless steel and shall be included with the sleeve or saddle.

## 2.16 TRACER WIRE TEST STATION BOXES

Tracer wire test station boxes shall be provided at plug valves, butterfly valves, blowoff valves, gate valves, fire hydrants and backflow preventers as indicated in these Standards. Tracer wire test station boxes for yard service shall be 2 ½ inch diameter, 15 inch length, ABS plastic with a cast iron rim and lid, P200NFGT as manufactured by Bingham & Taylor, or equal approved by Manatee County. Where test boxes will be in streets or subject to vehicular traffic, use B&T Model P525RD, 5 ¼ -inch diameter or equal, centered in a separate concrete pad similar to a valve box pad.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. All valves and appurtenances shall be installed in the location shown, true to alignment and rigidly supported. Any damage occurring to the above items before they are installed shall be repaired to the satisfaction of the County.
- B. After installation, all valves and appurtenances shall be tested at least two hours at the working pressure corresponding to the class of pipe, unless a different test

pressure is specified. If any joint proves to be defective, it shall be repaired to the satisfaction of the County.

- 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, the Contractor shall check all plans and figures which have a direct bearing on their location and he shall be responsible for the proper location of these valves and appurtenances during the construction of the structures.
- D. Pipe for use with flexible couplings shall have plain ends as specified in the respective pipe sections.
- E. Flanged joints and mechanical joints shall be made with high strength, low alloy Corten or 316 stainless steel bolts, nuts and washers.
- F. Prior to assembly of split couplings, the grooves as well as other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The housing sections then shall be placed. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact, metal-to-metal, without excessive bolt tension.
- G. Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly 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.
- H. Valve boxes with concrete bases shall be installed as shown on the Drawings. Mechanical joints shall be made in the standard manner. Valve stems shall be vertical in all cases. Place cast iron box over each stem with base bearing on compacted fill and the top flush with final grade. Boxes shall have sufficient bracing to maintain alignment during backfilling. Knobs on cover shall be parallel to pipe. Remove any sand or undesirable fill from valve box.

### 3.02 HYDRANTS

- A. Hydrants shall be set at the locations designated by the County and/or as shown on the Drawings and shall be bedded on a firm foundation. A drainage pit on crushed stone as shown on the Drawings shall be filled with gravel or crushed stone and satisfactorily compacted. During backfilling, additional gravel or crushed stone shall be brought up around and 6" over the drain port. Each hydrant shall be set in

true vertical alignment and shall be properly braced. Concrete thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Minimum bearing area shall be as shown on the plans. Felt paper shall be placed around the hydrant elbow prior to placing concrete. CARE MUST BE TAKEN TO ENSURE THAT CONCRETE DOES NOT PLUG THE DRAIN PORTS. Concrete used for backing shall be as specified herein.

- B. When installations are made under pressure, the flow of water through the existing main shall be maintained at all times. The diameter of the tap shall be a minimum of 2" less than the inside diameter of the branch line.
- C. The entire operation shall be conducted by workmen thoroughly experienced in the installation of tapping sleeves and valves, and under the supervision of qualified personnel furnished by the manufacturer. The tapping machine shall be furnished by the Contractor if tap is larger than 12" in diameter.
- D. The Contractor shall determine the locations of the existing main to be tapped to confirm the fact that the proposed position for the tapping sleeve will be satisfactory and no interference will be encountered such as the occurrence of existing utilities or of a joint or fitting at the location proposed for the connection. No tap will be made closer than 30" from a pipe joint.
- E. Tapping valves shall be set in vertical position and be supplied with a 2" square operating nut for valves 2" and larger. The valve shall be provided with an oversized seat to permit the use of full sized cutters.
- F. Tapping sleeves and valves with boxes shall be set vertically or horizontally as indicated on the Drawings and shall be squarely centered on the main to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Sleeves shall be no closer than 30" from water main joints. Thrust blocks shall be provided behind all tapping sleeves. Proper tamping of supporting earth around and under the valve and sleeve is mandatory. After completing the tap, the valve shall be flushed to ensure that the valve seat is clean.

### 3.03 SHOP PAINTING

Ferrous surfaces of valves and appurtenances shall receive a coating of rust-inhibitive primer. All pipe connection openings shall be capped to prevent the entry of foreign matter prior to installation.

### 3.04 FIELD PAINTING

All metal valves and appurtenances specified herein and exposed to view shall be painted safety blue.

## INSPECTION AND TESTING

All pipelines shall remain undisturbed for 24 hours to develop complete strength at all joints. All pipelines shall be subjected to a hydrostatic pressure and leak testing. Refer to Manatee County Public Works Utility Standards Part 1-Utility Standards Manual Section 1.8.7. Prior to testing, the pipe lines shall be supported in a manner approved by the County to prevent movement during tests.

All leaks shall be repaired and lines retested as approved by the County.

**\*\*END OF SECTION\*\***

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## SECTION 03200

### CONCRETE REINFORCEMENT

#### PART 1--GENERAL

##### 1.01 WORK INCLUDED

- A. Reinforcing steel bars and welded steel wire fabric for cast-in-place concrete, complete with tie wire.
- B. Support chairs, bolsters, bar supports and spacers, for reinforcing.

##### 1.02 QUALITY ASSURANCE

- A. Perform concrete reinforcing work in accordance with ACI 318 unless specified otherwise in this Section.

##### 1.03 REFERENCES:

- A. ACI 318 - Building Code Requirements for Reinforced Concrete.
- B. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- C. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- D. CRSI 63 - Recommended practice for placing reinforcing bars.
- E. CRSI 65 - Recommended practice for placing bar supports, specifications and nomenclature.
- F. ACI 315 - American Concrete Institute - Manual of Standard Practice

##### 1.04 SHOP DRAWINGS

- A. Submit shop drawings in accordance with Contract Documents.
- B. Indicate bar sizes, spacings, locations and quantities of reinforcing steel and wire fabric, bending and cutting schedules and supporting and spacing devices.
- C. Manufacturer's Literature: Manufacturer's specifications and installation instructions for splice devices.

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## PART 2--PRODUCTS

### 2.01 REINFORCEMENT

- A. Reinforcing steel: Grade 60, Minimum Yield Strength 60,000 psi, deformed billet steel bars, ASTM A615; plain finish.
- B. Welded steel wire fabric: Deformed wire, ASTM A497; smooth wire ASTM A185 in flat sheets; plain finish.

### 2.02 ACCESSORY MATERIALS

- A. Tie wire: Minimum 16-gauge annealed type, or patented system accepted by County.
- B. Chairs, bolsters, bar supports, spacers: Sized and shaped for strength and support of reinforcing during construction conditions.
- C. Special chairs, bolsters, bar supports, spacers (where adjacent to architectural concrete surfaces): Stainless steel type sized and shaped as required.

### 2.03 FABRICATION

- A. Fabricate concrete reinforcing in accordance with ACI 315.
- B. Locate reinforcing splices, not indicated on Drawings, at points of minimum stress. Location of splices shall be reviewed by County.
- C. Where indicated, weld reinforcing bars in accordance with AWS D12.1.

## PART 3--EXECUTION

### 3.01 PLACEMENT

- A. Reinforcing shall be supported and secured against displacement. Do not deviate from true alignment.
- B. Before placing concrete, ensure reinforcing is clean, free of loose scale, dirt, or other foreign coatings which would reduce bond to concrete.

### 3.02 QUALITY ASSURANCE

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- A. Acceptable Manufacturers: Regularly engaged in manufacture of steel bar and welded wire fabric reinforcing.
- B. Installer Qualifications: Three years experience in installation of steel bar and welded wire fabric reinforcing.
- C. Allowable Tolerances:
  - 1. Fabrication:
    - a. Sheared length:  $\pm 1$  in.
    - b. Depth of truss bars:  $+0, -1/2$  in.
    - c. Stirrups, ties and spirals:  $\pm 1/4$  in.
    - d. All other bends:  $\pm 1$  in.
  - 2. Placement:
    - a. Concrete cover to form surfaces:  $\pm 1/4$  in.
    - b. Minimum spacing between bars: 1 in.
    - c. Top bars in slabs and beams:
      - (1) Members 8 in. deep or less:  $\pm 1/4$  in.
      - (2) Members more than 8 in.:  $\pm 1/2$  in.
    - d. Crosswise of members: Spaced evenly within 2 in. of stated separation.
    - e. Lengthwise of members: Plus or minus 2 in.
  - 3. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 1 bar diameter.

### 3.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver reinforcement to project site in bundles marked with metal tags indicating bar size and length.
- B. Handle and store materials to prevent contamination.

### 3.05 INSTALLATION

- A. Placement:
  - 1. Bar Supports: CRSI 65.
  - 2. Reinforcing Bars: CRSI 63.
- B. Steel Adjustment:
  - 1. Move within allowable tolerances to avoid interference with other reinforcing steel, conduits, or embedded items.
  - 2. Do not move bars beyond allowable tolerances without concurrence of County.
  - 3. Do not heat, bend, or cut bars without concurrence of County.

C. Splices:

1. Lap splices: Tie securely with wire to prevent displacement of splices during placement of concrete.
2. Splice devices: Install in accordance with manufacturer's written instructions.
3. Do not splice bars without concurrency of County, except at locations shown on Drawings.

D. Wire Fabric:

1. Install in longest practicable length.
2. Lap adjoining pieces one full mesh minimum, and lay splices with 16 gauge wire.
3. Do not make end laps midway between supporting beams, or directly over beams of continuous structures.
4. Offset end laps in adjacent widths to prevent continuous laps.

E. Cleaning: Remove dirt, grease, oil, loose mill scale, excessive rust, and foreign matter that will reduce bond with concrete.

F. Protection During Concreting: Keep reinforcing steel in proper position during concrete placement.

**\*\*END OF SECTION\*\***

## SECTION 03300

### CAST-IN-PLACE CONCRETE

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Poured-in-place concrete slabs, thrust blocks, pile caps and pipe support cradles.

##### 1.02 QUALITY ASSURANCE

- A. Perform cast-in-place concrete work in accordance with ACI 318, unless specified otherwise in this Section.

##### 1.03 TESTING LABORATORY SERVICES

- A. Inspection and testing will be performed by the testing laboratory currently under contract to Manatee County in accordance with the Contract Documents.
- B. Provide free access to work and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of work.
- D. Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.
- E. Three concrete test cylinders will be taken for every 100 cu. yds. or part thereof of each class of concrete placed each day. Smaller pours shall have cylinders taken as directed by the County.
- F. One slump test will be taken for each set of test cylinders taken.

##### 1.04 REFERENCES:

- A. ASTM C33 - Concrete Aggregates
- B. ASTM C150 - Portland Cement
- C. ACI 318 - Building Code Requirements for Reinforced Concrete
- D. ASTM C260 - Air Entraining Admixtures for Concrete

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- E. ASTM C94 - Ready-Mixed Concrete
- F. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
- G. ACI 305 - Recommended Practice for Hot Weather Concreting

## PART 2 PRODUCTS

### 2.01 CONCRETE MATERIALS

- A. CEMENT: Moderate-Type II, High early strength-Type III, Portland type, ASTM C150.
- B. Fine and Coarse Aggregates: ASTM C33
- C. Water: Clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious material.

### 2.03 ACCEPTABLE MANUFACTURERS

#### Acceptable Products:

- 1. Pozzoloth
- 2. WRDA

### 2.04 ACCESSORIES

Non-shrink grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2400 psi in 2 days and 7000 psi in 28 days

### 2.05 CONCRETE MIXERS

- A. Mix concrete in accordance with ASTM C94.
- B. Provide concrete of following strength:
  - 1. Required concrete strengths as determined by 28 day cylinders shall be as shown on the Drawings, but shall not be less than 3000 psi.
  - 2. Select proportions for normal weight concrete in accordance with ACI 301 3.8 Method 1, Method 2, or Method 3. Add air entraining agent to concrete to entrain air as indicated in ACI 301 Table 3.4.1.
  - 3. All mixes shall be in accordance with FDOT Specifications

- C. Use set-retarding admixtures during hot weather only when accepted by County.
- D. Add air entraining agent to concrete mix for concrete work exposed to exterior. Bonding compounds shall be applied in accordance with the manufacturer's instructions.

## 2.06 FORMS

- A. Forms shall be used for all concrete masonry, including footings. Form shall be so constructed and placed that the resulting concrete will be of the shape, lines, dimensions, appearance and to the elevations indicated on the Drawings.
- B. Forms shall be made of wood, metal, or other approved material. Wood forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots; where used for expose surfaces, boards shall be dressed and matched. Plywood shall be sanded smooth and fitted with tight joints between panels. Metal forms shall be of an approved type for the class of work involved and of the thickness and design required for rigid construction.
- C. Edges of all form panels in contact with concrete shall be flush within 1/32-inch and forms for plane surfaces shall be such that the concrete will be plane within 1/16-inch in four feet. Forms shall be tight to prevent the passage of mortar and water and grout.
- D. Forms for walls shall have removable panels at the bottom for cleaning, inspection and scrubbing-in of bonding paste. Forms for walls of considerable height shall be arranged with tremies and hoppers for placing concrete in a manner that will prevent segregation and accumulation of hardened concrete on the forms or reinforcement above the fresh concrete.
- E. Molding or bevels shall be placed to produce a 3/4-inch chamfer on all exposed projecting corners, unless otherwise shown on the Drawings. Similar chamfer strips shall be provided at horizontal and vertical extremities of all wall placements to produce "clean" separation between successive placements as called for on the Plans.
- F. Forms shall be sufficiently rigid to withstand vibration, to prevent displacement or sagging between supports and constructed so the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for their adequacy.
- G. Forms, including new pre-oiled forms, shall be oiled before reinforcement is placed, with an approved nonstaining oil or liquid form coating having a non-paraffin base.

- H. Before form material is re-used, all surfaces in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn, all protrusions smoothed and in the case of wood forms pre-oiled.
- I. Form ties encased in concrete shall be designed so that after removal of the projecting part, no metal shall be within 1-inch of the face of the concrete. That part of the tie to be removed shall be at least 1/2-inch diameter or be provided with a wood or metal cone at least 1/2-inch in diameter and 1-inch long. Form ties in concrete exposed to view shall be the cone-washer type equal to the Richmond "Tyscru". Throughbolts or common wire shall not be used for form ties.

## PART 3--EXECUTION

### 3.01 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304.
- B. Notify County minimum 24 hours prior to commencement of concreting operations.
- C. Verify anchors, seats, plates and other items to be cast into concrete are placed, held securely and will not cause hardship in placing concrete. Rectify same and proceed with work.
- D. Maintain records of poured concrete items. Record date, location of pour, quantity, air temperature and test samples taken.
- E. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints are not disturbed during concrete placement.
- F. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's recommendations.
- G. Pour concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.
- H. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solidly with non-shrink grout.
- I. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify County upon discovery.
- J. Conform to ACI 305 when concreting during hot weather.

### 3.02 SCREEDING

- A. Screed surfaces level, maintaining flatness within a max deviation of 1/8" in 10 feet.

### 3.03 PATCHING

- A. Allow County to inspect concrete surfaces immediately upon removal of forms. Patch imperfections as directed. All patching procedures shall be submitted to and approved by the County prior to use.

### 3.04 DEFECTIVE CONCRETE

- A. Modify or replace concrete not conforming to required lines, details and elevations.
- B. Repair or replace concrete not properly placed resulting in excessive honeycomb and other defects. Do not patch, fill, touch-up, repair, or replace exposed architectural concrete except upon express direction of County for each individual area.

### 3.05 CONCRETE FINISHING

- A. Provide concrete surfaces to be left exposed, columns, beams and joists with smooth rubbed finish.

### 3.06 CURING AND PROTECTION

- A. Beginning immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury. Maintain concrete with minimal moisture loss at relatively constant temperature for a period of 7 days or until concrete strengths reaches 75% of the 28-day design strength.

Protection against moisture loss may be obtained with spray on curing compounds or plastic sheets. Protection against heat or cold may be obtained with insulated curing blankets or forms.

### 3.07 CONCRETE DRIVEWAY RESTORATION

Concrete driveways shall be restored with 6 inches of 3,000 psi concrete with W2.5 X W2.5, 6X6 wire mesh. Place ½ inch expansion joint between back of curb and new concrete. Area beneath restoration shall be mechanically tamped prior to placing concrete.

### 3.08 CONCRETE SIDEWALK RESTORATION

Concrete sidewalks across driveways shall be restored with 6 inches of 3,000 psi concrete with W2.5 X W2.5, 6X6 wire mesh. Place ½ inch expansion joint between back of curb and new concrete. Area beneath restoration shall be mechanically tamped prior to placing concrete.

Concrete sidewalks outside of driveways shall be restored with 4 inches of 3,000 psi concrete per FDOT Design Standards, Sections 522 & 310.

**\*\*END OF SECTION\*\***

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## SECTION 03350

### CONCRETE FINISHES

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to finish cast-in-place concrete surfaces as specified herein.

##### 1.02 SUBMITTALS

Submit to the County as provided in the Contract Documents, the proposed chemical hardener manufacturer's surface preparation and application procedures.

##### 1.03 SCHEDULE OF FINISHES

- A. Concrete for the Project shall be finished in the various specified manners either to remain as natural concrete or to receive an additional applied finish or material under another Section.
- B. The base concrete for the following conditions shall be finished as noted and as further specified herein:
  - 1. Exterior, exposed concrete slabs and stairs - broomed finish.
  - 2. Interior, exposed concrete slabs - steel trowel finish.
  - 3. Concrete on which process liquids flow or in contact with sludge - steel trowel finish.
  - 4. Concrete where not exposed in the finished work and not scheduled to receive an additional applied finish or material - off-form finish.
  - 5. Provide concrete surfaces to be left exposed such as walls, columns, beams and joists with smooth rubbed finish.

##### 1.04 RESPONSIBILITY FOR CHANGING FINISHES

- A. The surface finishes specified for concrete to receive additional applied finishes or materials are the finishes required for the proper application of the actual products specified under other Sections. Where different products are approved for use, it shall be the Contractor's responsibility to determine if changes in finishes are required and to provide the proper finishes to receive these products.
- B. Changes in finishes made to accommodate product different from those specified shall be performed at no additional cost to the County. Submit the proposed new

finishes and their construction methods to the County for approval.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Portland cement and component materials required for finishing the concrete surfaces shall be as specified in the Contract Documents.
- B. Hardener shall be Lapidolith as manufactured by Sonneborn Building Products or approved equal. Hardener shall be used on all floors, stair treads and platforms.

## PART 3 EXECUTION

### 3.01 FORMED SURFACES

- A. Forms shall not be stripped before the concrete has attained a strength of at least 50 percent of the ultimate design strength. This is equivalent to approximately five "100 day-degrees" of moist curing.
- B. Care shall be exercised to prevent damaging edges or obliterating the lines of chamfers, rustications, or corners when removing the forms or doing any work adjacent thereto.
- C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to the satisfaction of the County.
- D. Off-form finish. Fins and other projections shall be removed as approved. Tie cone holes and other minor defects shall be filled with non-shrink grout specified under the Contract Documents.

### 3.02 FLOORS AND SLABS

- A. Floors and slabs shall be screeded to the established grades and shall be level with a tolerance of 1/8-inch when checked with a 10-foot straight edge, except where drains occur, in which case floors shall be pitched to drains as indicated. Failure to meet either of above shall be cause for removal, grinding, or other correction as approved by the County.
- B. Following screeding as specified above, power steel trowel as follows:
  - 1. Immediately after final screeding, a dry cement/sand shake in the proportion of 2-sacks of portland cement to 350-pounds of coarse natural concrete sand shall be sprinkled evenly over the surface at the rate of approximately 500 pounds per 1,000 square feet of floor. Neat, dry cement shall not be sprinkled on the surface. This shake shall be thoroughly floated into the

surface with an approved disc type power compacting machine weighing at least 200 pounds if a 20-inch disc is used or 300 pounds if a 24-inch disc is used (such as a "Kelly Float" as manufactured by the Weisner-Rapp Corporation of Buffalo, New York). A mechanical blade-type float or trowel is not acceptable for this work.

NOTE: This operation (application of the cement/sand shake) may be eliminated at the discretion of the County if the base slab concrete exhibits adequate fattiness and homogeneity.

2. In lieu of power steel troweling, small areas as defined by the County shall be compacted by hand steel troweling with the dry cement/sand shake as ordered.
3. The floor or slab shall be compacted to a smooth surface and the floating operation continued until sufficient mortar is brought to the surface to fill all voids. The surfaces shall be tested with a straight edge to detect high and low spots which shall be eliminated.
4. Compaction shall be continued only until thorough densification is achieved and a small amount of mortar is brought to the surface. Excessive floating shall be avoided.

- C. After Paragraph 3.02 A and B procedures are accomplished, floors and slabs for particular conditions shall be completed as scheduled in one of the following finishes:

1. Wood float finish. Hand wood float, maintaining the surface tolerance to provide a grained, nonslip finish as approved.
2. Broomed finish. Hand wood float maintaining the surface tolerance and then broom with a stiff bristle broom in the direction of drainage to provide a nonslip finish as approved.
3. Steel trowel finish. Hand steel trowel to a perfectly smooth, hard even finish free from high or low spots or other defects as approved.

- D. Floors, stair treads and platforms shall be given a floor hardener. Application shall be according to manufacturer's instructions.

### 3.03 APPROVAL OF FINISHES

- A. All concrete surfaces will be inspected during the finishing process by the County.
- B. Surfaces which, in the opinion of the County, are unsatisfactory shall be refinished or reworked until approved by the County.

**\*\*END OF SECTION\*\***

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## SECTION 03600

### GROUT

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

This section specifies grout for columns and other structural support bases, equipment bases, crack repair, surface repair and uses other than masonry.

##### 1.02 QUALITY ASSURANCE

###### A. QUALITY CONTROL BY CONTRACTOR

If a product other than those listed below is proposed and test data is not available from the supplier to demonstrate equivalence to the specified grout, then to demonstrate equivalence with the grout properties of the specified product, the Contractor shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329. The testing laboratory shall sample and test the proposed grout materials. Costs of testing laboratory services shall be borne by the Contractor.

###### B. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM C230	Standard Specification for Flow Table for Use in Tests of Hydraulic Cement
ASTM C307	Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C942	Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1181	Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts
ASTM E329	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
COE CRD-C611	Flow of Grout for Preplaced Aggregate Concrete
COE CRD-C621	Specification for Nonshrink Grout
FBC	Florida Building Code, 2014 edition

### 1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Complete product literature and installation instructions for the following: Cementitious non-shrink grout, epoxy grout, adhesive for dowel and anchor setting, and concrete repair mortar products to be used on the project.
2. Current ICC Evaluation Report for adhesives used for dowel and anchor setting.
3. Installer certification in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined adhesive anchors.

## PART 2 – PRODUCTS

### 2.01 CEMENTITIOUS NONSHRINK GROUT

Cementitious nonshrink nonmetallic aggregate grout shall be Five Star Products, Inc. Five Star Grout, BASF Masterflow 928, Sika Corporation SikaGrout 212, Euclid Chemical Company Hi-Flow Grout, or approved equal.

### 2.02 EPOXY GROUT FOR EQUIPMENT MOUNTING

Epoxy grout for equipment mounting shall be a non-cementitious, resin based, multi-component formulation. Epoxy grout shall be flowable, with shrinkage minimized to achieve minimum 98% effective bearing area. Epoxy grout shall be BASF Masterflow 648, Sika Corporation Sikadur 42, Euclid Chemical Company E3-G; or approved equal.

### 2.03 ADHESIVE FOR DOWEL AND ANCHOR SETTING

Adhesive for setting dowels and anchoring connection/base plate bolts shall be an injectable two-component epoxy adhesive. Adhesive shall be approved for the intended use per the product ICC Report. Adhesive shall be HIT-RE 500-SD by Hilti or approved equal (equivalent product must have ICC approval for use in cracked concrete).

### 2.04 CONCRETE REPAIR MORTAR

Horizontal repair mortars shall be BASF MasterEmaco S 466CI, Sika Corporation SikaTop 111 Plus, or approved equal.

Vertical and overhead repair mortars shall be BASF MasterEmaco 1500HCR Vertical Overhead, Sika Corporation SikaTop 123 Plus, or approved equal.

## PART 3 – EXECUTION

### 3.01 CEMENTITIOUS NONSHRINK GROUT

Nonshrink, cementitious, nonmetallic aggregate grout shall be used for column base plates, structural bearing plates, and all locations where the general term “non-shrink grout” is indicated on the drawings. Use of this grout to support the bearing surfaces of machinery shall be as specified in Section 11002 or as detailed on the Drawings for specific locations or pieces of equipment. If guidance is not provided in locations noted above, use of non-shrink grout for equipment mounting shall be limited to equipment less than 25 horsepower or 750 pounds. Grout shall be placed and cured in accordance with manufacturer's instructions.

Nonshrink cementitious grout shall not be used as a surface patch or topping. Nonshrink cementitious grout must be used in confined applications only.

### 3.02 EPOXY GROUT FOR EQUIPMENT MOUNTING

Prepare concrete surfaces of equipment pads as indicated in details on the Drawings and as required by the epoxy grout manufacturer. Epoxy grout for equipment mounting shall be placed and cured in accordance with the requirements of Section 11002, details on the Drawings, and in strict conformance with manufacturer's recommendations.

### 3.03 CONCRETE REPAIR MORTAR

Concrete repair materials and procedures shall be submitted for review to the Engineer and shall be accepted prior to commencement of the repair work.

Follow all manufacturer's instructions, including those for minimum and maximum application thickness, surface preparation and curing. Add aggregate as required per manufacturer's recommendations. Any deviations from the manufacturer's instructions shall be submitted for review to the Engineer and shall be accepted prior to commencement of the work.

**\*\*END OF SECTION\*\***

SECTION 05501  
ANCHOR BOLTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Bolts and all-thread rods used to attach structural elements and equipment to concrete. Included are cast-in-place and post-installed anchors (adhesive systems and wedge type expansion anchors), nuts and washers.
- B. Cast-in-place and post-installed anchors shall be Type 316 stainless steel unless noted otherwise.

1.01 RELATED SECTIONS

- A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
  - 1. Section 03300 Cast-In-Place Concrete
  - 2. Section 03600 Grouting
  - 3. Section 11002 Rigid Equipment Mounts

1.02 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 318	Building Code Requirements for Structural Concrete
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A320	Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM A563	Carbon and Alloy Steel Nuts
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use

Reference	Title
ASTM F1554	Anchor Bolts, Steel, 36, 55, 105-ksi Yield Strength
IBC	International Building Code with local amendments
Florida State & Manatee County	Building Code with local amendments

### 1.03 SUBMITTALS

#### A. Action Submittals

1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Anchor bolt placement plans.
5. Anchor bolt, nut, and washer material information, including material certifications.
6. Record copy of design calculations and details showing the required diameter, length, embedment, edge distance, confinement, anchor reinforcement, anchor bolt sleeves, connection redesign, and other conditions, stamped and signed by a Professional Engineer currently registered in the state of FL. Calculations shall comply with the provisions of ACI 318-14, Chapter 17 ACI 318, Appendix D. Base anchor capacity determination on cracked concrete condition and compressive strength of new concrete per Section 03 30 00. Assume compressive strength of existing concrete is 3,000 psi unless otherwise noted.
7. Submit record copy of proof loading test results within five days after test.
8. Product Data:
  - a. ICC Evaluation Service Reports for post-installed adhesive type anchors and expansion (wedge type) anchors when allowed. Products shall be ICC approved for use in cracked concrete in high seismic areas (Seismic Design Category D, E and F).
  - b. Product data indicating load capacity charts/calculations.
  - c. Chemical resistance.
  - d. Temperature limitations.

- e. Manufacturers written installation instructions.
- 9. Installer certification for horizontal or upwardly inclined adhesive anchors in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program.

## 1.04 QUALITY ASSURANCE

### A. Quality Assurance By Owner

1. Special inspection of anchor bolts shall be performed by the Special Inspector under contract with the Owner and in accordance with IBC Chapter 17.
2. A five percent sample of installed post-installed anchors shall be proof-loaded by an independent laboratory contracted by the Contractor. The quantity of samples and locations shall be coordinated with the Owner's Representative.
3. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by a Special Inspector.
4. The Special Inspector shall furnish a report to the Engineer, Owner's Representative, and Building Official that the work covered by the report has been performed and that the materials used and the installation procedures used conform with the approved Project Manual and the Manufacturer's Printed Installation Instructions (MPII).

### B. Certifications

1. Installer certification shall be in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined adhesive anchors.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts for equipment mounting and vibration isolation systems shall be provided as specified in Sections 43 05 13 and 43 05 18, respectively.
- B. Tapered washers shall be provided where mating surface is not square with the nut.
- C. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings. Substitution of post-installed anchors will not be permitted unless specifically requested by the Contractor and approved by the Engineer.

## 2.02 PERFORMANCE/DESIGN CRITERIA

- A. Anchor bolts for equipment shall be designed by the equipment manufacturer to include equipment operational loads combined with seismic and wind forces when applicable. Design criteria provided in Section 01 73 24.
- B. Design anchor bolts for support and bracing of non-structural components and non-building structures for loading specified in Section 01 73 24.

## 2.03 MATERIALS

- A. Anchor bolt materials shall be as specified in the following table:

Material	Specification
Stainless Steel Anchor Bolts	ASTM A193 or A320, Type 316
Stainless Steel Threaded Rods	ASTM F593, Type 316
Stainless Steel Nuts	ASTM A194 Heavy Hex Nuts, Type 316 ASTM F594 Heavy Hex Nuts at Adhesive Anchors, Type 316
Stainless Steel Washers	Type 316 to match bolt material
Carbon Steel Anchor Bolts	ASTM F1554, Grade 36, Hot Dip Galvanized
High-Strength Carbon Steel Anchor Bolts	ASTM F1554, Grade 55, Weldable per Supplementary Requirement S1, Hot Dip Galvanized
Carbon Steel Nuts and Washers	ASTM A563 and F844, Heavy Hex, Hot-Dip Galvanized
Concrete Adhesive Anchors	Hilti "HIT-RE 500v3", Simpson Strong-Tie "SET-XP", or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Adhesive Anchors	Hilti "HIT-HY 70", Simpson Strong-Tie "SET-XP", or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Expansion (wedge) Anchors*	Hilti "KWIK BOLT 3", or approved equal, Type 316 Stainless Steel
Concrete Expansion (wedge) Anchors *	Hilti "KWIK BOLT TZ", or approved equal, Type 316 Stainless Steel

*\*Post installed anchors shall always be an adhesive type anchor system except where noted otherwise or when Contractor makes a request for a specific application and Engineer approves.*

## 2.04 STAINLESS STEEL FASTENER LUBRICANT (ANTI-SEIZING)

- A. Anti-seizing Lubricant for Stainless Steel Threaded Connections:

1. Formulated to resist washout.
2. Acceptable manufacturers are Bostik, Saf-T-Eze, or equal.

## 2.05 ANCHOR BOLT SLEEVES

- A. Provide anchor bolt sleeves as shown on design drawings and as required by equipment manufacturer's design.
  1. Provide high density polyethylene plastic sleeves of single unit construction with deformed sidewalls such that the concrete and grout lock in place.
  2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
  3. Acceptable manufacturers are Contec, Wilson, or equal.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings.
- B. Grouting of anchor bolts using plastic sleeves with non-shrink or epoxy grout, where specified, shall be in accordance with Section 03 60 00.
- C. The threaded end of anchor bolts and all-thread rods shall be long enough to project through the entire depth of the nut and if too long, shall be cut off at ½-inch beyond top of nut and ground smooth.

### 3.02 CAST-IN-PLACE ANCHOR BOLTS

- A. Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position using templates while the concrete is placed.
- B. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

### 3.03 ADHESIVE ANCHOR BOLTS

- A. Note that adhesive anchors shall not be substituted for cast-in-place anchor bolts unless the adhesive anchors have been specified or shown on the Drawings, or approval has been obtained from the Engineer that substitution of adhesive anchors is acceptable for the specific use and location. Use of adhesive anchors shall be subject to the following conditions:
  1. Limit to locations where intermittent or continuous exposure to the following is extremely unlikely:
    - a. Acid concentrations higher than 10 percent
    - b. Chlorine gas

- c. Machine or diesel oils
- 2. Limit to applications where exposure to the following is extremely unlikely:
  - a. Fire
  - b. Concrete or rod temperature above 120 degrees F
- 3. Overhead applications (such as pipe supports) shall not be allowed unless approved by the Engineer and installation is by an Installer specially certified for overhead applications.
- 4. Approval from Engineer for specific application and from supplier of equipment to be anchored, if applicable.
- 5. Anchor diameter and material shall be per Contract Documents or equipment manufacturer's specifications. Anchor shall be threaded or deformed the full length of embedment and shall be free of rust, scale, grease, and oils.
- 6. Embedment depth shall be as specified or as required by the equipment manufacturer.
- 7. Follow the anchor system manufacturer's installation instructions.
- 8. Holes shall have rough surfaces created by using a hammer drill with carbide bit. Core drilled holes are not allowed.
- 9. Holes shall be blown clean with oil-free compressed air and be free of dust or standing water prior to installation. Follow additional requirements of the adhesive manufacturer.
- 10. Concrete and air temperature shall be compatible with curing requirements of adhesives per adhesive manufacturer's instructions. Anchors shall not be placed in concrete when the temperature is below 25 degrees F.
- 11. Anchors shall be left undisturbed and unloaded for full adhesive curing period, which is based on temperature of the concrete.

### 3.04 EXPANSION ANCHORS

- A. Expansion (wedge type) anchors shall not be substituted for cast-in-place anchor bolts or adhesive anchors unless approved by the Engineer for a specific application. Use of expansion anchors shall be subject to conditions 4 through 9 as specified above for adhesive anchors. Expansion anchors shall not be used in a submerged condition or in mounting of equipment subject to vibration or cyclic motion.

### 3.05 REINFORCING STEEL CONFLICTS WITH POST-INSTALLED ANCHOR INSTALLATION

- A. When reinforcing steel is encountered in the drill path, slant drill to clear obstruction and provide beveled washer to match angle of anchor. Drill shall not be slanted more than 10 degrees.
- B. Where slanting the drill does not resolve the conflict, notify the Owner's Representative and resolve the conflict to the satisfaction of the Owner's Representative in consultation with the Engineer.

- C. Abandoned post-installed anchor holes shall be cleaned and filled with non-shrink grout and struck off flush with adjacent surface.
- D. The costs of determining and executing the resolution shall be borne by the Contractor. The determination and execution of the resolution shall not result in additional cost to the Owner.
- E. Reinforcing steel in masonry shall not be damaged.
- F. In order to avoid or resolve a conflict, locate embedded reinforcing steel using non-destructive methods and/or redesign the attachment.
  - 1. Redesign shall be done by the Contractor's Professional Engineer currently registered in the state of FL.
  - 2. Calculations and details for redesign shall be submitted.

\*\* END OF SECTION\*\*

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## SECTION 07100

### WATERPROOFING, DAMPPROOFING AND CAULKING

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all materials, labor, equipment, and incidentals required to perform all through wall flashing work, waterproofing, dampproofing, caulking, and related work necessary for the proper completion of the project as required by the Drawings and as specified herein.
- B. Dampproof the exterior surfaces of all exterior poured- in-place concrete walls or concrete masonry foundation walls from the top of the footings up to 6 inches below finished grade.

##### 1.02 APPLICABLE SCHEDULE

- A. Deliver all materials in original manufacturer's packages with labels and seals intact. Handle and store in accordance with manufacturer's instructions.
- B. Inspect job conditions for defects which would prevent proper installation of caulking. Do not proceed until defects have been corrected.
- C. Caulk all exterior wall joints between metal wall panels and adjacent materials, between frames in openings and adjacent materials, between masonry and cast-in-place concrete, brick paver expansion and control joints and all other joints shown on the Drawings or required for the completion of the Work.
- D. Caulk all interior joints between frames and masonry, at tops of masonry walls, between masonry and structural concrete, expansion and control joints in ceramic tile and brick pavers, exterior window and door frames, louvers, and all other joints shown on the drawings or required for the completion of the Work.
- E. Joints noted as "caulk", "caulking", or "sealant" shall be caulked with the sealant specified herein.
- F. Furnish and place through wall flashing in exterior masonry walls as shown on the Drawings.
- G. Furnish and place vapor barrier under all building structure slabs contacting soil as specified herein.

1.03 SUBMITTALS

Submit two representative samples of any or all other proposed materials and installation method required for the work of this Section as requested by the County.

PART 2 PRODUCTS

2.01 DAMPPROOFING

- A. Dampproofing shall be Bitumastic Black Solution by the Koppers Company, Inc., Dehydrating 4 by W.R. Grace and Co., or equal.

2.02 CAULKING

- A. Caulking Compound: One component, synthetic rubber base sealant, soft curing, nonstaining, conforming to F.S. TT-S-00230 and Thiokol's Building Trade Performance Specifications for Type 1 Class B sealants. Colors shall match material receiving caulking, as directed by the County.
- B. Interior Silicone Sealant: F.S. TT-001543 for perimeter of plumbing fixtures against walls and floors and joints between laminated plastic counters and walls shall be transparent.
- C. Primer: As recommended by caulking compound manufacturer.
- D. Back-up Material: Closed cell foam polyethylene, or similar nonbituminous material as recommended by manufacturer of caulking compound and completely compatible with selected compound.

2.03 HYDRAULIC CEMENT

- A. Material for quick-set hydraulic cement shall be Waterplug as manufactured by Thoro System Products, or equal.

2.04 VAPOR BARRIER

- A. Vapor barrier shall be 10 mil thick polyethylene sheet with a vapor transmission rating of 0.20 perms. Laps between adjacent sheets shall be 10 inches minimum. Vapor barrier shall be carefully inspected by the County prior to concrete placement. Additional polyethylene sheet required for repair or replacement of damaged vapor barrier shall be furnished and installed by the Contractor as directed by the County at no additional cost to the County.

## PART 3 EXECUTION

### 3.01 INSTALLATION

#### A. Installation of Dampproofing

1. Surface to be treated shall be free from oil and dirt and shall be in the proper condition as indicated by the manufacturer prior to the application of the dampproofing material. The concrete shall have been completely cured and the surface shall be dry and free from frost at the time of application.
2. Surfaces to be dampproofed shall receive two (2) heavy coats 10 mils thick, the first coat being carefully applied so that "holidays" or untreated air-bubble depressions in the surface shall be completely filled and the second coat will guarantee a 100% coating of the surface.
3. Particular care shall be given to the application of dampproofing at all construction joints which are encountered.
4. The number of coats specified is in addition to primer coats as recommended by the manufacturer.

#### B. Installation of Caulking

1. Surface Preparation: Clean metal surfaces free of grease, oil, wax, lacquer, and other foreign residue by wiping with a clean cloth moistened with a suitable solvent. Scrape or brush masonry surfaces clean. Apply appropriate primer to contact surfaces.
2. Joint Preparation: Joints to be caulked having a depth in excess of 3/8-inch shall be packed with back-up material. Round back-up material shall be sized to require 20 percent to 5 percent compression upon insertion. In joints not of sufficient depth to allow packing, install polyethylene bond-breaking tape at back of joint. Avoid lengthwise stretching of back-up material. Cut all corners, avoid wrapping around corners.
3. Application: Apply compound with pressure flow gun with nozzle of proper size and shape to suit width of joint, promptly after mixing and with sufficient pressure to fill joint. Apply as a continuous operation horizontally in one direction and vertically from bottom to top, except joints having excessive widths where compound might sag, the joints shall be built up with excessive beads. Finish joints smooth and slightly covered.
4. Cleaning: Immediately clean adjacent material which may be soiled by caulking operation.

#### C. Installation of Quick-Set Hydraulic Cement

1. The surface shall be cleaned and free of dirt, loose mortar particles, paints, films, protective coatings, efflorescence, laitance, form treatments, curing compounds, and other materials.

2. Cut out crack at least 3/4 inches wide and deep, cutting back into wall slightly. Flush away all cuttings and dirt. Force water-plug into prepared crack with a round tool and smooth out. Form cove at junction.
3. To be applied under manufacturer's recommendations.

**\*\* END OF SECTION\*\***

## SECTION 08100

### MTEAL DOORS AND FRAMES

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to deliver the following as shown on the Drawings and as specified herein:
  - 1. Steel hollow-metal doors with louvered vent and dead-bolt lock.
  - 2. Pressed-metal frames.
  - 3. All fasteners and appurtenances required.

##### 1.02 SUBMITTALS

- A. Submit to the County for review, as provided in the General Conditions and Section 01300, shop drawings of all metal doors, frames, panels and appurtenances.
- B. Shop drawings shall show elevations and details of doors and frames, location and installation requirements for hardware, thickness of materials, joints and connections and trim.
- C. Hardware templates shall be furnished to the door manufacturer by the Contractor for correct hardware alignment and reinforcing.

##### 1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver material in manufacturer's original unopened and undamaged packages with labels legible and intact. Doors and panels shall be individually wrapped in corrugated cardboard with wood strips on vertical edges and banded with metal straps. Store materials in unopened packages in a manner to prevent damage from the environment and construction operations. Handle in accordance with manufacturer's instructions.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS FOR STEEL DOORS

- A. Hollow metal doors and panels (steel) shall be 1-3/4" full flush and as manufactured by Steelcraft Manufacturing Company, Republic Steel, Ceko Steel or equal. The face panels shall be formed of 16 gauge, cold-rolled leveled sheet steel conforming to ASTM A526 galvanized in conformance with ASTM A525, 1.25 oz. zinc per

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square foot. Doors shall be fabricated to receive all hardware specified. Hinge reinforcement shall be 8 gauge. Closer and other hardware reinforcement shall be 12 gauge. Provide "L" shape 12-gauge galvanized steel astragals on exterior double doors. Doors shall be reinforced, stiffened, sound deadened and insulated with impregnated kraft honeycomb core completely filling inside.

1. Door louvers shall be integrally framed, 1" deep, 45 degrees, "Z" blade, stationary type of aluminum with clear finish. The maximum size of the louvered vent shall be 16" wide and 12" high. An insect screen shall be attached on inside of vent.
  2. Wherever fire labeled classification is shown or scheduled for hollow metal work, provide fire-rated hollow metal doors and frames investigated and tested as a fire door assembly, complete with type of fire door hardware to be used. Identify each fire door and frame with UL labels, indicating applicable fire rating of both door and frame.
  3. Construct fire labeled assemblies to comply with NFPA Standard No. 80, and as herein specified.
- B. Pressed Metal Frames (steel) for hollow metal doors and transoms shall be 14 gauge cold-rolled steel, formed with integral stops and rabbets, and shall be made by the same manufacturer as the doors. Frames shall be furnished as set-up assemblies with arc welded and smooth ground miters. The jambs shall be constructed to set on the finished slab. Provide tee shaped, masonry anchors at all jambs with one anchor at each course. The frames shall be mortised, reinforced, drilled, and tapped for hinges and strike plates and other hardware specified. All frames shall be provided with a steel spreader temporarily attached to the feet of both jambs to serve as a brace during shipping, handling and installations.
- C. All pressed metal frames shall be weather-stripped.
- D. Anchors and fastening devices shall be galvanized steel.
- E. All pressed metal frames in masonry openings shall be fully grouted with mortar.
- F. Pressed metal frames shall be primed and painted as noted in Section 09900.

## 2.02 FINISH FOR STEEL DOORS

- A. The doors, panels, frames, etc., shall receive one (1) field coat of primer and one (1) field coat of finish paint as specified in Painting Section 09900.

## 2.03 HARDWARE

- A. Door Closures: The door closers shall be steel and shall be rated for standard duty application.

B. Locksets: The locksets shall be dead-bolt locks. Each lockset shall be furnished with two (2) keys and all locks shall be keyed alike.

C. Hardware Supplier

1. The door manufacturer shall furnish all requisite hardware. The hardware shall be enclosed in the original packaging along with the hardware manufacturer's installation instructions.
2. The Contractor shall be responsible for properly storing, handling and installing the hardware once it reaches the job site.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. The Contractor shall install the doors, frames, thresholds and hardware in strict accordance with the instructions and recommendations of the manufacturers and the approved shop drawings. The installations shall also be in full compliance with the applicable portions of Steel Door Institute SDI-100.
- B. The frames shall be installed plumb and square and shall be securely attached to the structure before the spreader bars are removed.
- C. The doors shall be hung plumb and square within the frames and shall not bind at any point. The Contractor shall not cut or otherwise alter the door to fit the frame. Should the door and frame not properly mate, the Contractor shall consult with the door manufacturer for remediation instructions.
- D. The thresholds shall be installed in such a manner as to provide a smooth, trip-free pathway through the doorway for both ingress and egress.
- E. After the doors are property hung in the frames and the thresholds are installed, the Contractor shall attach the kickplates, door closers and locksets to the doors in a thoroughly workmanlike manner.
- F. After the door installations are completed, the Contractor shall take adequate precautions to protect the exposed surfaces from damage by both environmental conditions and construction activity.

### 3.02 TESTS

- A. After installation, the Contractor shall check the doors and attached appurtenances for proper operation.

- B. The doors shall swing smoothly and freely without binding, the door closers shall allow both an easy opening and a "slamless" closing, and the keys shall freely lock and unlock the locksets without any binding of the locking plunger.

### 3.03 GUARANTEES AND WARRANTIES

- A. The Contractor shall guarantee and/or warrant the door installations against defects in materials and workmanship in accordance with the requirements of Section 01740 of these Specifications.

**\*\*END OF SECTION\*\***

## SECTION 09150

### CEMENT PLASTER (STUCCO)

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to install cement plaster (stucco).

##### 1.02 QUALITY ASSURANCE

- A. Portland Cement Plastering Standards - ASTM A42.2 and A42.3.

##### 1.03 SUBMITTALS

- A. Submit to the County, as provided in Section 01340, a listing of brand names and types of materials proposed for use in the work of this Section.

##### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in sealed containers and bundles, fully identified with manufacturer's name, brand, type and grade; store on pallets in dry, well ventilated space, protected from the weather, under cover and handle in accordance with manufacturer's recommendations.

##### 1.05 JOB CONDITIONS

- A. Examine the substrates of the areas to receive the stucco and the conditions under which the work is to be performed. Notify the County, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Environmental conditions: Maintain a minimum temperature of 50 degrees F in spaces being plastered. Maintain adequate continuous ventilation in plastered spaces until plaster is dry. Protect plaster from freezing and too rapid drying. Do not plaster on rusted metal materials.
- C. Protect other work from soiling, spattering, moisture deterioration and other harmful effects which may result from plastering operations.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

A. Stucco Accessories

1. Stucco accessories shall be produced from weatherproof PVC as manufactured by VinylTech Accessories, Plastic Components, Inc., or equal.
2. Corner beads shall be No. 1 Corner Bead.
3. Soffit external corner beads shall be No. 540 Drip Screed.
4. Casing beads shall be No. 10 Casing Bead.
5. Control joints shall be No. 20M Joint.

B. Plaster Materials

1. Portland cement shall conform with ASTM C150, Type I or IA.
2. Lime shall be special finishing hydrated lime conforming to ASTM C206, Type S.
3. Sand shall be clean, sharp, washed, natural and free from soluble salts and organic matter. Sand shall comply with ASTM C35 and when dry, shall pass No. 4 sieve.
4. Fiber shall be pure manilla, glass or synthetic fiber, good quality 1/2" to 2" in length, free from grease, oil, dirt and other impurities. No asbestos will be allowed.
5. Water shall be clean, fresh, potable water.

PART 3 EXECUTION

3.01 THREE COAT PLASTERING

- A. Portland cement plaster shall be three-coat work on CMU walls with a minimum thickness of 3/4". Exterior three-coat cement plaster (stucco) shall be made waterproof during and/or after application of one or more coats. Waterproofing materials shall be a product of Thoro System Products, Miami, Florida, or equal. Contractor shall be responsible for scheduling a review meeting with the supplier's technical representative and the County to determine the specific product and application techniques most appropriate for the masonry walls prior to the beginning of the stucco work.

B. Proportions and Mixing

1. All plaster shall be proportioned by weight. The materials shall be weighed by an approved weighing device. Measuring with a shovel will not be permitted.
2. All plaster shall be mechanically mixed. Hand mixing will not be permitted. Mixer to be cleaned after each batch is dumped. Re-tempering of partially set material is not permitted. Discard plaster which has begun to stiffen.
3. Scratch and brown coats shall be 100 lbs. Portland cement, 10 lbs. hydrated lime and not more than 300 lbs. sand. Add 2 lbs. fiber to scratch coat.

4. Finish coat shall be mixed in proportions of 100 lbs. Portland cement to 10 lbs. hydrated lime mixed with 200 lbs. sand.

C. Moisture Retention and Curing

1. Dampen previous plaster coats which have dried out prior to time for applications of next coat. Dampen with water as required for uniform suction.
2. Determine the most effective procedure for curing and the time lapse between application of coats based on climatic and job conditions. Plaster which is cracked or crazed due to improper timing and curing will not be accepted. Remove and replace defective plaster including plaster base materials, if damaged during removal of defective plaster.

3.03 CUTTING AND PATCHING

- A. Cut, patch, point-up and repair plaster as necessary to accommodate other work and to restore cracks, dents and imperfections. Repair or replace work to eliminate blisters, excessive crazing and check cracking, dry-outs, efflorescence, sweat-outs and similar defects, including areas of the work which do not comply with specified tolerances, and where bonding to the substrate has failed.
- B. Provide approved procedures for protection of plaster from deterioration and damage during the remainder of the construction period.

**\*\* END OF SECTION\*\***

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SECTION 09900  
COATING SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This Section specifies coating systems, surface preparations, and application requirements for coating systems.

B. Definitions:

1. Specific coating terminology used in this Section is in accordance with definitions contained in ASTM D16, ASTM D3960, and the following definitions.

a. Definitions:

- 1) Abrasive: Material used for blast cleaning, such as sand, grit or shot.
- 2) Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.
- 3) Anchor Pattern: Profile or texture of prepared surface(s).
- 4) ANSI: American National Standards Institute.
- 5) Bug Holes: Small cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.
- 6) Coating/Paint/Lining Thickness: The total thickness of primer, intermediate and/or finish coats.
- 7) Coating System Applicator (CSA): A generic reference to the specialty subcontractor or subcontractors retained by the Contractor to install the coating systems specified in this Section.
- 8) Coating System Manufacturer (CSM): Refers to the acceptable coating system manufacturer, abbreviated as the CSM.
- 9) Coating System Manufacturer's Technical Representative(s) (CTR): Refers to the technical representative(s) of the acceptable Coating System Manufacturer and is abbreviated as CTR.
- 10) Dew point: Temperature of a given air/water vapor mixture at which condensation starts.
- 11) Dry Film Thickness (DFT): Depth of cured film, usually expressed in mils (0.001 inch). Use this definition as opposed to existing definition.
- 12) Drying Time: Time interval between application and curing of material.
- 13) Dry to Recoat: Time interval between application of material and ability to receive next coat.
- 14) Dry to Touch: Time interval between application of material and ability to touch lightly without damage.
- 15) Feather Edging: Reducing the thickness of the edge of paint.

- 16) Feathering: Operation of tapering off the edge of a point with a comparatively dry brush.
- 17) Field Coat: The application or the completion of application of the coating system after installation of the surface at the site of the work.
- 18) Hold Point: A defined point, specified in this Section, at which work shall be halted for inspection.
- 19) Holiday: a discontinuity, skip, or void in coating or coating system film that exposes the substrate.
- 20) Honeycomb: Segregated condition of hardened concrete due to non-consolidation.
- 21) ICRI: International Concrete Repair Institute.
- 22) Incompatibility: Inability of a coating to perform well over another coating because of bleeding, poor bonding, or lifting of old coating; inability of a coating to perform well on a substrate.
- 23) Laitance: A layer of weak, non-durable concrete containing cement fines that is brought to the surface through bleed water because of concrete finishing and/or over-finishing.
- 24) Mil: 0.001 inch.
- 25) NACE: National Association of Corrosion Engineers.
- 26) Overspray: Dry spray, particularly such paint that failed to strike the intended surface.
- 27) Pinhole: A small diameter discontinuity in a coating or coating system film that is typically created by outgassing of air from a void in a concrete substrate resulting in exposure of the substrate or a void between coats.
- 28) Pot Life: Time interval after mixing of components during which the coating can be satisfactorily applied.
- 29) Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-base material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.
- 30) Shelf Life: Maximum storage time for which a material may be stored without losing its usefulness.
- 31) Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of the work, where the field or finishing coat is applied.
- 32) Spreading Rate: Area covered by a unit volume of paint at a specific thickness.
- 33) SSPC: The Society for Protective Coatings.
- 34) Stripe Coat: A separate coat of paint applied to all weld seams, pits, nuts/bolts/washers and edges by brush. This coat shall not be applied until any previous coat(s) have cured and, once applied, shall be allowed to cure prior to the application of the subsequent coat(s).
- 35) Surface Saturated Dry (SSD): Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.

- 36) Tie Coat: An intermediate coat used to bond different types of paint coats. Coatings used to improve the adhesion of a succeeding coat.
- 37) Touch-Up Painting: The application of paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.
- 38) TPC: Technical Practice Committee.
- 39) Volatile Organic Compound (VOC) Content: The portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates during drying or curing, expressed in grams per liter (g/l) or pounds per gallon (lb/gal).
- 40) Immersion: Refers to a service condition in which the substrate is below the waterline or submerged in water or wastewater at least intermittently if not constantly.
- 41) Weld Splatter: Beads of metal scattered near seam during welding.
- 42) Wet Film Thickness (WFT): The primer or coating film's thickness immediately following application. Wet film thickness is measured in mils or thousandths of an inch (0.001 inch) and is abbreviated WFT.

## 1.02 QUALITY ASSURANCE

### A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ANSI/ASC 29.4 Exhaust Systems	Abrasive Blasting Operations – Ventilation and Safe Practice
ANSI/NSF 61	Drinking Water System Components Health Effects
ANSI B74.18	Grading of Certain Abrasive Grain on Coated Abrasive Material

Reference	Title
ASTM D16	Standard Terminology for Paint, Related Coatings, Materials, and Applications
ASTM D2200 (SSPC-VIS1)	Pictorial Surface Preparation Standards for Painting Steel Surfaces
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4262	Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4414	Standard Practice for Measurement of Wet Film Thickness by Notch Gages
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4541	Standard Test Methods for Pull-Off Strength of Coatings On Metal Substrates Using Portable Adhesion Testers
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
ASTM D5162	Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Adhesion Testers.
ASTM E337	Standard Test Method for Measuring Humidity With a Psychrometer
ASTM F1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
FS 595b	Federal Standard Colors
ICRI 03732	Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
NACE Publication 6D-163	A Manual for Painter Safety
NACE Publication 6F-163	Surface Preparation of Steel or Concrete Tank/Interiors
NACE Publication 6G-164 A	Surface Preparation Abrasives for Industrial Maintenance Painting
NACE Standards	January 1988 Edition of the National Association of Corrosion Engineers, TPC.
NACE Standard RP0188	Standard Recommended Practice – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE Standard RP0288	Standard Recommended Practice, Inspection of Linings on Steel and Concrete

Reference	Title
NACE Standard RP0892	Standard Recommended Practice, Linings Over Concrete in Immersion Service
NACE Publication TPC2	Coatings and Linings for Immersion Service
NAPF 500-03	Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings
NAPF 500-03-04	Abrasive Blast Cleaning for Ductile Iron Pipe
NAPF 500-03-05	Abrasive Blast Cleaning for Cast Ductile Iron Fittings
OSHA 1910.144	Safety Color Code for Marking Physical Hazards
OSHA 1915.35	Standards – 29CFR - Painting
SSPC	Paint Application Specification No. 1.
SSPC-AB 1	Mineral and Slag Abrasives
SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages
SSPC-PA 9	Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
SSPC-PA Guide 1	Guide for Illumination of Industrial Painting Project
SSPC-PA Guide 3	A Guide to Safety in Paint Application
SSPC-PA Guide 6	Guide for Containing Debris Generated During Paint Removal Operations
SSPC-PA Guide 11	Guide for Coating Concrete
SSPC SP1	Solvent Cleaning
SSPC SP2	Hand Tool Cleaning
SSPC SP3	Power Tool Cleaning
SSPC SP5	White Metal Blast Cleaning
SSPC SP6	Commercial Blast Cleaning
SSPC SP7	Brush-Off Blast Cleaning
SSPC SP10	Near-White Blast Cleaning
SSPC SP11	Power Tool Cleaning to Bare Metal
SSPC SP12	Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultra-High Pressure Water Jetting Prior to Recoating
SSPC SP13	Surface Preparation of Concrete
SSPC-TR2	Wet Abrasive Blast Cleaning
SSPC-TU-3	Overcoating
SSPC-TU-4	Field Methods for Retrieval and Analysis of Soluble Salts on Substrates.

Reference	Title
SSPC V2	Systems and Specifications: Steel Structures Painting Manual, Volume 2
SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel
SSPC-VIS 3	Visual Standard for Power and Hand – Tool Cleaned Steel
SSPC-VIS 4	Visual Standards (Waterjetting)
SSPC-VIS 5	Visual Standards (Wet Abrasive Blast Cleaning)
WPCF Manual of Practice No. 17	Paints and Protective Coatings for Wastewater Treatment Facilities. Guide and Paint Application Specifications.

**B. Standardization:**

1. Materials and supplies provided shall be the standard products of CSMs. Materials in each coating system shall be the products of a single CSM.
2. The standard products of CSMs other than those specified may be acceptable when it is demonstrated to the Construction Manager that they are equal in composition, durability, usefulness, and convenience for the purpose intended. Requests for consideration of CSMs other than those specified in this Section will be considered, provided the following minimum conditions are met. Such requests are not a substitution for submittals after the alternative CSMs have been considered and accepted.
  - a. The proposed coating system shall use an equal or greater number of separate coats to achieve the required total dry film thickness.
  - b. The proposed coating system shall use coatings of the same generic type as that specified including curing agent type.
  - c. Requests for consideration of products from CSMs other than those specified in this Section shall include information listed in paragraph 1.04, demonstrating that the proposed CSM's product is equal to the specified coating system.
  - d. The Contractor and the proposed alternative CSM shall provide a list of references for the proposed product where the coating of the same generic type has been applied. The reference list shall include the project name, city, state, owner, phone number of owner; coating system reference and number from this Section 09900; type of facility in which it was used, generic type, and year coating was applied.

**C. Quality Control Requirements:**

1. The Contractor is responsible for the workmanship and quality of the coating system installation. Inspections by the Construction Manager or the CTR will not relieve or limit the Contractor's responsibilities.
2. The Contractor's methods shall conform to requirements of this specification and the standards referenced in this Section. Changes in the coating system

installation requirements will be allowed only with the written acceptance of the Construction Manager before work commences.

3. Only personnel who are trained by the CTR specifically for this contract or who are approved by the CSM specifically for this contract shall be allowed to perform the coating system installation specified in this Section.
4. Contaminated, outdated, diluted materials, and/or materials from previously opened containers shall not be used.
5. For repairs, the Contractor shall provide the same products, or products recommended by the CSM, as used for the original coating.
6. The Contractor shall identify the points of access for inspection by the Owner or the Construction Manager. The Contractor shall provide ventilation, ingress and egress, and other means necessary for the Construction Manager's personnel to access safely the work areas.
7. The Contractor shall conduct the work so that the coating system is installed as specified and shall inspect the work continually to ensure that the coating system is installed as specified. Coating system work that does not conform to the specifications or is otherwise not acceptable shall be corrected as specified.
8. The Contractor shall complete the Coating System Inspection Checklist, **Form 09900-A**, included in **Section 01999**, for coating system installations. Follow the sequential steps required for proper coating system installation as specified and as listed in the Coating System Inspection Checklist. For each portion of the work, install the coating system and complete sign-offs as specified prior to proceeding with the next step. After completing each step as indicated on the Coating System Inspection Checklist, the Contractor shall sign the checklist indicating that the work has been installed and inspected as specified.
9. The Contractor shall provide written daily reports that present, in summary form, test data, work progress, surfaces covered, ambient conditions, quality control inspection test findings, and other information pertinent to the coating system installation.

#### D. Inspection at Hold Points:

1. The Contractor shall conduct inspections at Hold Points during the coating system installation and record the results from those inspections on **Form 09900-A**. The Contractor shall coordinate such Hold Points with the Construction Manager such that the Construction Manager may observe Contractor's inspections on a scheduled basis. The Contractor shall provide the Construction Manager a minimum of two (2) hours of notice prior to conducting Hold Point Inspections. The Hold Points shall be as follows:
  - a. Environment and Site Conditions. Prior to commencing an activity associated with coating system installation, the Contractor shall measure, record, and confirm acceptability of ambient air temperature and humidity as well as other conditions such as proper protective measures for surfaces not to be coated and safety requirements for personnel. The acceptability of the weather and/or environmental conditions within the structure shall be determined by the requirements specified by the CSM of the coating system being used.

- b. Conditions Prior to Surface Preparation. Prior to commencing surface preparation, the Contractor shall observe, record, and confirm that oil, grease, and/or soluble salts have been eliminated from the surface.
- c. Monitoring of Surface Preparation. Spot checking of degree of cleanliness, surface profile, and surface pH testing, where applicable. In addition, the compressed air used for surface preparation or blow down cleaning shall be checked to confirm it is free from oil and moisture.
- d. Post Surface Preparation – Upon completion of the surface preparation, the Contractor shall measure and inspect for proper degree of cleanliness and surface profile as specified in this Section 09900 and in the CSM's written instructions.
- e. Monitoring of Coatings Application – The Contractor shall inspect, measure, and record the wet film thickness and general film quality (visual inspection) for lack of runs, sags, pinholes, holidays, etc. as the application work proceeds.
- f. Post Application Inspection – The Contractor shall identify defects in application work including pinholes, holidays, excessive runs or sags, inadequate or excessive film thickness and other problems as may be observed.
- g. Post Cure Evaluation – The Contractor shall measure and inspect the overall dry film thickness. The Contractor shall conduct a DFT survey, as well as perform adhesion testing, holiday detection, or cure testing as required based on the type of project and the specific requirements in this Section 09900 and/or in the CSM's written instructions.
- h. Follow-up to Corrective Actions and Final Inspection. The Contractor shall measure and reinspect corrective coating work performed to repair defects identified at prior Hold Points. This activity also includes final visual inspection along with follow-up tests such as holiday detection, adhesion tests, and DFT surveys.

### 1.03 DELIVERY AND STORAGE

#### A. General:

- 1. Materials shall be delivered to the job site in their original, unopened containers. Each container shall be properly labeled. Materials shall be handled and stored to prevent damage to or loss of label.
- 2. Labels on material containers shall show the following information:
  - a. Name or title of product.
  - b. CSM's batch number.
  - c. CSM's name.
  - d. Generic type of material.
  - e. Application and mixing instructions.
  - f. Hazardous material identification label.

- g. Shelf life expiration date.
- 3. Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold in accordance with the CSM's recommendations. Flammable materials shall be stored in accordance with state and local requirements.
- 4. Containers shall be clearly marked indicating personnel safety hazards associated with the use of or exposure to the materials.
- 5. Material Safety Data Sheets (MSDS) for each material shall be provided to the Construction Manager.
- 6. The Contractor shall store and dispose of hazardous waste according to federal, state and local requirements. This requirement specifically addresses waste solvents and coatings.

#### 1.04 SUBMITTALS:

##### A. General:

- 1. Provide in accordance with **Section 01300**:
  - a. A copy of this specification section, with addendum updates included, and referenced and applicable sections, with addendum updates included, with each paragraph check-marked (☐) to indicate specification compliance or marked to indicate requested deviations from specification requirements or those parts which are to be provided by the Contractor or others. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined shall signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for requested deviations to the specification requirements shall be cause for rejection of the entire submittal and no further submittal material will be reviewed.
  - b. CSM's current printed recommendations and product data sheets for coating systems including:
    - 1) Volatile organic compound (VOC) data.
    - 2) Surface preparation recommendations.
    - 3) Primer type, where required.
    - 4) Maximum dry and wet-mil thickness per coat.
    - 5) Minimum and maximum curing time between coats, including atmospheric conditions for each.
    - 6) Curing time before submergence in liquid.
    - 7) Thinner to be used with each coating.

- 8) Ventilation requirements.
- 9) Minimum atmospheric conditions during which the paint shall be applied.
- 10) Allowable application methods.
- 11) Maximum allowable moisture content.
- 12) Maximum shelf life.
- c. Affidavits signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with current and promulgated federal, state, and local air pollution control regulations and requirements.
- d. Material Safety Data Sheets (MSDS) for materials to be delivered to the job site, including coating system materials, solvents, and abrasive blast media.
- e. List of cleaning and thinner solutions allowed by the CSMs.
- f. Storage requirements including temperature, humidity, and ventilation for Coating System Materials as recommended by the CSMs.
- g. CSM's detailed, written instructions for coating system treatment and graphic details for coating system terminations in the structures to be coated including pipe penetrations, metal embedments, gate frames, and other terminations to be determined from the contract drawings. This information shall also include detail treatment for coating system at joints in concrete.
- h. The Contractor and CSA shall provide a minimum of five project references each including contact name, address, and telephone number where similar coating work has been performed by their companies in the past five years.

## 1.05 RESPONSIBILITIES OF THE CTR

### A. General:

- 1. The Contractor shall retain or obtain the services of the CTR to be on site to perform the Contractor and/or CSA application training and to routinely inspect and verify in writing that the application personnel have successfully performed surface preparation, filler/surface application, coating system application, and Quality Control Inspection in accordance with this Section 09900 and to warrantable level of quality. This must include checking the required degree of cleanliness, surface pH for concrete substrates, surface profile of substrates, proper mixing of coating materials, application (including checking the wet and dry film thickness of the coating systems), proper cure of the coating systems, and proper treatment of coating systems at terminations, transitions, and joints and cracks in substrates. Refer to paragraph 1.05 Coating System Installation Training. for further details on these CTR requirements. This inspection is in addition to the inspection performed by the Contractor in accordance with this Section 09900.

### B. Coating System Installation Training:

- 1. Provide a minimum of 8 hours of classroom and off site training for application and supervisory personnel (both the Contractor's and CSA's). Provide training to

a minimum of two supervisory personnel from the CSA and one supervisor from the Contractor. Alternatively, the CTR shall provide a written letter from the CSM stating that the application personnel (listed by name) who shall perform coating work are approved by the CSM without further or additional training.

2. One CTR can provide training for up to fourteen application personnel and three supervisory personnel at one time. The training shall include the following as a minimum:
  - a. A detailed explanation of mixing, application, curing, and termination details.
  - b. Hands-on demonstration of how to mix and apply the coating systems.
  - c. A detailed explanation of the ambient condition requirements (temperature and humidity) and surface preparation requirements for application of the coating system as well as a detailed explanation of re-coat times, cure times, and related ambient condition requirements.
  - d. When training is performed, the CTR shall provide a written letter stating that training was satisfactorily completed by the personnel listed by name in the letter.

C. Coating System Inspection:

1. While on site to routinely inspect and verify, the CTR shall perform the following activities to confirm acceptability and conformance with the specifications:
  - a. Inspect ambient conditions during various coating system installation at hold points for conformance with the specified requirements.
  - b. Inspect the surface preparation of the substrates where the coating system will terminate or will be applied for conformance to the specified application criteria.
  - c. Inspect preparation and application of coating detail treatment (for example, terminations at joints, metal embedments in concrete, etc.).
  - d. Inspect application of the filler/surface materials for concrete and masonry substrates.
  - e. Inspect application of the primers and finish coats including wet and dry film thickness of the coatings.
  - f. Inspect coating systems for cure.
  - g. Review adhesion testing of the cured coating systems for conformance to specified criteria.
  - h. Review coating system continuity testing for conformance to specified criteria.
  - i. Inspect and record representative localized repairs made to discontinuities identified via continuity testing.
  - j. Conduct a final review of completed coating system installation for conformance to the specifications.
  - k. Prepare and submit a site visit report following each site visit that documents the acceptability of the coating work in accordance with the CSM's Recommendations.

D. Final Report:

1. Upon completion of coating work for the project, the CTR shall prepare a final report. That report shall summarize daily test data, observations, drawings, and photographs in a report to be submitted in accordance with paragraph 2.02. Include substrate conditions, ambient conditions, and application procedures, observed during the CTR's site visits. Include a statement that the completed work was performed in accordance with the requirements of this Section 09900 and the CSM's recommendations.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. General:

1. Notwithstanding the listing of product names in this Section 09900, the Contractor shall provide affidavits, signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with current and promulgated federal, state, and local air pollution control regulations and requirements. No coatings shall be applied to a surface until the specified affidavits have been submitted and have been reviewed and accepted. Failure to comply with this requirement shall be cause for rejection and removal of such materials from the site.
2. The following list specifies the material requirements for coating systems. Coating systems are categorized by generic name followed by an identifying abbreviation. If an abbreviation has a suffix number, it is for identifying subgroups within the coating system. Coating Systems E-5 and E-6 shall be NSF 61 certified.

#### Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
Epoxy Coatings			
E-1	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI *	Devran 224 HS	Devran 224
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E-1-G	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 894	Carboguard 894
	International Paint/ICI *	Devran 223/224HS	Devran 224HS

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
	Sherwin Williams	Macropoxy 646 Epoxy B67-600	Macropoxy 646 Epoxy B67-600
	Tnemec	Series V27 or V69	Series V69
E-2	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Sea Guard 6000 Epoxy N11-400	Sea Guard 6000 Epoxy N11-400
	Tnemec	Series V27 or V69	Series V69
E-3	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Sea Guard 6000 Epoxy N11-400	Sea Guard 6000 Epoxy N11-400
	Tnemec	Series V69	Series V69
E-4	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E-5	PPG PMC	Amercoat 395FD	Amercoat 395FD
	Carboline	Carboguard 691	Carboguard 691
	International Paint/ICI	Bar-Rust 233H	Bar-Rust 233H
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E6	PPG PMC	Amercoat 395FD	Amercoat 395FD
	Carboline	Carboguard 691	Carboguard 691
	International Paint/ICI	Tru-Glaze 4408 - WB	Tru-Glaze 4408 - WB

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
E7	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
	PPG PMC	Amercoat 385	Amercoat 385
	Carboline	Sanitile 120	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
E8	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
	PPG PMC	Amercoat 385	Amercoat 385
	Carboline	Carboguard 1340	Carboguard 1340
	International Paint/ICI	Prep and Prime (Gripper)	Tru-Glaze 4408 - WB
E-9	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series 201	Series 201
	PPG PMC	Amercoat 395 FD	Amercoat 395 FD
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 231	Bar-Rust 231
E-9-C	Sherwin Williams	Sea Guard 6000 Epoxy N11-400	Sea Guard 6000 Epoxy N11-400
	Tnemec	Series 104	Series 104
	PPG PMC	Amercoat 395 FD	Amercoat 395 FD
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 231	Bar-Rust 231
E-10	Sherwin Williams	Sea Guard 6000 Epoxy N11-400	Sea Guard 6000 Epoxy N11-400
	Tnemec	Series 104	Series 104
	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236

### Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69

### Specialty Epoxy Linings

EA-1	Carboline	Plasite 4500S			Plasite 4500S	
	Sauereisen	Sewergard 210S			Sewergard 210S	
	Tnemec	Series 435			Series 435	
Coating System	CSM	Base Coat	Filler/Surfacer		Glaze Coat	
EA-2	Carboline Carboguard	Plasite 4500S	Carboguard 510		Plasite 4500S	
	Sauereisen	Sewergard 210S	Series 209 HB		Sewergard 210S	
	Tnemec	Series 435	Series 218		Series 435	
EA-3	Carboline	N/A	Carboguard 510		Plasite 5371	
	Sauereisen	N/A	Series 209 HB		Sewergard 210T	
	Tnemec	N/A	Series 218		Series 434	
Coating System	CSM	Primer	Base Coat		Glaze Coat	
EA-4	Carboline	N/A	Plasite 5371		Plasite 4500S	
	Sauereisen	N/A	Sewergard 210T		Sewergard 210G	
	Tnemec	N/A	Series 434		Series 435	
Coating System	CSM	Primer	Filler/ Surfacers	Base Coat w/Scrim Cloth	Saturation Coat w/Silica Sand	Finish Coats
EA-5	Tnemec	Series 201	Series 218	Series 239	Series 239	Series 282
	Carboline	Semstone 110/110EP	Carboguard 510	Semstone 145	Semstone 145	Semstone 145

### Elastomeric Coatings

EC-1	Carboline	Carboguard 671		Polibrid 705 (2 coats)
	Sherwin Williams	Corobond 100		Envirolastic 170 (2 coats)
	Tnemec	Series 1		Series 406 (2 coats)
EC-2	Carboline	Carboguard 671		Polibrid 705 (2 coats)

### Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
	Sherwin Williams	Corobond 100	Envirolastic 520PW (2 coats)
	Tnemec	Series V69	Series 264

### Epoxy Flooring Systems

Coating System	CSM	Primer	Intermediate Coat	Finish Coat
EF-1	Stonhard	Stonhard Standard Primer	Stonshield Undercoat and Broadcoat	Stonshield Sealer
	Tnemec	Series 238	Series 238 with Broadcoat	Series 284 Clear
EF-2	Stonhard	Stonhard Standard Primer	Stonclad GS	Stonkote GS-4
	Tnemec	Series 238	Series 238	Series 280

### Epoxy Polyurethane

		Primer Coat(s)	Intermediate Coat(s)	
EU-1	PPG PMC	Amercoat	Amercoat 385	Amercoat 450H
	Carboline	Carbozinc 859	Carboguard 890	Carbothane 134 VOC
	International Paint/ICI	Cathacoat 313	Devran 233 or 224HS	Devthane 379
	Sherwin Williams	Zinc Clad IV	Macropoxy 646	Hi Solids Polyurethane
	Tnemec	Series 90-97	Series V69	Series 1075
EU-1-FRP	PPG PMC	Amerlock 2/400 Series		Amershield VOC
	Carboline	Carbocrylic 120		Carbothane 134 VOC
	International Paint/ICI	Devran 223/224		Devthane 378H
	Sherwin Williams	Macropoxy 646		High Solids Polyurethane
	Tnemec	Series V27		Series 1075

### Grease

G	Texaco	N/A	Rust Inhibitive Grease
	Chevron	N/A	E.P. Roller Grease

### High Heat

# Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
HH-1	High Temperature Coatings, Inc.	Hi Temp 1027	1000 VS (any color)
HH-2	High Temperature Coatings, Inc.	Hi Temp 1027	1000 VS (black or aluminum)

## Latex Acrylic

L-1	PPG PMC	Amercoat 148	Amercoat 220
	Carboline	Carbocrylic 120	Carbocrylic 3359
	International Paint/ICI	UH Gripper 3210	Dulux Pro 1406
	Sherwin Williams	Loxon Acrylic Primer	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-2	PPG PMC	Amercoat 220	Amercoat 220
	Carboline	Carbocrylic 120	Carbocrylic 3359
	International Paint/ICI	Prep and Prime Gripper	Ultrahide 250-1406
	Sherwin Williams	Sher Cryl HPA	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-3	PPG PMC	Amercoat 148	Amercoat 220
	Carboline	Carbocrylic 3359 DTM	Carbocrylic 3359 DTM
	International Paint/ICI	Devflex 4020 PF	Dulux Pro 1406
	Sherwin Williams	Procryl Primer	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-4	PPG PMC	Amercoat 148	Amercoat 220
	Carboline	Sanitile 120	Sanitile 155
	International Paint/ICI	Prepared Prime Gripper	Ultrahide 250-1406
	Sherwin Williams	Prep Rite ProBlock	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029

## Miscellaneous

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
M-1	Carboline	Carbowrap Priming Paste	Tape A, B, or C (temp. dependent)
	Denso	Denso Paste	Densyl Tape
	Trenton	Waxtape Primer	#1 Wax Tape
M-2	Carboline	Carbomastic 15	Carbomastic 15
	International Paint/ICI	Bar-Rust 231 (231K 9100)	Bar-Rust 231 (231K 9100)
	Sherwin Williams	Epoxy Mastic Aluminum II	Epoxy Mastic Aluminum II
	Tnemec	Series 135 (1243)	Series 135 (1243)

Penetrating Stain

	CSM	Primer	Finish
S-1	Carboline	Carbocrete Sealer WB	Carbocrete Sealer WB
	International Paint/ICI	Groundworks	Groundworks
	Sherwin Williams	H&C Acrylic Concrete Stain	H&C Acrylic Concrete Stain
	Tnemec	Series 617	Series 617
S-2	Tnemec	N/A	Series 636 Dur A Pell 20
	Curecrete Chemical Company	N/A	Ashford Formula
S-3	Tnemec	N/A	Series V626 Dur A Pell GS
S-4	Tnemec	N/A	Series V626 Dur A Pell GS
	Professional Products of Kansas	N/A	PWS-15 Super

*\*See CSM's Product Data Sheets for acceptable thinners for VOC compliance or do not thin.*

Material Requirements for Coating Systems: All California Except SCAQMD

Coating System	CSM	First Coat(s)	Finish Coat(s)
Epoxy Coatings			
E-1	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890

Material Requirements for Coating Systems: All California Except SCAQMD

Coating System	CSM	First Coat(s)	Finish Coat(s)
	International Paint/ICI*	Devran 224 HS	Devran 224 HS
	Sherwin Williams	Macropoxy 646 CA	Macropoxy 646 CA
	Tnemec	Series V69	Series V69
E-1-G	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI*	Devran 224 HS	Devran 224 HS
	Sherwin Williams	Macropoxy 646 CA	Macropoxy 646 CA
	Tnemec	Series V69	Series V69
E-2	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series V69	Series V69
E-3	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E-4	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E-5	PPG PMC	Amercoat 333	Amercoat 333
	Carboline	Carboguard 691	Carboguard 691
	International Paint/ICI	Bar-Rust 233H	Bar-Rust 233H

Material Requirements for Coating Systems: All California Except SCAQMD

Coating System	CSM	First Coat(s)	Finish Coat(s)
E6	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
	PPG PMC	Amercoat 333	Amercoat 333
	Carboline	Carboguard 691	Carboguard 691
	International Paint/ICI	Bar-Rust 233H	Bar-Rust 233H
E7	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
	PPG PMC	Amerlock 400	Amerlock 400
	Carboline	Sanitile 120	Sanitile 120
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
E8	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
	PPG PMC	Amerlock 400	Amerlock 400
	Carboline	Carboguard 1340	Carboguard 1340
	International Paint/ICI	UH Gripper 3210	Tru-Glaze 4408
E-9	Sherwin Williams	Macropoxy 646 CA	Macropoxy 646 CA
	Tnemec	Series 201	Series 201
	PPG PMC	Amercoat 253	Amercoat 253
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 231	Bar-Rust 231
E-9-C	Sherwin Williams	CorCote HCR-FF	CorCote HCR-FF
	Tnemec	Series 104	Series 104
	PPG PMC	Amercoat 253	Amercoat 253
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 231	Bar-Rust 231
	Sherwin Williams	CorCote HCR-FF	CorCote HCR-FF

### Material Requirements for Coating Systems: All California Except SCAQMD

Coating System	CSM	First Coat(s)	Finish Coat(s)
	Tnemec	Series 104	Series 104
E-10	PPG PMC	Amerlock 400	Amerlock 400
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69

### Specialty Epoxy Linings

EA-1	Carboline	Plasite 4550S			Plasite 4550S	
	Sauereisen	Sewergard 210S			Sewergard 210S	
	Tnemec	Series 435			Series 435	
Coating System	CSM	Base Coat	Filler/Surfacer		Glaze Coat	
EA-2	Carboline	Semstone 501 optional	Carboguard 510		Plasite 4550S	
	Sauereisen	Sewergard 210S	Series 209 HB		Sewergard 210S	
	Tnemec	Series 435	Series 218		Series 435	
EA-3	Carboline	Semstone 501 optional	Carboguard 510		Plasite 5371	
	Sauereisen	Sewergard 210T	209 HB		Sewergard 210T	
	Tnemec	Series 435	Series 218		Series 434	
Coating System	CSM	Primer	Base Coat		Glaze Coat	
EA-4	Carboline	N/A	Plasite 5371		Plasite 4500S	
	Sauereisen	N/A	Sewergard 210T		Sewergard 210G	
	Tnemec	N/A	Series 434		Series 435	
Coating System	CSM	Primer	Filler/ Surfacer	Base Coat w/Scrim Cloth	Saturation Coat w/Silica Sand	Finish Coats
EA-5	Tnemec	Series 201	Series 218	Series 239	Series 239	Series 282
	Carbolin e	Semstone 110/110EP	Carboguard 510	Semstone 145	Semstone 145	Semstone 145

### Elastomeric Coatings

EC-1	Carboline	Carboguard 954		Policlad 708
	Sherwin Williams	Corobond 100		Envirolastic 170
	Tnemec	Series V69		Series 406 (2 coats)

### Material Requirements for Coating Systems: All California Except SCAQMD

Coating System	CSM	First Coat(s)	Finish Coat(s)
EC-2	Carboline	Carboguard 954	Polyclad 708/Polibrand 705
	Sherwin Williams	Corobond 100	Envirolastic 520 PW
	Tnemec	Series V69	Series 264

### Epoxy Flooring Systems

Coating System	CSM	Primer	Intermediate Coat	Finish Coat
EF-1	Stonhard	Stonhard Standard Primer	Stonshield Undercoat and Broadcoat	Stonshield Sealer
	Tnemec	Series 238	Series 238 with Broadcoat	Series 284 Clear
EF-2	Stonhard	Stonhard Standard Primer	Stonclad GS	Stonkote GS-4
	Tnemec	Series 238	Series 238	Series 280

### Epoxy Polyurethane

	CSM	Primer Coat(s)	Intermediate Coat(s)	Finish Coat(s)
EU-1	Ameron	N/A	Amerlock 400	Amershield VOC
	Carboline	N/A	Carboguard 890	Carbothane 134 VOC
	Sherwin Williams	N/A	Macropoxy 646 100	Hi Solids Polyurethane 100
	Tnemec	N/A	Series V69	Series 1075
EU-1-FRP	Ameron	Amercoat 400		Amershield VOC
	Carboline	Carboguard 890		Carbothane 134 VOC
	Sherwin Williams	Macropoxy 646-100		VOC Hi Solids
	Tnemec	Series V69		Polyurethane 100 Series 1075

### Grease

G	Texaco	N/A	Rust Inhibitive Grease
	Chevron	N/A	E.P. Roller Grease

### High Heat

HH-1	High Temperature Coatings, Inc.	Hi Temp 1027	1000 VS (any color)
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# Material Requirements for Coating Systems: All California Except SCAQMD

Coating System	CSM	First Coat(s)	Finish Coat(s)
HH-2	High Temperature Coatings, Inc.	Hi Temp 1027	1000 VS (black or aluminum)

## Latex Acrylic

L-1	PPG PMC	Amercoat 148	Amercoat 220
	Carboline	Sanitile 120	Carbocrylic 3359 DTM
	International Paint/ICI	Prep and Prime Gripper	Ultrahide 250-1406
	Sherwin Williams	Loxon Acrylic Primer	Sher Cryl
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-2	PPG PMC	Amercoat 220	Amercoat 220
	Carboline	Sanitile 120	Carbocrylic 3359 DTM
	International Paint/ICI	UH Gripper 3210	Dulux Pro 4206
	Sherwin Williams	Sher Cryl	Sher Cryl
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-3	PPG PMC	Amercoat 148	Amercoat 220
	Carboline	Carbocrylic 3359 DTM	Carbocrylic 3359 DTM
	International Paint/ICI	Devflex 4020 PF	Dulux Pro 1406
	Sherwin Williams	Procryl Primer	Sher Cryl
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-4	PPG PMC	Amercoat 148	Amercoat 220
	Carboline	Carbocrylic 3359 DTM	Carbocrylic 3359 DTM
	International Paint/ICI	Prep and Prime Gripper	Ultrahide 250-146
	Sherwin Williams	Prep Rite ProBlock	Sher Cryl
	Tnemec	Series 1028 or 1029	Series 1028 or 1029

## Miscellaneous

M-1	Carboline	Carbowrap Tape Paste	Carbowrap Petrolatum Tape
	Denso	Denso Paste	Densyl Tape
	Trenton	Waxtape Primer	#1 Wax Tape

### Material Requirements for Coating Systems: All California Except SCAQMD

Coating System	CSM	First Coat(s)	Finish Coat(s)
M-2	PPG PMC	Amerlock 400	Amerlock 400
	Carboline	Carbomastic 615 HS	Carbomastic 615 HS
	International Paint/ICI	Bar-Rust 231	Bar-Rust 231
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series 135	Series 135

### Penetrating Stain

S-1	Tnemec	Series 617	Series 617
S-2	Tnemec	N/A	Series 636 Dur A Pell 20
	Curecrete Chemical Company	N/A	Ashford Formula
S-3	Tnemec	N/A	Series V626 Dur A Pell GS
S-4	Tnemec Professional Products of Kansas	N/A N/A	Series V626 Dur A Pell GS PWS-15 Super

*\*See CSM's Product Data Sheets for acceptable thinners for VOC compliance or do not thin.*

### Material Requirements for Coating Systems: California SCAQMD Only

Coating System	CSM	First Coat(s)	Finish Coat(s)
<b>Epoxy Coatings</b>			
E-1	PPG PMC	Amercoat 351	Amercoat 351
	Carboline	Carboguard 890VOC	Carboguard 890VOC
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series L69	Series L69
E-1-G	PPG PMC	Amercoat 351	Amercoat 351
	Carboline	Carboguard 890VOC	Carboguard 890VOC
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series L69	Series L69
E-2	PPG PMC	Amercoat 351	Amercoat 351
	Carboline	Carboguard 890VOC	Carboguard 890VOC

# Material Requirements for Coating Systems: California SCAQMD Only

Coating System	CSM	First Coat(s)	Finish Coat(s)
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series L69	Series L69
E-3	PPG PMC	Amercoat 351	Amercoat 351
	Carboline	Carboguard 890VOC	Carboguard 890VOC
	Sherwin Williams	Duraplate 235	Duraplate 235
	Tnemec	Series L69	Series L69
E-4	PPG PMC	Amercoat 351	Amercoat 351
	Carboline	Carboguard 890VOC	Carboguard 890VOC
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series L69	Series L69
E-5	PPG PMC	Amercoat 133	Amercoat 333
	Carboline	Plasite 4500	Plasite 4500
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series 22	Series 22
E6	PPG PMC	Amercoat 133	Amercoat 333
	Carboline	Plasite 4500	Plasite 4500
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series 22	Series 22
E7	PPG PMC	Amercoat 351	Amercoat 351
	Carboline	Carboguard 954HB	Carboguard 954HB
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series L69	Series L69
E8	PPG PMC	Amercoat 351	Amercoat 351
	Carboline*	Carboguard 1340	Carboguard 1340
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series 201	Series 201
E-9	PPG PMC	Amercoat 351	Amercoat 351
	Carboline	Carboguard 890VOC	Carboguard 890VOC

### Material Requirements for Coating Systems: California SCAQMD Only

Coating System	CSM	First Coat(s)	Finish Coat(s)
E-9-C	Sherwin Williams	CorCote HCR-FF	CorCote HCR-FF
	Tnemec	Series 22	Series 22
	PPG PMC	Amercoat 351	Amercoat 351
	Carboline	Carboguard 890VOC	Carboguard 890VOC
E-10	Sherwin Williams	CorCote HCR-FF	CorCote HCR-FF
	Tnemec	Series 22	Series 22
	PPG PMC	Amercoat 351	Amercoat 351
	Carboline	Carboguard 890VOC	Carboguard 890VOC
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series L69	Series L69

### Specialty Epoxy Linings

EA-1	Carboline		Plasite 4550S		Plasite 4550S	
	Sauereisen		Sewergard 210S		Sewergard 210S	
	Tnemec		Series 435		Series 435	
Coating System	CSM		Base Coat	Filler/Surfacer	Glaze Coat	
EA-2	Carboline		Plasite 4550S	Carboguard 510	Plasite 4550S	
	Sauereisen		Sewergard 210S	Series 209 HB	Sewergard 210S	
	Tnemec		Series 435	Series 218	Series 435	
EA-3	Carboline		N/A	Carboguard 510	Plasite 5371	
	Sauereisen		N/A	Series 209 HB	Sewergard 210T	
	Tnemec		N/A	Series 218	Series 434	
Coating System	CSM		Primer	Base Coat	Glaze Coat	
EA-4	Carboline		N/A	Plasite 5371	Plasite 4500S	
	Sauereisen		N/A	Sewergard 210T	Sewergard 210G	
	Tnemec		N/A	Series 434	Series 435	
Coating System	CSM	Primer	Filler/ Surfacer	Base Coat w/Scrim Cloth	Saturation Coat w/Silica Sand	Finish Coats
EA-5	Tnemec	Series 201	Series 218	Series 239	Series 239	Series 282

# Material Requirements for Coating Systems: California SCAQMD Only

Coating System	CSM	First Coat(s)			Finish Coat(s)	
	Carboline	Semstone 110/110EP	Carboguard 510	Semstone 145	Semstone 145	Semstone 145

## Elastomeric Coatings

EC-1	Carboline	Carbogard 954			Polyclad 708 Carbothane 234	
	Sherwin Williams	Corobond 100			Envirolastic AR170	
	Tnemec	Series L69			Series 406	
EC-2	Carboline	Carbogard 954			Polyclad 708/Polibrid 705	
	Sherwin Williams	Corobond 100			Envirolastic 520 PW	
	Tnemec	Series L69			Series 406	

## Epoxy Flooring Systems

Coating System	CSM	Primer	Intermediate Coat	Finish Coat
EF-1	Stonhard	Stonhard Standard Primer	Stonshield Undercoat and Broadcoat	Stoneshield Sealer
	Tnemec	Series 238	Series 238 with Broadcoat	Series 284 Clear
EF-2	Stonhard	Stonhard Standard Primer	Stonclad GS	Stonkote GS-4
	Tnemec	Series 238	Series 238	Series 280

## Epoxy Polyurethane

		First Coat	Intermediate Coat(s)	
EU-1	Sherwin Williams	N/A	Macropoxy 646-100	Hi Solids Polyurethane 100
	Tnemec*	N/A	Series L69	Series 740

## Grease

G	Texaco	N/A	Rust Inhibitive Grease	
	Chevron	N/A	E.P. Roller Grease	

## High Heat

HH-1	High Temperature Coatings, Inc.	Hi Temp 1027		1000 VS (any color)
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# Material Requirements for Coating Systems: California SCAQMD Only

Coating System	CSM	First Coat(s)	Finish Coat(s)
HH-2	High Temperature Coatings, Inc.	Hi Temp 1027	1000 VS (black or aluminum)

## Latex Acrylic

L-1	Carboline	Sanitile 120	Carbocrylic 3359 DTMC
	International Paint/ICI	Prep & Prime 9116	Lifemaster 9300
	Sherwin Williams	Loxon Acrylic Primer A24WA300	Metalatex
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-2	Carboline	Sanitile 120	Carbocrylic 3359 DTM MC
	International Paint/ICI	Prep & Prime 9116	UHDurus 2416
	Sherwin Williams	Loxon Acrylic Primer A24WA300	Metalatex
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-3	Carboline	Carbocrylic 3359 DTM MC	Carbocrylic 3359 DTM MC
	International Paint/ICI	UH Gripper 3210	Lifemaster 9300
	Sherwin Williams	Procryl Primer	Metalatex
	Tnemec	Series L69	Series 1028 or 1029
L-4	Carboline	Carbocrylic 3359 DTM MC	Carbocrylic 3359 DTM MC
	International Paint/ICI	UH Gripper 3210	Lifemaster 9300
	Sherwin Williams	PrepRite Pro Block Latex Primer	Metalatex
	Tnemec	Series L69	Series 1028 or 1029

## Miscellaneous.

M-1	Carboline	Carbowrap Tape Paste	Carbowrap Petroatum Tape
	Denso	Denso Paste	Densyl Tape
	Trenton	Waxtape Primer	#1 Wax Tape
M-2	PPG PMC	Amerlock Sealer	Amercoat 351
	Carboline	Carbomastic 615 Aluminum	Carbomastic 615 Aluminum
	Sherwin Williams	Macropoxy 646-100	Macropoxy 646-100
	Tnemec	Series L69	Series L69

## Material Requirements for Coating Systems: California SCAQMD Only

Coating System	CSM	First Coat(s)	Finish Coat(s)
Penetrating Stain			
S-1	Tnemec	Series 617	Series 617
S-2	Tnemec Curecrete Chemical Company	N/A N/A	Series 635 Dur A Pell 10 Ashford Formula
S-3	Tnemec	N/A	Series V626 Dur A Pell GS
S-4	Tnemec Professional Products of Kansas	N/A N/A	Series V626 Dur A Pell GS PWS-15 Super

*\*See CSM's Product Data Sheets for acceptable thinners for VOC compliance or do not thin.*

## 2.02 PRODUCT DATA

### A. General:

1. Prior to application of coatings, submit letter(s) from the CTR(s) identifying the application personnel who have satisfactorily completed training as specified in paragraph 1.05 or a letter from the CSM stating that personnel who shall perform the work are approved by the CSM without need for further or additional training.
2. Submit reports specified in paragraph 1.02 Quality Control Requirements and 1.05 Coating System Inspection when the work is underway.
3. Submit the Coating System Inspection Checklists, using Form 09900-A, included in Section 01 99 90, for the coating work.
4. CTR final report in accordance with paragraph 1.05 Final Report.

## PART 3 EXECUTION

### 3.01 COATINGS

#### A. General:

1. Coating products shall not be used until the Construction Manager has accepted the affidavits specified in paragraphs 1.04 and 2.01, the Construction Manager has inspected the materials, and the CTR has trained the Contractor and CSA in the surface preparation, mixing and application of each coating system.
2. Erect and maintain protective enclosures as stipulated per SSPC-Guide 6 Guide for Containing Debris Generated During Paint Removal Operations.

#### B. Shop and Field Coats:

1. Shop Applied Prime Coat: Except as otherwise specified, prime coats may be shop-applied or field-applied. Shop-applied primer shall be compatible with the

specified coating system and shall be applied at the minimum dry film thickness recommended by the CSM. Data sheets identifying the shop primer used shall be provided to the on-site coating application personnel. Adhesion tests shall be performed on the shop primer as specified in paragraph 3.01 Adhesion Confirmation. Damaged, deteriorated and poorly applied shop coatings that do not meet the requirements of this Section 09900 shall be removed and the surfaces recoated. If the shop primer coat meets the requirements of this Section 09900, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.

2. Field Coats: Field coats shall consist of one or more prime coats and one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until other work in the area is complete and until previous coats have been inspected.
3. Adhesion Confirmation: The Contractor shall perform an adhesion test after proper cure in accordance with ASTM D3359 to demonstrate that (1) the shop applied prime coat adheres to the substrate, and (2) the specified field coatings adhere to the shop coat. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on other surfaces shall be considered acceptable for coatings 5 mils or more in thickness (Method A). Test results showing an adhesion rating of 5B on immersed surfaces and 4B or better on other surfaces shall be considered acceptable for coating thicknesses less than 5 mils.

C. Application Location Requirements:

1. Equipment, Nonimmersed: Items of equipment, or parts of equipment that are not immersed in service, shall be shop primed and then finish coated in the field after installation with the specified or acceptable color. If the shop primer requires topcoating within a specified period, the equipment shall be finish coated in the shop and then touch-up painted after installation. If equipment removal and reinstallation is required for the project, touch-up coating work shall be performed in the field following installation.
2. Equipment, Immersed: Items of equipment, or parts and surfaces of equipment that are immersed when in service, with the exception of pumps and valves, shall have surface preparation and coating work performed in the field. Coating systems applied to immersed equipment shall be pinhole free.
3. Steel Water Tanks: The interior surfaces of steel water tanks or reservoirs shall have surface preparation and coating work performed in the field.

### 3.02 PREPARATION

A. General:

1. Surface preparations for each type of surface shall be in accordance with the specific requirements of each coating specification sheet (COATSPEC) and the following. In the event of a conflict, the COATSPEC sheets shall take precedence.

2. Surfaces to be coated shall be clean and dry. Before applying coating or surface treatments, oil, grease, dirt, rust, loose mill scale, old weathered coatings, and other foreign substances shall be removed. Oil and grease shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free from contaminants that might interfere with the adhesion of the coatings. The air used for blast cleaning shall be sufficiently free of oil and moisture so as not to cause detrimental contamination of the surfaces to be coated.
3. Where deemed necessary by the Owner's representative, a NACE International certified coatings inspector, provided by the Owner, will inspect and approve surfaces to be coated before application of a coating. Surface defects identified by the inspector shall be corrected by the Contractor at no additional cost to the Owner.
4. Cleaning and painting shall be scheduled so that dust and spray from the cleaning process shall not fall on wet, newly coated surfaces. Hardware, hardware accessories, nameplates, data tags, machined surfaces, sprinkler heads, electrical fixtures, and similar uncoated items which are in contact with coated surfaces shall be removed or masked prior to surface preparation and painting operations. Following completion of coating, removed items shall be reinstalled. Equipment adjacent to walls shall be disconnected and moved to permit cleaning and painting of equipment and walls and, following painting, shall be replaced and reconnected.

**B. Blast Cleaning:**

1. When abrasive blast cleaning is required to achieve the specified surface preparation the following requirements for blast cleaning materials and equipment shall be met:
  - a. Used or spent blast abrasive shall not be reused on this project.
  - b. The compressed air used for blast cleaning shall be filtered and shall contain no condensed water and no oil. Moisture traps shall be cleaned at least once every four hours or more frequently as required to prevent moisture from entering the supply air to the abrasive blasting equipment.
  - c. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. These shall be checked on the same frequency as the moisture traps as defined above.
  - d. Regulators, gauges, filters, and separators shall be in use on compressor air lines to blasting nozzles times during this work.
  - e. An air dryer or desiccant filter drying unit shall be installed which dries the compressed air prior to blast pot connections. This dryer shall be used and maintained for the duration of surface preparation work.
  - f. The abrasive blast nozzles used shall be of the venturi or other high velocity type supplied with a minimum of 100 psig air pressure and sufficient volume to obtain the blast cleaning production rates and cleanliness/specified.

- g. The Contractor shall provide ventilation for airborne particulate evacuation (meeting pertinent safety standards) to optimize visibility for both blast cleaning and inspection of the substrate during surface preparation work.
- h. If, between final surface preparation work and coating system application, contamination of prepared and cleaned metallic substrates occurs, or if the prepared substrates' appearance darkens or changes color, recleaning by water blasting, reblasting and abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.
- i. The Contractor is responsible for dust control and for protection of mechanical, electrical, and other equipment adjacent to and surrounding the work area.

C. Solvent Cleaning:

- 1. Any solvent wash, solvent wipe, or cleaner used, including but not limited to those used for surface preparation in accordance with SSPC SP-1 Solvent Cleaning and shall be of the emulsifying type which emits no more than 340 g/l VOCs for AIM regions, 250 g/l for CARB regions and 100 g/l for SCAQMD regions, contains no phosphates, is biodegradable, removes no zinc, and is compatible with the specified primer.
- 2. Clean white cloths and clean fluids shall be used in solvent cleaning.

D. Metallic Surfaces:

- 1. Metallic surfaces shall be prepared in accordance with applicable portions of surface preparation specifications of the Society for Protective Coatings (SSPC) specified for each coating system. See Coat Spec for each coating system in this Section 09900. The profile depth of the surface to be coated shall be in accordance with the COATSPEC requirements in this Section measured by Method C of ASTM D4417. Blast particle size shall be selected by the Contractor to produce the specified surface profile. The solvent in solvent cleaning operations shall be as recommended by the CSM.
- 2. Preparation of metallic surfaces shall be based upon comparison with SSPC-VIS1-89 (ASTM D2200), and as described in the Coat Spec for each coating system. If dry abrasive blast cleaning is selected and to facilitate inspection, the Contractor shall, on the first day of cleaning operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8-1/2 inches by 11 inches. Panels meeting the requirements of the specifications shall be initialed by the Contractor and the Construction Manager and coated with a clear non-yellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as the comparison standard throughout the project.
- 3. Blast cleaning requirements for steel, ductile iron and stainless steel substrates are as follows:
  - a. Steel piping shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) and primed before installation. Ductile iron piping surfaces

including fittings shall be prepared in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 500-03-05.

- b. Stainless steel surfaces shall be abrasive blast cleaned to leave a clean uniform appearance with a minimum surface profile of 1.5 to 2.5 mils that is uniform.
- c. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasive from substrate by vacuum cleaning prior to coating application.
- d. Care must be taken to prevent contamination of the surface after blasting from worker's fingerprints, deleterious substances on workers' clothing, or from atmospheric conditions.
- e. Ambient environmental conditions in the enclosure must be constantly monitored and maintained to ensure the degree of cleanliness is held and no "rust back" occurs prior to coating material application.

E. Concrete Surfaces:

- 1. Inspection of concrete surfaces prior to surface preparation and surface preparation of concrete surfaces shall be performed in accordance with SSPC-SP13 (also called NACE 6).
- 2. Prepare substrate cracks, areas requiring resurfacing and perform detail treatment including but not limited to, terminating edges, per CSM recommendations. This shall precede surface preparation for degree of cleanliness and profile.
- 3. The surface profile for prepared concrete surfaces to be coated shall be evaluated by comparing the profile of the prepared concrete with the profile of graded abrasive paper, as described in ANSI B74.18 or by comparing the profile with the ICRI 03732 (surface profile replicas). Surface profile requirements shall be in accordance with the Coat Spec requirements and the CSM's recommendations.
- 4. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to making repairs or applying a coat in the coating system. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness prior to application of the coating system.
- 5. Surface preparation of concrete substrates shall be accomplished using methods such as dry abrasive blast cleaning, high, or ultra high-pressure water blast cleaning in accordance with SSPC-SP-13. The selected cleaning method shall produce the requirements set forth below.
  - a. A clean substrate that is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances shall be achieved. Blast cleaning and other means necessary shall be used to open up air voids or bugholes to expose their complete perimeter. Leaving shelled over, hidden air voids beneath the exposed concrete surface is not acceptable. Concrete substrate must be dry prior to the application of filler/surface or coating system materials.
  - b. Acceptable surface preparation must produce a concrete surface with a minimum pH of 8.0 to be confirmed by surface pH testing. If after surface preparation, the surface pH remains below 8.0, perform additional water

blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.

- c. Following inspection by the Contractor of the concrete surface preparation, thoroughly vacuum clean concrete surfaces to be coated to remove loose dirt, and spent abrasive (if dry blast cleaning is used) leaving a dust free, sound concrete substrate. Debris produced by blast cleaning shall be removed from the structures to be coated and disposed of legally off site by the Contractor.
6. Should abrasive blast cleaning or high or ultrahigh pressure water blasting not remove degraded concrete, chipping or other abrading tools shall be used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances. Concrete substrates must be dry prior to the application of filler/surfacers or coating system materials.
7. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to application of coating materials. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness and required surface profile prior to application of the coating system.
8. Moisture content of concrete to be coated shall be tested in accordance with ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method and ASTM F 1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride. The ASTM D4263 plastic sheet test shall be conducted at least once for every 500 sq. ft. of surface area to be coated. The presence of any moisture on plastic sheet following test period constitutes a non-acceptable test. For concrete surfaces to be coated which are on the negative or back side of concrete walls or structures exposed to soils (back filled) or immersed and waterproofed in accordance with Section 07100, perform calcium chloride tests in accordance with ASTM F-1869 once for each 500 sq. ft. of surface area to be coated. Comply with CSM's written recommendations regarding acceptance/non-acceptance of moisture vapor emissions.

#### F. Masonry Surfaces:

1. Prepare masonry surfaces such as Concrete Masonry Units (CMU) to remove chalk, loose dirt, dried mortar splatter, dust, peeling, or loose existing coatings, or otherwise deleterious substances to leave a clean, sound substrate.
2. Be certain masonry surfaces are dry prior to coating application. If pressure washing or low-pressure water blast cleaning is used for preparation, allow the masonry to dry for at least 5 days under dry weather conditions or when the minimum ambient temperature is 70 degrees F prior to coating application work.

#### G. Fiberglass Reinforced Plastic (FRP) Surfaces:

1. Prepare FRP surfaces by sanding to establish uniform surface roughness and to remove gloss from the resin in the FRP. Next, vacuum clean to remove loose FRP dust, dirt, and other materials. Next, solvent clean using clean white rags and allow solvent to evaporate completely before application of coating materials.

### 3.03 APPLICATION

#### A. Workmanship:

1. Coated surfaces shall be free from runs, drips, ridges, waves, laps, and brush marks. Coats shall be applied to produce an even film of uniform thickness completely coating corners and crevices.
2. The Contractor's equipment shall be designed for application of the materials specified. Compressors shall have suitable traps and filters to remove water and oils from the air. A paper blotter test shall be performed by the Contractor when requested by the Construction Manager to determine if the air is sufficiently free of oil and moisture so as not to produce deteriorating effects on the coating system. The amount of oil and moisture in spray air shall be less than the amount recommended by the CSM. Spray equipment shall be equipped with mechanical agitators, pressure gages, and pressure regulators, and spray nozzles of the proper sizes.
3. Each coat of coating material shall be applied evenly and sharply cut to line. Care shall be exercised to avoid overspraying or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs, and other adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.
4. Coating applications method shall be conventional or airless spray, brush or roller, or trowel as recommended by CSM.
5. Allow each coat to cure or dry thoroughly, according to CSM's printed instructions, prior to recoating.
6. Vary color for each successive coat for coating systems when possible.
7. When coating complex steel shapes, prior to overall coating system application, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the primer coat. This involves applying a separate coat using brushes or rollers to ensure proper coverage. Stripe coat via spray application is not permitted.

#### B. Coating Properties, Mixing and Thinning:

1. Coatings, when applied, shall provide a satisfactory film and smooth even surface. Glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats. Coating materials shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings consisting of two or more components shall be mixed in accordance with the CSM's instructions. Where necessary to suit the conditions of the surface, temperature, weather and method of application, the coating may be thinned as recommended by the CSM immediately prior to use. The volatile organic content (VOC) of the coating as applied shall comply with prevailing air pollution control regulations. Unless otherwise specified, coatings shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the CSM.

C. Atmospheric Conditions:

1. Coatings shall be applied only to surfaces that are dry, and only under conditions of evaporation rather than condensation. Coatings systems shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation. During damp weather, when the temperature of the surface to be coated is within 10 degrees F of the dew point, forced dehumidification equipment may be used to maintain a temperature of minimum 40 degrees F and 10 degrees F above the dew point for the surfaces to be coated, the coated surface, and the atmosphere in contact with the surface. These conditions shall be maintained for a period of at least 8 hours or as recommended by the CSM. Where conditions causing condensation are severe, dehumidification equipment, fans, and/or heaters shall be used inside enclosed areas to maintain the required atmospheric and surface temperature requirements for proper coating application and cure.

D. Concrete Substrate Temperatures and Detail Treatment:

1. When the surface temperatures of the concrete substrates to be coated are rising or when these substrates are in direct sunlight, outgassing of air from the concrete may result in bubbling, pinhole formations, and/or blistering in the coating system. The application of the filler/surface and the coating system will only be allowed during periods of falling temperature. This will require that application of the filler/surface and coating system shall only occur during the cooler evening hours. Contractor shall include any cost for working outside of normal hours in the bid.
2. Should bubbles, pinholes, or discontinuities form in the applied coating system material, they shall be repaired as recommended by the CSM. Should pinholes develop in the filler/surfacer material or in the first coat of the coating material, the pinholes shall be repaired in accordance with the CSM's recommendations prior to application of the next coat of material. Whenever pinholes occur, the air void behind or beneath the pinhole shall be opened up completely and then completely filled with the specified filler/surfacer material. Next, the coated area around the pinhole repair shall be abraded and the coating reapplied over that area.
3. Perform application detail work per CSM's current written recommendations and/or drawings.

E. Protection of Coated Surfaces:

1. Items that have been coated shall not be handled, worked on, or otherwise disturbed, until the coating is completely dry and hard. After delivery at the site, and upon permanent erection or installation, shop-coated metalwork shall be recoated or retouched with specified coating when it is necessary to maintain the integrity of the film.

F. Method of Coating Application:

1. Where two or more coats are required, alternate coats shall contain sufficient compatible color additive to act as indicator of coverage, or the alternate coats shall be of contrasting colors. Color additives shall not contain lead, or lead compounds, which may be destroyed or affected by hydrogen sulfide or other corrosive gas, and/or chromium.
2. Mechanical equipment, on which the equipment manufacturer's coating is acceptable, shall be touch-up primed and coated with two coats of the specified coating system to match the color scheduled. Electrical and instrumentation equipment specified in Divisions 26 and 40 shall be coated as specified in paragraph 3.03 Electrical and Instrumentation Equipment and Materials.
3. Coatings shall not be applied to a surface until it has been prepared as specified. The primer or first coat shall be applied by brush to ferrous surfaces that are not blast-cleaned. Coats for blast-cleaned ferrous surfaces and subsequent coats for nonblast-cleaned ferrous surfaces may be either brush or spray applied. After the prime coat is dry, pinholes and holidays shall be marked, repaired in accordance with CSM's recommendations and retested before succeeding coats are applied. Unless otherwise specified, coats for concrete and masonry shall be brushed, rolled, or troweled.

G. Film Thickness and Continuity:

1. WFT of the first coat of the coating system and subsequent coats shall be verified by the Contractor, following application of each coat.
2. The surface area covered per gallon of coating for various types of surfaces shall not exceed those recommended by the CSM. The first coat, referred to as the prime coat, on metal surfaces refers to the first full paint coat and not to solvent wash, grease emulsifiers or other pretreatment applications. Coatings shall be applied to the thickness specified, and in accordance with these specifications. Unless otherwise specified, the average total thickness (dry) of a completed protective coating system on exposed metal surfaces shall be not less than 1.25 mils per coat. The minimum thickness at any point shall not deviate more than 25 percent from the required average. Unless otherwise specified, no less than two coats shall be applied.
3. In testing for continuity of coating about welds, projections (such as bolts and nuts), and crevices, the Construction Manager shall determine the minimum conductivity for smooth areas of like coating where the dry-mil thickness has been accepted. This conductivity shall be the minimum required for these rough or irregular areas. Pinholes and holidays shall be recoated to the required coverage.
4. The ability to obtain specified film thickness is generally compromised when brush or roller application methods are used and, therefore, more coats may need to be applied to achieve the specified dry film thickness.
5. For concrete substrates, the Contractor shall apply a complete skim coat of the specified filler/surfacer material over the entire substrate prior to application of the coating system. This material shall be applied such that all open air voids and

bugholes in the concrete substrate are completely filled prior to coating application.

H. Special Requirements:

1. Before erection, the Contractor shall apply all but the final finish coat to interior surfaces of roof plates, roof rafters and supports, pipe hangers, piping in contact with hangers, and contact surfaces that are inaccessible after assembly. The final coat shall be applied after erection. Structural friction connections and high tensile bolts and nuts shall be coated after erection. Areas damaged during erection shall be hand-cleaned or power-tool cleaned and recoated with primer coat prior to the application of subsequent coats. Touch-up of surfaces shall be performed after installation. Surfaces to be coated shall be clean and dry at the time of application. Except for those to be filled with grout, the underside of equipment bases and supports that have not been galvanized shall be coated with at least two coats of primer specified for system E-2 prior to setting the equipment in place. Provide coating system terminations at leading edges and transitions to other substrates in accordance with the CSM's recommendations or detail drawings.

I. Electrical and Instrumentation Equipment and Materials:

1. Electrical and instrumentation equipment and materials shall be coated by the equipment manufacturer as specified below.
  - a. Finish: Electrical equipment shall be treated with zinc phosphate, bonderized or otherwise given a rust-preventive treatment. Equipment shall be primed, coated with enamel, and baked. Minimum dry film thickness shall be 3 mils.
    - 1) Unless otherwise specified, instrumentation panels shall be coated with system E-1 for indoor mounting and system EU-1 for outdoor mounting.
    - 2) Before final acceptance, the Contractor shall touch up scratches on equipment with identical color coating. Finish shall be smooth, free of runs, and match existing finish. Prior to touching up scratches, Contractor shall fill them with an appropriate filler material approved by the CSM.
  - b. Color: Exterior color of electrical equipment shall be FS 26463 (ANSI/NSF 61) light gray. Interior shall be painted FS 27880 white. Nonmetallic electrical enclosures and equipment shall be the equipment manufacturer's standard grey color.
    - 1) Exterior color of instrumentation panels and cabinets mounted indoors shall be FS 26463 light gray; unless otherwise specified, exterior color for cabinets mounted outdoors shall be FS 27722, white. Cabinet interiors shall be FS 27880, white.

J. Soluble Salt Contamination of Metallic Substrates:

1. Contractor shall test in accordance with SSPC-TU-4 metallic substrates to be coated that have been exposed to seawater or coastal air or to industrial fallout of particulate or other sources of soluble chlorides (such as wastewater exposure). If testing indicates detrimental levels of soluble salts, those in excess of 25 ppm, the Contractor shall clean and prepare these surfaces to remove the soluble salts.

### 3.04 CLEANUP

#### A. General:

1. Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean surfaces and repair overspray or other coating-related damage.

### 3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

#### A. General:

1. Coating systems for different types of surfaces and general service conditions for which these systems are normally applied are specified on the following COATSPEC sheets. Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified. Coating systems shall be as specified in paragraph 3.06. In case of conflict between the schedule and the COATSPECS, the requirements of the schedule shall prevail.
2. Coating Specification Sheets included in Table A are included in this paragraph 3.05.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
E-1	Epoxy	Metal	Interior; exterior, covered, not exposed to direct sunlight, non-corrosive exposure.
E-1-G	Epoxy	Galvanized Steel	Interior; exterior, covered non-corrosive exposure. Do not use in immersion service.
E-2	Epoxy	Metal	Immersed, nonpotable; non-immersed, moderately corrosive environment, color required.
E-3	Epoxy	Concrete or Masonry	Immersed, nonpotable; non-immersed, corrosive environment, color required.
E-4	Epoxy	Concrete, masonry, plaster, gypsum board	Interior
E-5 (NSF 61 certified)	Epoxy	Metal	Interior potable water tanks and reservoirs and other metal components in contact with water being treated and stored for potable use.
E-6 (NSF 61 certified)	Epoxy	Concrete	Interior potable water tanks and reservoirs and other metal components in contact with water being treated or stored.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
E-7	Epoxy	Plastic	Interior; exterior covered, not exposed to direct sunlight.
E-8	Clear epoxy	Wood	Interior
E-9	Epoxy	Metal	Immersed, nonpotable; non-immersed, corrosive environment, color required. (Not for Biogenic Sulfide Corrosion areas.)
E-9-C	Epoxy	Concrete or masonry	Immersed, nonpotable; non-immersed, moderately corrosive environment, color required. (Not for Biogenic Sulfide Corrosion areas.)
E-10	Polyamidoamine epoxy	Metal or concrete	Below grade (buried).
EF-1	Amine Epoxy Broadcast Floor Coating	Concrete Floors	Light duty, wheeled traffic, frequent foot traffic, mildly corrosive.
EF-2	Amine Epoxy Troweled Floor Coating	Concrete Floors	Heavy-duty, wheeled traffic, frequent foot traffic, wet and moderately corrosive.
EA-1	Blended Amine Cured Epoxy	Metal	Immersed, nonpotable; non-immersed, corrosive environment, color not required especially for headspace environments that are corrosive due to biogenic sulfide corrosion.
EA-2	Blended Amine Cured Epoxy	Concrete or masonry	Immersed, nonpotable; non-immersed, corrosive environment, color not required, new construction especially for headspace environments that are corrosive due to biogenic sulfide corrosion.
EA-3	Blended Amine Cured Epoxy	Concrete or Masonry	Immersed, nonpotable; non-immersed, corrosive environment, color not required, new or existing construction, especially for headspace environments that are corrosive due to biogenic sulfide corrosion.
EA-4	Blended Amine Cured Epoxy – For Very Corrosive Conditions	Concrete or Masonry Potable	Non-immersed or immersed, very corrosive environment. Very high H <sub>2</sub> S conditions.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
EA-5	Novolac Epoxy Lining	Concrete	Secondary containment for spills of HFS acid or ferric chloride.
G	Grease	Metal	Ferrous Metal: Ferrous metal surfaces shall be prepared in accordance with SSPC SP-1 (Solvent Cleaning.)
HH-1	Proprietary Primer Plus Silicone Topcoat	Metal	Temperature to 750 degrees F.
HH-2	Proprietary Primer Plus Silicone Topcoat (black or aluminum only)	Metal	Temperature to 1200 degrees F.
L-1	Latex	Concrete, masonry, plaster, gypsum board	Interior and Exterior including existing exterior coated concrete.
L-2	Latex	PVC and CPVC pipe	Exterior, direct sunlight exposure.
L-3	Latex-Direct to Metal	Ferrous Metal	Interior or Exterior
L-4	Latex	Wood	Interior
M-1	Petrolatum based mastic or wax based wrapping tapes	Metal	Below grade (buried) or where little to no surface preparation can be performed on piping or structural steel.
M-2	Epoxy mastic or equal	Ferrous Metal	Interior, corrosive environment, confined enclosures, where minimal surface preparation is possible.
EU-1	Zinc-epoxy-polyurethane system	Ferrous Metal	Exterior, exposed to direct sunlight, moderately corrosive non-immersed.
EU-1-FRP	Specialty Primer plus Polyurethane Finish Coat	Exterior of FRP pipe and tanks, etc.	Exterior, exposed to direct sunlight, non-immersed.
EC-1	Hybrid Polyurethane	Concrete or dense masonry where existing crack or joint movement is suspected of propagating through rigid cured epoxy coatings	Service Condition: Interior or exterior, exposed to direct sunlight or not, corrosive (immersion pH 4.0 or lower and/or headspace pH 4.0 or lower and/or gaseous H <sub>2</sub> S concentrations between 10 and 150 ppm typically.)

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
EC-2 (NSF-61)	Modified Polyurethane	Concrete or dense masonry where existing crack or joint movement is suspected due to thermal conditions and would propagate through rigid epoxy coating systems and/or where NSF-61 certification is required	Interior or exterior, submerged or non-submerged indirect sunlight – moderately corrosive.
S-1	Penetrating acrylic stain, color required	Concrete	Non-immersed, exposure to moisture and sunlight.
S-2	Silane/Siloxane or Blended Sealer	Concrete Floors	Wet, non-immersed, non-corrosive. Interior or exterior for waterproofing.
S-3	RTV Silicone Rubber Based Sealer	Concrete or Masonry Walls	Exterior or Interior – Weathering Exposure, Non-Corrosive.
S-4	Acrylic Co-polymer Blend	Concrete Floors	Wet, non-immersed, non-corrosive, interior for oil and water repellent.

## Coating System Specification Sheets (COATSPEC)

### A. Coating System Identification: E-3

1. Coating Material:	Epoxy
2. Surface:	Concrete or masonry
3. Service Condition:	Immersed, nonpotable; non-immersed, corrosive environment, color required.
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM before coating work proceeds. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in <a href="#">Section 03300</a> . Surface preparation can be performed by abrasive blast cleaning or water blast cleaning and must achieve a uniform concrete surface profile of CSP3 in accordance with ICRI 03732. After cleaning, air voids or bugholes in the concrete shall be filled with a surfacer or block filler compatible with the specified primer and finish coats.
b. Masonry:	<p>Masonry surfaces shall be allowed to cure for at least 28 days after being constructed and be allowed to dry to the moisture content recommended by the CSM. Holes or other joint defects shall be filled with a material compatible with the primers and finish coats or shall be filled with masonry mortar that shall cure for at least 28 days. Loose or splattered mortar shall be removed by scraping and chipping.</p> <p>Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign, loose, and deleterious substances.</p> <p>Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.</p>
5. Application:	Field
a. General:	<p>Apply filler/surfacer as recommended by CSM to fill bugholes and air voids or block texture, etc. leaving a uniformly filled surface that does not produce blowholes or outgassing causing pinholing of the coating system. Filler/surfacers shall dry a minimum of 48 hours prior to application of prime coat or as required by the CSM.</p> <p>Prime coat shall be thinned and applied as recommended by the</p>

## Coating System Specification Sheets (COATSPEC)

	CSM, provided the coating as applied complies with prevailing air pollution control regulations.
	Drying time between coats shall be as recommended by CSM.
6. System Thickness:	15 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

### B. Coating System Identification: E-4

1. Coating Material:	Epoxy
2. Surfaces:	Concrete, masonry, plaster, gypsum board.
3. Service Condition:	Interior
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete, form oils, surface hardeners, curing compounds and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in <b>Section 03300</b> . Surface preparation shall produce a concrete surface profile of CSP-2 in accordance with ICRI 03732. After cleaning, air voids or bugholes in the concrete shall be filled with a surfacer or block filler compatible with the specified primer and finish coats.
b. Masonry:	Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be removed by scrapping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, exterior masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.
c. Plaster:	Plaster surfaces shall be dry, clean, and free from grit, loose plaster, and surface irregularities. Cracks and holes shall be repaired with acceptable patching materials, keyed to existing surfaces, and sandpapered smooth. Surfaces shall be cleaned with clean water by washing and scrubbing to remove foreign and deleterious substances.

5. Application:	Field
a. General:	Block Filler shall be multiple component epoxy block filler or an acrylic based or waterborne epoxy based block filler and shall dry a minimum of 48 hours prior to primer application or as required by the CSM.  Prime coat shall be thinned and applied as recommended by CSM, provided the coating as applied complies with prevailing air pollution control regulations.  Drying time between coats shall be as recommended by CSM.
6. System Thickness:	10 mils dry film, excluding block filler and sealer.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

#### C. Coating System Identification: L-1

1. Coating Material:	Latex
2. Surfaces:	Concrete, masonry, plaster, gypsum board.
3. Service Condition:	Interior and exterior including existing exterior coated concrete.
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03300.
b. Existing Coated Concrete:	Remove all loose coating down to a sound substrate or intact, well-adhered existing coating by scraping or other means. Then, abrade all surfaces to achieve a 0.5- to 1.5-mil uniform profile and vacuum clean to remove all loose dirt, paint chips, and dirt.
c. Masonry:	Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be removed by scraping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be filled with block filler compatible with the specified primer.
d. Plaster:	Plaster surfaces shall be dry, clean, and free from grit, loose plaster, and surface irregularities. Cracks and holes shall be

	repaired with acceptable patching materials, keyed to existing surfaces, and sandpapered smooth. Surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. After cleaning, surfaces shall be sealed with a compatible sealer.
e. Gypsum Wallboard:	Tape joints and spackled nail heads shall be sanded smooth and dusted. Seal with PVA sealer for interior uses only.
5. Application:	Field
a. General:	Sealer or filler shall dry a minimum of 48 hours prior to primer application. Drying time between coats shall be as recommended by CSM.
6. System Thickness:	4 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

#### D. Coating System Identification: L-2

1. Coating Material:	Latex
2. Surface:	PVC and CPVC pipe.
3. Service Condition:	Exterior, direct sunlight exposure.
4. Surface Preparation:	Plastic pipe shall be cleaned with solvent compatible with the specified primer and sanded to roughen surfaces to achieve a uniform surface profile of 1.0 to 1.5 mils. Vacuum clean after sanding to remove all loose dust, plastic particles, and dirt.
5. Application:	Field
6. System Thickness:	3 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

#### E. Coating System Identification: L-3

1. Coating Material:	Latex – Direct to Metal
2. Surface:	Ferrous Metal
3. Service Condition:	Interior or Exterior
4. Surface Preparation:	
a. Ferrous Metals:	Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) unless specified otherwise. Impart a 1.5- to 2.0-mil profile to substrate. Ferrous metal with rust bleeding shall be cleaned in accordance

	with SSPC SP-1 (Solvent Cleaning). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) and spot primed with the specified primer.
	Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC-SP-3 (Power Tool Cleaning).
b. Nonferrous and Galvanized Metal:	Galvanized or nonferrous surfaces shall be prepared in accordance with SSPC SP-1 (Solvent Cleaning) after Brush Blast Cleaning in accordance with SSPC-SP-7.
5. Application:	Field
6. System Thickness:	6 to 8 mils dry film excluding sealer
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

### 3.06 COATING SYSTEMS SCHEDULE (FINISH SCHEDULE)

#### A. General:

1. Specific coating systems, colors, and finishes for rooms, galleries, piping, equipment, and other items that are coated or have other architectural finishes are specified in the following coating system schedule. Unless otherwise specified in the coating system schedule, the word "interior" shall mean the inside of a building or structure, and the word "exterior" shall mean outside exposure to weather elements.

# Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
A. General: All Surfaces not Specified by Area or Structure		
1. Structural Steel, Metal Decking, and Galvanized Acoustical Decking	Uncoated or E-2	
2. Equipment and Metal Appurtenances		
a. Equipment, non immersed, unless otherwise specified		
1) Indoors	E-1	FS 25051 Blue
2) Outdoors	EU-1	FS 20040 Brown
b. Equipment, immersed, unless otherwise specified	E-2	Beige
c. High temperature equipment operable at		
1) 200 to 750 degrees F	HH-1	FS 26306 Grey
2) above 750 degrees F to 1200 degrees F	HH-2	Aluminum or Black
d. Existing equipment		
1) Not damaged nor modified by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		
a) Indoors	E-1 (see paragraph 3.02)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02)	Match existing color
e. Diffusers and grilles on coated surfaces, unless otherwise specified		
1) Indoors	E-1	Match background color
2) Outdoors	EU-1	Match background color

# Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
f. Diffusers and grilles on uncoated surfaces, unless otherwise specified		
1) Indoors	E-1	FS 25051 Blue
2) Outdoors	EU-1	FS 20040 Brown
g. Existing diffusers and grilles		
1) Not damaged not modified by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color
h. Electrical switchgear panels, unit substations, motor control centers, power transformers, distribution centers, and relay panels; indoors and outdoors	See paragraph 3.03 Electrical and Instrumentation Equipment and Materials	ANSI 61 Grey (outside) FS 27880 White (inside)
i. Instrumentation panels, graphic indicating panels, indicating and transmitting field panels, unless otherwise specified		
1) Indoors	See paragraph 3.03 Electrical and Instrumentation Equipment and Materials	FS 26306 Grey (outside) FS 27880 White (inside)
2) Outdoors	See paragraph 3.03 Electrical and Instrumentation Equipment and Materials	FS 27722 White (outside) FS 27880 White (inside)

## Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
j. Existing electrical and instrumentation panels		
1) Not damaged by work in this contract	Uncoated	--
2) Damaged or exposed to outside surfaces by work in this contract		
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	FS 26306 Grey
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	FS 26306 Grey (Electrical) FS 27722 White (Instrumentation)
3. Conduit, Piping and Ductwork		
a. Ferrous, non-ferrous and galvanized piping, and appurtenant hangers and supports, non-immersed, unless otherwise specified.		
1) Indoors – noncorrosive	E-1	FS 25051 Blue
2) Outdoors – noncorrosive	EU-1	FS 20040 Brown
3) Indoors – in corrosive environment	EA-1	To be determined
4) Buried piping	M-1 or M-2	Not required
b. Ferrous piping, appurtenant and supports, immersed	E-2	To be determined
c. Conduit, outlet and junction boxes, lighting transformers, lighting, communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps, and supports on coated surfaces, unless otherwise specified.		
1) Indoors	E-1	Match background color

# Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
2) Outdoors	EU-1	Match background color
d. Conduit, outlets and junction boxes, lighting transformers, lighting, communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps and supports on uncoated surfaces, unless otherwise specified		
1) Indoors	E-1	FS 25051 Blue
2) Outdoors	EU-1	FS 20040 Brown
e. Existing conduit, outlet and junction boxes, lighting transformers, lighting communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps, and supports		
1) Not damaged nor modified by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color
f. Racked conduits and cable trays	Uncoated	--
g. Insulated pipe jacketing	Uncoated	--
h. Plastic, fiberglass and flexible conduit and piping		
1) Unless otherwise specified	Uncoated	--
2) PVC and CPVC Piping	L-2	FS 25051 Blue
a) Exposed to direct sunlight	L-2	FS 25051 Blue

# Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
b) Not exposed to direct sunlight	E-7	FS 25051 Blue
i. High temperature piping operable at		
1) 200 to 750 degrees F	HH-1	FS 26306 Grey
2) Above 750 degrees F to 1,200 degrees F	HH-2	Aluminum or Black
j. Exposed ductwork, unless otherwise specified	Uncoated	--
4. Concrete, Grout, Masonry and Plaster		
a. Immersed tank and channel walls and bottoms unless otherwise specified	Uncoated	--
b. Outside concrete walls below grade common with dry area or room	In accordance with Section 07100	--
c. Walls and ceilings		
1) Precast concrete or colored masonry	Uncoated	--
2) Outdoors, unless otherwise specified	Uncoated	--
3) Indoors, unless otherwise specified	E-4	FS 23617 Beige
d. Concrete equipment bases unless otherwise specified	E-4	Match equipment color
e. Floors unless otherwise specified	S-2	
f. Existing coated surfaces.	L-1	Match existing color
5. Door and Door Frames		
a. Doors unless otherwise specified		
1) Ferrous metal		
a) Indoors	E-1	FS 20040 Brown
b) Outdoors	EU-1	FS 25051 Blue
2) Aluminum	Uncoated	--
3) Other	Plastic laminate	Formica 947 Brown
4) Existing		

### Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
a) Not damaged by work in this contract	Uncoated	--
b) Damaged, exposed, or modified by work in this contract		
(1) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
(2) Outdoors	EU-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b. Door frames unless otherwise specified		
1) Adjacent wall coated		
a) Indoors	E-1	Match wall color
b) Outdoors	EU-1	Match wall color
2) Adjacent wall uncoated		
a) Indoors	E-1	FS 20040 Brown
b) Outdoors	EU-1	FS 25051 Blue
3) Aluminum	Uncoated	--
4) Existing		
a) Not damaged by work in this contract	Uncoated	--
b) Damaged, exposed, or modified by work in this contract		
(1) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
(2) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color

*Note: Owner will select color from coating manufacturer's list of EPA approved colors for potable water.*

### 3.07 INSPECTION AND TESTING BY OWNER

#### A. General:

1. Inspection by the Owner or others does not limit the Contractor's or CSA's responsibilities for quality workmanship or quality control as specified or as required by the CSM's instructions. Inspection by the Owner is in addition to any inspection required to be performed by the Contractor.
2. The Owner may perform, or contract with an inspection agency to perform, quality control inspection and testing of the coating work covered by this Section 09900. These inspections may include the following:
  - a. Inspect materials upon receipt to ensure that are supplied by the CSM.
  - b. Inspect to verify that specified storage conditions for the coating system materials, solvents and abrasives are provided.
  - c. Inspect and record findings for the degree of cleanliness of substrates.
  - d. Inspect and record the pH of concrete and metal substrates.
  - e. Inspect and record substrate profile (anchor pattern)
  - f. Measure and record ambient air and substrate temperature.
  - g. Measure and record relative humidity.
  - h. Check for the presence of substrate moisture in the concrete.
  - i. Inspect to verify that correct mixing of coating system materials is performed in accordance with CSM's instructions.
  - j. Inspect, confirm, and record that the "pot life" of coating system materials is not exceeded during installation. Inspect to verify that recoat limitations for coating materials are not exceeded.
  - k. Perform adhesion testing.
  - l. Measure and record the thickness of the coating system.
  - m. Inspect to verify proper curing of the coating system in accordance with the CSM's instructions.
  - n. Perform holiday or continuity testing for coatings that will be immersed or coatings that will be exposed to aggressively corrosive conditions.

### 3.08 FINAL INSPECTION

#### A. General

1. Contractor shall conduct a final inspection to determine whether coating system work meets the requirements of the specifications.
2. The Construction Manager will subsequently conduct a final inspection with the Contractor to determine the work is in conformance with requirements of the contract documents.
3. Any rework required shall be marked. Such areas shall be recleaned and repaired as specified at no additional cost to the Owner.

**\*\*END OF SECTION\*\***

## SECTION 10520

### FIRE EXTINGUISHERS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install fire extinguishers and the requisite wall mounting brackets at the locations shown on the Contract Drawings.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Fire extinguishers shall be 10-pound capacity, dry chemical type, rated for A, B and C Class fires. Extinguishers shall be red enamel painted steel cylinders with indicating gauge and shall be as manufactured by Larsen's Manufacturing Company, Fyr-Fyter Company, or County Fire Equipment Company.
- B. Brackets for wall mounting, as manufactured by extinguisher manufacturer, shall be furnished for all fire extinguishers.

#### PART 3 EXECUTION

##### 3.01 INSTALLATION

- A. Fire extinguishers and brackets shall be wall mounted.
- B. Mount brackets 4 feet 6 inches above finish floor with expansion bolts or toggle bolts into concrete blocks.

**\*\*END OF SECTION\*\***

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## SECTION 11000

### GENERAL REQUIREMENTS FOR EQUIPMENT

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies general requirements which are applicable to all mechanical equipment. The Contractor is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to the specific requirements of each individual equipment specification section.

###### B. EQUIPMENT LISTS:

Equipment lists, presented in these specifications and as specified on the drawings, are included for the convenience of the Contractor and are not complete listings of all equipment, devices and material required to be provided under this contract. The Contractor shall prepare his own material and equipment takeoff lists as necessary to meet the requirements of this project manual.

##### 1.02 QUALITY ASSURANCE

###### A. ARRANGEMENT:

The arrangement of equipment shown on the drawings is based upon information available to the County at the time of design and is not intended to show exact dimensions conforming to a specific manufacturer. The drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual submitted equipment installation requirements; these may vary significantly from manufacturer to manufacturer. The contractor shall, in determining the cost of installation, include these differences as part of his bid proposal. Structural supports, foundations, connected piping, valves, and electrical conduit specified may have to be altered to accommodate the equipment actually provided. No additional payment shall be made for such revisions and alterations.

###### B. REFERENCES:

This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
ABMA Std 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125, and 250)
ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI S2.19	Mechanical Vibration – Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Unbalance, Including Marine Applications

#### C. UNIT RESPONSIBILITY:

The Contractor shall cause equipment assemblies made up of two or more components to be provided as a working unit by the unit responsibility manufacturer, where specified. The unit responsibility manufacturer shall coordinate selection, coordinate design, and shall provide all mechanical equipment assembly components such that all equipment components furnished under the specification for the equipment assembly, and all equipment components specified elsewhere but referenced in the equipment assembly specification, is compatible and operates reliably and properly to achieve the specified performance requirements. Unless otherwise specified, the unit responsibility manufacturer shall be the manufacturer of the driven component equipment in the equipment assembly. The unit responsibility manufacturer is designated in the individual equipment specifications found elsewhere in this project manual. Agents, representatives or other entities that are not a direct division of the driven equipment manufacturing corporation shall not be accepted as a substitute for the driven equipment manufacturer in meeting this requirement. The requirement for unit responsibility shall in no way relieve the Contractor of his responsibility to the County for performance of all systems.

The Contractor shall ensure that all equipment assemblies provided for the project are products for which unit responsibility has been accepted by the unit responsibility manufacturer(s), where specified. Unit responsibility for related components in a mechanical equipment assembly

does not require or obligate the unit responsibility manufacturer to warranty the workmanship or quality of component products not manufactured by them. Where an individual specification requires the Contractor to furnish a certificate from a unit responsibility manufacturer, such certificate shall conform to the content, form and style of Form 11000-C specified in Section 01999, shall be signed by an officer of the unit responsibility manufacturer's corporation and shall be notarized. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment even though the equipment may have been installed in the work.

#### D. BALANCE:

Unless specified otherwise, for all machines 10 HP and greater, all rotating elements in motors, pumps, blowers and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. All rotating elements shall be balanced to the following criteria:

$$U_{per} = 6.015 \frac{GW}{N}$$

Where:

$U_{per}$	=	permissible imbalance, ounce-inches, maximum
$G$	=	Balance quality grade, millimeters per second
$W$	=	Weight of the balanced assembly, pounds mass
$N$	=	Maximum operational speed, rpm

Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data. Equipment balance quality grade shall be  $G 2.5$  ( $G = 2.5$  mm/sec) or better in accordance with ANSI S2.19.

## PART 2--PRODUCTS

### 2.01 FLANGES AND PIPE THREADS

Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.

Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

## 2.02 BEARINGS

Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of ABMA Methods of Evaluating Load Ratings of Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L-10 rating life of 50,000 hours. The rating life shall be determined using the maximum equipment operating speed.

Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.

Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C and shall be equipped with a filler pipe and an external level indicator gage.

All bearings accessible to touch, and located within 7 feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, fixed ladders or other access structures, shall either incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 degrees C or less for continuous operation at bearing rated load and a 50 degrees C ambient temperature or shall be provided with appropriate shielding shall be provided that will prevent inadvertent human contact.

## 2.03 V-BELT ASSEMBLIES

Unless otherwise specified, V-belt assemblies shall be Dodge Dyna-V belts with matching Dyna-V sheaves and Dodge Taper-lock bushings, Wood's Ultra V-belts with matching Ultra-V sheaves and Wood's Sure-Grip bushings, or equal.

Sheaves and bushings shall be statically balanced. Additionally, sheaves and bushings which operate at a peripheral speed of more than 5500 feet per minute shall be dynamically balanced. Sheaves shall be separately mounted on their bushings by means of three pull-up grub or cap tightening screws. Bushings shall be key seated to the drive shaft.

Belts shall be selected for not less than 150 percent of rated driver horsepower and, where two sheaves sizes are specified, shall be capable of operating with either set of sheaves. Belts shall be of the antistatic type where explosion proof equipment is specified.

## 2.04 PUMP SHAFT SEALS

A. GENERAL:

Seals for water and wastewater pump shafts shall be mechanical seals.

B. MECHANICAL SEALS:

Unless otherwise specified in the detailed pump specifications, mechanical seals shall be split mechanical seals requiring no field assembly, other than assembly around the shaft and insertion into the pump. They shall be self-aligning, and self-centering, single seals. They shall be of a nondestructive (nonfretting) type requiring no wearing sleeve for the shaft. Shafts for pumps specified with mechanical seals shall be furnished with no reduction in size through the seal area (no shaft sleeve). Where the detailed specifications call for cartridge instead of split seals, all other requirements of this paragraph apply.

Metal parts shall be Type 316 or 316L stainless steel. Springs shall be Hastelloy C, Elgiloy, or other Duplex SS selected for resistance to chloride attack. Rotary faces shall be silicon carbide or chrome oxide. Stationary faces shall be silicon carbide for solids bearing fluid service and carbon for clean water service. Elastomers shall be ethylene propylene or fluorocarbon. Mechanical seals shall be suitable for operation between full vacuum (0 psia) up to 200 percent of the maximum specified operating pressure, but in any event not less than 200 psig.

Seal chambers shall be provided with vented solids removal restriction bushings except for enclosed line shaft pumps where the seal barrier fluid is used for line shaft bearing lubrication. The bushing shall both control the amount of flushing water flow and restrict solids and gas accumulation from the seal face area.

Candidate seals include:

1. Chesterton 442 seals provided with Chesterton/SpiralTrac solids removal restriction bushings Version N or D, as recommended by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada.
2. AESSEAL RDS seals with Cyclops bushing.
3. John Crane 3710 seals with Type 24SL bushing.

Seals on pumps for contaminated water service (sludge or polymer) shall be drilled and tapped for connection of a clean water flushing supply.

C. SHAFT PACKING:

Where shaft packing is specified, stuffing boxes shall be tapped to permit introduction of seal liquid and shall hold a minimum of five (5) rows of packing. Stuffing boxes shall be face attached. Stuffing box and shaft shall be suitable for field installation, without machining or other modifications, of the mechanical seal specified in paragraph 11000-2.04.B for the applicable pump and operating conditions.

Unless otherwise specified, lantern rings shall be bronze or Teflon, packing shall be die-molded packing rings of non-asbestos material suitable for the intended service and as recommended by the manufacturer, and glands shall be bronze, two piece split construction. Lantern rings shall be of two-piece construction and shall be provided with tapped holes to facilitate removal. Lantern rings shall be drilled and tapped 1/4 NC-20. The impeller end of the packing on all but line shaft pumps with external source water lubricated bearings shall be fitted with a SpiralTrac, Version P packing protection system as manufactured by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada.

The section of each shaft or impeller hub that extends through or into the stuffing box shall be fitted with a replaceable stainless steel sleeve with a Brinell hardness of not less than 500. The sleeve shall be held to the shaft to prevent rotation and shall be gasketed to prevent leakage between the shaft and the sleeve. Minimum shaft sleeve thickness shall be 3/8 inch.

## 2.05 COUPLINGS

Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taper lock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas-Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

## 2.06 GUARDS

Exposed moving parts shall be provided with guards which meet all applicable OSHA requirements. Guards shall be fabricated of 14-gage steel, 1/2-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

## 2.07 CAUTION SIGNS

Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION - AUTOMATIC EQUIPMENT MAY START AT

ANY TIME". Signs shall be constructed of fiberglass material, minimum 1/8 inch thick, rigid, suitable for post mounting. Letters shall be white on a red background. The sign size and pattern shall be as shown on the drawings. Signs shall be installed near guarded moving parts.

## 2.08 GAGE TAPS, TEST PLUGS AND GAGES

Gage taps shall be provided on the suction and discharge sides of pumps, blowers and compressors. Pressure and vacuum gages shall be provided where specified. Gage taps, test plugs, and gages shall be as specified in Divisions 15 and 17, respectively.

## 2.09 NAMEPLATES

Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible and visible location with stainless steel screws or drive pins.

## 2.10 LUBRICANTS

The Contractor shall provide for each item of mechanical equipment a supply of the required lubricant adequate to last through the specified commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the County's current lubricant supplier. The Contractor shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment (Section 01660), the Contractor shall provide the County with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

## 2.11 ANCHOR BOLTS

Anchor bolts shall be designed for lateral forces for both pullout and shear in accordance with the provisions of Section 05501. Unless otherwise stated in the individual equipment specifications, anchor bolt materials shall conform to the provisions of Section 05501.

## 2.12 SPARE PARTS

Spare parts, wherever required by detailed specification sections, shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified by part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration, such as ferrous metal items and electrical components, shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be

painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.

### PART 3--EXECUTION

Installation of equipment accessories included in this section shall be as recommended by the equipment manufacturer unless otherwise specified in the individual equipment specification section.

**\*\*END OF SECTION\*\***

## SECTION 11002

### RIGID EQUIPMENT MOUNTS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies minimum requirements for rigid equipment mounts (baseplates, soleplates, and mounting blocks) and their installation on equipment pads. Completed equipment supports shall consist of equipment pads, equipment anchors, and rigid equipment mounts (baseplates, soleplates, or mounting blocks) set in grout.

Unless alternate requirements for equipment mounts are specified in the applicable equipment specification, the requirements of this section shall be applied to rigid mounts for all rotating or reciprocating equipment that is used to mix, convey, or pressurize fluids (gases and liquids). The requirements of this section shall also apply whenever referenced in specifications for other types of equipment. If conflict exists between this section and requirements of individual equipment manufacturers, the more restrictive requirements shall prevail.

###### B. DEFINITIONS:

Specific equipment mounting terminology used in this section conforms to the following definitions:

1. Baseplate: Fabricated (welded structural steel elements), cast, or plate steel base providing a common mounting element on which the legs, feet, or mounting surfaces of equipment are mounted by means of bolted connections.
2. Soleplate: A machined plate, spanning an opening in the floor or equipment pad, providing a common mounting element on which the legs, feet, or mounting surfaces of equipment are mounted by means of bolted connections.
3. Mounting Blocks: Multiple smaller baseplates on which individual legs, feet or equipment supports are mounted when equipment or drivers are not fastened to a common baseplate or sole plate.
4. Equipment Pad: Concrete foundation (block or slab) supporting and elevating equipment mounts above the supporting structural floor slab or local grade.

5. Mounting Pads: Thickened or raised areas of baseplates and soleplates where the feet or mounting surfaces of mounted equipment and drivers are bolted and/or doweled to the baseplate or soleplate.
6. Leveling Blocks: Temporary steel blocks placed under baseplates, soleplates, or a mounting block at leveling positions (at equipment anchors) for the purpose of leveling baseplates, soleplates, or mounting blocks prior to grouting.
7. Shims: Thin stainless-steel plates of a uniform thickness installed on top of Leveling Blocks for fine adjustment of level. Shims may also be used between equipment or drivers and baseplates, soleplates, or mounting blocks for equipment alignment purposes.
8. Wedges: Pairs of uniformly tapered metal blocks that are stacked with the tapered surfaces reversed (relative to the other wedge) so that the top and bottom surfaces of the wedges are parallel. Wedges are used between equipment pads and baseplates, soleplates, or mounting blocks for the purpose of leveling baseplates, soleplates, or mounting blocks.
9. Mounting Stud: Threaded rod or bolts anchored to baseplates, soleplates, or mounting blocks for the purpose of mounting equipment or ancillary devices onto baseplates, soleplates, or mounting blocks.
10. Reinforcement Dowels: Steel reinforcement rods embedded in concrete, across a cold joint, for the purpose of transferring loads or force across the joint.
11. Machine Alignment Dowels: Tapered diameter rods inserted in tapered diameter holes for the purpose of aligning machinery. The practice of drilling tapered diameter holes through machinery and baseplates so that Machine Alignment Dowels may be inserted to facilitate alignment of machinery is known as Doweling.
12. Leveling Position: A location on the top of a concrete equipment pad where leveling tools and equipment will be temporarily installed or used for the purpose of leveling baseplates, soleplates, and mounting blocks prior to grouting.
13. Grout Manufacturer: Refers to the manufacturer of the epoxy grout system used for installation of rigid equipment mounts.
14. Grout Manufacturer's Technical Representative(s): Refers to the technical representative(s) of the Grout Manufacturer.

C. EQUIPMENT MOUNTING REQUIREMENTS:

Unless otherwise specified, equipment and drivers shall be rigidly mounted on a common cast iron or fabricated steel baseplate or soleplate grouted into place on a concrete equipment pad. Under no circumstances shall baseplates, soleplates, or mounting blocks be grouted directly to concrete slabs or floors. Equipment that uses an interdependent equipment and driver mounting configuration (equipment that is bolted onto the driver frame and equipment that supports the driver entirely from the equipment frame) may be bolted directly on concrete or grout surfaces of equipment pads if the driver is less than five horsepower. Bolting equipment directly on concrete or grout surfaces of equipment pads is not acceptable for equipment and drivers that do not have an interdependent equipment and driver mounting configuration.

## 1.02 QUALITY ASSURANCE

### A. REFERENCES:

This section contains references to the following documents. It is a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed document, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/HI 1.4	Centrifugal Pumps – Installation, Operation and Maintenance
ANSI/HI 2.4	Vertical Pumps – Installation, Operation and Maintenance
API RECOMMENDED PRACTICE 686	Recommended Practices for Machinery Installation and Installation Design
ASTM E329	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
MIL-PRF-907E	Anti-Seize Thread Compound, High Temperature
SSPC	Society for Protective Coatings Specifications, Vol. 2
IBC	2001 International Building Code (including local amendments)

## B. QUALITY CONTROL BY CONTRACTOR:

To demonstrate conformance with the specified requirements for rigid equipment mounts, the Contractor shall provide the services of an independent testing laboratory that complies with the requirements of ASTM E329. The testing laboratory shall sample and test equipment mount related materials as indicated in this Section (11002). Costs of testing laboratory services shall be borne by the Contractor.

For equipment with drivers 20 horsepower and greater, the Contractor shall furnish the services of a grout manufacturer's technical representative that has been factory trained by the grout manufacturer. The grout manufacturer's technical representative shall perform training and quality control of epoxy grout installation for rigid equipment mounts as indicated in this section (11002).

### 1.03 SUBMITTALS

The following information shall be provided in accordance with the submittal requirements specified in Section 01300.

1. A copy of this specification section, with addendum updates included, (referenced sections need not be included for Section 11002) with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. Copies of this specification section shall be numbered and marked (specification number and equipment number) for inclusion (filing) with the associated equipment submittal requirements.
2. Schedule of rigid equipment mount installations specified in paragraph 11002-2.01.

3. Name, employer and certificates or other information documenting compliance with the journeyman qualifications requirements for millwrights who will install rigid equipment mounts, as specified in paragraph 11002-3.03. C.
4. Certificates or other documentation issued by the epoxy grout manufacturer that demonstrates that the grout manufacturer's technical representative has been factory trained on installation of epoxy grout for equipment mounts, as specified in paragraph 11002-1.02 B. 2.
5. Shop drawings for all equipment pads, equipment anchors, and baseplate, soleplate or mounting block details. Shop drawings shall depict size and location of equipment pads and reinforcement; equipment drains; equipment anchor, size, location, and projection; expansion joint locations; elevation of top of grout and grout thickness; elevation of top of baseplate; soleplate; or mounting block; size and location of electrical conduits; and any other equipment mounting features embedded in equipment pads. Shop drawings for equipment pads, equipment anchors, and baseplate, soleplate, or mounting blocks shall be numbered and marked (specification number and equipment number) for inclusion (filing) with the associated equipment submittal requirements.

## PART 2--PRODUCTS

### 2.01 GENERAL

Prior to initiating any installation efforts, the Contractor shall produce a rigid equipment mount installation schedule containing the expected dates for installing equipment anchors and preparation of equipment pads for leveling, grouting, and final equipment anchor clamping for each item of equipment. The schedule shall list the equipment, by equipment tag number, and shall list applicable equipment specification section, motor horsepower, and name of the Contractor's representative responsible for quality control during installation of rigid equipment mounts. The schedule shall be accompanied by written verification of equipment anchor clamping torque from the manufacturer of each item of equipment to be installed with rigid equipment mounts.

### 2.02 CONCRETE EQUIPMENT PADS

Concrete equipment pads shall be as shown in the structural details for equipment pads and equipment anchors for rigid mounted equipment.

The Contractor shall submit equipment anchor calculations for all equipment with drivers 20 horsepower and greater. Equipment anchor calculations shall demonstrate that equipment anchor size, embedment, and edge distance comply with the Florida Building Code and are sufficient to resist the maximum lateral and vertical forces specified in paragraph 11000-2.11.

Equipment anchor calculations shall be sealed by a registered structural or civil engineer licensed in the State of Florida.

## 2.03 BASEPLATES, SOLEPLATES, AND MOUNTING BLOCKS

### A. GENERAL:

Unless otherwise specified, Type I baseplates, soleplates, and mounting blocks shall be a minimum of 1 inch thick for equipment with drivers 20 horsepower and larger. All Type I baseplates, soleplates, and mounting blocks shall have edges of surfaces bearing on grout rounded to a radius of not less than 0.25 inch. Horizontal corners of Type I baseplates, soleplates, or mounting blocks shall be rounded to a radius of not less than two inches to avoid producing stress risers on the grouted foundation. Grout pouring holes (minimum 4 inches in diameter for epoxy grout, minimum 2 ½ inches in diameter for cementitious nonshrink grout) shall be provided in all baseplates and soleplates and all baseplates and soleplates shall have grout release holes. Mounting blocks may be grouted without grout pouring holes provided that no dimension of the mounting block (width or length) exceeds 18 inches. Grout relief or vent holes (minimum 1 inch in diameter) shall be provided in all baseplates, soleplates, and mounting blocks. Internal stiffeners shall be provided on all cast and fabricated baseplates and shall be designed to allow free flow of grout from one section of the baseplate to another. The minimum acceptable opening in cross bracing and stiffeners shall be 2-inches high by 6-inches in width. All welds shall be continuous and free from skips, blowholes, laps and pockets.

Mounting holes for equipment anchors shall be drilled through baseplates, soleplates, and mounting blocks. Mounting holes for equipment anchors shall not be burned out and they shall not be open slots. All mounting studs shall be Type 316 stainless steel. An anti-seize or anti-galling compound, as specified in paragraph 11002-2.06, shall be applied to all mounting stud threads prior to installing nuts on mounting studs. Terminations requiring connections to baseplates, soleplates, or mounting blocks shall be acorn nuts welded to the under side of the baseplate or nuts welded to the underside of the baseplate and plugged with cork, plastic plugs or grease. In no case shall the fastener terminate only into the metal base. Where baseplates, soleplates, or mounting blocks are leveled using jackscrews, jackscrew threads shall be tapped in thickened pads or otherwise in sufficient metal to provide ease in adjusting level.

Mounting pads for equipment shall be machined after all welding and stress relieving and shall be coplanar within 0.002 inch per foot in all directions. Mounting pads shall extend not less than 0.5 inch beyond the perimeter of the foot or mounting surface of the mounted equipment, in any direction.

Equipment baseplates shall provide common support for the equipment and driver (and flywheel, if one is specified). Baseplates for equipment with drivers 20 horsepower and greater shall be furnished with eight transverse alignment (horizontal) positioning jackscrews for alignment of equipment drivers on horizontal surfaces of baseplates. Two of the eight transverse alignment/positioning jackscrews shall be installed in perpendicular directions in a horizontal plane at the mounting position for each corner or foot of the equipment driver. (Eight additional jackscrews shall be provided for transverse alignment of the flywheel, if flywheels are specified.)

B. TYPE I BASEPLATES:

Type I baseplates shall be plate or fabricated structural steel baseplates with thickened steel mounting pads for doweling and bolting equipment to the baseplate. The baseplates shall be rectangular in shape for equipment other than centrifugal refrigeration machines and pump baseplates, which may be "T" or "L" shaped to accommodate the equipment drive and accessories. Baseplates for split case pumps shall include supports for suction and discharge elbows, if required by the specified configuration. Perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the baseplate. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.

C. TYPE II/III BASEPLATES:

Type II and Type III baseplates, which are applicable for vibration isolation mounting, are not applicable to this project.

D. TYPE IV BASEPLATES:

Type IV baseplates shall be cast iron with thickened mounting pads for doweling and bolting equipment to the baseplate. Cast iron baseplates shall be sealed in accordance with the requirements for bleeding surfaces specified in prior to grouting.

E. SOLEPLATES:

Where soleplates are provided, the underside shall be scribed with the words "THIS SIDE DOWN" using welding rod material prior to milling the mounting pad for each equipment foot or mounting surface. Mounting surfaces and mounting pads on soleplates shall be milled flat to a tolerance of not less than 0.002 inch per foot in all directions. Soleplates shall be machined for an indexed fit to the mounted equipment or driver.

F. MOUNTING BLOCKS:

Where equipment is fabricated or cast with feet or mounting surfaces that are not fastened to a common baseplate or soleplate, as in dry-pit bottom suction pumps, the equipment may be supported on individual concrete piers or equipment pads in lieu of a common baseplate or soleplate and equipment pad. In such instances, the equipment shall be supported at the feet or mounting surfaces on individual mounting blocks, which shall be leveled and grouted into place on the individual piers or equipment pads as specified in this section. Vertical volute-type pumps weighing more than 2000 pounds shall be mounted on mounting blocks under each foot or mounting surface for the pump. All mounting blocks shall be furnished with jackscrew threads (three locations, minimum) tapped in the mounting block for the purpose of leveling mounting blocks with jackscrews.

## 2.04 GROUT FOR EQUIPMENT PADS

A. EPOXY GROUT FOR EQUIPMENT MOUNTING:

Unless otherwise specified, grout for setting bearing surfaces of baseplates, soleplates, and mounting blocks on equipment pads shall be Epoxy Grout for Equipment Mounting as specified in Section 03600. Where the term epoxy grout is used in the context of details and specifications for equipment mounting it shall mean Epoxy Grout for Equipment Mounting.

B. CEMENTITIOUS NONSHRINK GROUT:

Cementitious Nonshrink Grout, specified in Section 03600, may be used for setting bearing surfaces of baseplates, soleplates, or mounting blocks on equipment pads where equipment drivers are 20 horsepower and smaller and the combined weight of equipment and driver is less than 1000 pounds. Where the term nonshrink grout or cementitious grout is used in the context of details and specifications for equipment mounting it shall mean Cementitious Nonshrink Grout. Training and quality control by the grout manufacturer's technical representative is not required for rigid equipment mounts installed with cementitious non-shrink grout.

2.05 EPOXY PRIMER

Epoxy primer shall be a lead free, chrome free, rust inhibitive, two-component epoxy primer specifically designed for use on metal substrates and in conjunction with epoxy grout. The epoxy primer shall be a product of the epoxy grout manufacturer.

2.06 ANTI-SEIZE/ANTI-GALLING COMPOUND

Anti-seize or anti-galling compound shall be a molybdenum disulfide and graphite combination in an aluminum complex base grease conforming to MIL-PRF-907E. Acceptable products include Jet Lube 550 by Jet Lube, Inc., E-Z Break by LA-CO, or equal.

2.07 PRODUCT DATA

The following information shall be provided in accordance with the product data requirements specified in Section 01300:

1. Equipment anchor calculations specified in paragraph 11002-2.02.
2. Results of grout strength tests, as specified in paragraph 11002-3.03 D.
3. Completed Rigid Equipment Mount Installation Inspection Checklist Forms (11002-A), as specified in paragraph 11002-3.02 B.

4. List of Contractor's equipment installation staff that has completed epoxy grout manufacturer's grout installation training specified in paragraph 11002-3.02 A.

## PART 3--EXECUTION

### 3.01 GENERAL

Grouting for installation of equipment on equipment pads shall take place prior to connecting any field piping or electrical and instrumentation systems. Unless the Construction Manager accepts an alternate installation procedure in writing, baseplates, soleplates, and mounting blocks shall be leveled and grouted with the equipment removed. Pumps shall be installed in accordance with this section and ANSI/HI 1.4 or ANSI/HI 2.4, as appropriate for the type of pumping equipment installed.

Connecting piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system without imposing strain on the equipment connections.

Where an equipment manufacturer's installation requirements include a rigid connection between the machine and connecting piping systems, the Contractor shall delete any flexible coupling (including equipment connection fittings) shown on the drawings and install the equipment in the following manner, in lieu of installing the flexible coupling:

1. The equipment pad shall be prepared as shown on the details for rigid equipment mounts
2. The baseplate, soleplate, or mounting blocks supporting the equipment shall be installed, leveled, and grouted in place as specified in this section.
3. The equipment shall be installed, aligned and doweled in place.
4. The piping shall be installed and aligned to the equipment connections and the field piping connections without welding one of the joints for one section of pipe between the equipment connection and the field piping and all valving. All flanged joints shall be bolted up and pressure tested.
5. All piping shall be fully supported by supports designed to accept their full weight and thrust forces.
6. The final sections of piping shall be aligned with the equipment and field connections without the use of jacks, chain falls or other devices to force it into alignment.

7. The final piping joints shall be welded only after the previous steps have been completed and accepted by the Construction Manager.

### 3.02 EPOXY GROUT TRAINING AND QUALITY CONTROL

#### A. EPOXY GROUT TRAINING

Prior to commencing rigid equipment mount installation work on equipment pads, the Contractor shall furnish the services of a grout manufacturer's technical representative to conduct a training school for the workers that will be using the epoxy grout for rigid equipment mount installations.. The school shall be not less than 4 hours in length and shall cover all aspects of using the products, from mixing to application. This requirement, however, shall not be construed as relieving the Contractor of overall responsibility for this portion of the work. The epoxy grout manufacturer shall furnish a list of school attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

#### B. EPOXY GROUT QUALITY CONTROL

For equipment with drivers 20 horsepower and greater, the epoxy grout manufacturer's technical representative shall provide quality control services for epoxy grout installation in rigid equipment mounts. The epoxy grout manufacturer's technical representative shall be on site to inspect and verify that the application personnel have successfully performed surface preparation, epoxy grout application, and Quality Control Inspection in accordance with these specifications for a representative portion of the epoxy grout installation work.

Specifically, the epoxy grout manufacturer's technical representative shall perform the following services for at least one rigid equipment mount installation for each equipment type and size:

1. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.
2. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria, including but not limited to substrate profile, degree of cleanliness, and moisture.
3. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
4. Inspect the epoxy-primed metallic substrate for coverage and adhesion.
5. Inspect preparation and application of epoxy grout form work for conformance to the specifications.

6. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during installation.
7. Inspect epoxy grout for cure.
8. Inspect and record that localized repairs made to grout voids are in conformance with the specification requirements.
9. Conduct a final review of completed epoxy grout installation for conformance to these specifications.
10. Attest to conformance of the Contractor's work by signing appropriate entries in the "Rigid Equipment Mount Inspection Checklist," form 11002-A in Section 01999.

### 3.03 INSTALLATION

#### A. CONCRETE EQUIPMENT PAD PREPARATION:

After the concrete is fully cured, the top of the equipment pad shall be roughened by chipping the surface. Chipping shall remove all laitance and defective or weak concrete and result in a rough surface profile with a 0.25 inch minimum amplitude. Chipping shall expose broken aggregate without dislodging unbroken aggregate from the cement matrix and shall not cause fractures below the concrete surface. Leveling surfaces of the concrete that have been finished smooth and level for baseplate, soleplate, or mounting block leveling at equipment anchors shall be protected from damage during chipping. A light duty, hand held pneumatic chipper with a chisel type tool shall be used for chipping the equipment pad concrete surface. Abrasive blast, bush-hammer, jack hammers with sharp chisels, heavy chipping tools, or needle gun preparation of concrete surfaces to be grouted is not acceptable.

Prior to leveling activities, satisfactory removal of defective or weak concrete shall be demonstrated in the presence of the Construction Manager by operating the chipper on the chipped concrete surface at locations identified by the Construction Manager. The chipped surface of the concrete shall be such that the final baseplate, soleplate, or mounting block elevation results in the grout manufacturer's recommended grout thickness between the surface of the equipment pad and the lower baseplate flange, underside of the soleplate or underside of mounting block.

All dust, dirt, chips, oil, water, and any other contaminants shall be removed and the surface protected with plastic sheeting until grout is installed.

Concrete equipment pad surfaces that have been finished smooth and level for use as leveling positions shall be protected from damage during chipping activities. Alternatively, leveling positions may be restored on chipped surfaces. Leveling positions shall be restored by installing leveling blocks or leveling plates for jackscrews on a high compressive strength epoxy putty (Philadelphia Resins, Phillybond Blue 6A, or equal). Leveling blocks and

leveling plates shall be installed level on the epoxy putty.

**B. BASEPLATES, SOLEPLATES, AND MOUNTING BLOCKS:**

All surfaces of baseplates, soleplates, and mounting blocks to be in contact with epoxy grout shall be cleaned to SSPC SP-6 and shall be primed with epoxy primer within 8 hours of cleaning.

**C. LEVELING:**

All machinery shall be mounted and leveled by journeyman millwrights. Precision surveying equipment shall be used for leveling. Machinists' spirit levels will not be permitted for leveling purposes for any baseplate, soleplate, or mounting block with a plan dimension greater than 4 feet. Baseplates and mounting blocks shall be leveled to a maximum tolerance of 0.002 inch per foot or as otherwise required by the equipment manufacturer, if more stringent. Soleplates shall be leveled to 0.0005 inch per foot or as otherwise required by the equipment manufacturer, if more stringent. An anti-seize or anti-galling compound specified in paragraph 11002-2.06 shall be applied to all equipment anchor threads prior to beginning baseplate, soleplate, or mounting block leveling.

All baseplates, soleplates, and mounting blocks shall be leveled against steel surfaces (jackscrew plates, leveling blocks, leveling nuts, support plates, or other steel surfaces). Use of other materials for leveling purposes is strictly and specifically prohibited. Unless otherwise specified, baseplates, mounting blocks, and soleplates shall be leveled as indicated in the leveling details. Leveling equipment and tools shall be stainless steel leveling blocks and shims, steel wedges, or jackscrews bearing on leveling plates. Leveling nuts may be used for leveling baseplates and soleplates weighing less than 200 pounds. The use of leveling nuts for leveling mounting blocks is not permitted.

After baseplates, soleplates, or mounting blocks have been leveled on the leveling equipment, the Contractor shall clamp the baseplates, soleplates, or mounting blocks in position by installing the equipment anchor nuts and washers. Clamping torque shall be less than the final clamping torque specified in paragraph 11002-2.01, but sufficient to hold the baseplate, soleplate, or mounting block in position. The Contractor shall verify that the correct level and position of the baseplate, soleplate, or mounting block has been maintained after clamping on the leveling equipment.

Leveling blocks shall be stainless steel, four inches square and 1-1/2 inches thick with an open-ended slot terminating in the center for the equipment anchor. Leveling blocks shall be machined flat on all horizontal surfaces and placed under the baseplate or soleplate at each equipment anchor. Shims shall be pre-cut stainless steel, slotted for removal after grouting, and shall extend not less than three inches beyond the baseplate, soleplate or mounting block. Leveling blocks and shims shall be coated with a light oil just prior to beginning the leveling and grouting work. Shims shall be placed so the tabs on the shims are easily accessible.

**D. GROUTING:**

Grout forms shall be built of minimum 0.75 inch thick waterproof plywood and shall be securely braced (minimum brace size shall be two-by-four lumber). Forms shall be designed for a minimum of 6 inches hydrostatic head above the final elevation of the grout, to assist in flow during installation. Equipment mounting grout shall be furnished with expansion joints installed at four to six foot intervals, perpendicular to the centerline of baseplates.

Forms shall be coated with three coats of paste wax on all areas that will come in contact with the grout to prevent the grout from bonding to the forms. Forms shall be waxed before assembly to prevent accidental application of wax to surfaces where the grout is to bond. Before any forms are installed, all concrete surfaces that will contact epoxy grout shall be free from any foreign material, such as oil, sand, water, wax, grease, etc. Forms shall be liquid-tight. Any open spaces or cracks in forms, or at the joint between forms and the foundation, shall be sealed off, using sealant, putty, or caulking compound. All outside vertical and horizontal edges of the grout shall have 45-degree chamfers as indicated in the equipment anchor details for rigid equipment mounts. Match chamfers in concrete portions of the equipment pad. Block outs shall be provided at all shimming and leveling positions to allow removal of leveling equipment and tools after the grout has cured. Jackscrews shall be coated with a light oil or other acceptable bond-breaking compound prior to grouting.

The 45-degree perimeter chamfer strip shall be located at the final elevation of the grout. The final elevation of the grout on baseplates with exposed I-beam or C-channel supports shall be at the top of the lower support flange. The top of the grout, on all other baseplates soleplates, and mounting blocks, shall be at least 1.0 inch above the bottom or underside of the baseplate, soleplate, or mounting block and shall not be higher than the top of the baseplate, soleplate, or mounting block. The grout's final elevation shall not be so high as to bond the equipment anchor nut and washer.

The resin and hardener for epoxy grout for equipment mounting shall be mixed in accordance with the epoxy grout manufacturer's recommendations. Epoxy grout shall be placed at the center of one end of the baseplate or soleplate and worked toward the ends in such a manner as to force the air out from beneath the baseplate or soleplate and out the vent holes, to eliminate voids. Epoxy grout shall be placed in a manner that avoids air entrapment, using a head box to pour grout into the grout holes. When the head box is moved to the next grout hole, a 6-inch high standpipe shall be placed over the grout hole and filled with grout. Use of vibrating tools and/or jarring (rapping or tapping) forms to facilitate grout flow is not permitted during placement of epoxy grout.

The Contractor shall exercise care to never allow the grout to fall below the baseplate level once the grout has made contact with the baseplate. Grout placement shall be continuous until all portions of the space beneath the baseplate, soleplate, or mounting block have been filled. Subsequent batches of grout shall be prepared so as to be ready when the preceding batch has been placed. Under no circumstances shall the grouting operation be halted because of lack of grout mix. After the entire baseplate is full, 6-inch high standpipes shall be maintained over each grout hole, to continue purging of air. When the grout has

started to take an initial set (typically this is determined by a noticeable increase in temperature and no flow of grout at the vent holes) the standpipes shall be removed and excess grout cleaned from all surfaces.

Where the cavity under a baseplate or mounting block extends above the elevation of the top of the bolting flange for the baseplate or mounting block, grouting may be completed in two pours. Under these circumstances, the first grout pour shall be continuous until the lower face of the bolting flange for the baseplate or mounting block is submerged in grout a minimum of one inch. The second grout pour shall be completed with standpipes and air purges as specified in the previous paragraph.

Grout forms shall be checked for leaks throughout grout pours. Leaks shall be repaired immediately to prevent formation of voids. A final check of baseplate, soleplate, or mounting block level and elevation shall be performed before the grout sets.

A grout sample shall be taken for each equipment pad that has a baseplate, soleplate, or mounting block set in grout. The sample shall be placed in a cylinder of sufficient size to yield three two-inch cubes as test samples. The samples shall be tagged with project name, date, time, the equipment number and ambient temperature at the time of placement. Once the epoxy grout cylinder has been completely filled, it shall be placed next to the foundation of the equipment being grouted and allowed to cure for 48 hours. After 48 hours, the test cylinder shall be tested in accordance with the grout manufacturer's recommendations by the independent testing laboratory specified in paragraph 11002-1.02 B. The results shall be reported directly to the Construction Manager. Forms shall be removed only after the grout has cured sufficiently and upon specific permission from the Construction Manager.

#### E. COMPLETION:

Upon acceptance by the Construction Manager and the equipment manufacturer's representative and after the grout has reached sufficient strength, grout forms and block outs at leveling positions shall be removed. Leveling blocks and shims or wedges and support plates shall be removed, leveling nuts and jack screws shall be backed off to allow the grout to fully support the baseplate, mounting block, or soleplate. Take care not to damage the grout during removal of extended shimming material or leveling equipment and tools.

The equipment anchor nuts shall be tightened, using calibrated indicating torque wrenches, to develop the full clamping force required by the equipment manufacturer.

Equipment anchor nuts shall be tightened in increments of not more than 25 percent of the final torque value in an alternating pattern to avoid stress concentration on the grout surface. After tightening equipment anchor nuts to final values, apply additional wax, grease, or mastic to all exposed portions of the equipment anchor beneath the baseplate, soleplate, or mounting block.

After applying additional wax or mastic to exposed portions of equipment anchors, block outs (pockets) for access to leveling nuts, leveling blocks and shims, or wedges shall be

filled with the grout material installed under baseplates, soleplates, or mounting blocks and pointed after the equipment anchor nuts have been tightened to final values. Jackscrews shall be removed and holes in the baseplate, soleplate, or mounting blocks filled with a flexible sealant (silicone rubber) or a short cap screw.

Check for baseplate, soleplate, or mounting block movement (soft foot) by individually loosening and re-tightening each equipment anchor. Vertical movement at each equipment anchor shall be measured and recorded during loosening and retightening and shall not exceed 20 micrometers (0.001 inch). Vertical movement shall be measured using a magnetic-based dial indicator on the baseplate, soleplate, or mounting block referenced to the epoxy grout surface of the equipment pad or other approved method. Soft foot conditions shall be sufficient cause for removal and reinstallation of grout and baseplates, soleplates, or mounting blocks.

Check for grout voids by tapping along the upper surfaces of the baseplate, soleplate, or mounting block. Grout voids shall be sufficient cause for removal and reinstallation of grout and baseplates, soleplates, or mounting blocks. Grout voids shall be marked. At the discretion of the Construction Manager, grout voids may be repaired as specified in Chapter 5, Section 3.16 of API 686.

### 3.04 FINAL INSPECTION

The Construction Manager will conduct a final inspection with the Contractor for conformance to requirements of the contract documents.

**\*\*END OF SECTION\*\***

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## SECTION 11050

### GENERAL REQUIREMENTS FOR CENTRIFUGAL AND AXIAL FLOW PUMPING EQUIPMENT

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section, when referenced in the detailed specification section, provides minimum requirements applicable to centrifugal and axial flow pumping equipment furnished under this contract. More restrictive requirements, where found in individual pump specifications, shall supersede requirements of this section.

“Detailed pump specification”, “detailed specification”, “individual pump specification”, “referencing section”, or words of similar import in this section, shall mean the specification section where the requirements for specific pump performance are presented. “Pumping unit”, whenever and wherever used, shall mean the complete pumping assembly, including driver (whether engine, turbine, or motor) and shall include all accessories such as variable speed drives required for motor operation, gear reducers, intermediate shafting and bearings, flywheels, and all supports for all equipment furnished with the pump.

A number of provisions of this section shall be required for a subset of pumps. These requirements (refer to Paragraphs 1.05 and 1.07.A, in this Section) are in addition to requirements applicable to all pumps. The subset of pumps is defined as pumping equipment meeting any of the following criteria:

- All pumping unit specifications where the words “Custom Engineered” appear in the title of the specification section.
- Where a particular Section 11050 provision is specifically cited in the detailed section.

###### B. DEFINITIONS:

The following definitions apply for classifying pumps specified in this and referencing sections:

1. GENERAL: Terminology and definitions in this Section follow those established in ANSI/HI 9.1 - 9.5, unless otherwise noted.

2. SOLIDS BEARING LIQUIDS: Liquids to be pumped containing, or assumed to contain, solids that require appropriate pump design considerations and/or materials of construction. Solids Bearing Liquids are liquids with settleable solids exceeding 50 mg/L and

shall include wastewater, stormwater, primary effluent, return sludge, return activated sludge (RAS), trickling filter circulation, and similar services.

3. CLEAR LIQUIDS: Liquids to be pumped generally free of deleterious solids. Clear Liquids shall include potable water, heat reservoir, raw water, secondary effluent pumping, and similar services.

4. EFFICIENCY: For the purposes of this section and sections referencing this section, efficiency, as related to pumps, shall be the ratio of the pump output power (water horsepower) divided by the pump input power (brake horsepower) required to deliver the total head, with meanings as defined in HI 1.2.3.8 and 2.2.3.8. For column type pumps, it shall be computed inclusive of inlet, bowl, column and discharge head losses.

5. NET POSITIVE SUCTION HEAD – 3 PERCENT REDUCTION (NPSH3): For the purposes of this section and sections referencing this section, NPSH3 shall mean the value of net positive suction head resulting in a reduction of 3 percent in the developed pump discharge head when the pump is tested in accordance with procedures established by the Hydraulic Institute. NPSH3 is the successor designation to NPSHR (net positive suction head required). Where NPSHR is used in the Contract Documents it shall be taken to mean NPSH3.

6. NPSH MARGIN: For the purposes of this section and sections referencing this section, “NPSH Margin” wherever used shall mean Net Positive Suction Head Available (NPSHA) divided by the candidate pump’s Net Positive Suction Head-3 Percent Reduction (NPSH3) for the specific operating condition in question.

7. PACL: For the purpose of this section and sections referencing this section “PACL” Wherever used shall mean Pump Application Capacity Limits and is used in these specifications in lieu of the terms Preferred and Allowable Operating Region. PACL is defined in terms of percentage Best Efficiency Flow (BEPQ) to define the margins (based upon suction specific speed) that respectively identify the minimum and maximum flows defining acceptable performance regions for pumps covered by this specification section and any specification section referencing this section. Refer to paragraph 11050-1.04 B. 4.

## 1.02 TYPE

Provisions and requirements contained in this section apply specifically to centrifugal and axial flow pumps, both vertical and horizontal, commonly falling into the generic types covered by ANSI/HI 1.1 through 1.4 and 2.1 through 2.4. This section does not apply, except by specific reference, to positive displacement pumps of any type.

## 1.03 REFERENCES

This section (Section 11050) contains references to the following documents. They are a part of this section and any referencing section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of

this section or any referencing section and those of the listed documents, the following order of precedence shall prevail (in the order of primacy):

1. The referencing section.
2. This section.
3. The referenced document.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
AISC	American Institute of Steel Construction –Manual of Practice
ANSI/API 610	Standard for Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
ANSI/ASME B46.1	Surface Texture, Surface Roughness, Waviness and Lay
ANSI/HI 1.1 – 1.4	Rotodynamic (Centrifugal) Pumps
ANSI/HI 2.1 – 2.4	Rotodynamic (Vertical) Pumps
ANSI/HI 9.1 – 9.5	Pumps – General Guidelines
ANSI/HI 9.6.2	Centrifugal and Vertical Pumps for Allowable Nozzle Loads
ANSI/HI 9.6.4	Centrifugal and Vertical Pumps. Vibration Measurements and Allowable Values
ANSI/HI 9.8	Pump Intake Design
ANSI/HI 11.6	Submersible Pump Tests
ANSI/HI 14.6	Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
API 686/PIP REIE 686	Recommended Practices for Machinery Installation and Installation Design
ASME B18.8.2	Taper Pins, Dowel Pins, Straight Pins, Grooved Pins, and Spring Pins (Inch Series)
ASME Code	ASME Boiler and Pressure Vessel Code

Reference	Title
ASTM A27	Steel Castings, Carbon, for General Application
ASTM A36	Carbon Structural Steel
ASTM A148	Steel Castings, High Strength, for Structural Purposes
ASTM A322	Steel Bars, Alloy, Standard Grades
ASTM A564	Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A571	Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service
ASTM A995	Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts, Grades 2A, 3A, or 6A
ASTM B148	Aluminum-Bronze Sand Castings
AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
AWWA C550	Protective Epoxy Coatings for Valves and Hydrants
NSF/ANSI 61	Drinking Water System Components – Health Effects
IEC 61298-2	Process Measurement and Control Devices. General Methods and Procedures for Evaluating Performance Tests Under Reference Conditions
ISO 9001	Quality Management Systems – Requirements, 3rd Ed. (2000)
ISO 10816-1	Mechanical Vibration—Evaluation of Machine Vibration by Measurement on Non-rotating Parts—Part 1: General Guidelines, Annex B, Table B.1. Zone A, Class I, II or II, as applicable. For the purposes of this specification, Annex B of ISO 10816, Part 1 shall form a part of this specification and ISO 10816, Part 1.
ISO 10816-7	Mechanical Vibration—Evaluation of Machine Vibration by Measurement on Non-rotating Parts—Part 7: Rotordynamic Pumps for Industrial Applications, Including Measurements on Rotating Shafts, Annex A, Tables A-1 and A-2 as applicable. For the purposes of this specification, Annex A of ISO 10816, Part 7 shall form a part of this specification and ISO 10816, Part 7.
MIL STD 167-2	Mechanical Vibrations of Shipboard Equipment (Reciprocating Machinery and Propulsion System and Shafting)
Corbo and Malanoski, 1996	Practical Design Against Torsional Vibration, 25th Turbomachinery Symposium, Turbomachinery Laboratory, Texas A & M University, p. 186 – 222

Reference	Title
Corbo and Malanoski, 1998	Pump Rotordynamics Made Simple, Pumping Technology, June 1998, p. 202 – 236

#### 1.04 DESIGN REQUIREMENTS – ALL PUMPS:

##### A. GENERAL:

Equipment furnished under all sections referencing this section shall conform to the requirements and objectives of paragraph 6.1, ANSI/API 610, unless specifically stated in this and the detailed specification section. All components associated with the rotating elements in the drive train, including equipment supports and supports for rotating elements, shall be selected and designed to function without damage or disassembly at reverse rotational speeds up to 150 percent of maximum operational speed during flow reversals through the pump. The complete pumping unit shall operate without overload on any component at any point along the pump's entire full-speed operating curve. Pumps required by virtue of the specified operating conditions to operate against a closed valve or throttled for any period of time exceeding five seconds shall be furnished with drivers sized to operate continuously at the power requirement for that condition even though the power requirements at the rated condition may be less.

With the exception of submersible pumps and the inlet connection for pumps designed to operate in open forebays or wet wells, pump connection nozzles shall be designed for the loads and moments stipulated in ANSI/HI 9.6.2. Where ANSI/HI 9.6.2 does not cover a specific pump type or category, or where that document is silent on allowable nozzle loads or a particular type of nozzle load (e.g. thermal pipe strain), the Contractor shall furnish documentation from the manufacturer attesting to the limitations on loads and moment forces that can be tolerated on each connection and recommended connection details to be used.

##### B. PUMP SELECTION:

1. **PROVEN DESIGNS:** Pumps furnished under all sections referencing this section shall be proven designs that shall have been in service under similar conditions of service with no objectionable performance characteristics for a period of not less than five years. The Contractor shall furnish a detailed list, duly signed by an officer of the pump manufacturer's corporation and notarized, of installations with contact information supporting qualification under this requirement with the information required under paragraph 11050-1.08. In order to satisfy this requirement, listed pump shall be of the same size volute or bowl, discharge case and nozzle size, impeller design (including number of vanes) and shall be operating under similar conditions of pumped fluid, head, capacity, speed, rotation, and Net Positive Suction Head Available (NPSHA).

The Contractor may propose equipment that cannot meet this requirement only under the following conditions:

- a. The proposed design has been in successful operation under similar conditions of volute or bowl, discharge case and nozzle size, impeller

design (including number of vanes), pumped fluid, head, capacity, rotation and NPSHA, but at a higher speed for a period of not less than three years;

or

- b. The proposed design has been in operation in designs where both larger and smaller nozzle size pumps have been in service for a period of not less than five years, and impeller design (including number of vanes), pumped fluid, head, capacity, speed and NPSHA are similar to that for the proposed installation. Under no circumstances will an existing pump design operating at a higher speed than those currently in service in similar applications be considered.

If the proposed pump qualifies under either exception (a. or b.), the Contractor shall demonstrate, by operation of a test pump in a fully equipped hydraulic test facility, that the proposed pump in the size and at the speed proposed, with the proposed impeller design will have acceptable operating characteristics under the conditions specified for the proposed installation. The test pump shall be set up and a witnessed demonstration shall be performed prior to designing, fabrication and testing any of the equipment proposed for the specific installation.

2. GENERAL PERFORMANCE CRITERIA: Pumps furnished under this section and any referencing section shall operate without loss of head due to cavitation or vibration over the entire specified range of flow and head conditions and shall be specifically selected for NPSH margin requirements detailed in paragraph 11050-1.04.F. Pump selections which do not provide the specified margin will be rejected.

3. GENERAL DESIGN CRITERIA: All pumps furnished under sections referencing this section shall be designed in accordance with applicable portions of ANSI/HI 1.1 – 1.4, 2.1 – 2.4 and ANSI/HI 9.6.2 – 9.6.6 and the requirements of this section. The pumps shall be specifically designed to pump the fluid described in the detailed specification and shall operate without clogging or fouling caused by material in the pumped fluid at any operating condition within the range of service specified.

Unless otherwise noted or specified, pump head capacity curves shall slope in one continuous curve within the specified operating conditions. No points of reverse slope inflection capable of causing unstable operation will be permitted within the specified zone of continuous duty operation. Pumps with head/capacity curves with a reverse inflection are specifically prohibited if these characteristics will cause unstable operation within the specified range of operating conditions and where startup/shutdown conditions entail operation against a slow opening/closing valve.

Column type (vertical turbine, vertical column solids handling, and axial flow propeller and mixed flow) pumps shall have bells selected to provide an intake velocity of not less than 3.5 feet/second nor more than 4.0 feet/second when operating at the maximum specified flow or the flow resulting from the lowest specified operating head at maximum speed, whichever is the

greatest (“peak flow”). Pump discharge column sizes shall be selected to limit the calculated average velocity at peak flow to no more than 12 feet/second. Pump discharge column sizes shall be selected to limit the calculated average velocity at peak flow (Condition Point B, as defined previously) to no more than 12 feet/second.

Pumps specified to operate at variable speed shall function without loss of head due to cavitation or excessive vibration over the entire specified range of flow and head conditions defined by the region bounded by Condition Points A, B and C and any other continuous duty operating condition specified in the detailed specification referencing this section. The region shall be displayed as a cross-hatched area on a linear X-Y plot of the selected pump’s variable speed performance curves plotted in 10 percent increments for the proposed maximum speed to the speed required to meet Operating Condition Point C or any other specified reduced speed operating condition, whichever is less. Unless otherwise specified in the section referencing this section, acceptance criteria shall include the following:

- a. Operating Condition Points B and C shall reside within the region defined by the PACL limits set forth in this section for the proposed pump selection, based upon the pump’s suction specific speed.
- b. No more than 10 percent of the cross-hatched zone noted above shall reside outside the PACL limits set forth in this section for the proposed pump selection, based upon the pump’s suction specific speed. Operating Condition A may reside in the area outside the PACL limits.

Pumps shall be specifically selected for NPSH margin requirements detailed in paragraph 11050 1.04.F. Pump selections which do not provide the specified margin will be rejected.

4. PUMP APPLICATION CAPACITY LIMITS: (PACL): Pump selection for a given application shall be predicated on locating the specified most frequent operating condition(s) in the PACL. These points will always include Condition Points A and B and additionally will include any other Condition Points indicated in the detailed specification as continuous duty conditions, or any additionally specified for inclusion in the PACL. Condition Point A shall be the pump’s rated condition and shall be guaranteed to meet both specified head and flow within the limit established in ANSI/HI 14.6, acceptance grade 1U.

A given pump’s PACL shall be determined as a percentage of Best Efficiency Flow (BEPQ) at the given speed, the pump’s suction specific speed as determined in accordance with ANSI/HI 1.3, paragraph 1.3.2.2 and the relationships presented in the following table.

**Limiting Flow, percent Best Efficiency Point Flow (BEPQ)\***

Suction Specific Speed, less than but not greater than:	Clear Liquid pumps, minimum limit	Clear Liquid Pumps, maximum limit	Solids Bearing Liquids Pumps, minimum limit	Solids Bearing Liquids Pumps, maximum limit

7000	50	125	70	125
8000	57	122	75	122
9000	60	120	80	120
10000	65	120	83	117
11000	68	110	85	112
12000	72	112	88	110
13000	78	110	91	110

\* Straight line interpolation may be used for intermediate values of suction specific speed

Exceptions to the foregoing will be considered by the Construction Manager only when the Contractor can provide certified test data demonstrating conclusively a wider region of stable pump performance. The test data shall include suction pressure pulse information as well as actual service information for the same impeller design and trim, operating at the same speed, capacities and head for the same size pump as required for the specified application.

#### C. CRITICAL SPEEDS AND NATURAL FREQUENCIES:

1. GENERAL: The criteria of this paragraph, 11050-1.04.C., apply to all pumps. Pumps exhibiting adverse field behavior from resonance, vibration or fatigue shall be repaired or replaced at no cost to the Owner. The criteria shall apply to the equipment in like new condition as well as the as worn condition (i.e., when all parts, individually and as a composite, reach the manufacturers' maximum tolerances). Critical speed and natural frequency data submittal requirements depend upon the pump:

- a. For the more critical pumps that are covered under paragraph 11050-1.05 the Contractor is required to submit analytical reports confirming requirements on critical speeds and natural frequencies prior to pump fabrication as specified in that paragraph.
- b. Unless otherwise specified constant speed pumps and variable speed pumps with suction size less than 6-inch diameter – no critical speed submittal is required.

2. LATERAL ROTOR DYNAMICS: The complete pumping unit, including all related frames, supports, enclosures, and casings, shall be free from dangerous critical speeds from 20 percent below to 30 percent above the operating speeds required to achieve the specified performance characteristics. The logarithmic decrement for each damped natural frequency (forward or backward) shall be greater than +0.3, and the amplitude magnification factor shall not exceed 3, for any natural frequency within this range.

Process sensitivities are such that operation at infinitely variable speed within the specified operational conditions is an absolute requirement. Any remedy imposing a locked-out speed interval or intervals will not be considered an acceptable remedy for identified critical speeds. Acceptable remedies include combinations of adjustments in rotor geometry or

materials, and the substitution of energy absorbing couplings. Other remedies may be considered so long as they are justified in writing and the proposal sealed and signed by the design professional retained by the manufacturer to perform the system mass elastic system analyses.

3. TORSIONAL AND COMBINED SHAFT STRESS: For constant torque applications, the pump rotor shall be free from torsional response which produces combined (steady plus alternating torque induced) stresses exceeding 30 percent of the material's elastic limit (but no more than 18 percent of the material's ultimate tensile strength) at any speed from 10 percent below to 20 percent above that required by the specified operating conditions, or during startup, shutdown or motor control transients.

For variable torque applications (including variable speed pumps, vertical pumps and pumps with large overhung loads) the pump rotor and any intermediate shafting shall be free from torsional responses which, in accordance with MIL STD 167-2, produce combined (torsional steady and alternating) peak shear stresses at points of stress concentration (calculated in accordance with the requirements of this section) that exceed 4 percent of the material's ultimate tensile strength, nor more than 50 percent of the material's fatigue limit, whichever is less.

#### D. IMPELLER CLEARANCES, VANE PASSING FREQUENCY AND IMPELLER KEYWAYS:

The radial clearance between the tip of the impeller vane and diffuser or volute vanes shall be not less than 3 percent and 6 percent, respectively, of impeller diameter. The ratio of liquid channel widths (diffuser or volute/impeller) shall be not less than 1.15 nor more than 1.3 for diffuser pumps and 1.4 – 1.5 for volute-type pumps. The pump shall be designed so that internal geometry shall not cause uneven flow distribution at impeller vane inlets.

Impeller vane combinations shall not be an even multiple of diffuser vanes in column type pumps.

Impeller keyways for multistage column type pumps shall be cut at differing positions and equal angular spacing on the impeller shaft to avoid multiple simultaneous vane passing pulses.

#### E. COMPONENT DESIGN CRITERIA:

1. GENERAL: Unless otherwise specified, combined stresses in steel frames and supports shall not exceed those permitted by the AISC Manual of Practice. Combined stresses in cast, forged, rolled, or fabricated pressure retaining components, frames and supports shall not exceed that allowed for the given material in Section VIII, Division 1 of the ASME Code. Design pressures for pressure-retaining parts shall be not less than twice the pump's shutoff head at the manufacturer's listed maximum operating speed. Pump casing strain at any head on the full speed operating curve (including allowances for increases caused by specified multi-stage applications) shall not result in distortions at the bearing housings greater than the maximum allowable by the bearing manufacturer to provide the specified bearing life.

The term “combined stresses” in this section shall mean the sum of all operating stresses, including stresses induced by dynamic and static forces as developed via the analysis procedures stipulated in this section. Static forces (x, y, z, and moments in all planes) shall include the relevant maximum nozzle loads specified in ANSI/HI 9.6.2 or as stipulated by the pump manufacturer. Dynamic forces shall include both steady state and transient stresses induced by operating conditions within the zone of operation established by the specified operating conditions.

2. ANCHORAGE AND EQUIPMENT MOUNTS: The Contractor shall cause the pump manufacturer to be responsible for the design of the anchor bolting system and equipment supports for each separately mounted component furnished under the detailed specification. Anchorage and equipment support requirements for pumps shall conform to the requirements of Section 11002 and the standards of the Hydraulic Institute.

Anchor bolts and connecting bolts for all pumps and assemblies supported by other assemblies furnished under this section, or sections referencing this section, shall be designed in accordance with Section 01900. All operation and maintenance manuals for all pumps and assemblies shall contain criteria for anchor and baseplate bolt torque values.

Unless otherwise recommended by the equipment manufacturer, all pump discharge nozzles shall be restrained using the equipment connection fitting specified in Section 15085.

Equipment mounts for vertical (column and volute type) pumps weighing more than 1000 pounds, with discharge nozzles 6 inches in diameter and greater, shall employ soleplates conforming to the requirements of Section 11002. Soleplate mounting conforming to Section 11002 shall also be provided for all separately supported components in the pump drive system. Fabricated steel supports regardless of design and the nature of the structural shapes used for such proposed supports, will not be accepted.

Soleplates shall be designed to span openings for equipment connections and provide access to maintenance points. Soleplates shall be of sufficient section to key, not less than 1 inch, into the supporting grout provided for bonding the soleplate to the structure. Soleplates shall be of sufficient size to bolt the pump base to the soleplate and allow dowelling the pump base to the soleplate without encumbering the anchor bolts required for clamping the soleplate to the structure.

Equipment mounts for horizontal pumps shall be designed in accordance with Section 11002 and paragraph 7.3, ANSI/API 610 and shall provide common support for the pump and motor (and flywheel, if one is specified). Baseplate bolting shall conform to assumptions contained in ANSI/HI 9.6.2. Pump base shall be drilled and dowel pinned to the base plate in addition to bolting.

Tapered dowel pins shall be used to record the final position of all machine bases on soleplates or pump baseplates. Dowel pins shall be hardened and machine-ground conforming to the requirements of ANSI/ASME B18.8.2. Holes for tapered dowels shall conform to the requirements set forth in Appendix A of ANSI/HI B18.8.2.

3. TORSIONAL AND COMBINED SHAFT STRESSES: Shaft stresses shall be calculated using the following equation and the stress concentration factors in the table below.

$$S = S_{cf} \times \frac{G \times D \times \Delta_{\Theta}}{2 \times L}$$

where:

S	=	stress, psi
S <sub>cf</sub>	=	stress concentration factor, dimensionless
D	=	minimum shaft diameter at point of concentration, inches
Δ <sub>Θ</sub>	=	twist in shaft between adjacent masses, radians
L	=	effective length between masses, inches
G	=	shear modulus of shaft material, lb/in <sup>2</sup>

The S<sub>cf</sub>, to be applied at all the roots of all keyways and changes in shaft diameter shall be as follows:

S <sub>cf</sub>	Ratio of fillet radius to shaft diameter
4.3	0.0025
3.7	0.01
3.05	0.02
2.75	0.03
2.6	0.04
2.55	0.05 and greater

Values of S<sub>cf</sub> between data points in the table above shall be based upon a straight line interpolation.

4. SHAFT DEFLECTION: Pump shafts on volute type pumps shall be designed to provide sufficient stiffness to operate without distortion or damaging vibration throughout the range of service specified. Shaft deflection at the face (impeller side) of the shaft seal shall be limited to no more than 1.5 mils at any operating condition within the zone described by the specified continuous duty operating conditions. Deflection at the shaft seal shall be calculated as required by provisions set forth in paragraph 11050-1.05.B.5.c.

5. BEARINGS: Unless otherwise specified, anti-friction bearings for pumps shall be selected for a minimum L-10 life of 50,000 hours in accordance with ABMA 9 or 11. Anti-friction bearings for Custom Engineered pumps shall have bearings selected for an L-10 life of 100,000 hours in accordance with ABMA 9 or 11. Bearings for other elements in the rotating system such as motors, intermediate shaft bearings, and flywheel bearings shall be selected using the same criteria as specified for the pump. Bearing selection shall be based upon the worst combination of continuous duty operating conditions specified and shall include both steady state and transient loads. Calculations supporting the selection of bearing sizes shall be provided as Product Data.

6. BEARING ISOLATORS: Unless otherwise specified, all pump and motor bearings shall be fitted with bearing isolators, specifically selected for the size and type bearing. Bearing isolators shall be labyrinth, non-fretting type designed to expel contaminants by centrifugal force and prevent escape of lubricants. Vapor block capability shall be provided. Bearing seals shall be Inpro/Seal or approved equal.

7. PUMP SHAFT SEALS: Unless otherwise specified in the detailed specification, pump shaft seals shall be packing as specified in Section 11000.

F. NET POSITIVE SUCTION HEAD MARGIN LIMITATIONS:

1. GENERAL: Pumps furnished under this section and sections referencing this section shall be selected for NPSH (Net Positive Suction Head) margin limitations using the criteria set forth in this section. Net Positive Suction Head Required - 3 Percent Reduction (NPSH3) characteristics for the candidate pump shall be based upon documented test data not more than five years old, performed on a pump not more than two nominal pump diameters larger or smaller than the proposed pump with an impeller of the same geometry as that proposed for the pump to be used for the subject application, and operating at the same speed as the pump for the proposed application. The Contractor shall document the basis for pump selection based upon NPSH margin limitations as set forth in this paragraph.

The detailed specification sections provide NPSHA (Net Positive Suction Head Available) information for anticipated operating conditions for each application. This information is generally referenced to a specific elevation, stated in terms of project datum. It shall be the Contractor's responsibility to cause the pump manufacturer to adjust the NPSHA information in the specification section to the elevation of the pump impeller eye for the specific pump model and size proposed for the application. NPSH3, as used in the following paragraphs, shall mean the NPSH3 at the impeller eye, determined in accordance with ANSI/HI 11.6 or 14.6, as applicable for the proposed pump. The Contractor shall cause the pump manufacturer to document the method used to determine NPSH3 for the proposed pump and justifying compliance with the NPSH margin limitations established under this paragraph for each specified operating condition in material submitted under paragraph 11050-1.08. The documentation shall include justification of the NPSH3 tests used to develop NPSH3 characteristics, including the following:

- a. Date, test procedure, and test logs of original NPSH3 information used to project requirements for pump selected for the application.

- b. Test pump size, impeller diameter, impeller model, eye diameter, and speed.
- c. Calculations projecting NPSH3 test information to NPSH3 curve information for the pump proposed for the application.
- d. Calculations demonstrating compliance with the NPSH margin requirements established in this paragraph.

The Contractor shall submit the manufacturer's margin calculations justifying the proposed pump selection with the material required under paragraph 11050-1.08. The NPSH margin ratios specified in this paragraph shall be the minimum acceptable margin ratios. If the proposed pump requires greater margin ratios to operate within the specified operating conditions without loss of head due to cavitation, then it shall be the responsibility of the Contractor to bear all costs associated with achieving the required margin ratio by lowering the elevation of the pump setting, lowering the elevation of the structure or other means. Any such adjustments shall be subject to review and acceptance by the Construction Manager.

Individual restrictions that apply to NPSH margin shall be as set forth below, depending upon the type of pumping equipment and the fluid to be pumped.

2. CENTRIFUGAL PUMPS – WASTEWATER SERVICE: The following restrictions shall apply to pumps for wastewater and all solids bearing liquids applications including storm water.

- a. Pumps classified as centrifugal pumps under ANSI/HI 1.1 – 1.2 with suction specific speeds less than 8500 with cast duplex stainless steel impellers and to vertical column-type sewage pumps with cast duplex stainless steel impellers and specific speeds less than 5000, a minimum NPSHA/NPSH3 margin ratio of 1.1 shall apply to pumps at any operating condition within 85 percent and 115 percent of best efficiency capacity. The minimum acceptable NPSH margin ratio at any other location on the pump's head/capacity curve shall be 1.2.
- b. Pumps with suction specific speeds greater than the above limitations shall have NPSH margins of 1.5 and 2 applicable to the capacity envelope limitations defined previously. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.
- c. Pumps with suction specific speeds greater than the above limitations and pumps with impeller materials that do not meet the requirement for duplex cast stainless steel set forth in this section, and all pumps with suction specific speeds greater than 10,000 shall have NPSH margins not less than 2.5 at operating conditions

within  $\pm 15$  percent of best efficiency capacity and not less than 3.5 for all operating conditions falling outside the  $\pm 15$  percent of best efficiency capacity envelope. Under no circumstances shall the absolute value of the margin for pumps qualifying with the foregoing restrictions, be less than 3.5 feet greater than NPSH3.

### 3. CENTRIFUGAL PUMPS - CLEAR LIQUID SERVICE:

- a. The minimum NPSH margin requirements set forth in the table below shall apply to water and all non-solids bearing liquid pumps classified as centrifugal pumps under ANSI/HI 1.1 – 1.2 with specific speeds less than 7000 fitted with cast duplex stainless steel or aluminum bronze impellers and to vertical column-type pumps with cast duplex stainless steel impellers or aluminum bronze impellers and specific speeds less than 4000. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.

Power per stage, Kw	Operating Condition Within PACL	Operating Conditions Outside PACL
< 75	1.1	1.2
$\geq 75$ but $\leq 225$	1.05	1.1
>225	1.2	1.3

- b. Pumps with specific speeds greater than the above limitations, pumps with impeller materials that do not meet the requirement for duplex cast stainless steel set forth in this section, and all pumps with suction specific speeds greater than 10,000 shall have NPSHA margins not less than 3.0 at operating conditions within  $\pm 15$  percent of the best efficiency capacity and not less than 4.0 for all operating conditions falling outside the  $\pm 15$  percent of best efficiency envelope. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.

### G. ELECTRIC MOTORS:

1. GENERAL: Unless otherwise specified, pumps shall be electric motor driven. All motors shall be selected to be non-overloading at any operating point along the pump's full speed operating curve, including all points located beyond specified operating conditions. All vertical motors shall be solid shaft construction. Hollowshaft motors will not be accepted. Motors furnished with pumps specified for operation at variable speed shall be inverter duty types conforming to the requirements of Section 11060 and shall be compatible with the variable speed equipment furnished with the pump.

Motor bearings shall be protected with bearing isolators as specified in paragraph 11050-1.04.E.

2. MOTORS FOR CUSTOM ENGINEERED PUMPS: In addition to the information submitted under the requirements of Section 11060, the Contractor shall provide certified reed frequency calculations for both the motor rotor and frame for vertical motors driving custom engineered pumps with the data to be submitted under paragraph 11050-1.08. Upon completion of construction of motors for custom engineered pumps, each rotor and frame and the completed assembly shall be given a bump test to confirm reed frequency calculations in the dynamic analysis modeling work performed under paragraph 11050-1.05.B. The results of the bump test, certified by an officer of the manufacturing corporation and notarized, shall be submitted as Product Data under paragraph 11050-2.09.

All vertical motors shall meet motor face dimension tolerances as follows:

Motor face bolt circle diameter, inches	Motor face runout, inches
12	0.002
16.5 through 24.5	0.002
30 through 42	0.003
42 and larger	0.005

Motor face register concentricity, referenced to the shaft centerline, shall be not greater than 0.002 inches, if the motor is furnished without jack screws. Motor shaft total indicated runout (TIR) shall not exceed 0.002 inches.

3. BALANCE: Motors rated 50 horsepower and greater, all motors driving custom engineered pumps and all motors operating at less than 1200 rpm shall be precision balanced motors conforming to the requirement set forth in the table below.

Speed, rpm	Mils displacement (peak to peak)
3000 and above	0.5
1500 - 2999	1.0
1000 - 1499	1.0
<1000	1.5

The Contractor shall provide certified balance logs attesting to achieving these requirements, as Product Data under paragraph 11050-2.09. Displacement readings shall be taken at the shaft with an FFT analyzer at 1X speed. Balance logs shall be notarized and signed

## 1.05 ADDITIONAL DESIGN REQUIREMENTS

### A. SCOPE

The following paragraphs present requirements that apply to only some pumps on the project. The first sub-paragraph titled GENERAL explains when the paragraph applies.

**B. ROTOR CRITICAL SPEED ANALYSIS AND SYSTEM DESIGN:**

1. **GENERAL:** The requirements of this paragraph shall apply to all pumping equipment in detailed specifications where the words “Custom Engineered” appear in the title of the specification section, and elsewhere when the referencing specification section stipulates. The analyses shall be applied to the equipment in like new condition as well as the as worn condition (i.e., when all parts, individually and as a composite, reach the manufacturers’ maximum tolerances).

2. **REQUIREMENTS:** The complete pumping unit, including rotating elements, frames, supports, and all related structural elements, including pump, motor and bearing supports, shall be subjected to a lateral rotordynamic analysis, including a rotordynamic critical speed analysis, to identify and eliminate harmful resonant conditions.

The complete pumping unit rotating element including pump, motor, intermediate shafting and flywheel rotors (if specified), and all other elements in the power train (or powered via the power train) shall be designed and manufactured to limit torsional stresses.

Overhung shaft pumps and between bearings pumps operating in single volute casings shall be subject to analysis for shaft deflection in accordance with the terms of this section.

The torsional and rotordynamic analyses shall together be termed the pumping equipment’s “mass elastic design”. No fabrication work on any component for the equipment specified under this section and any referencing section shall be started until the mass elastic design has been completed and has been reviewed by the Construction Manager.

If the Contractor proposes the use of alternative methods for the required analyses, documentation shall be submitted justifying the substitution. The documentation shall include justification that product results will be equivalent to that specified and with an equivalent level of accuracy. The location and description of projects of an equivalent size where the procedure has been employed and the length of time these projects have been in actual service shall also be included.

3. **PROFESSIONAL QUALIFICATIONS:** The Contractor shall cause the manufacturer of the pumping equipment to retain the services of an independent professional engineering firm, employing a qualified design professional, which has been engaged in performance of the required, mass elastic design analyses for not less than ten years on equipment of similar size and complexity. The design professional shall not have been in the employ of any pump manufacturer, for a period of not less than 10 years from the date of the request for proposals for this project. The design professional’s firm shall submit a notarized certification attesting to having no contractual arrangements with the proposed pump manufacturer. The pump manufacturer’s internal engineering organizations, regardless of

qualifications, are specifically prohibited from doing this work. This provision, however, shall not be construed as relieving the Contractor of overall responsibility for this portion of the work.

The mass elastic design shall be the product of a registered design professional who has been responsible for the design of not less than five systems similar to that specified in the detailed specification section. The design professional shall have been engaged in this type of analysis for not less than 10 years and shall directly supervise the performance of the work and be responsible for analysis of results and recommendations for any corrections to the specific rotating system and the associated frames and supports. The Contractor shall submit the design professional's qualifications as a part of the initial submittal information required under this section.

The Owner and Construction Manager believe the following firms are capable of providing services which will satisfy the requirements of this paragraph. This statement, however, shall not be construed as an endorsement of a particular firm, nor shall it be construed that a named firm's standard service will comply with the requirements of this Section. Candidate firms performing these analyses satisfactorily in the past include:

- a. DynaTech , Roseville, California
- b. Engineering Dynamics Incorporated, Houston, Texas
- c. No Bull Engineering (Corbo, Malanoski & Associates), Brandon, Vermont

The Contractor may propose a firm other than those listed. However, before a substitute firm can perform the analyses, the proposed firm's qualifications, the qualifications of personnel proposed for assignment to this project, along with examples of analyses performed on similar pumping equipment using the Corbo and Malanoski procedures specified in this section shall be submitted for review by the Construction Manager. Examples shall include the types of graphical displays required under this section as well as a complete report describing the analyses performed and the recommendations arising out of the analysis results. Construction Manager retains the right to reject any proposed firm with justification.

4. **REPORTS, CALCULATIONS AND RECOMMENDATIONS:** All reports, calculations and recommendations resulting from the required analyses shall bear the design professional's original signature and professional registration seal. All reports, recommendations and calculations produced under this paragraph shall be submitted under the requirements of this section, as follows:

- a. Following completion of the pumping equipment's mass elastic design, Contractor shall cause the design professional to prepare a plain-English "Executive Summary" report with a narrative including: a description and assumptions about proposed operating system; detailed description of the analysis process; results of analyses and findings; detailed recommendations for modification

of the Pumping Unit (defined in paragraph 11050-1.01.A), if any; and sufficient graphical depictions to describe the information to a lay reader. Detailed calculations and extensive data reports are not to be submitted at this time and will cause the entire report to be rejected, if included. This Executive Summary shall be submitted for review and acceptance prior to pump or component fabrication. The Executive Summary report shall state that analysis procedures have complied fully with the requirements of this section and that the proposed system will meet all of the requirements set forth herein for limitations in stresses, deflection and fatigue limits. The design professional shall affirm in writing that all requirements of this section have been achieved or shall specifically state where exceptions have been taken, with justification citing recognized authorities for taking such exceptions. The reports shall be signed and sealed by the design professional, as specified, and shall be notarized.

- b. Following review and approval of the Executive Summary, the Contractor shall cause the design professional to review and address any comments from the Construction Manager and incorporate all changes that may be required. Subsequently, Contractor shall direct the design professional to issue a complete, "Final Report" with a revised Executive Summary, recommendations binding on the manufacturer, calculations, data and other supporting information. The format and documentation for this report shall follow the requirements of ANSI/HI 9.6.4. The Contractor shall submit this report as Product Data.
- c. Upon completion and receipt of certified results of the bump tests required for the motor rotor, frame and assembly specified under paragraph 11050-1.04.G., the design professional shall review the data and submit a "Supplemental Report", as Product Data, either accepting the test results or recommending alterations to assembly structures to adjust for differences between calculated values used for the original analyses and actual values determined subsequent to motor fabrication.
- d. Upon completion of installation and as a part of the initial test procedures specified under Section 01660, the design professional responsible for the mass elastic design shall visit the site and inspect the installed equipment. Prior to the initiation of any field tests, the design professional shall issue a report bearing the design professional's original signature and original registration seal attesting that the equipment, as installed, conforms to the recommendations contained in the report setting forth the results of the mass elastic system design.

- e. During initial testing of the equipment, the design professional shall be prepared with all necessary monitors, instruments and recorders, and shall conduct an in-situ torsional vibration test on one of the installed pumping units, to be selected by the Construction Manager, to confirm the torsional natural frequency results of the original mass elastic system design. The torsional vibration test shall be conducted with transducers suitable for narrow band spectrum analysis, including strain gauges, magnetic or optical pulse demodulation, or shaft position encoders. If the torsional vibration test should reveal any anomalies that cause the equipment to be out of compliance with the requirements of this section, the design professional shall conduct torsional vibration tests on all other like pumping units and submit a comprehensive report, sealed and signed as specified above, detailing the reasons for failure to comply with these specifications and recommendations for attaining compliance. The design professional shall consider all feasible options for compliance and shall provide detailed descriptions of the modifications required to achieve the required performance. Those recommendations accepted by the Construction Manager shall be implemented by the Contractor at no cost to the Owner.

## 5. METHODOLOGY:

a. LATERAL ROTOR DYNAMIC ANALYSIS: The rotor dynamic analysis shall follow the procedure prescribed in Corbo and Malanoski, 1998, and shall include the following features:

- 1) The procedure shall consider all speeds required to operate the equipment within the envelope of specified continuous operating conditions specified.
- 2) The procedure shall produce Campbell diagrams for the proposed operating conditions depicting all potential sources of excitation to check interference with all relevant frequencies up to, and including, not less than 6 times (6X) operating speed.
- 3) For all pumps, the analysis shall also consider vane pass excitation at  $\text{rev}/2$ .

For column type pumps only, the procedure shall consider variations in assumed coefficients for seal and wearing ring clearances (Lomakin effect), bearing stiffness and damping, rotor imbalance (up to 10 percent of rotor disc weight at

each disc position), impeller destabilizing forces, rotor shaft bending, hydraulic imbalance at not less than five operating conditions within the envelope of continuous operating conditions specified in addition to the specified continuous operating conditions.

Unless specifically accepted by the Construction Manager, the range in variation of component characteristics shall comply with the ranges recommended in Corbo and Malanoski, 1998.

- 4) The mathematical modeling tools to be employed for the analyses and the procedure to be used shall be as described in the references specified in paragraph 11050-1.05.B.5.a, Item 3) with the following modifications:
  - a) The mathematical model of the rotating element shall be built on a rotordynamics code such as FEATURE or DYROBES. Use of a finite element modeling program for this purpose will be unacceptable. The model shall specifically be constructed to contain axisymmetrical models of the rotor and casing. This model shall be used to determine the natural frequencies of the rotating elements.
  - b) A finite element code such as NASTRAN or ANSYS shall be used to construct three dimensional models of the casing and support structures for the equipment furnished under this contract. This model shall be used to determine the natural frequencies of the support structures and casing as well as the pump bearing frames.
  - c) The axisymmetrical model shall then be adjusted, preferably by changing component materials or sizes, or by changing component type, until its output frequencies agree with the models constructed under b).
- 5) Physical adjustments to provide the required characteristics shall be preferably by changes in component dimensions and secondarily by providing torsionally resilient dampening devices such as fluid-damped couplings or all metallic couplings such as manufactured by Bibby and

Holset. Couplings or dampeners using rubber or similar elastic materials shall not be used.

- 6) The final report shall include three-dimensional graphic presentation of frame and shaft distortion and rotor element performance at identified critical speeds within the pump's operating range.

b. **TORSIONAL DYNAMIC ANALYSIS:** The methodology used for evaluation of the mass elastic system and shaft combined stresses shall follow the approach prescribed in Corbo and Malanoski, 1996, using either the Matrix-Eigenvalue or Holzer methods for determining natural frequencies. The computer analysis results shall be verified by hand calculations for the fundamental frequency and for mode shapes. Exciting frequencies to be considered during the analysis shall be 0.5, 1, and 2 times running speed, vane passing frequencies and twice vane passing frequencies for the pump impeller/cutwater-diffuser vane combinations, line and twice line frequency, motor pole frequency and motor starting transients. Forcing function magnitudes used for the analysis shall be not less than 10 percent of the maximum transmitted torque. The analysis shall also include evaluation of control pulse frequencies induced by variable frequency drives or engine power stroke frequencies, if provided as part of the specified system. The analysis report shall include a statement produced by the variable frequency drive manufacturer detailing all control pulse frequencies generated by the equipment between 1/4 and 18 times motor running speed.

Unless otherwise justified by documentation supported by independent studies, the analysis procedure shall use the range of factors recommended in Corbo and Malanoski, 1996. The Contractor shall produce a Campbell-type interference diagram showing the relationship between operating range, natural frequencies and exciting frequencies with all relevant frequencies up to, and including, not less than 6 times (6X) operating speed. The stress analysis procedure shall be based upon a finite element analysis technique using a digital computer program that has been field calibrated with not less than five similar installations

The analysis shall include a time-integration study showing transient peak stresses resulting from startup, shutdown and motor control transients if synchronous drives are specified. The diagrams shall include calculated stresses throughout the range of frequencies considered in the analysis. Tomographic diagrams, displaying colorimetrically stresses at all positions in the pump shaft and all frames, including roots at changes in section and keyways or other stress concentrating locations, shall be provided with the analysis report. The diagram shall indicate operating speeds identified that produce the peak stresses and shall be specific for speeds inducing identified peak stresses at keyways, changes in section and at connections to other components. The reported stresses shall be combined stresses incorporating all identified loads from torsional, lateral and hydraulic sources.

c. **SHAFT RADIAL LOAD AND DEFLECTION:** Calculation of radial thrust loads shall be performed in accordance with the methodology set forth in ANSI/HI 1.3, paragraph 1.3.5.1. Shaft deflection calculations shall be performed in accordance with ANSI/HI 1.3.5.4. Shaft deflection criteria and limits shall be as required by API 610 (ISO

13709). Calculations justifying the shaft and bearing sizes (selected in accordance with the requirements of this Section, performed at 0%, 20%, 40% 60%, 80% 100% and 120% of BEP Flow and head shall be submitted with the information specified under paragraph 11050-1.08.

#### C. SUCTION WELLS FOR COLUMN PUMPS:

1. GENERAL: This paragraph applies where the detailed specification requires a column type pump to be installed in a suction or inlet well.

2. REQUIREMENTS: Where the detailed specification requires a column type pump to be installed in a suction or inlet well, the Contractor shall cause the well to be designed and provided by the pump manufacturer. The design shall include an arrangement that results in acceleration of flow down the suction well and into the cone. These provisions, however, shall not be construed as relieving the Contractor of responsibility for this portion of the work. Inlet wells shall be designed in accordance with the requirements of ANSI/HI 9.8 and design documentation shall be provided as a part of the information to be submitted under paragraph 11050-1.08.

3. MODEL TESTING: The Contractor shall cause the pump manufacturer to verify the design of suction or inlet wells for pumps specified in detailed sections with “Custom Engineered” in the section title by physical model tests conducted in accordance with ANSI/HI 9.8. Acceptance criteria for design confirmation and final report of the model study shall be as set forth in ANSI/HI 9.8.

The physical model shall include the pump, inlet well, upstream inlet piping, and any valving or piping appurtenances within the 10 D upstream reach preceding the inlet well.

The physical modeling effort shall be the product of a commercial hydraulics laboratory specializing in physical model studies of this type. Hydraulics laboratories associated with colleges or universities and pump manufacturer's hydraulics laboratories are specifically prohibited from providing this service. All development work required for the conduct of the study shall be under the direct supervision of an engineer licensed to practice in at least one of the states comprising the United States of America, hereinafter called ‘the design professional’ for the purposes of this paragraph. The design professional shall have not less than 10 years’ experience in hydraulic modeling of pump intake designs of at least the magnitude required by these specifications, using physical modeling techniques. Computation Fluid Dynamics (CFD) modeling techniques are not an acceptable substitute for the requirements of this paragraph. The final report, describing the work performed and the results and recommendations arising out of the study, shall bear the original seal and signature of the design professional.

### 1.06 QUALITY ASSURANCE – ALL PUMPS

#### A. QUALITY CERTIFICATION:

All manufacturers and manufacturing sites proposed by the Contractor for supply of equipment furnished under this section and sections referencing this section shall hold current certification under ISO 9001. Application for certification under ISO 9001 shall not be deemed

as an acceptable substitute for current certification. Documentation attesting to current certification shall be signed by an officer of the manufacturer's corporation and shall be notarized. The documentation shall also include the manufacturer's written Quality Assurance/Quality Confirmation (QA/QC) program and the documentation plan necessary for ISO 9001 certification.

**B. UNIT RESPONSIBILITY:**

The Contractor shall assign Unit Responsibility to the pump manufacturer in conformance with the requirements of Section 11000.

**C. PERFORMANCE CONFIRMATION:**

1. **HYDROSTATIC TESTS:** All pressure sustaining parts shall be subjected to factory hydrostatic tests. Hydrostatic tests shall conform to the requirements of paragraph 8.3.2 of ANSI/ ANSI/API 610. Castings shall be held at the test pressure for 30 minutes for all pumps with discharge nozzles 14 inches in diameter and less and for 60 minutes for pumps with discharge nozzles 16 inches in diameter and greater. Test results shall be certified correct by an officer of the pump manufacturer's corporation, and shall be notarized.

2. **PERFORMANCE GUARANTEE:** Unless specified otherwise in the detailed specification, pump performance (flow and head, efficiency and NPSH3) shall be guaranteed by the pump manufacturer to the criteria specified under this paragraph.

Equipment performance documentation, including test data, where tests are specified, shall include sufficient test points (not less than 8) to document hydraulic performance along the complete head/capacity curve from shutoff to maximum capacity and shall cover all full speed operating points specified in the detailed specification section referencing this Section. Tests conducted at specified operating conditions shall be the inlet throttled to produce the NPSHA indicated for that specific condition in the detailed specification. NPSH3 tests shall be performed for not less than four full speed operating conditions, but not less than all specified operating conditions and at Best Efficiency.

Test procedures shall conform to those set forth in ANSI/HI 14.6 acceptance grade 1U, and as specifically detailed in these specifications. Performance tests shall be conducted at the specified maximum speed. Affinity relationship-predicted test results will not be accepted. For column type pumps, performance documentation shall include curves showing both bowl efficiency and overall efficiency (including inlet, bowl, column and discharge head losses) at maximum operating speed for the application.

Acceptance criteria for head and capacity test results, based upon the rated condition specified in the detailed specification shall be as required in ANSI/HI 11.6 and 14.6, acceptance grade 1U.

Acceptance criteria for NPSH3 at any specified operating condition shall be the values proposed by the Contractor in the submittal curves submitted under paragraph 11050-1.08 and duly accepted by the Construction Manager, with a tolerance of plus 0, minus unlimited, with the

exception that suction specific speed, as calculated for the specific pump, shall not exceed the limitation established under paragraph 11050-1.04.B.

The guarantee shall include a statement to the effect that the pump will operate within the operating regions specified in the detailed specification. The guarantee shall be in writing, shall be signed by an officer of the manufacturing corporation, and shall be notarized. Under no circumstances shall deviations from specified operating conditions result in overload of the driver furnished with the equipment, nor shall such deviations result in power requirements greater than the driver's nameplate (1.0 service factor) rating.

3. NON-WITNESSED TESTS: Unless specified otherwise, all pumps shall be performance tested in accordance with ANSI/HI 14.6, Acceptance Grade 1E. The factory tests shall include test data for each full speed performance requirement (Condition Points A and B specified in the detailed specification) and any other points stipulated for this test procedure in the detailed specification. These tests shall be conducted with the pump inlet throttled to provide the specified NPSHA. For large column pumps, model performance testing with reduced NPSHA, pursuant to paragraph 11050-1.07.B.2, may be used. If specified in the detailed specification, test data at the full speed operating conditions shall include shaft vibration and case noise.

The test setup in the manufacturer's test facility shall duplicate as closely as possible the inlet conditions in the proposed installation, using temporary baffles and other means. Where centrifugal pumps are furnished with inlet elbows, inlet adapters or inlet reducers, the pumps shall be tested with the elbow, adapter or reducer fitted to the pump and specified performance criteria shall apply to the complete pump assembly, including losses through any elbow, adapter or reducer. Where submersible pumps are to be furnished with inlet nozzles and/or discharge elbows or adapters, the pumps shall be tested with these components fitted to the pumps. The specified performance requirements shall apply to the complete pumping assembly including any inlet nozzles, and discharge elbows or adapters. Certified test data shall include separate readings for inlet and discharge head for each data point.

Not less than eight test points shall be taken, including not less than three within  $\pm$  eight percent (in terms of rated flow) of the rated condition (Condition Point A) and not less than two test points within  $\pm 4$  percent of the pump's best efficiency point at the test speed. In addition, one test point shall be sufficient to define head and power requirements at shutoff head.

NPSH3 tests shall be performed to confirm the data used to establish NPSHA margin for each specified operating condition as specified in paragraph 11050-1.04.F. NPSH3 tests for column type (axial and mixed flow and vertical turbine) pumps shall be performed using the method described for Figure 2.74 or Figure 2.75 in ANSI/HI 2.6. NPSH3 tests for submersible wastewater pumps shall be performed using the method described in Figure 11.6.8 in ANSI/HI 11.6. All NPSH3 tests shall extend from 30 percent to 140 percent of Best Efficiency Flow at full speed, or to not less than 10 percent (in terms of flow) past the flow at Operating Condition B, whichever is greater. Failure to achieve specified performance or performance proposed in accepted submittal documents (capacity and head, efficiency or NPSH3), whichever

is more restrictive, shall be cause for rejection. Acceptance tolerances shall be as set forth in paragraph 11050-1.06.C.2.

All test procedures shall be in strict conformance with the referenced standards, except prediction of performance of a trimmed impeller from test data of the larger impeller will not be permitted. If trimming is required, the pump shall be retested. Under no circumstances shall deviations from specified operating conditions, though allowed by the referenced standards, result in overload of the driver furnished with the equipment, nor shall such deviations result in power requirements greater than the driver's nameplate (1.0 service factor) rating.

The Contractor shall furnish the Construction Manager with not less than two weeks' advance written notice of the date and place of the non-witnessed tests.

All test results, including test logs and generated curves, shall be certified correct by an officer of the pump manufacturer's corporation and shall be notarized. Contractor shall submit test results as Product Data.

## 1.07 QUALITY ASSURANCE – ADDITIONAL REQUIREMENTS

### A. SCOPE:

In addition to the requirements under Section 11050-1.06 applicable to all pumps, the following are required for the subset of larger and custom engineered pumps defined in Section 11050-1.01.A. Contractors are advised that the results of NPSH3 and pressure pulse tests will be used by the Construction Manager to determine if the tested pumps conform to the PACL requirements set forth in paragraph 11050-1.04 B. Failure to meet these requirements will likely require remanufacture of the pumps or rework of one or more of the pump components to achieve the required and necessary pump stability characteristics. All costs associated with such remanufacture or rework shall be borne by the Contractor.

### B. PERFORMANCE TESTING:

1. WITNESSED TESTS: All custom engineered pumps, and other pumps where required by the detailed specification, shall be subject to a witnessed factory performance, NPSH3 and pressure pulse tests in accordance with the provisions of this portion of the specifications. The Contractor shall furnish the Construction Manager with not less than two weeks' advance written notice of the date and place of the witnessed tests.

2. PERFORMANCE TESTS: Factory performance tests shall conform to the requirements of ANSI/HI 14.6, Acceptance Grade 1U. The factory tests shall include test data for each full speed performance requirement (Condition Points A and B specified in the detailed specification) and any other points stipulated for this test procedure in the detailed specification. These tests shall be conducted with the pump inlet throttled to provide the specified NPSHA. For large column pumps, model performance testing with reduced NPSHA, pursuant to 11050-1.07.B.5, may be used. Test data shall also include suction and discharge pressure pulse, shaft vibration and case noise at full speed.

The test setup in the manufacturer's test facility shall duplicate as closely as possible the inlet conditions in the proposed installation, using temporary baffles and other means. Where centrifugal pumps are furnished with inlet elbows, inlet adapters or inlet reducers, the pumps shall be tested with the elbow, adapter or reducer fitted to the pump and specified performance criteria shall apply to the complete pump assembly, including losses through any elbow, adapter or reducer. Where submersible pumps are to be furnished with inlet nozzles and/or discharge elbows or adapters, the pumps shall be tested with the inlet nozzles or adapters and the specified performance requirements shall apply to the complete pumping assembly including any inlet nozzles, and discharge elbows or adapters. Under no circumstances shall NPSHA exceed that specified in the detailed specification during any performance test. Certified test data shall include separate readings for inlet and discharge head for each data point.

Not less than eight test points shall be taken, including not less than four within  $\pm 8$  percent (on the basis of rated flow) of the rated condition (Condition Point A) and not less than two test points within  $\pm 4$  percent of the pump's best efficiency point at the test speed. In addition, one test point shall be sufficient to define head and power requirements at shutoff head.

3. NPSH3 TESTS: NPSH3 tests shall also be performed to confirm the data used to establish NPSHA margin for each specified operating condition as specified in paragraph 11050-1.04.F. NPSH3 tests for submersible wastewater pumps shall be performed using the method described in Figure 11.6.8 in ANSI/HI 11.6. All NPSH3 tests shall extend from 30 percent to 140 percent of Best Efficiency Flow at full speed, or to not less than 10 percent (in terms of flow) past the flow at Operating Condition B, whichever is greater. Failure to achieve guaranteed performance or performance proposed in accepted submittal documents, whichever is the more restrictive (capacity and head, efficiency or NPSH3) shall be cause for rejection. Tolerances and restrictions shall be as set forth in paragraph 11050-1.06.C.3, above, for non-witnessed tests.

4. PRESSURE PULSE TESTS: Pressure pulse testing shall be performed on all dry pit centrifugal pumps provided under specifications containing the term 'Custom Engineered' in the specification section title or where specified in individual pump specification sections. Pressure pulse testing equipment shall include sufficient calibrated transducers to measure both static and dynamic pressures simultaneously at the pump discharge and suction; the latter if a centrifugal pump. The transducers shall be suitable for narrow band spectrum analysis and shall be mounted less than one pipe diameter away from the pipe wall, with suction and discharge gauge taps at acceptable mounting locations. Operating pressure capability of the sensors shall be selected on the basis that the peak rating shall be less than four times the expected maximum pressure at the measurement location, with total accuracy (combined non-linearity, non-repeatability, and hysteresis as defined by IEC 61298-2) less than one percent of full scale. Sensors at pump inlets shall be capable of compound pressure output. Output from the sensors shall be recorded by vibration data acquisition equipment, with manual notation of either static or dynamic pressure unacceptable. A frequency range from DC to 20 times the maximum operating speed of the pump shall be used for dynamic pressure measurements. A lower frequency range for static measurements may be used if desired. Pressure data shall be obtained from steady operating conditions during testing, and for presentation purposes shall be the result of 16 full

averages at the maximum frequency range. Static pressures must be corrected for elevation and velocity head.

Pressure pulse test procedures shall consist of operating the pump at full speed and manipulating the position of the discharge valve to record simultaneous flow, head, vibration and pressure pulse data beginning with the discharge valve positioned to achieve flow and head at Condition Point B and increasing head by 5 percent increments until the magnitude of the pressure pulses at the pump inlet and discharge increase by not less than 20 percent at which time the test run for that speed shall be terminated.

Reporting shall consist of description of the measurement system and must include both frequency and pressure range of the sensors. A National Institute of Standards of Technology-traceable calibration curve for each sensor, obtained in the last calendar year, shall be provided as part of the report appendix. Dynamic pressures shall be displayed in a spectral format, with any discrete peaks identified with harmonic order relative to pump speed and flow. Any significant non-integer dynamic pressure peak, defined as a peak with amplitude equal to or greater than 25% of the largest discrete peak, shall be marked in the spectrum and a source

5. MODEL TESTS: Where allowed in the detailed specification or upon specific application with adequate justification by the manufacturer, confirmation of performance of large pumps may be demonstrated by testing the prototype at reduced speed or by testing a model of the prototype pump. NPSH3 tests shall also be performed to confirm the data used to establish NPSHA margin for each specified operating condition as specified in paragraph 11050-1.04.F. Failure to achieve guaranteed performance (capacity and head, efficiency or NPSH3) shall be cause for rejection. Physical model testing shall be performed at qualified, commercial facilities, with at least 10 years of continuous operation. All tests shall be conducted in accordance with ANSI/HI 1.6 or 2.6. with the following restrictions:

- a. If the prototype is tested at reduced speed the ratio of test speed to prototype speed shall not be less than 0.66:1.
- b. Model test ratios shall not be less than 0.33:1, model to prototype.
- c. Impellers for model tests shall be not less than 12 inches in diameter.
- d. Impellers for prototype pumps shall be subject to a model-to-prototype profile comparison using templates ratioed from the impeller used for the completed and accepted model test. Impeller profiles shall be compared for the x, y and z planes. If model testing is proposed for any or all of the specified tests, the Contractor shall include the proposed methodology for profile confirmation as a part of the submittal material required under paragraph 11050-1.08. Impeller profile comparison shall be performed with a representative of the Construction Manager present. All costs associated with travel and subsistence of the

Construction Manager's representative shall be borne by the Contractor.

- e. Acceptance criteria, based upon projected prototype performance from model test results using Hydraulic Institute approved affinity relationships, shall be as set forth above under paragraph 11050-1.06.C. 3.
- f. Restrictions set forth above for witnessed tests shall apply.

The Contractor shall furnish the Construction Manager with not less than two weeks' advance written notice of the date and place of the model tests.

6. TEST CERTIFICATION AND REPORTING: All test results, including test logs and generated curves, shall be certified correct by an officer of the pump manufacturer's corporation and shall be notarized. Contractor shall submit test results as Product Data.

#### C. CONFIRMATION OF PASSAGE GEOMETRY:

For solids handling pumps, the design waterway passages and mating passages between rotating and stationary portions of such passages shall be subjected to confirmation that no mismatch of exiting and entering angles or angular discontinuities exist in all pumps furnished under specification sections containing the words 'Custom Engineered' in the title. The confirmation process shall employ Computational Fluid Dynamics (CFD) modeling techniques in which mesh generation is optimized and mesh size reduce in the regions of flow attachment, detachment and separation regions of the impeller and cutwater to detect angular mismatches of 0.25 degrees or greater.

A number of different convergence criteria shall be used to assess whether or not a solution is converged. These criteria may include, the residuals given by the software, global imbalances in momentum, energy etc., whether key global quantities have reached an equilibrium value, and whether information from various solution monitoring points have stabilized. Note that these monitoring points should be in areas where the flow could be much weaker, and not where the flow could be converged easily. High convergence criteria shall be utilized and runs shall be repeated with different monitoring points to assure proper convergence.

The modeling software shall be one that is professionally customized and optimized for the determination pump fluid dynamics especially flow attachment, detachment and separation. The mathematical model and software accuracy shall be verified by experimental data from test cases including similar dynamics. The individual conducting the modeling effort shall be a computational fluid dynamics specialist with graduate level education in the subject and over 5 years of relevant experience. The model graphic outputs, signed and notarized by the pump manufacturer's officer in charge of engineering, shall be submitted as a part of the documentation required under paragraph 11050-1.08.

#### 1.08 SUBMITTALS

In addition to the material listed in the detailed specification, the following submittals shall be provided in accordance with Section 01300:

1. Documentation of successful pump designs as specified under paragraph 11050-1.04.B.1. If included as part of the design, the documentation shall include applications where pump cans of a similar size have been provided as part of the design.
2. Certificate of Unit Responsibility attesting that the Contractor has assigned unit responsibility in accordance with the requirements of this section and paragraph 11000-1.02.C. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
3. A copy of this specification section and the referencing section and all other applicable specification sections governing the pump, drive and driver, supports and specified appurtenances. The specification copies shall be complete with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check-marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
5. Documentation of certification in accordance with ISO 9001 as specified under paragraph 11050-1.06.A.
6. Predicted pump performance curves for each condition point specified showing head, power, efficiency, and NPSH required on the ordinate

plotted against capacity (in mgd) on the abscissa. Curves for variable speed pumps shall be provided to demonstrate operation at all speeds required to achieve the specified reduced speed operating conditions. All curves shall clearly display the specified operating conditions and the manufacturer's limits for the POR and AOR, as specified in paragraph 11050-1.04.B. Curves for column type pumps shall show bowl efficiency and allowances for inlet, column and discharge head losses separately.

7. NPSH margin calculations performed for each specified operating condition in accordance with paragraph 11050-1.04.F.2 or .3 as applicable and including the information required under paragraph 11050-1.04.F.1.
8. Motor submittal information as specified in Section 11060. In addition, this information shall include certified calculations for motor rotor and frame reed frequencies, as specified under paragraph 11050-1.04.G.
9. Complete description and sketch of proposed test setup for factory test if a factory test has been required under the detailed specification section. Submittal material shall include sample calculations and proposed test log format. If the Contractor proposes a model test for a part or all of the specified performance tests, the submittal information shall include the proposed model details and a complete description of the proposed method for comparing the model impeller profiles with the impeller profiles for the prototype pumps.
10. Drawings showing general dimensions and confirming the size of pumps, motors, drives and specified appurtenances; piping connections; construction details of equipment (including bearings and bearing isolators); wiring diagrams; and weight of equipment.
11. Variable-speed drive information as required under Section 11069 if the equipment specified includes variable speed capability.
12. Driver unit support calculations and data if the driver is separately supported and if the analysis under the requirements of paragraph 11050-1.05.B. has been required by the terms of these specifications.
13. Shaft deflection calculations for volute type pumps: provide calculations to demonstrate compliance with paragraph 11050-1.04.E, per the methodology set forth as required by Section 11050-1.05.B.5.c.
14. Detail drawings of the pump and driver unit foundation demonstrating conformance to this Section and Section 11002. Submittal shall include drawings depicting type, size, number, projection, and arrangement of anchor bolts, dimensional drawings of the sole and baseplates, dimensional drawings for the concrete supports for both the pump and motor, if applicable. Drawings shall also depict all other pertinent

information, including: location of equipment pads and reinforcement; equipment drains; expansion joint locations; elevation of top of grout and grout thickness; elevation of top of baseplate; soleplate; or mounting block; size and location of electrical conduits; and any other equipment mounting features embedded in equipment pads.

15. Limiting nozzle loading criteria, if different from that established by ANSI/HI 9.6.2.
16. The qualifications of the independent testing laboratory and individual personnel proposed by the Contractor to perform field vibration testing, analysis and reporting in accordance with the requirements of paragraph 11050-3.06.
17. The qualifications of the personnel proposed by the Contractor to perform field alignment procedures in accordance with the requirements of paragraph 11050-3.04.

The following are applicable for pumps meeting specified applicability criteria:

1. Qualifications of the design professional, and firm name, proposed to perform the mass elastic design analyses specified under paragraph 11050-1.05.B. if the subject analyses are required by the terms of these specifications.
2. Notarized certification attesting that the firm proposed to perform the mass elastic design analyses specified under paragraph 11050-1.05.B has no contractual arrangements with the proposed pump manufacturer.
3. Descriptive material outlining the methodology and software to be used in the analyses required under paragraph 11050-1.05.B.
4. “Executive Summary” report of the mass elastic design analyses for pumps as specified in paragraph 11050-1.05.B.
5. The proposed instrumentation setup for the in-situ torsional vibration test specified under paragraph 11050-1.05.B.4.d.
6. Suction or inlet well design documentation specified under paragraph 11050-1.05.C.2, including bolt patterns for pump base and soleplate on suction or inlet well.
7. Final report of the model study specified under paragraph 11050-1.05.C.3.
8. Model graphic outputs specified in paragraph 11050-1.07.C.

## PART 2--PRODUCTS

### 2.01 MATERIALS

#### A. GENERAL:

Where this section and sections referencing this section are silent with respect to materials of construction on any component, material selection shall follow the requirements of Table H.1, ANSI/API 610, Materials Class I-1, with the exception that all shafts for vertical column type pumps shall be 12 percent chromium stainless steel. Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

#### B. PUMPS:

1. FINISH FOR SURFACES IN CONTACT WITH PUMPED FLUID: All pump components in contact with the pumped fluid shall conform to the following requirements.

Surfaces to be machine-finished shall be indicated on the shop drawings by symbols which conform to ANSI B46.1, Surface Texture, Surface Roughness, Waviness and Lay. Machine surfaces shall be finished to at least the following tolerances (SI units):

##### Nominal Roughness:

Surface	Grade, Ref: ANSI B46.1 (SI units)
General Machine Work	3.2 or better
Flange Faces	3.2
Journal Surfaces at Sleeve Bearings	0.4
Hydraulic Surfaces	
Impeller	4.5 or better
Impeller Bowl and Diffuser	3.2 or better
All other wetted surfaces	6.3 or better

Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable will be cause for rejection. Machine finished surfaces shall be thoroughly cleaned and coated with protective layer of rust preventive. Small pieces, unassembled pipe or finished bolts, shall be oiled and wrapped with moisture resistant paper.

2. MATERIALS: Unless otherwise specified, wetted cast iron parts for pumps for solids bearing liquid services shall have 2 to 3 percent nickel added to the cast iron.

Stainless steel impellers shall be provided for the first stage of all custom engineered pumps, pumps intended for pumping screened or unscreened wastewater and elsewhere when specified. Stainless steel impellers shall be cast duplex stainless steel conforming to ASTM A995, Grades 2A, 3A, or 6A, with Charpy impact energies greater than 40 ft-lbs at -40°C per ASTM A923 method B. Where cast nickel aluminum bronze impellers are specified, the material shall conform to ASTM B148, Alloy C95500. Unless otherwise specified, second and successive stage impellers on multistage column pumps may be porcelain coated cast iron.

Materials for all shaft sleeves for packed boxes, fretting seals and interstage seals shall conform to ANSI/API 610, Annex H; 12 percent chromium hardened; or hard-faced 316 austenitic stainless steel. Materials for seal glands for packed boxes and shaft sleeves shall be AISI 316 stainless steel. Fastener parts of all types in wetted areas shall conform to ANSI/API 610, Materials Class S-5 requirements. Regardless of the seal construction, all seal chambers shall be adequately sized to accommodate specified mechanical seals.

#### C. FLYWHEELS:

Where flywheel assemblies are to be provided with the pumping equipment, pump pressure containing parts shall be of ductile iron conforming to ASTM A571. Materials of construction for the flywheels shall be as follows:

Frame:	Steel, ASTM A-36, welded and stress relieved.
Shaft:	Alloy Steel, ASTM A322, Grade 4142 HT, ST, BHN 375-388 for shafts 3.5 inches in diameter and less; Stainless steel, ASTM A564, Type 630 HT, Condition H1150 for shafts larger than 3.5 inches in diameter.
Rotor :	Steel, ASTM A36, or cast steel, ASTM A27 for flywheels 3 feet in diameter or less; Cast steel, ASTM A148 for flywheels greater in diameter than 3 feet. All stress relieved after machining.

## 2.02 GENERAL QUALITY

Details of manufacture and assembly of equipment furnished under this section and referencing sections shall follow the requirements of ANSI/API 610 with respect to the following features (paragraph references, ANSI/API 610):

1. Alignment aids (paragraph 6.1.24).
2. Removal of rotating element (paragraph 6.1.25).
3. Jackscrews for assistance in alignment on all baseplates and equipment supports (paragraph 9.3.8.3.2).

#### 4. Castings (paragraph 6.12.2).

All components or subassemblies weighing 50 pounds or more shall have at least one lifting eye or a provision for threading in a lifting eye. Components 250 pounds or greater shall have lifting eyes or provisions for at least two lifting eyes. Components 1000 pounds or greater shall have at least 3 lifting eyes or provisions for inserting lifting eyes.

### 2.03 BASEPLATES AND SOLE PLATES

Unless otherwise noted in the detailed specification, all pumps shall be furnished by the pump manufacturer with baseplates or soleplates conforming to the requirements of Section 11002. Baseplates and sole plates shall be designed to be installed in the housekeeping curb shown and shall be machined flat and co-planar to within 0.002 inch per foot in all directions on the face mating with the pump and motor or driver support. Sole plates shall have the words "THIS SIDE DOWN" permanently affixed to the underside using welding rod material prior to milling. Alternative marking methods, using heavy scribing or machining, are acceptable provided that they may be observed following blasting in preparation for coating.

### 2.04 WEARING RINGS

Where specified, pumps shall be fitted with both stationary and rotating wearing rings. Except for the difference in hardness between stationary and rotating rings, wearing rings shall be of stainless steel and shall conform to the requirements of ANSI/API 610, paragraph 6.7 and material class S-8 (Table H.1, Annex H). Maximum wearing ring clearances shall not exceed 150 percent of the values stated in Table 6, ANSI/API 610. Minimum wearing ring hardness on the rotating ring shall be 350 Brinell Hardness Number (BHN), with the stationary ring not less than 100 hardness points greater.

L-form wearing rings are not acceptable for wastewater, sewage, stormwater, thickener overflow, mixed sludge, digester circulation, digested sludge, waste activated sludge, return activated sludge or primary effluent pumping service.

### 2.05 BALANCE

Balancing for pumps with suction nozzle sizes 6 inches in diameter and greater and all associated components shall conform to the requirements set forth in ANSI/API 610, paragraph 6.9.4.1 (equivalent to ISO 1940 or ANSI 2.19 Grade 2.5), unless other portions of this project manual impose more restrictive requirements. It is the intent that the components be balanced as an assembly ("rotor") in accordance with ANSI/API 610 definitions. For extended shaft pumps, balance impeller(s) and shaft up to the first coupling with the line-shaft.

For separately balanced components, perform a residual unbalance inspection after rotor assembly per ANSI/API 610 requirements, as described in Annex J of that document. Provide copies of worksheets and demonstrate that tolerances are in compliance (i.e. rotor has passed) in addition to other reporting requirements of this paragraph.

All balance logs, certified correct and signed by an officer of the manufacturing corporation and notarized, shall be furnished as Product Data in accordance with paragraph 11050-2.09.

## 2.06 DRIVE UNIT SUPPORTS FOR SEPARATELY SUPPORTED MACHINES AND INTERMEDIATE SHAFT SUPPORTS

Supports for separately mounted vertical pump drivers and intermediate shaft bearings shall be composite structures of fabricated steel, ASTM A36. Unless otherwise specified, the supports shall be designed to span an opening in the floor sufficient to allow removal for the complete pump. Rolled steel beams shall be provided to stiffen the support and a fabricated steel driver unit support pedestal shall be mounted on the support plate. The support pedestal top plate and all portions of the support plate assembly intended to join with surfaces in the installation structure shall be milled flat and parallel to 0.002 inches per foot. Pedestals shall be provided with access provisions to adjust or assemble/disassemble couplings. The support shall be designed to be supported on a sole plate or sole plates embedded in a house keeping pad at the edges of the floor opening or as indicated. Other details for the driver unit support shall be as indicated.

## 2.07 FLYWHEEL ASSEMBLIES

When a flywheel assembly is specified, the moment of inertia ( $WR^2$ ) of the rotating element for each complete motor/pump set, including entrained water, pump rotor, shafting, couplings, and motor rotor shall be adjusted to provide the value specified in the detailed specification by providing a flywheel.

The flywheel shall consist of cast or fabricated steel weight in the form of a torus with supporting struts, keyed and locked on a shaft supported by bearings at each end of the shaft. Flywheels with diameters greater than three feet shall be double keyed to the shafts. If cast construction is used, the struts and weight shall be cast as a unit. The flywheel shall be designed and fabricated for a coefficient of fluctuation no larger than 0.05. A factor of safety of 5 shall be used for the ratio of operating speed to maximum safe operating speed. The lateral critical frequency of the flywheel assembly shall be higher than the maximum safe operating speed by a factor of 1.5.

If the weight is to be fabricated steel, it shall be machined from a single billet to the diameter and shape required. All flywheels (cast and fabricated alike) shall be stress relieved before balancing. The size of the weight and the distance of the torus centroid from the center of the shaft shall be sufficient to achieve the overall rotating moment of inertia ( $WK^2$ ) specified for the pump rotating system. Cantilevered designs employing only one set of bearings will not be permitted in stand-alone flywheel assemblies. Flywheels mounted on the motor shaft and using the bearings of a custom designed drive motor may be of the cantilever type. The flywheel assembly shall be included in the lateral, torsional and rotordynamic analyses specified under paragraph 11050-1.05.B.

Bearings shall be selected in accordance with ABMA 9 or 11 for an L-10 life of not less than 100,000 hours. Input and output bearings shall be held in place by rigid fabricated steel struts. The entire rotating assembly shall be balanced in accordance with paragraph 11050-2.05.

The flywheel assembly shall be furnished with a fabricated steel enclosure designed to provide protection against accidental entry of tools or other objects and to provide enclosure protection in accordance with OSHA requirements. The flywheel enclosure shall have an outside width of at least that of the motor, but not greater than 110 percent of the motor's width. The housing shall match the quality of the motor enclosure and shall be equipped with at least two lifting eyes. A mounting pad shall be located on the upper portion of the flywheel housing to permit installation of the vibration detector specified in Division 17 or the referencing section. The flywheel bearing housings shall be supported independently by a rigid frame to maintain alignment.

Where horizontal flywheels are required, the flywheel assembly shall be mounted on a baseplate common with the pump and motor. Frames for horizontally mounted flywheel assemblies shall be fitted with mounting pads for bolting to the pumping unit baseplate. Sufficient space shall be provided on each pad to permit dowelling to the baseplate after final alignment. End plates shall be similar to those provided for the motor and shall provide complete closure to prevent incidental access to the flywheel. The flywheel input shaft shall be direct connected to the motor output shaft by means of a flexible coupling, and the output shaft shall be designed to accommodate the shaft spacer coupling specified.

Where vertical flywheel assemblies are shown supporting the electric motor, the frame shall be designed to support the weight of the motor in accordance with the design requirements of this section. The flywheel assembly frame shall be extended to carry a support plate which shall be rabbeted to provide self-aligning features with the motor base. The frame extension shall have access openings to permit assembly/disassembly of the motor output shaft coupling. The lower flywheel assembly end plate shall be finished flat for mating with the support pedestal on the driver unit support, if so mounted, or rabbeted for alignment with the pump drive shaft if mounted on a column pump discharge head.

Where vertical flywheel assemblies are mounted separately from the pump and motor, the lower end plate shall be finished flat. The input shaft shall be keyed for the specified flexible coupling and shaft guards shall be provided

## 2.08 INLET WELLS FOR COLUMN TYPE PUMPS

Unless specified otherwise, suction or inlet wells for column type pumps shall be fabricated from ASTM A36 steel with internal baffles fillet welded to the interior surface of the inlet well. Seal welds all around shall be provided at all welded joints and all welds shall be ground smooth. All internal surfaces shall be prepared and coated after welding with fusion-bonded epoxy conforming to the requirements of AWWA C213 using NSF/ANSI 61-compliant materials (3M Scotchkote 134, or approved equal). Minimum coating thickness shall be 12 mils. External epoxy coating shall be in accordance with Section 09900 requirements.

Where the detailed specification requires an inlet well suitable for service with an upstream hydraulic gradient in excess of the elevation required for the pump discharge head, the flanged connection to the pump discharge head shall be gasketed or fitted with a double O-ring seal designed to withstand not less than twice the pressure specified in the detailed specification

## 2.09 MACHINING

All machined surfaces shall have a 90 micro inch Ra finish without any grooves, surface imperfections or machining marks of any sort. Mating surfaces shall be coplanar within a maximum of 0.001 inches. Surfaces that are in contact with a gasket such as flanges and casing joints shall have the customary concentric grooves pattern to increase leak path. Bearing housings and seals shall all have collinear centerlines within less than 0.001 inch total difference. Shafts shall have a 64 micro inch Ra finish.

## 2.10 PRODUCT DATA

The following information shall be provided in accordance with Section 01300.

1. Performance guarantee as specified in paragraph 11050-1.06.C.
2. Equipment anchor calculations specified in paragraph 11050-1.04 E.2.
3. Operation and maintenance information specified in Section 01730.
4. Motor Product Data as specified in Section 11060.
5. Bearing L-10 life calculations.
6. Critical speed calculations demonstrating compliance with paragraph 11050-1.05.B shall be provided if a lateral rotordynamic analysis is required. Otherwise, critical speed calculations demonstrating compliance with paragraph 11050-1.04.C shall be provided.
7. Nozzle loading information required under paragraph 11050-3.01.
8. Motor balance logs, certified and notarized as specified in paragraph 11050-1.04.G.3.
9. Certified balance logs and worksheets, as specified in paragraph 11050-2.05.
10. Installation Certification Form 11000-A as specified in paragraph 11050-3.01.
11. Training Certification Form 11000-B as specified in paragraph 11050-3.08.

12. If factory tests are specified in the detail specification section, certification of satisfactory testing of each unit as specified. The certified material shall include copies of test logs and resulting performance curves. The results of pressure pulse tests shall also be included.
13. Documentation of field alignment data in accordance with Section 11005.

The following are applicable for pumps meeting specified applicability criteria:

1. Results of model tests for pump inlet wells if model tests are required by the provisions for paragraph 11050-1.05.C.
2. "Final Report" of mass elastic systems analyses for pumps as specified in paragraph 11050-1.05.B.
3. Results of motor rotor, frame and assembly bump tests, certified as specified under paragraph 11050-1.04.G., along with the design professional's "Supplemental Report" as specified under paragraph 11050-1.05 B.2.
4. Pump inlet well installation acceptance certification, as specified in paragraph 11050-3.03, if applicable.
5. Results of field vibration tests as specified under paragraph 11050-3.06.

## PART 3--EXECUTION

### 3.01 GENERAL

With the exception of submersible pumps and the inlet connection for column type pumps installed in open forebays or wet wells, all pump inlet and discharge nozzles shall be connected to field piping using equipment connection fittings conforming to the requirements of Section 15085. Restraining rods on equipment connection fittings shall be designed specifically to restrain the unbalanced hydraulic thrust developed by the pump when operating at full speed against a closed valve. All restraining rod nuts shall be torqued to assure that any moment or shear transmitted to the pump nozzles is within the values permitted under ANSI/HI 9.6.2 or that permitted by the equipment manufacturer, whichever is greatest. Where ANSI/HI 9.6.2 is silent with respect to any particular aspect of allowable nozzle loads, the Contractor shall follow the written requirements provided by the equipment manufacturer. All pumps furnished under specification sections containing the words 'Custom Engineered' in the title shall be installed under the presence of a factory authorized installation specialist or specialists. Under no circumstances shall any installation procedures take place without the installation specialists present. Equipment installation procedures shall conform to the requirements of Section 11002. Upon completion of installation work, the Contractor shall submit a complete, properly signed certification Form 11000-A as specified in Section 01999.

### 3.02 SOLE PLATES

Sole plates, if provided as required by this section, or any section referencing this section, or where required by the equipment manufacturer's recommendation, shall be leveled in the presence of a factory authorized installation specialist to a maximum tolerance of 0.002 inches/foot in all directions. Where the equipment manufacturer requires more stringent tolerances, those tolerances shall prevail.

### 3.03 PUMP INLET WELLS

When specified, pump inlet wells shall be installed as indicated to the following tolerances:

Horizontal position:  $\pm 0.125$  inches in all directions

Vertical axis: within  $\frac{1}{2}$  degree from vertical

Level: 0.02 inches per foot of diameter at the pump baseplate bolt circle

Elevation:  $\pm 0.125$  inches from planned elevation

Where the equipment manufacturer requires more stringent tolerances, those tolerances shall prevail.

Installation of equipment in pump inlet wells shall not take place until the pump manufacturer's factory trained and authorized installation specialist has furnished the Construction Manager with written and signed certification that the inlet well has been installed satisfactorily and is acceptable for installation of the equipment.

### 3.04 ALIGNMENT

Journeyman millwrights shall perform alignment of equipment furnished under this section and any referencing section. Carpenters, laborers or any other trades are specifically excluded from performing this work. In locations where such trades are not available, the Contractor shall retain the services of a firm specializing in this type of work to perform the setting and alignment work. The Contractor shall submit the qualifications of the proposed firm to the Construction Manager for acceptance prior to performing the work. The Construction Manager shall personally witness final alignment procedures for each item of equipment as a condition precedent to beginning any work required under Section 01660. Alignment techniques shall conform to the requirements of Section 11005.

### 3.05 FIELD TESTING

Field testing shall conform to the requirements of Section 01660. For all pumps furnished under specification sections containing the words 'Custom Engineered' in the title, the

testing procedure shall be a plan developed jointly by the Contractor and the equipment manufacturer to demonstrate performance of each item of equipment at all specified operating conditions.

Field testing includes lateral and vertical vibration, inlet and discharge pressure pulse and torsional vibration testing, as applicable.

### 3.06 FIELD VIBRATION AND PRESSURE PULSE TESTS

#### A. QUALIFICATIONS:

The Contractor shall retain the services of an independent testing laboratory to conduct the testing work specified under this paragraph. The work shall be directed by a professional mechanical engineer, registered to practice in any one of the 50 states making up the United States of America. The engineer (hereinafter termed “professional vibration analysis specialist”) shall be a graduate of a college holding ABET accreditation in mechanical engineering and shall have been engaged in the practice of providing the type of monitoring services required under this paragraph for rotating machinery for a period of not less than 10 years. The professional vibration analyst’s qualifications and references, certified and notarized, shall be submitted for review and acceptance by the Construction Manager not less than 6 weeks prior to the date scheduled for the field vibration test work specified herein. The Construction Manager shall review the required documentation and references and indicate acceptance or rejection of the proposed analyst’s qualifications within 14 days of submission. If the analyst proposed by the Contractor is rejected, the Contractor shall propose an alternative choice with appropriate documentation.

The independent testing laboratory’s testing team (comprised of the professional vibration analysis specialist and any technicians required to complete the specified tasks) shall be fully equipped to provide continuous pressure, velocity and displacement values for all rotating equipment installed under the requirements of this section. Vibration testing equipment shall include sufficient calibrated pressure and flow monitoring devices to determine pump operating conditions as well as vibration levels. Pressure pulse tests shall be conducted on all pumps where the words “Custom Engineered” appear in the specification title or where specified in the individual pump specification sections. Pressure pulse tests for vertical column type pumps (axial flow and vertical turbine pumps with submerged intakes) shall be limited to the discharge connection only.

#### B. VIBRATION TESTS:

RMS vibration velocity on any component when the pump is operating at any specified continuous duty operating condition shall not exceed the limits established for the appropriate machine by Tables 8 and 9 in ANSI/API 610 when the pump is operating within the PACL. Field vibration for custom engineered column type vertical pumps and motors shall not exceed 2.5 mils peak to peak RMS when the pump is operated at any capacity condition within 85 percent and 115 percent of the pump’s Best Efficiency Point capacity at full speed, when measured at the top of the pump motor. When operating at any combination of conditions

outside the POR for any pump, regardless of type, limiting values shall be 25 percent greater than the above limits.

Vibration test reports shall be submitted as Product Data, directly to the Construction Manager, and shall bear the signature of the responsible professional vibration analysis specialist. Vibration spectra shall be of sufficient resolution for legibility of magnitude and frequency data to be properly reviewed by the Construction Manager. Cascade diagrams are not sufficient for variable speed drive application unless supported by the required data in a format suitable for more detailed analyses. Separate spectra shall be provided at the maximum and minimum operating speeds and any potential resonant frequencies.

### C. PRESSURE PULSE TESTS:

Pressure pulse testing shall be performed on all dry pit centrifugal pumps provided under specifications containing the term 'Custom Engineered' in the specification section title or where specified in individual pump specification sections. Pressure pulse testing equipment shall include sufficient calibrated transducers to measure both static and dynamic pressures simultaneously at the pump discharge and suction; the latter if a centrifugal pump. The transducers shall be suitable for narrow band spectrum analysis and shall be mounted less than one pipe diameter away from the pipe wall, with suction and discharge gauge taps at acceptable mounting locations. Operating pressure capability of the sensors shall be selected on the basis that the peak rating shall be less than four times the expected maximum pressure at the measurement location, with total accuracy (combined non-linearity, non-repeatability, and hysteresis as defined by IEC 61298-2) less than one percent of full scale. Sensors at pump inlets shall be capable of compound pressure output. Output from the sensors shall be recorded by vibration data acquisition equipment, with manual notation of either static or dynamic pressure unacceptable. A frequency range from DC to 20 times the maximum operating speed of the pump shall be used for dynamic pressure measurements. A lower frequency range for static measurements may be used if desired. Pressure data shall be obtained from steady operating conditions during testing, and for presentation purposes shall be the result of 16 full averages at the maximum frequency range. Static pressures must be corrected for elevation and velocity head.

Pressure pulse test procedures shall consist of operating the pump at the speed required to meet each individual specified operating condition and manipulating the position of the discharge valve to record simultaneous flow, head, vibration and pressure pulse data beginning with a wide open discharge valve at full speed and increasing head by 5 percent increments until the magnitude of the pressure pulses at the pump inlet and discharge increase by not less than 20 percent at which time the test run for that speed shall be terminated. This procedure shall be repeated for each of the operating speeds required for each specified operating condition.

Reporting shall consist of description of the measurement system and must include both frequency and pressure range of the sensors. A National Institute of Standards of Technology-traceable calibration curve for each sensor, obtained in the last calendar year, shall be provided as part of the report appendix. Dynamic pressures shall be displayed in a spectral format, with any discrete peaks identified with harmonic order relative to pump speed and flow. Any

significant non-integer dynamic pressure peak, defined as a peak with amplitude equal to or greater than 25% of the largest discrete peak, shall be marked in the spectrum and a source postulated in the discussion of the data.

### 3.07 FIELD TORSIONAL VIBRATION TESTING

Where required by these specifications, field torsional vibration tests shall be performed under the direct supervision of the design professional responsible for the mass elastic system design on a pumping unit selected by the Construction Manager.

### 3.08 TRAINING

Training shall conform to the requirements of Section 01664 and shall include separate training sessions for each operator shift maintained by the Owner and a separate session for maintenance personnel. Unless otherwise specified in the referencing section, the training requirement is waived for constant speed pumping equipment with suction nozzle sizes 6 inches in diameter and smaller and for all pumps with connected power requirements 10 horsepower and less. The training session for maintenance personnel shall include a comprehensive presentation, employing cut-away models or comparable graphics, and documentation on the step-by-step disassembly and subsequent reassembly of a pumping unit. Upon completion of all training requirements, the Contractor shall submit certified Form 11000-B as specified in Section 01999.

**\*\*END OF SECTION\*\***

SECTION 11060  
ELECTRIC MOTORS

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies single and three phase, horizontal and vertical, single-speed and two-speed, low-voltage (600 volts and less), energy efficient (900 rpm) and premium efficiency (1200, 1800, and 3600 rpm) alternating current, induction motors, 250 horsepower or less. Standard NEMA MG 1 motors are specified, as modified herein.

This section also specifies IEEE 841 severe-duty, totally enclosed fan-cooled (TEFC Type-2, specified herein) squirrel cage induction motors from 1 to 500 horsepower with voltage ratings of 230V, 460V, 2300V, and 4000V. See Custom Motor criteria within the driven equipment specification for voltages above 600V and for high horsepower.

Motors shall be provided in compliance with these specifications. Ambient conditions for the Project are specified in Section 01800. Provide motors suitable for continuous operation under the ambient conditions:

1. Temperature: 0 degree C to 40 degree C.
2. Altitude: 10 feet above sea level.

Motors shall have aluminum rotor material and copper stator windings with F-insulation without exceeding the B-temperature rise of 80-degree C at rated load and with Design-B torque / current characteristics rated for continuous operation duty.

Two-speed motors shall be two-winding motors. Two-speed, one-winding consequential-pole motors that require special motor starters are prohibited.

Refer to Motor Types-1, 2, and 3 Classification and Inverter Duty variable torque and constant torque specification requirements herein. Motor Types-1, 2, and 3 have the additional requirements of Inverter Duty Motors as specified or scheduled.

Enclosures, as specified elsewhere in the Project Contract Documents:

- A. TYPE-1 – OPEN DRIP PROOF (ODP)
- B. TYPE-2 – TOTALLY ENCLOSED FAN COOLED (TEFC)
- C. TYPE-3 – EXPLOSION PROOF (EP)

D. CUSTOM MOTORS

1. Weather Proof-I (WP-I)
2. Weather Proof-II (WP-II)
3. Totally Enclosed Blower-Over (TEBC) for additional cooling

E. SPECIAL PURPOSE MOTORS: PER DRIVEN EQUIPMENT  
MANUFACTURER (Not Used)

1.02 QUALITY ASSURANCE

A. GENERAL

Motors shall be built in accordance with UL 674, UL 1004, and NEMA Standard MG 1. Motor nominal and minimal efficiency shall be based on NEMA MG 1, Table 12-10.

Motors shall comply with Energy Policy Act of 1992 (EPA) with full-load efficiency measurements per IEEE Standard 112, Test Method B, and shall comply with the requirements specified.

IEC Metric Motors and imported EPA Motors that do not meet the NEMA standards are prohibited.

B. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
IEEE 112	Standard Test Procedures for Polyphase Induction Motors and Generators
IEEE 841	Standard for Petroleum and Chemical Industry-Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 500 HP
NEMA ICS 2	Industrial Control and Systems Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NEMA MG 1	Motors and Generators
NEMA MG1-30	Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable- Frequency Controls or Both.  Note: Specifications for Standard TENV Submersible Motors rated 1/2 – 200 HP, 140TY-L360TY Frames, and rated at 200, 230, 460, 575, 600 Volt are available from motor manufactures.
NEMA MG1-31	Definite-Purpose Inverter-Fed Polyphase Motors: Rated 5000 horsepower or less at 7200 volt or less, intended for use with adjustable-voltage and adjustable frequency controls, commonly referred to as inverters.
UL 674	Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 1004	Electric Motors

### C. FACTORY TESTS

The manufacturer's factory motor Prototype Tests per IEEE Standard 112 Appendix-A on motors through 250 horsepower shall be submitted. Actual factory tests for these motors are not required. The standard routine factory tests shall be conducted, that may include:

1. Winding resistance in ohms and converted to 25 degree C.
2. Resistive Unbalance and Quarter Voltage Impedance, as applicable.
3. Locked-Rotor current (Single phase).
4. High Potential.
5. No-Load Excitation (volts, amperes, RPM).

6. Bearing vibration check.
7. Efficiency, Power Factor, Current at 115%, 100%, 75%, 50%, and no load.

#### D. WARRANTY

All motors ½ horsepower and greater shall be warranted against defects in materials and workmanship for a period of 1.5 years.

All motors specified to conform to IEEE 841 shall be warranted against defects in materials and workmanship for a period of five years.

All warranties shall be submitted in writing and shall include as a minimum 100 percent full payment coverage for parts and labor for repair or replacement of the motor during the entire warranty period due to defective workmanship or materials.

#### 1.03 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 and shall include the following:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole.

If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Motor Data Sheets:
  - a. For all motors other than those specified to conform to IEEE 841, supplier completed "Form 11060-A" in specification Section 01999 with required factory data.
  - b. For all motors specified to conform to IEEE 841, manufacturer completed IEEE Standard 841 Data Sheet for AC Squirrel Cage Induction Motors.
3. Speed-Torque curve per 1.02 C Factory Tests.
4. Factory test data for motors required to be subject to manufacturer's complete factory dynamometer tests as specified in paragraph 11060-1.02 C.
5. Guaranteed vibration level when measured per MG 1, Figure 7-6:
  - a. Displacement: 0.0025 inch peak-to-peak.
  - b. Velocity: 0.15 inches per second peak.
  - c. Acceleration: 1g (gravity) peak.
6. Motor heating curve for motors per 1.02 C Factory Tests.
7. Motor outline, dimensions, and weight.
8. Manufacturer's descriptive information relative to motor features.
9. Response curve where a winding over-temperature device is required.
10. For all inverter duty motors: Manufacturer's certification that the motor is compatible with the adjustable frequency drive to be used and that the motor meets the requirements of NEMA MG1 Part 31 as required herein.

#### 1.04 POWER SUPPLY VARIATIONS

Motors shall operate successfully under running conditions at rated load with +/- 10-percent of rated voltage with rated frequency or +/- 5-percent of rated frequency with rated voltage.

#### 1.05 NEMA WINDING TEMPERATURES

NEMA MG 1 Table 12-7 motors insulation system maximum winding temperatures in degrees-Centigrade (C), with the degrees-Fahrenheit (F) insulation system class specified herein.

1. Forty degree-C ambient (104 degree-F) is the basis for temperature rise.
2. For 50 degree C ambient (122F) and above, refer to the driven equipment specifications for additional requirements.

Insulation System Class	Degrees C / F	Temperature Rise by Resistance
A	140 / 284	NA
B	165 / 329	B-rise: 40 + 80 = 120 Degrees C / 248 F
F	190 / 374	F-rise: 40 + 105 = 145 Degrees C / 293 F
H	215 / 419	H-rise: 40 + 125 = 165 Degrees C / 329 F

#### 1.06 NEMA MOTOR TEMPERATURE PROTECTION TYPES

Refer to Thermal Protection in Part-2 for thermal device requirements. The NEMA design shall limit the temperatures of the windings without using a thermal device:

- A. NEMA Type-1: Winding Running and Locked Rotor Over-temperature Protection.
- B. NEMA Type-2: Winding Running Over-temperature Protection.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

The following manufacturer's motors generally meet the class and performance requirements of this specification when furnished with appropriate modifications and additional features as specified:

#### A. HORIZONTAL MOTORS

1. Type 1 - Premium efficiency guarded, open-drip-proof motors manufactured by:
  - a. Baldor-Reliance:
    - 1) Type ODP
    - 2) Type XEX
  - a. Emerson US Motor: Type DE or RE
  - b. General Electric Inc.: Type KS

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2. Type 2 - Premium efficiency totally enclosed-fan cooled, Chemical Industry severe duty motors manufactured by:
  - a. Baldor-Reliance Electric Co.:
    - 1) Type IEEE 841 XL Severe Duty
    - 2) Super-E Severe Duty TEFC IEEE 841
    - 3) Super-E TEFC for HVAC applications over 2 horsepower
  - b. Emerson US Motors: Type CE IEEE 841
  - c. General Electric X\$D Ultra 841:
    - 1) TEFC IEEE 841 Severe duty
    - 2) Inverter rated
  - d. Siemens TEFC, Severe Duty
    - 1) 1 to 400 hp
    - 2) SD100-IEEE 841: 1-20 hp in Frames 143T – 256T
    - 3) RGZEESDX: 25-400 hp in Frames 284T to 449T
  - e. WEG Electric Corp:
    - 1) TEFC IEEE 841 NEMA Premium Efficiency
    - 2) Motors Severe /Chemical Duty
    - 3) 1 hp NEMA Frame 143T to 500 hp NEMA Frame 586/7
3. Type 3 - Premium efficiency explosion-proof motors manufactured by:
  - a. Baldor-Reliance:
    - 1) XEX-XP, IP 54 with Temperature Code: T3C
    - 2) Super-E Explosion Proof with Temperature Code: T3C
  - b. Emerson US Motor: Type LCE

- c. General Electric: Type KS - Explosion Proof
- d. Siemens: RGZZESDI with Temperature Code: T3C

## B. VERTICAL MOTORS

1. Types 1 and Type 2 - Premium efficiency ODP and TEFC motors manufactured by:
  - a. Baldor-Reliance:
    - 1) Super-E Severe Duty IEEE 841
    - 2) Super-E TEFC for HVAC applications over 2 horsepower
  - b. Emerson US Motors:
    - 1) Type TUCE Corroducty
    - 2) Titan Line
  - c. General Electric:
    - 1) Type KS
    - 2) Value Line WP-1 deep well, hollow-shaft, high-thrust, high-efficiency, inverter duty 4:1 turndown, speeds: 3600, 1800, 1200 rpm, 5-300 horsepower
  - d. Siemens:
    - 1) RGZVESD: solid shaft, TEFC, severe duty, normal thrust, P-Base: 1-250 hp
    - 2) RGZVILESD: solid shaft, TEFC, severe duty, in-line thrust, P-Base: 1-250 hp
2. Type 3 - Premium efficiency explosion-proof motors manufactured by:
  - a. Baldor-Reliance: Super-E Explosion Proof
  - b. Emerson US Motors: Type LUCE
  - c. General Electric: Type KS, Class I, Group D
  - d. Siemens:
    - 1) RGZZVESD: solid shaft, EP, hazardous duty, normal thrust, P-Base: 1-250 hp with Temperature Code: T2A
    - 2) RGZZVILESD: solid shaft, EP, hazardous duty, in-line thrust, P-Base: 1-250 hp with Temperature Code: T2A

C. MOTOR TYPES 1, 2 OR 3 RATED FOR INVERTER DUTY SERVICE

1. Baldor-Reliance Electric Inc.:
  - a. V\*S Master XT:
    - 1) Variable Torque rated motor
    - 2) Constant Torque rated motor
2. Baldor-Reliance:
  - a. Vertical and horizontal.
  - b. TEBC, TENV, and TEFC:
    - 1) Variable Torque rated motor
    - 2) Constant Torque rated motor
3. General Electric Inc.:
  - a. KAF design for ODP, TEFC, or TEFC Severe Duty enclosures
  - b. KAF design in horizontal TEFC Severe Duty and EP enclosures with ASD construction for constant torque: 1000:1
  - c. XSD Ultra for Severe Duty IEEE 841
  - d. Value Line WP-1 vertical deep well:
    - 1) hollow-shaft, high-thrust, high-efficiency
    - 2) inverter duty with 4:1 turndown
    - 3) 3600, 1800, 1200 rpm
    - 4) 5-300 horsepower
4. Emerson US Electrical Motors:
  - a. VFM - Horizontal (TEFC) IEEE 841 Plus S:
    - 1) Variable Torque rated motor: 10:1 turndown
    - 2) Constant Torque rated motor: 4:1 turndown

5. Siemens:

a. TEFC RGZESDI:

- 1) Variable Torque rated motor
- 2) Constant Torque rated motor: 10:1 turndown

b. TEBC RGZESDI:

- 1) Constant Torque: 1000:1 turndown
- 2) Blower cooled

c. EP RGZZESDI:

- 1) Variable Torque: 6:1 turndown
- 2) Constant Torque: 6:1 turndown

2.02 GENERAL

A. NAMEPLATES

Motor nameplates shall be engraved or stamped stainless steel. Information shall include those items enumerated in NEMA Standard MG 1, as applicable. Nameplates shall be permanently fastened to the motor frame and shall be visibly positioned for inspection.

Additionally, provide the following information on nameplates or additional nameplates for:

1. Motors 1/2 horsepower and larger: Indicate the ABMA L-10 rated life for the motor bearings based on load data.
2. Motors 2 to 50 horsepower: Indicate the NEMA nominal efficiency.
3. Explosion-Proof motors: Indicate UL frame temperature limit code.
4. Space heater information.
5. NEMA MG 1 Over Temperature Protection Type Number.
6. Temperature device rating and alarm and shutdown setpoint information.

B. CONSTRUCTION

All motors provided under this specification shall have the following features of construction:

1. Frames:
  - a. Cast iron frames for TEFC motors and motors 60 horsepower and larger.
  - b. Steel frames for non-TEFC motors smaller than 50 horsepower.
  - c. Aluminum frame motors will not be permitted.
2. Stamped steel or cast metal fan shrouds with non-sparking fan blades.
3. Non-hygroscopic motor leads.
4. NEMA Design-B as standard design. NEMA Design-A, C, or D shall be identified as custom design features in the driven equipment specifications.
6. Motor Service Factor (percent of additional horsepower):
  - a. SF: 1.15 for Types-1, 2, and 3 Sine-wave motors.
  - b. SF: 1.0 for Inverter Duty motors.
  - c. SF dual rating: 1.15 Sine-wave and 1.0 Inverter Duty.
7. Grounding terminal in conduit box.
8. Stainless Steel nameplate.

2.03 MOTORS LESS THAN 1/2 HORSEPOWER

A. GENERAL

Motors less than 1/2 horsepower shall be squirrel cage, single phase, capacitor start, and induction run type with Class B or F insulation. Fan motors rated 1/8 horsepower or less may be split-phase or shaded-pole type. Windings shall be copper.

B. RATING

Motors shall be rated 115 volts, single phase, 60 hertz, and shall be continuous-time rated in conformance with NEMA Standard MG 1. Motors shall be non-overloading at all points of the equipment operation.

## C. ENCLOSURES

Motor enclosures shall be as defined in NEMA MG 1. Motors shall have totally enclosed fan cooled (TEFC) or totally enclosed non-ventilated (TENV) enclosures, unless specified otherwise in the driven equipment specification.

Explosion-proof (EP or XP) motors shall bear the UL Label for Class I, Division 1, Group D hazardous locations. The nameplate shall indicate the UL frame temperature limit code T2A. The enclosure surface temperature shall not exceed 280 degrees C. Provide self-protected over-temperature device in the motor to detect and automatically de-energize the motor if the frame temperature limit is exceeded and automatically reset.

### 2.04 MOTORS 1/2 HORSEPOWER THROUGH 250 HORSEPOWER

#### A. GENERAL

Motors 1/2 horsepower through 250 horsepower shall have copper windings and shall be three phase, squirrel cage, induction type rated for full-voltage start and continuous duty and rated for 460-Vac.

Motors shall have a NEMA MG 1 design for the duty service imposed by the driven equipment such as frequent starting, intermittent overload, high inertia, mounting configuration, or service environment.

#### B. RATING

Motors shall be rated 460 volts, three-phase, 60-Hertz, and shall be continuous time rated in accordance with NEMA Standard MG 1. Refer to the driven equipment specification for custom motors or special purpose motors with voltage rating above 460 volts.

Unless specified otherwise, motors shall have a service factor of 1.15 with additional 15-percent horsepower. Motors shall not be required to exceed the nameplate rating at service factor 1.00.

#### C. MOTOR TYPE CLASSIFICATIONS

##### 1. GENERAL

- a. Definition of terms shall be in accordance with NEMA MG 1.

##### 2. TYPE 1 MOTORS

- a. Enclosure: Open drip-proof, guarded ventilation openings (ODP).

- b. Class F insulation and Class B temperature rise at the motor's nominal rating.

3. TYPE 2 MOTORS

- a. Enclosure: Totally enclosed, fan cooled (TEFC).
- b. Class F insulation and Class B temperature rise at the motor's nominal rating.
- c. Conform to IEEE 841 Chemical Industry-Severe Duty rating through 500 Horsepower.
- d. Surfaces shall be coated with a corrosion-resistant treatment such as an epoxy paint that passes ASTM B117 for 96-hours.
- e. No load airborne sound power level below 90-dBA per MG 1 Part-9.
- f. Breather/drain fitting instead of solid drain plug.
- g. International Protection Standard IP55 bearing enclosure.

4. TYPE 3 MOTORS

- a. Enclosure: Explosion-proof motors (EP or XP).
- b. UL listed in accordance with UL 674 for Class I, Group D for Hazardous Atmospheres.
- c. Bear UL Label for Class I, Division 1, Group D Hazardous locations.
- d. UL-approved breather/drain device in the motor drain hole.
- e. Class F insulation.
- f. Nameplate: Indicate the UL frame temperature limit code T2A without thermostat and T2D with thermostat.
- h. Rated for the UL surface temperature limit codes for Class I Group D for gasoline, petroleum, alcohols, natural gas etc:
  - 1) Motor designed below the UL frame temperature limit code T2A of 280 degrees C or

- 2) Provide an internal frame temperature thermostat that meets the UL frame temperature limit code T2D of 215 degree C with normally closed contact rated 5-amperes at 115-Vac.

#### D. THERMAL PROTECTION

Type 1, Type 2 and Type 3 motors that require motor over-temperature protection, as defined in NEMA MG 1-12, with the motor controller interface wiring and devices as indicated on the drawings for the following:

1. Inverter duty motors and totally-enclosed-air-over (TEAO) motors:
  - a. NEMA Type-2 motor over-temperature self-protection: Thermal-overload, self-reset bimetallic Klixon switch for motors 5 horsepower and smaller.
  - b. Motors larger than 5 horsepower require controller alarm / trip:
    - 1) Self-powered by motor temperature or by motor voltage: the motor mounted auxiliary device with two Form-C output contacts wired to variable speed or adjustable frequency drive to shut down the motor controller. Both the normally open contact and the normally closed contact shall be available at the motor terminal box for remote alarm and shutdown functions. Indicate the setpoints on the temperature device nameplate.
    - 2) Non-self-powered power thermal devices are prohibited.
    - 3) Factory set thermal protection device with alarm and trip setpoints indicated on the motor device nameplate.
    - 4) Factory wired to separate motor termination box.
2. Motors 300 horsepower and larger and higher voltage. (Not Used)
3. Auxiliary equipment shall have normally closed NEMA ICS 2 B300 contacts and shall be housed in NEMA 250 enclosures as follows:
  - a. Type 1 motors NEMA 12.
  - b. Type 2 motors NEMA 4.
  - c. Type 3 motors NEMA 7D.

## E. INVERTER DUTY MOTORS

Motors for use with adjustable frequency controllers shall be inverter duty motors specifically designed for inverter service for the speed range and load torque characteristic required by the associated driven equipment. Inverter duty motors shall be specifically certified compatible with the adjustable frequency controller and driven equipment, as specified in Section 11000-1.02C Unit Responsibility.

Motors for use with adjustable frequency controllers shall not exceed NEMA MG 1, Class B temperature rise when operating over the specified speed range on the adjustable frequency controllers with the specified load speed/torque characteristic.

Inverter duty rated motors shall have 4:1 turndown with variable torque motor controllers or constant torque motor controllers rating designed to operate from 25% of base speed to base speed continuously with full load current and torque without exceeding the Class F insulation with B temperature rise.

Torque requirement for greater turndown and slower speed applications is a custom design; refer to the driven equipment specification for additional requirements. Inverter duty rated motors shall be designed to operate over the speed or frequency range specified.

Motor insulation shall be designed to meet 2000-volt peak at a minimum of 0.1 microsecond rise time which exceeds the NEMA MG 1, Part 31: 1600-volt peak requirement for the 460 volt motors.

Provide inverter duty motors with NEMA Type 2 over-temperature protection as specified in NEMA MG 1-12. Provide motor mounted and motor powered winding temperature device with a 5-ampere normally open and normally closed output contacts at the motor terminal box for monitoring by the adjustable frequency controller and shutdown where the temperature exceed 165 degree-Centigrade.

Inverter duty motors shall have electrically insulated bearings or shall be equipped with a shaft-grounding unit mounted on the fan housing with stub shaft extended from the motor shaft. Larger motors, using the shaft-grounding unit, shall be equipped with two brushes, totally enclosed, and sealed against environmental contamination.

## F. VERTICAL MOTORS

Vertical motors shall be solid-shaft P-base type specifically designed for vertical installation. Thrust bearing rating shall be compatible with the loads imposed by the driven equipment. Universal position motors are not acceptable.

Vertical motors shall conform to Type 1, Type 2, or Type 3 in accordance with the location and use. Vertical motors specified or indicated as rated for Inverter Duty Motor shall be as specified herein.

## G. MOTOR EFFICIENCY

NEMA Premium™ efficiency electric motor, single-speed, polyphase, 1-500 horsepower, 3600-rpm 2-pole, 1800-rpm 4-pole, and 1200-rpm 6-pole, squirrel cage induction motors, NEMA Design A or B, continuous rated. NEMA Standards Publication MG 1 2003, in Tables 12-12 and 12-13, respectively.

Table 1  
Nominal Efficiencies For "NEMA Premium™" Induction Motors  
Rated 600 Volts Or Less (Random Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0*	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4
250	95.4	95.8	95.0	95.8	96.2	95.8
300	95.4	95.8	95.4	95.8	96.2	95.8
350	95.4	95.8	95.4	95.8	96.2	95.8
400	95.8	95.8	95.8	95.8	96.2	95.8
450	96.2	96.2	95.8	95.8	96.2	95.8
500	96.2	96.2	95.8	95.8	96.2	95.8

Table 2  
Nominal Efficiencies For "NEMA Premium™" Induction Motors  
Rated Medium Volts 5kV or Less (Form Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

Motors in Table 3 shall be in accordance with IEEE 841 minimum nameplate efficiency for energy efficient 900-rpm 8-pole motors determined in accordance with IEEE 112B testing procedures.

Table 3  
IEEE STD 841-2001

Horsepower	Guaranteed Motor Minimum Efficiency (percent)
1	70.0
1.5	72.0
2	80.0
3	81.5
5	82.5
7.5	82.5
10	86.5
15	86.5
20	87.5
25	87.5
30	89.5
40	89.5
50	90.2
60	90.2
75	91.7
100	91.7
125	92.4
150	92.4

Table 3  
IEEE STD 841-2001

Horsepower	Guaranteed Motor Minimum Efficiency (percent)
200	92.4
250	93.6
300	94.1
350	94.1
400	94.1
450	94.1
500	94.1

#### H. CONDUIT BOXES

Conduit boxes shall be sized based on the conduit number and conduit size indicated on the drawings. Provide over-sized boxes with the number of openings as required to accommodate the conduits required. Replace undersized conduit boxes.

Conduit boxes shall be split construction with threaded hubs and shall conform to IEEE 841 for Type 2 motors. Motors shall be furnished with petroleum-resistant gaskets at the base of the conduit box and between the halves of the conduit box

Conduit boxes shall be designed to rotate in order to permit installation in any of four positions 90 degrees apart. Motors shall have grounding lug located within the conduit box for the ground connection.

Provide separate conduit boxes for temperature devices and space heaters.

#### I. BEARINGS

Bearings may be oil or grease lubricated ball bearings, angle contact roller bearings for axial thrust loads, and cylindrical bearings for radial-only loads. Bearings shall be rated for a minimum L-10 life of 100,000 hours in accordance with ABMA 9 or 11 at the ambient temperature specified.

Motor designs employing cartridge type bearings will not be accepted. Bearings shall be fitted with lubricant fill and drain or relief fittings. Belt loads shall not exceed forces calculated from NEMA MG 1 Table 14-1.

#### J. LIFTING EYES

Provide lifting eyes per NEMA standard with a safety factor of 5. Generally, motors weighing more than 50 pounds shall be fitted with at least one lifting eye and motors over 150 pounds or 150 horsepower shall be fitted with two lifting eyes.

## K. SPACE HEATERS

Where shown on the Drawings or Schedules, furnish motors with space heaters to prevent condensation inside the motor enclosure after motor shutdown and maintain the temperature of the winding at not less than 5-degree C above outside ambient temperature.

Heaters shall be flexible wraparound type rated 120 volts, single phase, 60 Hertz. The space heater rating in watts and volts shall be noted on the motor nameplate or on a second nameplate. Space heater leads H1 and H2 shall be brought to a separate terminal block or pigtails in the motor conduit box or separate conduit box with a threaded conduit opening. Provide separate label on small motors.

## L. MOTOR SHAFT GROUND RING

Provide shaft ground ring (SGR) kit during factory motor assembly on inverter duty motors with NEMA ODP enclosures and TEFC enclosures operating on AFD motor controllers, including motors with insulated or ceramic bearings.

SGR kits shall be factory install. If not received with the kits installed, then field install the kits: Install the shaft ground ring, adhesive ring, grounding pig tail in accordance with the manufacturer's installation instructions. Ground the motor frame to the ground grid.

Do not provide SGR grounding kit devices on explosion proof motors located in Division 1 or Division 2 hazardous locations, provide alternate factory provided means.

Provide Electro Static Technology's AEGIS Shaft Grounding Ring Pro Series for Bearing Protection <http://www.est-aegis.com/index.html> or approved equal:

1. Install circumferential ring of conductive micro fibers to reduce the shaft voltage, to divert current away from the bearings, and to protect bearings in attached equipment.
2. Install on either drive-end or non-drive-end of motors less than 100-horsepower.
3. Insulate the one bearing and install Shaft Grounding Ring on the opposite drive-end of motors 100-horsepower and larger.
4. Install with conductive epoxy to ensure ground connection from the SGR to motor frame.
5. Verify the discharge path for shaft voltages to ground.

## 2.05 PRODUCT DATA

The following product data shall be provided for each motor in accordance with Section 01300:

1. Operating and maintenance information as part of the motor driven equipment O&M manual as specified in Section 01730.
2. Include overhaul instructions in operation and maintenance information for motor driven equipment that is 50 horsepower and above.
3. Factory motor prototype test results specified in paragraph 11060-1.02 C.
4. Written warranty specified in paragraph 11060-1.02 D.

## PART 3 – EXECUTION

### 3.01 GROUNDING AND BONDING

Verify the circuit ground cable (green) is identified and connected to the grounding lug terminal in the conduit box.

Provide supplementary grounding by installing a bond from the motor frame to the grounding electrode system or as indicated on the drawings. Verify Shaft Grounding Rings are installed per manufacturers recommendations and that

### 3.02 FIELD COATING OF MOTORS

Provide motors with the field applied, Epoxy Coating System E-2 with thickness of 16 mils dry film in accordance with specification Section 09900 – Coating Systems for motors located in corrosive environments.

### 3.03 FIELD TESTING

Verify breather/drain fittings have been installed as specified herein. Winding insulation resistance for motors shall be not less than 10-megohm measured with a 1000-Vac megohmmeter at 1-minute at or corrected to 40-degree C.

**\*\*END OF SECTION\*\***

## SECTION 11069

### ADJUSTABLE FREQUENCY DRIVES

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE

This section specifies 480 Vac rated adjustable frequency drive motor controller systems using insulated gate bipolar transistors (IGBT) for pulse width modulation technology (PWM).

The AFDs specified in this section shall be the product of a single vendor and mounted in the specified cabinet enclosure or motor control center when required as shown on the drawings.

The terms AFD (adjustable frequency drive), ASD (adjustable speed drive), VFD (variable frequency drive), and VSD (variable speed drive) are interchangeable for the purposes of this specification.

Refer to the drawings for control and monitoring requirements including special interlocking requirements. Refer to the Control Specification 17010 for the control description for the AFD systems.

###### B. SYSTEM REQUIREMENTS

The AFD system shall convert 460 volt, 60-Hertz nominal input to a suitable voltage and frequency to cause a premium efficient, inverter duty, squirrel-cage induction motor to run at a speed proportional to an external input analog 4 to 20 ma dc or digital input command as specified for the required AFD speed range.

The AFD system shall include active front end drives, rectifier units, inverter units, control circuitry, protective equipment, input line reactors and output load reactors and other filters and accessories as necessary to provide the specified functions to meet voltage and current harmonics at the specified point of common connection and to mitigate the motor reflected voltage wave. Unless otherwise specified, the point of common connection for AFDs shall be the 480 distribution bus (motor control center, distribution panel, etc.) immediately upstream of the AFD.

The AFD system torque requirement shall match the pump torque requirement. Verify the equipment type and select variable torque (VT) or constant torque (CT). Select 6-Pulse units for motors less than 100 hp and 18-Pulse units for motors 100 hp and larger.

AFDs shall be provided as shown on the drawings.

### C. ENVIRONMENTAL CONDITIONS

Ambient conditions are specified in Section 01800.

### D. SEISMIC

Freestanding AFDs shall be braced per Section 01900.

## 1.02 QUALITY ASSURANCE

### A. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEEE 519	IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power System
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 2	Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
NEMA ICS 6	Industrial Control and Systems: Enclosures
NEMA ICS 7	Industrial Control and Systems: Adjustable-Speed Drives
NEMA ICS 7.1	Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems
NFPA 70	National Electrical Code (NEC)
UL Standard 508	Industrial Control Equipment

## B. INDUSTRY STANDARDS

The AFD shall be UL 508 listed and shall conform to the requirements specified in NEMA ICS 2, 6, 7 and 7.1.

## C. UNIT RESPONSIBILITY

The Contractor shall assign unit responsibility for the adjustable frequency drives in this section as specified in paragraph 11000-1.02 C. The Contractor shall submit letters of certification with the shop drawings from the AFD manufacturer, the motor manufacturer, and the driven equipment manufacturer stating that they have reviewed each application and that the combination will satisfy the application duties required, for the actual motor sizes required, regardless of deviations from the scheduled "nominal horsepower."

### 1.03 PRODUCT HANDLING

AFD units shall be shipped in air-cushion vans to ensure against shipping damage and packed in suitable protective containers. The units shall be inspected upon receipt for damage.

### 1.04 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with

addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal.

If no changes are required, the drawing or drawings shall be marked "*no changes required*". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

3. Certificate of Unit Responsibility attesting that the Contractor has assigned, and that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section and paragraph 11000-1.02 C. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
4. Catalog and technical data including outline dimensions, shipping section dimensions, weight, and foundation requirements for all assemblies.
5. Schematic diagrams and wiring connection diagram showing functions and identification of terminals.
6. Voltage and current Total Harmonic Distortion (THD) calculations with line reactors or filter design to mitigate harmonics to meet IEEE-519, if applicable.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

The Owner and Engineer believes the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. AFDs shall be installed in the custom enclosures as specified and Candidate manufacturers include:

1. ABB ACS-600
2. Toshiba Series:
  - a. W7 18-Pulse for centrifugal fan and pump motors
  - b. G7 18-Pulse for slow speed and high-torque motors
4. Cutler-Hammer SV9000
3. General Electric AF-300
5. Siemens Model 6SE32
6. Square D Altivar Series

7. Robicon
8. Allen Bradley
9. Or equal

## 2.02 ENCLOSURES

Enclosures shall be provided as specified in Section 16176 including enclosure types, heating and ventilating.

Provide each indoor mounted AFD in a NEMA 12 ventilated and filtered enclosure with fan cooling and conformal coating protection on circuit boards for corrosive atmosphere protection. The air filters shall be washable type.

Provide outdoor mounted or corrosive area mounted AFD in a NEMA 4X enclosure with dead front enclosure, inner door and panel air conditioning unit for cooling. Enclosures shall be shall meet the requirements of Section 16176.

### A. GENERAL

Provide enclosures with AFDs and custom control as required for the project and as indicated on the drawings. Each drive shall be designed for stand-alone operation and multiple drives shall not utilize shared components. Review the project site location, elevation, temperature, humidity, plant atmosphere, and load current-torque requirements to size the AFD and its associated enclosure with requirements specified herein and the control and monitoring devices and interlocks as indicated.

Enclosures shall be designed for indoor service. Each AFD system shall be mounted in a NEMA 250 internally force ventilated enclosure with UL approved Class 1 filters on ventilation openings. Enclosures shall be fabricated from 12-gage minimum thickness sheet steel with an interior frame or formed to provide a rigid structure.

Provide enclosure size to allow entry of power source and motor load cables as indicated on the drawings. Submit drawing of the source and load power cable location within the enclosure and indicated barriers from control and instrument wiring.

Door width shall not exceed 30 inches and shall be hung on removable-pin hinges, with three-point latch hardware, and handle latch for 3/8-inch-shackle padlock.

### B. FINISH AND COATINGS

AFD systems enclosures shall be finished with corrosion protection coatings inside and outside for hydrogen sulfide atmospheres. The electrical and electronic assemblies shall have conformal coatings.

## 2.03 AFD ASSEMBLIES

### A. GENERAL

AFDs shall include the following assemblies:

3. Flanged type power disconnect using a thermal magnetic circuit breaker sized for the specific application by the manufacturer.
4. 6 pulse drives shall include a line input reactor or harmonic filter, for harmonic mitigation.. MTE RL reactors, 3-5% impedance open reactor, MTE AP Matrix Filter or approved equal.
5. 6 pulse drives shall include a load harmonic filter with adaptive passive technology for dV/dT mitigation or motor terminator units for addressing dv/dt effects at the motor for all motors 300 feet or more from the AFD. MTE Matrix Series dV or approved equal. For distances between 50 – 300 feet a load reactor shall be provided. MTE RL reactors, 5% impedance open reactor or approved equal.
6. Rectifier, direct current bus filter, and inverter.
7. Control circuitry interface with Operator Interface Unit.
8. Output protection including phase overload.

### B. AFD FEATURES

Provided with the following features:

1. Fused control circuit transformer and microprocessor for system logic sequencing functions. Provide fuses with blown fuse indicator lamps.
2. Accept 4 to 20 mAdc speed reference signal.
3. A 4 to 20 mAdc output signal proportional to inverter output frequency for the speed range specified.
4. Adjustable minimum/maximum frequency limits:
  - a. Minimum frequency shall be adjustable from 6 to 40 Hertz.
  - b. Maximum frequency shall be adjustable from 48 to 90 Hertz.
5. Adjustable and independent timed linear acceleration and deceleration functions, adjustable from 6 to 20 seconds.

6. Current limiting.
7. Automatic restart.
8. Control Wiring:
  - a. 600 volt stranded copper
  - b. 90 degrees C color-coded insulation
  - c. No. 16 AWG
9. Wiring Identification and Termination: Sleeve type markers at each termination point and numbered terminal blocks for external connections.
10. Electrically isolated discrete output contacts for running, remote mode status and trouble alarm.
11. Control Power: Provide a 120 Vac, triple fused, control power transformer for cooling fans and external control circuits when required. Control circuits shall be isolated from power circuits by distance and by insulated barriers.
12. Provide 120 Vac or 24 Vdc as required for Operator Interface Unit.
13. Drives for submersible pump motors shall be furnished with circuitry to interface with the motor leak and temperature protection modules (such as the Flygt CAS module). Coordinate with pump supplier and obtain the pump/motor protection devices for mounting in the VFD enclosure as required. See the pump motor schematic diagram shown on the drawings for additional information.

#### C. FUNCTIONAL REQUIREMENTS

1. Supply Power: Operate continuously with supply power of 480 volts plus or minus 10 percent, 60 Hertz plus or minus 3 percent and remain on line and operate without damage to the AFD or connected load during a supply power under-voltage variation to the drive up to 85% of its nominal value for 30 milliseconds at full load.
3. Environmental Conditions
  - a. Ambient temperature: refer to Section 01800.
  - b. Atmosphere: refer to Contract drawings and Section 16000.

4. Load: Capable of driving the specified maximum motor load continuously and under the following conditions:
  - a. Deliver 110 percent of the specified load for up to 60 seconds in variable torque applications.
  - b. Deliver 150 percent of the specified load for up to 60 seconds in constant torque applications.
5. Efficiency: Not less than 95 percent at 60 Hertz output driving the specified maximum load at rated torque and speed at 40 degrees C ambient based on measured input power versus output power with all specified components in the system.
6. Frequency And Voltage Regulation: Output frequency regulated to within 0.6 Hertz of the signal/output frequency relationship. Output voltage regulated to within 1.0 percent to produce minimum motor heating at any operating frequency within the specified range.
7. Frequency Range: AFD shall be capable of continuous operation with the specified load at any frequency between 6 and 60 Hertz unless noted otherwise.
8. Space And AFD Access
  - a. Enclosure size shall not exceed the size allotments specified on the drawings nor shall any portion of the AFD system exceed a height of 90 inches.
  - b. Front accessible only and shall not require rear access.
  - c. Mount against the wall without any clearance for ventilation or other purposes.
  - d. Submit AFD in the enclosure drawing with the detail of front door and the internal arrangement, including the feeder and motor cables, and the control cables, and the instrument cable location and terminations.
9. Ambient Noise: Free field noise generated shall not exceed 85 dBA at 3 feet out from any point on the AFD enclosure under any normal operating condition.

10. Motor Coordination: AFDs shall be configured as required to maintain output voltage peaks at the connected motor windings from reaching levels damaging to the motor insulation. Provide protection integral to the AFD or as protective hardware to be installed at the motors.

Where motor terminator units are provided, they shall be rated for the environment in which they are located. Motor terminator units shall be:

- a. Allen Bradley 1204 Motor Terminator for AFD with the maximum carrier frequency of 6 kilohertz,
- b. Cutler Hammer Reflected Wave Trap (RWT) with the maximum carrier frequency of 12 kilohertz,
- c. Or Equal product.

#### D. PROTECTION AND ANNUNCIATION

1. Overcurrent Protection: Electronic current limit at 150 percent of motor nameplate current and provide motor running overcurrent protection in compliance with NFPA 70.
2. Short Circuit Protection: Protected against load faults: bolted faults, phase to phase or phase to ground shall not damage the unit. Fault protection based on a power source short circuit capacity of 65,000 amperes RMS symmetrical at the AFD power input terminals with impedance or current limiting device provided.
3. Line Voltage: Protected against high and low line voltage all phases.
4. Internal Faults: Internal fault monitoring system to detect malfunctions to protect from transient and sustained faults and to limit damage that may be caused.
5. Motor Over Temperature: Interface to motor over temperature device 2-ampere output contact to shut down and alarm if the motor becomes overheated.
6. Fault Alarm: Indicates the cause of any shutdown visible on the AFD keypad/display without opening the AFD enclosure. As a minimum, the following faults shall be alarmed:
  - a. Motor over-temperature.
  - b. Motor overcurrent.

- c. Incoming power line over/under/unbalanced-voltage.
  - d. AFD over-temperature.
  - e. AFD over-voltage.
  - f. AFD control failure.
7. Safety Features: The AFD shall include:
- a. Flanged mounted padlockable main disconnect handle.
  - b. Mechanical interlock to prevent opening enclosure door with disconnect in the “ON” position while the unit door is open.
  - c. Auxiliary contact on main disconnect to isolate 120Vac control power when fed from external source.
  - d. Barriers and warning signs on terminals that are energized with the power disconnect “OFF”.
  - e. Separation and insulated barriers between the power and control and instrument products.
  - f. External emergency stop input.
8. Reverse Direction Protection: Provide protection from inadvertent operation in reverse where reverse rotation can damage the driven equipment.
9. Critical Speed Bypass: Provide capability to program speed bypass for minimum two critical speed points.
10. Transient Voltage Protection: Provide solid state transient voltage protection to meet or exceed ANSI C37.90.

## 2.04 CONTROL AND MONITORING DEVICES

Front door mounted on the AFD enclosure between 36 and 72 inches above the floor for each unit:

- 1. Digital Operator keypad/display.
- 2. Hand/Off/Auto door mounted selector switch.
- 3. Manual speed control: potentiometer

4. Provide the following local indicators and controls with 30mm NEMA 4 oil tight devices as specified:
  - a. Hand/Off/Auto door mounted selector switch.
  - b. Status Indicators (ON, OFF, FAULT).
  - c. Reset Pushbutton.
  - d. Emergency Stop.
  - e. Any additional features as shown on the contract drawings; including schematics and P&ID diagrams.
5. Internal terminal strips for remote monitoring:
  - a. Run status.
  - b. Trouble / Fail alarm.
  - c. Auto Mode status.
  - d. Motor speed feedback 4-20mA.
  - e. Motor Current, 4-20mA.
  - f. Additional devices as indicated on the drawings.

A. OPERATOR INTERFACE UNIT

1. Digital keypad/display for monitoring and controlling the drive and to input drive parameter settings with a backlit LCD or equally visible display with a minimum of 16 characters per line.
2. Digital keypad for numerical settings in English engineering units and a guide to parameter settings. Setup operations and adjustments stored in non-volatile EEPROM memory transferable to new and spare boards. Settings shall be protected from unauthorized tampering, revision, or adjustment by a personal lockout code.
3. The digital keypad to provide programming of the drive and include:
  - a. Up and Down arrow keys: Increase or decrease output frequency or data values.
  - b. Monitor key: Selection of control mode.

- c. Run and Stop keys: Starting and stopping in the manual mode.
- d. Fault clear / Enter keys: Reset fault conditions and enter changes.
- e. Program key: Enter the program mode and adjust parameters.
- f. Remote / Local Location keys: Operation location and local speed control.
- g. Auto / Manual Mode keys: Program mode.
- h. Number keys: 0 through 9 keys to access specific parameters.
- i. Keypad digital illustrations: English and display the last 5 faults.
- j. Frequency / Motor Speed Indication: Calibrated in Hertz and RPM.
- k. Run Status Indication.
- l. Ready Status Indication.
- m. Fault Alarm Indication.

## B. CONTROL AND MONITORING COMMUNICATION

- 1. Additional analog I/O as required for the project.
- 2. Additional discrete I/O as required for the project.

## 2.05 KEYPAD FUNCTIONS AND OPERATION

Adjustment of the following parameters through the OIU digital keypad:

- 1. Current limit and torque boost.
- 2. Maximum voltage level.
- 3. Minimum/Maximum speed, Volts/Hertz, Upper and Lower limit.
- 4. Adjustable acceleration rate and deceleration rate.
- 5. Electronic thermal overload setting.
- 6. Coast, controlled ramp or DC injection selectable modes of stopping.

7. PID setpoint and time-function selection.
8. Critical frequency avoidance: Three set points selectable from 0 to maximum frequency with set points adjustable from 0-30 Hertz.

## 2.06 SPARE PARTS

The following spare parts shall be supplied with each type or frame size AFD:

1. Three sets of all replaceable fuses.
2. 10 of each type pilot light lamp.
3. Three of each type relay.

## 2.07 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Operation and maintenance information as specified in Section 01730, including:
  - a. Final reviewed submittal.
  - b. As-built drive configuration settings.
2. Installation certification Form 11000-A as specified in paragraph 11069-3.01.
3. Training certification Form 11000-B as specified in paragraph 11069-3.03.

# PART 3 – EXECUTION

## 3.01 FIELD INSTALLATION

Each adjustable speed controller shall be installed and tested by the Contractor with the assistance of factory-trained pump manufacturer engineer/technician and AFD engineer/technician in accordance with the manufacturer's specifications and Section 11069, and witnessed by the Engineer.

Manufacturers' factory representatives shall provide field testing for devices including the setup of the Operator Interface Unit and the setup of the data communication devices, where used. Upon satisfactory completion of the testing, the Contractor shall submit two certified copies of the test report to the Engineer.

Component failure during testing will require repeating any test associated with the failure or modified components to demonstrate proper operation.

The installation shall be certified on Form 11000-A specified in Section 01999.

1. Adjust drive and perform “start-up” tests as recommended by manufacturer. Set parameters and carrier frequency for existing motors to avoid insulation damage.
2. Establish proper direction of rotation for the motor controlled by the drive. Verify that the AFD is precluded from operating in a direction that can damage the driven equipment. Change motor or AFD power lead connection and not the AFD direction, where rotation is incorrect.
3. Verify that the drive will operate properly both in the “manual speed control mode” and in the “remote or automatic mode” from a remote speed signal input.
4. Set the maximum “locked rotor” current drawn during start-up recommended by the manufacturer and approved by the Engineer.
5. Set the minimum and maximum speeds and the acceleration and deceleration “ramps” recommended by the Engineer.
6. Verify the motor high temperature switch contacts are wired into the AFD 120 Vac control circuit and will trip on high winding temperature. Test or simulated the alarm and trip feature at the motor for high temperature and for high vibration, where used.
7. Operate the drive at 100 percent speed for one hour and monitor output current. The output current shall remain below the full load current listed on the motor nameplate.
8. Check for excessive heating of the drive and motor. Report any discrepancies to the Engineer.

### 3.02 HARMONIC TESTING

The Testing Firm specified in Section 01662 shall perform a harmonics acceptant test with all AFD motor controllers operating to verify compliance with IEEE-519 of less than 5 percent voltage THD and 12 percent current THD at the defined point of common connection when running from Power Utility power source with a BMI-Dranetz or equal harmonic test set that provides a hard-copy record of the test results.

The test shall also be run with power sourced from the standby generator where such a power source is being used at the project site. THD shall be limited to a maximum level of 8 percent voltage THD on standby generator operation.

Submit the test performance to the Engineer per latest version NETA ATS Acceptance Testing Specifications. Refer to the electrical testing specification Section 01662.

### 3.03 TRAINING

Two hours of onsite AFD operation and maintenance training shall be provided for the Owner's Operation and Maintenance Staff. Manufacturers' factory representative shall conduct the training, upon acceptance of a resume submitted by the trainer. Training shall be certified on Form 11000-B specified in Section 01999.

**\*\*END OF SECTION\*\***

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## SECTION 11350

### DRY POLYMER ACTIVATION SYSTEM AND APPURTENANCES

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE

This section specifies a packaged polymer system suitable for metering, diluting, mixing, and pumping polymer. The units shall be suitable for the feed of all types of polymers specified in this Section.

###### B. DRY PREPARATION SYSTEM

1. The automatic polymer preparation/dilution makedown system shall be an integrated equipment package capable of automatically preparing a homogenous polymer solution. The system shall be an automatically controlled, sequentially batching unit capable of preparing dry polymers.
2. The system shall incorporate two stage mixing. The first stage shall be a primary wetting bowl and the second stage will be an accelerated mixing zone that sends solution to an external mix tank.
3. System shall continuously supply the resulting polymer solution as controlled by level in external tanks.

###### C. EQUIPMENT LIST

Item	Value
Dewatering Polymer Blending Unit 1	CFR-7410
Dewatering Polymer Blending Unit 1 LCP	LCP-7410

###### D. OPERATING CONDITIONS

Refer below for environmental conditions. Dilution water will be filtered plant water and is expected to range between 50 degrees F and 80 degrees F.

The polymer blending unit shall be provided with a local control panel for manual and fully automatic control as described in this specification section.

###### E. ENVIRONMENTAL CONDITIONS

Ambient conditions are specified in **Section 01800**.

## 1.02 QUALITY ASSURANCE

### A. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A276	Stainless Steel Bars and Shapes
ASTM A320/A320M	Alloy/Steel Bolting Materials for Low-Temperature Service
NEMA 250	Enclosures for Electrical Equipment (1,000 Volts Maximum)
NFPA 70	National Electrical Code (NEC)

### B. UNIT RESPONSIBILITY

The Contractor shall assign unit responsibility, as specified in Section 11000-1.02-C Unit Responsibility, to the manufacturer of the polymer system provided under this section. This manufacturer is the unit responsibility manufacturer and has unit responsibility, as specified in Section 11000-1.02-C Unit Responsibility, for both the equipment assembly specified in this section and for the Local Control Panel specified in this section and in Section 16176. A completed, signed, and notarized Certificate of Unit Responsibility (Section 11000-Form 11000-C) shall be provided.

### C. FACTORY TESTS

The specified equipment with all mechanical and electrical components shall be completely assembled as a skid at the manufacturer's facility. Pump casings shall be hydrostatically tested to twice the discharge head. The skid shall be non-witnessed tested for desired functionality and operation at the manufacturer's facility prior to the shipment.

D. SHIPMENT, PROTECTION, AND STORAGE

Equipment shipment, protection, and storage shall conform to the requirements specified in Section 01605.

E. WARRANTY AND PERFORMANCE AFFIDAVIT

The system shall be covered by a conventional one-year limited warranty against defects in materials and workmanship. In addition, system installation shall be subject to the following provisions:

1. Polymer feed system shall be warranted for a period of 12 months from the date of start-up by authorized technician.
2. In addition, supplier shall warrant the system to operate in accordance with owner's expectation and performance. If dissatisfied with system performance for any reason, the owner shall have the right to return the system to vendor for a refund of vendor's sale price any time during the first 30 days following start-up.

1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

A. SHOP DRAWINGS

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark (☐) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are

required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

3. Completed Certificate of Unit Responsibility attesting that the Contractor has assigned, and that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section and Section 11000-1.02 Unit Responsibility. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
4. Motor Data Sheets specified in Section 01999 and 11060.
5. Manufacturer's specifications verifying the equipment performance. Motor data sheet.
6. Dimensional drawings, showing required access and clearances, including any layout requirements of the equipment.
7. Equipment mounting information as specified in Section 11002.
8. Manufacturer's catalog data and shop drawings confirming dimensions, weight, construction, materials, and installation details.
9. Descriptive control sequences of the dryer's manual and automatic operation.
10. Equipment control panels:
  - a. Schematic diagrams, including connections to remote equipment.
  - b. Drawings showing scaled front and interior views.
  - c. Bill of materials of components.
  - d. Marked product literature for all components.
11. Marked product literature for all instruments and controls.
12. Installation reference list including contact information as specified in this section.
13. Manufacturer's written certification that the polymer blending unit is suitable for the required polymer being used at the facility. The certification shall state that no additional equipment, such as aging tanks, are necessary and that the available source water is adequate for the application.
14. Predicted performance curves developed for the specific application. Performance curves shall plot speed, capacity, head, horsepower, efficiency, and NPSH required for the specified operating range for the pumps provided on the skid.

15. Shop drawings including location of all piping, electrical, instrumentation, and structural connections.
16. Descriptive control sequences of the polymer blending unit's manual and automatic operation.
17. PLC program listing printout and SCADA Input/Output List per paragraph 2.04 Local Alarms. to support development of Plant Control System interface. If submittal is electronic, entire submittal electronic file shall be compressed to reduce file size.
18. HMI screen printouts.

**B. OPERATION AND MAINTENANCE**

1. Applicable operation and maintenance information as specified in Section 01730, including
  - a. Final reviewed shop drawing submittal.
  - b. As-built drawings, PLC program listing, HMI screen printouts and SCADA Input/Output list.
  - c. Range and setting of indicators, instruments, timers, and other related devices.
  - d. Equipment Warranty.

**PART 2--PRODUCTS**

**2.01 MANUFACTURERS**

The Owner and Engineer believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. Dry polymer activation system shall be ProMinent, Polyrex 6.6, no equal.

**2.02 MANUFACTURED UNITS**

ProMinent Polyrex preparation shall have the capability to automatically prepare dry, polymers. The entire system shall be an integrated package pre-piped, prewired, skid-mounted system whose dimensions shall not exceed 138" high X 122" wide X 94" deep.

**2.03 MATERIALS**

Materials of components shall be as follows:

Component	Material
Wetting chamber	316SS

## 2.04 EQUIPMENT

### A. POLYREX WETTING ASSEMBLY

1. The Polyrex wetting system uses a step-by-step mixing system to effectively hydrate and mix the polymer. The first stage is the hydration system which utilizes wetting funnel to create a vortex effect. The second step utilizes a water ejector to create an accelerated mixing energy zone. The third stage is achieved in the efficient and gentle agitation achieved in the primary mixing tank.
2. Also included is an outlet valve to prevent moisture from reaching the polymer powder. The wetting system shall be enclosed to prevent any airborne dry polymer particles from escaping.

Each dry polymer activation system unit shall be a complete package that automatically dilutes, activates and feeds dry polymer and water. Blenders shall instantaneously invert polymer into solution, producing a thoroughly diluted and completed activated homogeneous blend, free of “fish-eyes” and unblended polymer. Units shall be capable of delivering a consistent dilute polymer solution at an adjustable rate of flow and concentration. Each unit shall be an integrated package, pre-piped and prewired.

### B. OPERATION PROCESS

1. Operation shall be initiated by low level in external mix/hold tank. This shall start the Polyrex wetting assembly, water, and polymer feeder to begin in a timed sequence, preparing a batch of polymer at a preset concentration. Polymer batch concentration is selected via a panel-mounted polymer feed timer. A high level in mix/hold tank shall initiate the shutdown sequence. The shutdown shall turn off polymer feeder (assuming it has not completed timing sequence) while allowing disperser water flow to flush the system and plumbing of activated polymer.

### C. WATER FLOW

1. Dilution water flow shall be maintained at a rate of up to 44 gpm at a minimum of 58PSIG and maximum of 87PSIG. Dilution line assembly shall include a pressure reducing valve, pressure switch, solenoid valve and shut-off valve

D. Total electrical service shall be 240/480VAC - 60 Hz - three-phase - 15 amps.

E. Noise level of polymer preparation unit shall be at or below 80 decibels.

### F. COMPONENTS

1. Volumetric Feeder

- a. The volumetric feeder shall be a multi-screw feeder assembly. The feeder will consist of a minimum of 2 counter turning screws. Single screw feeders shall not be acceptable.
- b. Volumetric feeder shall deliver a linear discharge with accuracy of 0.25-0.5%. Feeder screws shall be self cleaning and hollow wound wire or bar stock feeder screws are not acceptable.
- c. The feeder screws shall be support by solid shaft and bearings on both the drive and the discharge sides. Freely hanging discharge feeder screws are not acceptable.
- d. The discharge port of the multi-screw volumetric feeder shall be completely enclosed to prevent inadvertent drifting of airborne polymer dust and protect feeder discharge from environment.
- e. Dry polymer shall rely on gravity to transfer from feed device to wetting device.
- f. The volumetric feeder shall include a low-level powder switch to indicate low hopper level

## 2. Operator Control Panel

- a. The system shall have a control panel for fully automatic control. Control panel construction shall be NEMA 4X, door mounted operator interface module, and programmable controller (inside cabinet) for sequencing control.
    - i. Operator interface shall display messages with LCD, multi-character display and shall function as switches, timers, counter, lights and alarm indication.
    - ii. Operator interface shall clear all PLC faults without use of external programmer.
    - iii. Operator interface shall show status and condition of all monitored parameters, i.e. tanks levels, powder refill levels, pressure switches, heating cones, mixer status
    - iv. Operator interface shall display specific alarm condition in words to facilitate troubleshooting.
    - v. Operator interface shall contain alarm silence and alarm reset pushbuttons.
    - vi. Operator interface can be programmed with a security passcode.
3. Illuminated emergency stop pushbuttons shall be provided that will disable the system at any point in its cycle and re-start the cycle at the exact point previously disabled. Operator interface module shall remain usable while in an E-stop condition for changing control settings.

4. Panel door shall have “system enabled” and “system not enabled” lights to indicate system readiness for automatic operation. A power light shall indicate power available.
5. Front panel mounted controls shall be industrial duty.
6. Panel shall include an audible alarm for all monitored alarm conditions.
7. Supplier shall prove operation reliability by providing (5) five references for this specific control system, which have been operating successfully for at least (6) six months.

#### G. OTHER INSTRUMENTS

Provide stainless steel glycerin filled pressure gauges.

#### H. STAINLESS STEEL SKID

Polymer blending unit components shall be integrally mounted on a frame. All pipe supports shall be stainless steel. No mild steel shall be used. The frame shall be constructed of 3/16-inch angle or structural stainless steel tubing. The panel supporting the control panel shall be a minimum 12 gauge thickness.

Secure piping, valves and other components with rigid clamps. The frame shall be designed for lifting and shall have holes for mounting on concrete pads.

#### I. MOTORS

Motors shall conform to the requirements of Section 11060. Motor enclosures shall be TEFC and corrosive/washdown rated.

### 2.05 CONTROLS

#### A. CONTROL DESCRIPTIONS

1. Operator shall be allowed to start and stop the blending unit, set the polymer flow and dilution water flow using the local control panel’s HMI when the HOA is in the Hand position.
2. Operator shall be allowed to enter the following operating parameters through the HMI when the HOA is in the Auto position:
  - a. Polymer percent active concentration
  - b. Average sludge concentration, percent
  - c. Pound of polymer per ton of dry solids
  - d. Polymer specific gravity

- e. Diluted polymer concentration, percent.

Prior to starting and stopping the polymer feed pump at the initiation of the remote start/stop signal, the blending unit shall initiate a start-up and shutdown flush in accordance with the operator entered setpoints.

## B. CONTROL PANELS

Provide a control panel integral to the system's frame rated NEMA 4X and constructed of fiberglass reinforced plastic (FRP). The control panel shall consist of all switches, relays, indicator lights, digital displays, transformers, and controllers as required herein. The blender components shall be factory wired to the control panel for power supply and control.

An external lockout/disconnect for 480 Vac, 3 phase electric power source shall be provided for each blending unit control panel.

### Control Panel Lights:

1. Power ON indicator light.
2. Common alarm light.
3. Panel light colors.

## C. CONTROL DEVICES

Provide the following control devices:

1. Programmable Logic Controller (PLC) to control the operation of the blending unit in any mode of operation. PLC shall be Allen-Bradley Compactlogix 1769-L33ER PLC program to be written by Vendor in Ladder Logic or Function Block Diagram using Allen Bradley Studio 5000 Version 24. Vendor shall coordinate with Owner for seamless operation with Plant SCADA.
2. A liquid crystal display (LCD) 10" minimum touchscreen human machine interface (HMI) shall be provided for input of operating setpoints, alarm setpoints, monitoring of blending unit operation, and to acknowledge or clear alarm conditions. Provide Allen Bradley Panelview Plus or equal. The polymer dilution and feed unit control panel shall have, as a minimum, the following displays and lights or be integrated into the HMI system:
  - a. Actual polymer flow rate,
  - b. Actual dilution water flow rate,
  - c. Actual diluted polymer (solution) concentration,
  - d. Hand-Auto status,
  - e. Alarm setpoints and time delays,
  - f. Alarm status, and
  - g. Diluted polymer pressure.

3. Hand–Off–Auto (HOA) switch.
4. Heavy-duty emergency stop push button with red knob.
5. Polymer pump selector switch.

#### D. INTERLOCKS

The polymer pump shall be interlocked to shutdown in any mode of operation on the following alarm conditions:

1. Low dilution water flow
2. Low dilution water suction pressure

#### E. LOCAL ALARMS

Polymer blending unit shall be capable of generating the following alarms with adjustable time delays:

1. Polymer blending unit failure when unit is unable to maintain the setpoint polymer flow rate and setpoint diluted polymer (solution) concentration.
2. Low dilution water flow (operator adjustable)
3. Low dilution water suction pressure

#### F. REMOTE INPUT AND OUTPUTS

The polymer blending unit control panel shall provide the following alarms, control signals, and status signals to/from Plant Control System. Analog signals shall be 4 to 20 mAdc, discrete inputs and outputs shall be dry contacts.

1. Control Inputs:
  - a. Remote start/stop
2. Status Outputs:
  - a. Dilution water pump status (running or stopped)
  - b. Polymer blending unit control status (HAND or AUTO)
3. Alarm Outputs:
  - a. Common alarm

#### G. SCADA INPUT/OUTPUT LIST

Provide a SCADA I/O list in Microsoft Excel format for each type of polymer blender control panel. Include the following: LCP name (typical). The list shall be used as a check-off during testing. Include the following column headings filled in:

1. Tag name
2. I/O type
3. Communication register number
4. Description
5. P&ID drawing number
6. Register raw data count range (analog)
7. Minimum range value (analog)
8. Maximum range value (analog)
9. Alarm setpoint (digital)

## 2.06 SPARE PARTS

### A. MECHANICAL

The following spare parts shall be provided for each polymer blending unit of each size:

1. Special tools required for operation and maintenance.
2. Two (2) Feeder bearings
3. Tank Level Transmitter
4. Vacuum Conveyor Filter

Spare parts shall be tagged and stored as specified in **Section 11000**.

### B. PLC PROGRAM

Provide separate copies of PLC and HMI programs on CD-ROM. Label with Owner's name, facility name, project name, Owner's project number, LCP name, date, and PLC or HMI manufacturer's programming software used name; model; and revision/version. Programs shall be provided after completion of testing.

## 2.07 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

- A. Manufacturer's Installation Certification Section 11000-Form A.
- B. Manufacturer's Instruction Certification Section 11000-Form B.
- C. Operating and maintenance information specified in Section 01730
- D. Motor data specified in Section 11060.

- E. Manufacturer's Warranty specified in paragraph 1.02

## PART 3--EXECUTION

### 3.01 INSTALLATION

The dry polymer activation system shall be installed in accordance with the manufacturer's written recommendations. The Contractor shall coordinate with the manufacture during installation to ensure correct installation has occurred. The Contractor shall coordinate with the manufacture during installation to ensure correct installation has occurred. The installation and initial operation shall be certified on form specified in Section 01990.

### 3.02 FIELD TESTING

Each polymer blending unit shall be field tested to ensure compliance with the specified requirements. At minimum, the blending unit will be start up tested and calibrated to set the dry feeder and polymer feed settings to the desired setpoints. The Contractor shall demonstrate that the blending unit can produce a batch of polymer to the satisfaction of the manufacturer's and owner's representatives.

### 3.03 TRAINING

A minimum of 4 hours of training conforming to the requirements of Section 01664 shall be provided. Training shall be certified on Form 11000-B specified in Section 01999.

**\*\*END OF SECTION\*\***

## SECTION 11390

### PROGRESSING CAVITY POLYMER PUMPS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies positive displacement progressing cavity pumps, complete with electric motors, and all specified appurtenances, mounted on a common baseplate.

###### B. TYPE:

The pumping units shall be of the self-priming, positive displacement, progressing cavity type specifically designed for pumping liquid wastewater treatment scum and sludge containing organic solids and small inorganic particles.

###### C. EQUIPMENT LIST:

Item	Equipment No.
Polymer Feed Pumps	SWR85-P-301 through SWR85-P-308

###### E. GENERAL PERFORMANCE AND DESIGN REQUIREMENTS:

Equipment shall be designed and selected specifically for *continuous* duty pumping of concentrated solids derived from the treatment of wastewater, as well as to serve as a polymer feed. All pumps shall be suitable for exposure to wastewater, byproducts, corrosive environments, polymer, moisture, scum consisting of floatable materials skimmed from the surface of primary sedimentation tanks; and primary and thickened sludge containing grit, small particles of wood, rags and stringy material, industrial solvents, heavy greases, fats, detergents, petroleum products, and organic particles in concentrations as great as 10 percent. The pumped fluids are expected to range in temperature between 40 degrees F and 110 degrees F, and the pH may vary between 4 and 9.

The pumps along with associated drive appurtenances shall be mounted on common fabricated steel baseplate. A new baseplate shall be provided for each pump that is replaced.

###### F. SERVICE REQUIREMENTS:

Progressing cavity pumps shall provide the following services:

Equipment No / Location	Fluid type	Fluid Temperature Range	Percent Solids	Control
SWR85-P-301 through SWR85-P-308 / SWWRF Belt Filter Press Building	Polymer Feed Pumps	40°F – 110°F	N/A	VFD

**G. PERFORMANCE REQUIREMENTS:**

Progressing cavity pumps shall meet the following performance requirements:

Equipment Nos	Rated capacity, gpm	Rated head, psig <sup>a</sup>	Inlet pressure range, psig <sup>b</sup>	Minimum/Maximum pump speed, rpm <sup>c</sup>
SWR85-P-301 through SWR85-P-308	15 gpm	90 psig	0-5	280

- Rated head (discharge pressure) is based on pumping clean water at 68 degrees F.
- Potential range in pressure at the pump inlet (suction). The pump shall be capable of continuous operation over the entire inlet pressure range.
- Pump speed after fixed reduction and at the highest allowed adjustable frequency drive frequency.

**H. DESIGN REQUIREMENTS:**

**1. PUMPS:** Pumps shall meet the following design requirements:

Equipment Nos	Suction and disch port size, in. <sup>a</sup>	Max pump layout dims, in. (L x W x H) <sup>b</sup>	Minimum number of pump stages	Shaft seal type <sup>c</sup>	Configuration <sup>d</sup>
SWR85-P-301 through SWR85-P-308	3" Suction & 2.5" Discharge		2	Packing	Inline direct coupled

- If a suction or discharge port size different than the size specified is provided, pipe expansions and contractions required to conform the pump installation to the designed piping shall be supplied at no additional cost to Owner.
- Maximum pump layout dimension is the largest footprint allowable for the entire pump assembly, including the motor. The pump shall not exceed any one dimension listed.
- See paragraph 11390-2.03 E.
- See paragraphs 11390-1.01 C and 11390-2.03 B.

**2. MOTORS:** Motors shall meet the following design requirements:

Equipment Nos	Maximum motor hp	Motor type <sup>a</sup>	Inverter duty	Motor speed, rpm	Pump (or motor) brake?	Adjustable frequency drive?
Polymer Feed Pumps 1 - 8	3	TEFC	Y	1760	TBD	Yes

a. See paragraph 11060-2.01 for motor types.

## 1.02 QUALITY ASSURANCE

### A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AGMA 6010-E	Spur, Helical, Herringbone, and Bevel Enclosed Drives
AGMA 6019-E	Gear Motors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears
ASTM A331-90	Standard Specification for Steel Bars, Alloy, Cold-Finished
ASTM A322	Standard Specification for Steel Bars, Alloy, Standard Grades

### B. UNIT RESPONSIBILITY:

The Contractor shall assign unit responsibility, as specified in paragraph 11000-1.02 C, to the pump manufacturer for the equipment provided under this section. This manufacturer is the unit responsibility manufacturer and has unit responsibility, as specified in paragraph 11000-1.02 C, for the equipment assembly specified in this section, and the electric motors specified in

Section 11060 , and the adjustable frequency drives specified in Section 11069 and all other equipment assembly components specified elsewhere but referenced in this section. A completed, signed, and notarized Certificate of Unit Responsibility (Form 11000-C, Section 01999) shall be provided.

C. FACTORY TESTS:

Factory tests shall be performed according to the manufacturer's standard test procedures. Certified test results shall be provided as product data. However, the manufacturer must be prepared to guarantee the pump performance specified in paragraph 11390-1.01 G.

D. WARRANTY:

1. UNIVERSAL JOINTS ONE-YEAR FULL WARRANTY: Provide all warranties as described in the General Conditions, including normal commercial warranties available from equipment manufacturers. The rotor drive trains, consisting of universal joints, connecting rods and related components, furnished with progressive cavity pumps specified in this Section, shall be warranted by the pump manufacturer against defects in materials, workmanship, and wear regardless of the cause or fault of the wear or failure for a period of one (1) years. Rotor drive trains shall be repaired or replaced by the pump manufacturer at no cost to the Owner during the one-year warranty period. The pump manufacturer shall provide the warranty labor for repair or replacement of rotor drive trains. The warranty period shall commence at the date of final acceptance of the equipment specified in this Section.

2. ROTORS AND STATORS WARRANTY: The rotors and stators, furnished with progressive cavity pumps specified in this Section, shall be warranted by the pump manufacturer against defects in materials, workmanship, and wear regardless of the cause or fault of the wear or failure for a period of 10,000 hours of operation or two-years, whichever occurs first. Rotors and stators shall be repaired or replaced by the pump manufacturer at no cost to the Owner during the warranty period. The pump manufacturer shall provide the warranty labor for repair or replacement of rotors and stators. The warranty period shall commence at the date of final acceptance of the equipment specified in this Section.

1.03 SUBMITTALS

- a. Submit the following shop drawings in accordance with Section 01300
  - i. Data regarding pump, gear reducer and motor characteristics and performance:
    - 1. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity and horsepower.

- a. For units of same size and type, provide curves for a single unit only.
  2. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum speeds available, manufacturer's recommended maximum speed for the operating conditions and service specified and indicated.
  3. Results of shop performance tests as specified.
  4. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch (A4) sheets, one curve per sheet.
- ii. Shop drawing data for accessory items.
  - iii. Contractor to submit certified setting plans, with tolerances, for anchor bolts.
  - iv. Materials listing.
  - v. Manufacturer's literature as needed to supplement certified data.
  - vi. Operating and maintenance instructions and parts lists.
  - vii. Certified results of hydrostatic testing.
  - viii. Bearing temperature operating range for the service conditions specified.
  - ix. List of recommended spare parts other than those specified.
  - x. Shop and field inspection reports. Field inspection reports shall be supplied after start-up.
  - xi. Bearing Life: Certified by the pump manufacturer. Include design data.
  - xii. Pump shop test results.
  - xiii. Recommendations for short and long-term storage.
  - xiv. Shop and field-testing procedures, pump and piping set up, equipment to be used and testing tolerances to be followed.
  - xv. Special tools (if required).
  - xvi. Number of service person-days provided and per diem field service rate.
  - xvii. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.

- xviii. Recommended location of suction and discharge pressure gauges.
  - xix. Manufacturer's product data, specifications and color charts for shop painting.
  - xx. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
  - xxi. The latest ISO 9001 series certification.
- b. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
    - i. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.
  - c. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
    - i. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    - ii. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

## PART 2—PRODUCTS

### 2.01 MANUFACTURERS

The Owner and Construction Manager believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. Candidate manufacturers and pump models include Moyno 2000, Seepex Range BN, or equal, modified to meet the requirements of this specification.

### 2.02 MATERIALS

Materials of construction shall be as follows:

Component	Material
Rotor	ASTM A331-90 Grade 4150 cold finish alloy steel with hard chrome plating, 0.010-inch minimum thickness, 800 Vickers minimum hardness  Or  Air-hardened D-6 tool steel with a chromium nitride coating, 26 µm minimum thickness, 1750 Vickers minimum hardness
Stator	Buna-N synthetic rubber with a Shore durometer hardness between 50 and 70, and bonded to a steel tube
Pump body	Cast iron

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose. Mill certifications confirming hardness of rotor and stator shall be provided as product data.

## 2.03 EQUIPMENT

### A. ROTOR AND STATOR:

Each pump shall be a one stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator, which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber. Stators for sludge pumps shall have Buna elastomer. The sludge pump rotors shall be constructed of hardened tool steel. Additionally, the sludge pump rotors shall have a chromium nitride coating (Duktil process) with a minimum thickness of (.0108").

1. Stators shall be replaceable without dismantling the pump suction or discharge flanges or any associated piping. Additionally stators should be of a split 2 piece design so that the top piece can be removed to inspect for suction side clogs without disconnecting the rotor. Pumps that require additional space for axial/horizontal removal of the stator shall not be allowed. Stator designs shall additionally incorporate a retensioning feature to compensate for wear in lieu of increasing pump speed.
2. Rotors shall be replaceable without dismantling the pump suction or discharge flanges or associated piping. Pumps that require additional space for axial/horizontal

removal of the rotor shall not be allowed. The rotor design shall include provisions so that rotor replacement does not require the disassembly of either universal joint.

#### B. ALTERNATIVE DEDUCT ROTAR AND STATOR CONFIGURATION

Section 2.03 describes a base bid for a “smart stator”, as described by Seepex pumps. Due to the proprietary nature of the smart stator, there is an Alternative Deduct for a Moyno, or equal, substitute pump without the “smart stator” design that provide an alternate rotor and stator configuration. The Owner shall have the option to select the progressive cavity polymer pumps based on bid prices and County preference. The following describes the Alternate Deduct rotor and stator configuration.

1. Each pump design shall be a minimum single-stage design employing a convoluted rotor operating in a similarly convoluted stator. The number of stages required shall be not less than the number specified in paragraph 11390-1.01 H. The convolutions shall be configured to form a cavity between the rotor and stator which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a good seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber. The stator material hardness shall be suitable for the abrasiveness of the medium to be pumped. Where softer stators (i.e., 50 to 54 shore durometer) are provided the rotors shall be oversized to assure maintenance of a good seal to minimize stator wear.

#### C. CONNECTING ROD AND GEAR JOINTS:

Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRC, in the rotor head and coupling rod. The pin shall be constructed of high speed steel, air hardened to 60-65 HRC. The joint shall be grease lubricated with a high temperature (450° F), PTFE filled synthetic grease, covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel.

#### D. CASING:

The pump casing shall be provided with a cleanout opening on each side of inlet fitting. Cleanout opening shall be located immediately opposite the rotor head gear joint to provide access for maintenance. A 125-pound flanged connection shall be provided at the inlet port. A 125-pound flanged connection shall be provided at the discharge port. The suction shall be provided with a 1/2-inch tap to permit installation of a water lubrication system.

#### D. STUFFING BOX AND BEARINGS:

Each pump shall be provided with grease lubricated thrust and radial bearings designed for all loads imposed by the specified service and rated per Section 11000. The stuffing box shall be of ample depth for 6 rings of packing and be provided with lantern rings. The lantern

ring and gland shall be split for convenient removal. The stuffing box housing shall be drilled and tapped for water flush connections.

E. MOTOR AND DRIVE UNIT:

1. Gear motors or gear reducers shall be designed in accordance with AGMA 6019-E (Class II). Unless otherwise noted, motors shall be energy-efficient, TEFC motors.
2. Pumps that require variable frequency drives (VFDs) are noted in paragraph 1.01 E. VFDs shall be constant torque type. For VFD-driven units, the pump supplier shall be responsible for the provision of the fixed reduction between the motor and pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed in accordance with the schedule in paragraph 1.01 E. VFD-driven units may be operated at up to 85 Hz at the maximum speed.

F. BASE:

1. Mount each pump and drive on a common base.
  - a. Material: ASTM A36 fabricated structural steel.
  - b. Provide structural steel shape bases, bent form bases are not acceptable.
  - c. Provide bases with provisions for grouting and for anchor bolts.
  - d. Design baseplates to support pump and driver.
  - e. Provide planed surfaces of bearing pads for pumps and drives.

G. OVER PRESSURE PROTECTION

1. Provide each pump with a pressure sensor ring with a dual mounted gauge and single point pressure switch.

H. MOTORS:

1. Provide in accordance with Section and as specified and indicated.
2. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.
3. Provide motors for horizontal pumps with mounts for bolting to baseplate.
4. In addition to the requirements for bearings specified under Electric Motors in Section , provide pump motors with ball or roller bearings. Provide vertical

motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

5. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet (1 meter) from motor.
6. Operate without overheating at the speeds specified and indicated.
7. Service Factor: 1.15, with 1.0 inverter duty rating for pumps equipped with variable frequency motor controllers.
8. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.
9. Rating: 460V, 3 PH, 60 Hertz.
10. Insulation: Class F with Class B temperature rise, 40 degree C ambient.
11. Site Altitude: Less than 100 feet above sea level.
12. Provide Inpro/Seal bearing isolators.

I. SHOP TESTING:

1. Provide motor shop testing in accordance with Section .

J. Pump Tests:

1. Provide hydrostatic test of assembled pump at a maximum of 65 psi. Test wet end with pump assembled.
2. Certified performance and witness testing.
  - a. Run pump at full speed rating point for 60 minutes prior to start of any testing.
  - b. Full speed tests:
    - (1) Take readings to determine flow, differential pressure, rpm, horsepower, displacement and efficiency.
  - c. Variable speed tests:
    - (1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.

- (2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.
  - d. Factory tests on pumps:
    - (1) Use tested job motors.
    - (2) Use factory calibrated test drives.
  - e. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.
3. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.
4. Testing Tolerances: ANSI/HI
5. In the event that specified tests indicate that pump, motor, or variable frequency motor controller will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency motor controllers at no additional cost to the Owner.
6. Repeat tests until specified results are obtained.
7. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

#### L. ADJUSTABLE FREQUENCY DRIVES:

Pumps that require adjustable frequency drives (AFDs) are listed within this Section. AFDs shall be constant torque type and shall be as specified in Section 16000. For AFD driven units, the pump supplier shall be responsible for the provision of the fixed reduction between the motor and the pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed in accordance with the schedule in paragraph 11390-1.01 G. AFD controls shall be such that pumps cannot operate at a speed lower than that which corresponds to the minimum pumping rate as specified within this Section.

#### 2.04 CONTROLS:

Vendor shall provide control strategies for the pumping equipment.

#### 2.05 COATINGS

Painting of equipment shall be in accordance with Section 09900.

All equipment and fabricated surfaces shall be shop primed and finish coated prior to shipment from the factory.

## 2.06 SPARE PARTS

Furnish one set of packing tools to service the pumps if packing seals are furnished. In addition, furnish the following spare parts for each pump model and size:

- 1 - stator
- 1 - rotor
- 1 - connecting rod
- 2 - sets of packing rings
- 1 - bearing kit
- 1 - gear joint kit including gear joint seals/pin joint kit

Spare parts shall be tagged and stored as specified in Section 11000.

## 2.07 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

1. Mill certifications confirming hardness of rotor and stator specified in paragraph 11390-2.02.
2. Operating and maintenance information specified in Section 01730, including manufacturer's warranties specified in paragraph 11390-1.02 D and Section 01739.
3. Certified factory test results as specified in paragraph 11390-1.02 C.
4. Manufacturer's certification that the pumping units will meet the vibration and critical speed limitations specified in Section 11020.
5. Installation Certification Form 11000-A as specified in paragraph 11390-3.01.
6. Training Certification Form 11000-B as specified in paragraph 11390-3.03.

## PART 3--EXECUTION

### 3.01 INSTALLATION

Each pumping unit shall be aligned, connected and installed in accordance with the manufacturer's recommendations. The installation and trial operation shall be certified by the pump manufacturer's authorized representative on Form 11000-A as specified in Section 01999.

### 3.02 TESTING

- A. Comply with the requirements specified in Section 01663 and as specified herein.
- B. Test piping connections to prove the pump nozzle are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.
- C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.
  - 1. During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and motor inputs.
    - a. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.
  - 2. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.
  - 3. Repeat tests until specified results are obtained.
  - 4. Contractor to provide all water labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.
    - a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.
    - b. All calibrations must be within 30 days of the field testing.
    - c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.
    - d. Contractor is responsible for delivery and disposal of water used for testing.
- D. Make all adjustments necessary to place equipment in specified working order at time of above tests.
- E. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

- F. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

### 3.03 TRAINING

A minimum of 8 hours of training shall be provided by the pump manufacturer's service engineer. Training shall conform to Section 01664 and shall be certified on Form 11000-B as specified in Section 01999.

**\*\*END OF SECTION\*\***

## SECTION 11391

### PROGRESSING CAVITY SLUDGE PUMPS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies positive displacement progressing cavity pumps, complete with electric motors, and all specified appurtenances, mounted on a common baseplate.

###### B. TYPE:

The pumping units shall be of the self-priming, positive displacement, progressing cavity type specifically designed for pumping wastewater treatment sludges containing organic solids and small inorganic particles.

###### C. EQUIPMENT LIST:

Item	Equipment No.
Belt Filter Press Sludge Feed Pumps	SWR82-P-101 through SWR82-P- 106

###### D. PERFORMANCE AND DESIGN REQUIREMENTS:

Equipment shall be specifically designed and selected for continuous duty pumping of concentrated solids derived from the treatment of wastewater. Pumps shall be suitable for exposure to digested sludge containing grit, tramp iron, small particles of wood, industrial solvents, greases, detergents, petroleum products, and organic particles in concentrations as great as 12 percent. The pumped fluids are expected to range in temperature between 40 degrees F and 110 degrees F, and the pH may vary between 4 and 9.

Where indicated, the equipment including the drive train, shall be designed for operation at variable speed, with inline base configuration with coupling and coupling guard.

The pumps, along with associated drive appurtenances, shall be mounted on common fabricated steel baseplates.

###### E. OPERATING CONDITIONS:

The progressing cavity pumps shall have the following operating characteristics:

Equipment number / Location	Rated capacity, gpm <sup>a</sup>	Rated head, psi <sup>a</sup>	Minimum, maximum pump speed, rpm	Suction and discharge port size, in	Maximum motor HP	Variable speed drive
SFP 1-6 Dewatering Bldg	100	50	250	8	10	YES

<sup>a</sup> Based on pumping clean water at 68 degrees F.

## 1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AGMA 6010-E	Spur, Helical, Herringbone, and Bevel Enclosed Drives
AGMA 6019-E	Gear Motors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears

## 1.03 ENVIRONMENTAL CONDITIONS

Pumps to be provided under this section will be installed in the Dewatering Building as shown in the Contract Drawings. The dewatering building is conducive to a corrosive environment. See Section 01800 for design ambient temperatures and conditions.

### A. 1.04 SUBMITTALS: Submit the following shop drawings in accordance with Section 01300

1. Data regarding pump, gear reducer and motor characteristics and performance:

- a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity and horsepower.
    - (1) For units of same size and type, provide curves for a single unit only.
  - b. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum speeds available, manufacturer's recommended maximum speed for the operating conditions and service specified and indicated.
  - c. Results of shop performance tests as specified.
  - d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch (A4) sheets, one curve per sheet.
- 2. Shop drawing data for accessory items.
  - 3. Contractor to submit certified setting plans, with tolerances, for anchor bolts.
  - 4. Materials listing.
  - 5. Manufacturer's literature as needed to supplement certified data.
  - 6. Operating and maintenance instructions and parts lists.
  - 7. Certified results of hydrostatic testing.
  - 8. Bearing temperature operating range for the service conditions specified.
  - 9. List of recommended spare parts other than those specified.
  - 10. Shop and field inspection reports. Field inspection reports shall be supplied after start-up.
  - 11. Bearing Life: Certified by the pump manufacturer. Include design data.
  - 12. Pump shop test results.
  - 13. Recommendations for short and long-term storage.
  - 14. Shop and field-testing procedures, pump and piping set up, equipment to be used and testing tolerances to be followed.
  - 15. Special tools (if required).
  - 16. Number of service person-days provided and per diem field service rate.

17. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.
  18. Recommended location of suction and discharge pressure gauges.
  19. Manufacturer's product data, specifications and color charts for shop painting.
  20. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
  21. The latest ISO 9001 series certification.
- B. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.
- C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
  2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

## PART 2--PRODUCTS

### 2.01 ACCEPTABLE PRODUCTS

Progressing cavity pumps shall be Robbins and Myers Moyno 2000, modified to meet the requirements of this specification. Pressure gauge, switch, and seal shall be Ashcroft 5503 Differential Pressure Gauge, B-Series NEMA 4X Pressure Switch, and annular seal.

### 2.02 MATERIALS

Component	Material
Rotor	ASTM A331-90, grade 4150, yield strength 55,000 psi with 0.010 inches hard chrome plate
Stator	Nitrile with minimum shore A durometer of 71+4
Pump and stator	Pump, thick-walled cast iron. Stator, carbon steel tube.
Pump body	Cast iron

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

## 2.03 EQUIPMENT

### A. ROTOR AND STATOR:

Each pump shall be single-stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a good seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber.

### B. CONNECTING ROD AND GEAR JOINTS:

Each pump rotor shall be driven through a connecting rod which shall be connected to the rotor and input shaft through precision machined grease lubricated crowned gear type joints. The balls and sockets shall be machined from chrome alloy tool steel and shall be designed to withstand shock and thrust reversal. Each gear joint shall be protected against the entrance of dirt, sludge, and other foreign objects by a wire reinforced elastomeric seal. Gear joint shall be positively secured to the connecting rod to ensure against failure when the pump is in operation. The connecting rod shall pass through the shaft seal area inside the hollow drive shaft quill so that no eccentric loads are imparted on the shaft seal area. The connection rod shall maintain shaft angularity of less than 1.5 degrees.

The drive shaft shall be of two-piece construction through the bearings and shaft seal area. This design shall permit disassembly of the gear type universal joints without affecting the alignment of the shaft in the shaft sealing area.

### C. CASING:

The pump casing shall be provided with a cleanout opening on each side of inlet fitting. Cleanout opening shall be located immediately opposite the rotor head gear joint to provide access

for maintenance. A 125-pound flanged connection shall be provided at the inlet port. A 125-pound flanged connection shall be provided at the discharge port. The suction shall be provided with a 1/2-inch tap to permit installation of a water lubrication system.

D. STUFFING BOX AND BEARINGS:

Each pump shall be provided with grease lubricated thrust and radial bearings designed for all loads imposed by the specified service and rated per Section 11000. The stuffing box shall be of ample depth for 6 rings of packing and be provided with lantern rings. The lantern ring and gland shall be split for convenient removal. The stuffing box housing shall be drilled and tapped for water flush connections. The shaft, where inside the stuffing box, shall be fitted with a replaceable sleeve.

E. MOTOR AND DRIVE UNIT:

Gear motors or gear reducers, designed in accordance with AGMA 6019-E (Class II) or AGMA 6010-E (Service Factor 1.25), shall be provided where greater speed reduction is specified. Unless otherwise noted, motors shall be energy-efficient, Type 2 motors in accordance with Section 11060.

F. BASE:

1. Mount each pump and drive on a common base.
  - a. Material: ASTM A36 fabricated structural steel.
  - b. Provide structural steel shape bases, bent form bases are not acceptable.
  - c. Provide bases with provisions for grouting and for anchor bolts.
  - d. Design baseplates to support pump and driver.
  - e. Provide planed surfaces of bearing pads for pumps and drives.

G. OVER PRESSURE PROTECTION

1. Provide each pump with a pressure sensor ring with a dual mounted gauge and single point pressure switch.

H. MOTORS:

1. Provide in accordance with Section and as specified and indicated.
2. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.
3. Provide motors for horizontal pumps with mounts for bolting to baseplate.

4. In addition to the requirements for bearings specified under Electric Motors in Section , provide pump motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.
  5. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet (1 meter) from motor.
  6. Operate without overheating at the speeds specified and indicated.
  7. Service Factor: 1.15, with 1.0 inverter duty rating for pumps equipped with variable frequency motor controllers.
  8. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.
  9. Rating: 460V, 3 PH, 60 Hertz.
  10. Insulation: Class F with Class B temperature rise, 40 degree C ambient.
  11. Site Altitude: Less than 100 feet above sea level.
  12. Provide Inpro/Seal bearing isolators.
- I. SHOP TESTING:
1. Provide motor shop testing in accordance with Section .
- J. Pump Tests:
1. Provide hydrostatic test of assembled pump at a maximum of 65 psi. Test wet end with pump assembled.
  2. Certified performance and witness testing.
    - a. Run pump at full speed rating point for 60 minutes prior to start of any testing.
    - b. Full speed tests:
      - (1) Take readings to determine flow, differential pressure, rpm, horsepower, displacement and efficiency.
    - c. Variable speed tests:
      - (1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.

- (2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.
  - d. Factory tests on pumps:
    - (1) Use tested job motors.
    - (2) Use factory calibrated test drives.
  - e. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.
3. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.
4. Testing Tolerances: ANSI/HI
5. In the event that specified tests indicate that pump, motor, or variable frequency motor controller will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency motor controllers at no additional cost to the Owner.
6. Repeat tests until specified results are obtained.
7. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

## 2.04 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Mill certifications confirming hardness of rotor and stator specified in paragraph 11390-2.02.
2. Operating and maintenance information specified in Section 01730.
3. Motor data as specified in paragraph 11060-2.05.
4. Manufacturer's certification that the pumping units will meet the vibration and critical speed limitations as specified in Section 11020.
5. Installation certification Form 11000-A as specified in paragraph 11390-3.01.
6. Training Certification Form 11000-B as specified in paragraph 11390-3.03.

## 2.05 SPARE PARTS

The following shall be provided for each pump size:

- 1 - stator
- 1 - rotor
- 1 - connecting rod
- 2 - sets of packing rings
  - 1 - bearing kit
- 1 - gear joint kit including gear joint seals

Spare parts shall be tagged and stored in accordance with provisions of paragraph 11000-2.12.

## PART 3--EXECUTION

### 3.01 INSTALLATION

The pumps shall be installed as specified and in accordance with manufacturer's written recommendations. The installation and initial operation of all components shall be certified on Form 11000-A as specified in Section 01999.

### 3.02 TESTING

- A. Comply with the requirements specified in Section 01663 and as specified herein.
- B. Test piping connections to prove the pump nozzle are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.
- C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.
  - 1. During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and motor inputs.
    - a. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.
  - 2. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.
  - 3. Repeat tests until specified results are obtained.

4. Contractor to provide all water labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.
  - a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.
  - b. All calibrations must be within 30 days of the field testing.
  - c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.
  - d. Contractor is responsible for delivery and disposal of water used for testing.
- D. Make all adjustments necessary to place equipment in specified working order at time of above tests.
- E. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.
- F. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

### 3.03 TRAINING

A minimum of 8 hours of training shall be provided by the pump manufacturer's service engineer. Training shall conform to Section 01664 and shall be certified on Form 11000-B as specified in Section 01999.

**\*\*END OF SECTION\*\***

## SECTION 11622

### CONTINUOUS BELT FILTER PRESS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

This section shall include furnishing, unloading, handling, storage and installing a complete sludge dewatering system including the belt filter presses, complete with ancillary equipment (including washwater motor-operated valve), as specified and indicated on the drawings and as required to meet the specified performance requirements.

##### A. SCOPE:

This section specifies continuous belt filter press equipment, including variable speed drives and appurtenances, for dewatering wastewater sludge.

##### B. TYPE:

The sludge dewatering system shall consist of in-kind replacement of two (2) existing belt filter presses and all appurtenances. Each belt filter press shall be a complete prefabricated unit consisting of at least a sludge conditioning system, a gravity drainage section, a pressure section, a belt alignment and tensioning system and a belt washing system. Only units having a measured belt width of 2.2, and an effective belt width of 2.0 shall be considered acceptable under this specification. The units shall be the Klampress 2.0 Meter with Extended Gravity and Wedge Section Belt Filter Presses as manufactured by Alfa Laval, Inc, Houston, Texas, no equal will be considered.

The overall dimensions of the belt filter press room shall be such that the installation of the press allows clearance on one side equal to the overall width of the belt filter press for the removal of rollers, as well as a minimum clearance of 3'-0" on all other sides of the press.

The belt filter press shall have the maximum dimensions, 102 1/4 inches high, 244 3/4 inches long, and 138 7/16 inches wide. The overall static weight of the belt filter press shall not exceed 24,800 pounds so as to minimize installation and civil work.

The minimum clearance requirements specified herein shall not relieve the contractor from allowing additional clearances for the proper installation, operation, and maintenance of the units. Should equipment other than that specified be proposed, the contractor shall be responsible for any redesign based on the requirements contained herein.

##### C. EQUIPMENT LIST:

	Belt Filter Press	
	1	2
Filter press identifier number	3	6
Washwater Booster Pump	3	6
Motor-operated valve	3	6

#### D. DESIGN REQUIREMENTS:

The belt filter press shall be designed in accordance with the following:

Minimum overall belt width, meters	2.2
Minimum effective filtration areas, square feet	
Gravity zone	93 <sup>1</sup>
Wedge zone	55 <sup>2</sup>
High pressure zone	As needed to meet Performance requirements

Notes:

1. Area determined on the basis of only the area supported by the belt support grid.
2. Area determined on the basis of only the lower belt area supported by the belt support grid.

The press shall be designed to accommodate solids up to and including 5/8 inch in any dimension without jamming, clogging, or overflow. The press shall be designed for continuous operation under the conditions set forth in this section. The press shall be configured to afford an unimpeded view of the sludge in the gravity dewatering section.

#### E. PERFORMANCE REQUIREMENTS:

As a minimum, the press shall provide the following performance characteristics when operating in accordance with the conditions presented in this section:

Sludge flow, gpm	
Maximum	200
Minimum	50
Solids capture, percent, minimum	95
(Solids capture is defined as a total dry weight of cake solids divided by total dry weight of feed solids multiplied by 100.)	
Dewatered cake discharge solids, percent, minimum	18
Guaranteed belt life, hours of operation, minimum	2500
Belt wash water flow rate, gpm, maximum	90

F. SERVICE CONDITIONS:

1. ENVIRONMENTAL CONDITIONS: The sludge belt filter presses will be located in the SWWRF belt filter press building. The press will be mounted on an existing raised concrete curb arranged to form a drainage sump directly beneath the press. The press will be subjected to frequent hosedown for cleaning purposes. The temperatures within the press room may be expected to range between 15 and 110 degrees F; relative humidity will range between 50 and 100 percent.

It may be expected the material discharged to each press will be in an actively digesting state, and small quantities of digester gas may be present. The gas is expected to contain methane in concentrations of up to 70 percent, with the remainder comprised of principally carbon dioxide with up to 2000 parts per million hydrogen sulfide and trace quantities of nitrogen. While it is very unlikely explosive concentrations of methane will be present in the room atmosphere, the Contractor is advised that corrosive agents (moisture, hydrogen sulfide gas, sulfuric acid, etc.) will be present at all times. Accordingly, materials shall be selected to provide appropriate resistance to corrosion and every effort shall be exercised in the manufacture of the equipment to eliminate crevices, unsealed overlapping plates and similar inaccessible areas where corrosion can take place without allowing access for application of preventive measures.

2. CONTROLS: The press, along with the associated sludge and polymer pumps, will be operated at a variable rate to optimize combinations of feed rate, polymer addition and belt speed for various conditions of sludge concentration, organic/inorganic solids percentage and other characteristics. Control of individual operational speeds for the press and pumps shall be through master/slave speed adjustment devices located on the press control panel.

3. UTILITY SERVICES: Each belt filter press shall be equipped with individual belt wash stations for both the upper and lower belts. Each station shall consist of a spray pipe, fitted with spray nozzles, contained within a fabricated housing which encapsulates a section of each belt. The housing and nozzle assembly shall be readily removable.

Nozzle spacing, and spray pattern shall be such that the sprays from adjacent nozzles overlap one another at the belt surface. Individual spray nozzles shall be replaceable.

The housing shall be sealed against the belt with rubber seals. The spacing between the upper and lower housing shall be adjustable to insure continuous contact between the seals and belt. The seals shall be replaceable without disassembly of the wash station.

Each belt wash station shall be furnished with a drain valve having an external handwheel to which is mounted a stainless-steel cleaning brush located inside the spray pipe. One full turn of the handwheel shall cause the brush bristles to enter each spray nozzle, and dislodge any solid particles which have accumulated, open the valve and allow the solids particles to be flushed into the drainage system.

Each belt filter press shall be provided with a 1 1/2 inch female pvc connection for belt wash

water with a motor operated valve to control the flow of the washwater between the washwater booster pump and spray system of the belt filter press. The cost of all appurtenances required to conform the booster pump motor operated valve installation to the standards for this project shall be considered unit responsibility required by the Manufacturer of the belt filter press and borne by the Contractor. Water consumption shall not exceed 90 gallons per minute. Water for cleaning sprays will be strained plant effluent, which is expected to contain up to 10 mg/l chlorine, small quantities of biological floc and dilute concentrations of industrial solvents.

Polymer, in diluted solution form, will be pumped to the press polymer/sludge mixing section by a variable speed, positive displacement pump located as specified, and enter downstream of the Klampress.

Power for motors 1/2 horsepower and larger will be provided at 480 volts AC, 60 Hz, 3 phase. The maximum recommended belt speed for performance in accordance with paragraphs 11622-1.02 C and 1.02 D shall correspond to operation of the drive motor at 480 volts AC, 60 Hz.

4. APPLIED SOLIDS: Anaerobically digested primary and waste sludge from the treatment process will be pumped to the press by a dedicated, variable speed positive displacement feedstock pump located as specified. The sludge is expected to contain quantities of industrial wastes including solvents, petroleum products, grit, hair, rags, grease, rubber goods, and organic solids in concentrations ranging from 0.5 to 5 percent.

Sludge delivered to the press will have a temperature of 55 to 95 degrees F and will have a pH which may range from 5 to 8.

## 1.02 QUALITY ASSURANCE

### A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A36/A36M	Structural Steel
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A320/A320M	Alloys--Steel Bolting Materials for Low-Temperature Service
AWWA C213	Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 2	Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	Enclosures for Industrial Controls and Systems

#### B. UNIT RESPONSIBILITY

The Contractor shall assign unit responsibility as specified in paragraph 11000-1.02 C to the belt filter press manufacturer for the equipment specified in this section, including the replacement of the washwater booster pumps' motor operated valve. A certificate of unit responsibility shall be provided.

#### C. EXTENDED LIMITED WARRANTY:

The Contractor is not allowed to supply equipment other than the named manufacturer. The warranty shall bind the equipment manufacturer and shall be backed by a performance and maintenance bond in the amount of 150 percent of the cost of the equipment. An irrevocable letter of credit, drawn on a U.S. government-insured banking institution, may be substituted for the specified bond. The warranty must be supplied to the Owner by the Contractor prior to start-up of the equipment and must be in a form acceptable to the Owner. The warranty shall be limited to all direct costs, including labor, and consequential costs relating to any required remedy, including replacement of the equipment, associated with failure of the equipment to perform as specified, a demonstrated belt filter press belt life lower than that specified, consistent failure of bearings, or failure of the structural frame or rollers. Warranty-related costs arising out of premature replacement of components and belts will be calculated upon a present worth basis to derive the additional costs due the Owner because of additional costs for operating the equipment. The present worth calculation will be based upon the Owner's cost of funds at the time the calculation is performed. The warranty shall cover the period during initial start-up and testing and from the date of expiration of the Contractor's guarantee for period of 365 days to allow for evaluation of belt life and structural and roller integrity over a period of 5 years. The direct and consequential costs of reduced belt life will be extended to cover the full 20-year lifetime of the machine; however, such costs will be reduced to reflect the value of invested monies. All costs of a major failure of structural frame or rollers shall be covered.

### 1.03 SUBMITTALS

The following information shall be submitted in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (□) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "*no changes required*". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
3. Certificate of Unit Responsibility attesting that the Contractor has assigned, and that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section and paragraph 11000-1.02 C. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
4. Drawings showing the entire belt filter press assembly, including material list and description of all components, structural members, auxiliary items and devices, and anchoring details. Anchoring details shall be submitted and be signed and sealed by a Professional Engineer licensed in the State of Florida. The seal provided must be from the State of Florida.
5. Detailed installation drawings, showing the size and location of all equipment, piping, electrical, instrumentation and structural connections.

6. Details of any additional equipment, structural items, and devices required to conform to the layout shown on the contract drawings (Reference: paragraph 11622-2.02).
7. Motor data as specified in paragraph 11060-1.03.
8. Proposed on-site testing and start-up procedures.
9. Training course outline and proposed class materials per paragraph 11622-3.03.
10. Control panel submittal requirements listed in Section 16176 and 17110.
11. Product information including manufacturer, pump curve, single line diagrams, electrical requirements, and proposed operating points regarding the provided booster pump.

## PART 2--PRODUCTS

### 2.01 ACCEPTABLE PRODUCTS

The following presses, modified to meet the requirements of the contract documents, are qualified for this project:

1. Ashbrook Corporation Klampress 2.0 Meter with Extended Gravity and Wedge Section Belt Filter Press

No manufacturers other than those identified above have been considered for this project and no equals shall be considered. The Contractor is cautioned, however, that by identifying the above manufacturers or suppliers, the Owner does not warrant or guarantee that the manufacturers' standard equipment and warranties will meet all requirements of the contract documents. In making such determination, the Owner has relied on the data submitted by each manufacturer or supplier. No determination by the Owner shall act or be interpreted or construed to relieve the Contractor of his responsibility for ensuring that all equipment provided hereunder shall fully comply with the requirements set forth in the contract documents.

### 2.02 EQUIPMENT LAYOUT

The Contractor is alerted to the fact that sludge dewatering room layout and orientation and layout of the conveyor belts from the belt filter press to the ultimate point of disposal is dictated by the dewatered sludge loading system envisioned for this project and therefore is fixed. The belt filter press layout depicted on the contract drawings is based upon Ashbrook Corporation Klampress 2.0 Meter with Extended Gravity and Wedge Section Belt Filter Press machines.

Because there may be significant design and configuration differences between the above-named belt filter presses, the location of the sludge cake discharge point will vary. The Contractor shall be responsible for installing the belt filter presses in a manner that allows for the dewatered cake to be conveyed to the proper conveyor belts. Any costs required to modify the discharge to ensure the proper conveyance shall be borne by the Contractor.

The Contractor shall submit, as part of the shop drawings for the belt filter presses, complete layout of all auxiliary equipment to be provided per these specifications.

## 2.03 MATERIALS

Component	Material
Frame	Steel, ASTM A36, hot-dip galvanized or ASTM A320, stainless steel
Splash guard	ASTM A320, stainless steel, Type 316LT
Drum rollers	ASTM A320, stainless steel, Type 316L
Rollers	Steel tube, ASTM A-36, 3/4-inch minimum coated with Buna-N, neoprene, nylon or Teflon
Roller shafts	ASTM A572 Grade 50 Type 2
Hydraulic piping	ASTM A320, stainless steel, Type 316
Plows and sludge distribution equipment	ASTM A123, carbon steel hot dip galvanized,
Belt filter cloth	Monofilament polyester
Belt seam closures (for seamed belts)	ASTM A320, Type 316, stainless steel
Spray headers	ASTM A320, Type 316, stainless steel
Spray nozzles	ASTM 320, Type 316, stainless steel
Drainage pans	ASTM A320, Type, 316L, stainless steel
Internal pressure piping	ASTM A320, stainless steel, Type 316
Drains	Schedule 40 PVC or ASTM 320, Type 316
Anchor bolts and miscellaneous hardware, including the bolts, nuts and washers	ASTM A320, Type 316 stainless steel

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

## 2.04 CORROSION PROTECTION

The mild steel frame members and related components shall be protected by both hot dip galvanizing and a top-coating system of industrial grade epoxy-based paint. Hot-dip galvanizing shall be in accordance with manufacturers recommendations after fabrication. No cutting, welding, drilling, or punching will be permitted on any portion of the frame after galvanizing.

The epoxy coating system shall conform to Coating System E-2 as specified in Section 09900.

Alternatively, the frame may be protected by fusion applied epoxy, AWWA C213. The epoxy system shall be applied after fabrication. Flame-sprayed application of the zinc coating will be permitted as long as the weight of the zinc coating conforms to applicable portions of ASTM A123. No cutting, welding, drilling, or punching will be permitted on any portion of the frame after galvanizing.

## 2.05 EQUIPMENT

### A. FRAME:

The press frame shall be designed to accommodate all operating and static loads with a factor of safety of not less than 5 and shall function without deflection, deformation, or vibration which will in any manner degrade performance of the equipment. No disassembled component shall weigh more than 4000 pounds, and the frame design shall incorporate skids for even distribution of all loads to the supporting building structural system. Lifting lugs shall be provided, and access platforms shall be provided by the contractor to afford convenient access to maintenance points throughout the press. Splash guards shall be provided to confine all liquid to within the confines of the curbed drain containment basin specified. Splash guards shall be designed to permit convenient access to all interior portions of the press for maintenance purposes.

In their principal load bearing direction, no unsupported frame spans greater than 84 inches will be permitted. The structural design of all framing members shall limit deflection to no more than 1/480 of span. Design maximum stresses shall not exceed 20 percent of the material's yield strength. Upon completion of all fabrication work, all components of the press' framing system shall be coated in accordance with the requirements of paragraph 11622-2.04.

### B. DRAINAGE:

Drainage pans shall be provided under all dewatering and belt washing zones to contain all liquids and conduct this material to the drain sump to be incorporated into the machine's support

base. The drainage pans, shields and piping shall be designed to confine all spray and splashed liquids and to conduct these to the sump. Drained connections shall be self-venting to prevent overflow. The main sludge inlet area shall include a high-level overflow which shall discharge, through appropriate piping to the sump beneath the press. A NEMA 4X float switch shall be provided in the drainage pan. The switch shall be set to close when the sludge receptor area is near overflow elevation.

Each belt filter press shall be furnished with a gravity drainage section to accept sludge from the sludge conditioning system. The gravity drainage section shall be furnished with a sludge feed chute and an inlet distributor to evenly distribute the conditioned sludge over the effective width of the moving filter belt.

The conditioned sludge shall be contained on the belt with adjustable containment barriers equipped with replaceable rubber seals to prevent leakage. Rubber seals are designed to be attached to the containment barriers, with a friction fit, to allow for easy replacement without the use of tools.

The gravity drainage section shall have a minimum dewatering area of 93 square feet.

The filter belt, while in the gravity drainage section, shall be supported by a steel grid fitted with high-density polyethylene wiper bars. The wiper bars shall be spaced at a maximum of two and one half inches and shall have a nominal wear thickness of one half inch, to minimize the frequency of replacement. The wiper bars shall be arranged in a chevron pattern, with the apex toward the sludge inlet, to reduce the possibility of belt creasing. The belt support grid shall be a minimum of 2 inches wider than the belt on each side and so designed to reduce belt wear. Wiper bars constructed of fiberglass, other high friction materials, or table rollers, which require extra maintenance due to coatings, and additional bearings shall not be considered an acceptable substitute to this specification.

The gravity drainage section shall be furnished with chicanes (plows) to adequately furrow the conditioned sludge to facilitate drainage. Each row of chicanes shall be provided with a single lifting handle, designed to remove the entire row of chicanes at least 6 inches from the belt, out of the sludge flow, to facilitate cleaning. Chicanes shall be designed to be individually adjustable laterally and shall pivot to allow them to pass over obstructions on the belt. The minimum of number of chicanes shall be 84, and the minimum number of rows shall be 10.

The manufacturer shall be required to demonstrate that each individual chicane shall be capable of allowing a one-inch vertical obstruction on the belt to pass under them without damage to the equipment.

Vacuum assisted, inclined gravity drainage sections, which are subject to flooding, or independent gravity drainage sections, which require a separate belt drive motor and tensioning device will not be considered an acceptable substitute to this specification.

#### C. BELT WASH SYSTEM:

Both dewatering belts shall be provided with a washing system consisting of booster pump, piping, motor operated valve, nozzles, drip pans, and spray containment shields as required to clean the area in contact with the sludge prior to returning to the pressing zones. The nozzles shall be designed with a self-cleaning feature to provide cleaning action without disassembly or interruption of operation. Spray piping and nozzles shall be adequately braced and shall be of sufficient pressure rating to withstand pressure transients caused by sudden valve closures. All spray water shall be contained within the press enclosure.

#### D. SLUDGE CONDITIONING:

The press shall be provided with a sludge conditioning system designed specifically for polymer aided flocculation of the digested sludge. The system shall be configured to prevent floc breakup during transport to the gravity drainage section. The sludge conditioning device shall provide an appropriate, infinitely variable range of conditioning energies to assure economic flocculation of the sludge under all conditions.

Motor driven polymer conditioning systems will not be accepted.

#### E. FILTERING MEDIUM:

The filter belts shall be manufactured of a continuous weave of monofilament polyester wires. Filter belts may be of split type or continuous. Seams for split belts must be equal or greater in strength to that of the belt, be repairable and facilitate replacement. The seam shall be designed to prevent interference with doctor blades or any other belt press equipment. Regardless of design, belts shall be suitable for convenient replacement by operating personnel. If seamless belts are provided, the machine's design shall permit installation from either the left or right side of the machine.

#### F. ROLLER ASSEMBLIES:

Drum rollers, if provided, shall have one-inch diameter minimum diameter perforations spaced at not more than three inches. Scoop blades or similar devices shall be provided to extract filtrate from the center of the drum.

All rollers shall be designed for a maximum deflection of 0.05 inch at the center when under maximum loading. Maximum roller loading shall include roller mass forces and the tension forces resulting from the belt drive and belt tension. Belt tension shall be based upon not less than 200 pounds per inch of belt width and drive tension shall be calculated on the basis of a belt speed of not less than 15 feet per minute.

All rollers shall be supported with heavy-duty bearings in sealed, splashproof enclosures. Bearings shall be located outboard from the rollers in pillow-block housings. Bearings shall have an AFBMA L-10 rating of 300,000 hours of operation based upon all forces and loads, including belt tension, roller mass and drive torque loads. Load calculations shall be based on both belts at a simultaneous belt tension of 50 pounds per lineal inch of belt and at a belt speed of 15 feet per minute.

Grease fittings shall be extended to the face of the press frame and shall be grouped to facilitate maintenance operations.

G. BELT TRACKING AND TENSIONING SYSTEMS:

1. GENERAL: The press shall be provided with both tracking and tensioning systems to insure reliable operation. The belt tracking and tensioning system may incorporate either hydraulic or pneumatic belt adjustments. All hydraulic piping or pneumatic tubing shall be rigidly and firmly anchored to the structural frame of the press. All lines shall be sized according to the intended use and operating pressure with a factor of safety of not less than 10.

Hydraulic systems shall include all pumps, reservoirs, piping, and controls for system operation. The hydraulic power pack, including pump, reservoir and pressure controls, shall be located on the frame of the press.

Pneumatic systems shall include all piping, control panels, motor operated valves and controls necessary for system operation.

2. BELT TRACKING SYSTEM: Automatic sensing devices shall be provided to actuate the automatic belt tracking system and assure proper alignment of the belts at all times. The sensing devices shall continuously monitor the position of the belt, allowing the alignment roller to effect minor belt position adjustments continuously to maintain the belt properly positioned within the belt track. The belt tracking system shall be designed so that all belt position adjustments are performed smoothly without sharp, sudden movements of the filter belt or alignment roller. The belt tracking system shall be designed to minimize belt and roller wear and extend the working life of the filter belts.

NEMA 4X limit switches shall be provided to detect malfunctioning of the tracking system. The switches shall be designed to detect gross belt misalignment and shall close to indicate belt misalignment.

3. BELT TENSIONING ASSEMBLY: A hydraulically or pneumatically adjusted belt tensioning assembly shall be provided. Belt tension adjustment shall be through cylinder actuators for hydraulic systems or bellows actuators for pneumatic systems acting on the takeup roller hubs. Bellows type actuators shall be self aligning type, designed for a working pressure of 150 psig. Tension adjustment devices acting on the center of the roller will not be permitted. Means shall be provided to maintain roller alignment and provide even tension throughout the width of the belt. A pressure gage or similar device shall be provided to indicate actual belt tension in psi. The belt tensioning system shall accommodate at least 3 percent increase (but not less than 24 inches) in belt length. Belt tension shall be infinitely variable and shall be adjustable without shutdown of the machine.

H. GRAVITY DEWATERING SECTION:

Flocculated sludge shall be evenly distributed onto the filter belt through an inlet distribution assembly. The inlet distributor shall be designed to prevent leakage and splash through the use of corrosion-resistant containment seals. A series of plows or similar devices shall be employed in the gravity drainage section to promote sludge dewatering and to insure an even distribution of the material across the entire width of the filter belt. All surfaces of plows and other devices contacting the filter cloth shall be coated with teflon or similar smooth material to prevent rapid deterioration of the belt surface. Splash type distribution systems will not be permitted.

I. WEDGE COMPRESSION SECTION:

Following the gravity drainage section, the sludge shall enter a low-pressure section where converging belts shall exert continuously increasing pressure. Means shall be provided to adjust the angle of convergence while the press is in operation to permit operators to optimize dewatering operations. Containment seals shall be provided on both sides of the wedge compression section to prevent sludge from escaping.

J. ROLL PRESSURIZATION SECTION:

Following the wedge compression section, the sludge shall enter a dewatering section of increasingly greater pressure, where the two belts pass sequentially over series of rollers of decreasing diameter. The roller diameters and belt tensioning system, in combination, shall exert increasingly greater pressure as liquid is removed from the sludge, thereby effecting efficient dewatering, yet assuring efficient capture of solids.

K. SCRAPER BLADES AND DISCHARGE CHUTE:

Replaceable scraper blades shall be provided to efficiently separate dewatered cake from the belt. A discharge chute shall be provided to conduct the cake to the middle of the belt conveyor for removal. The scraper blade shall be mounted opposite a belt roller to insure efficient cake removal.

L. ELECTRICAL:

All conduit shall be RACESPEC type GRS, hot-dip galvanized conduit and standard weight conduit coated and lined with fusion applied epoxy in accordance with paragraph 11622-2.04. Limit switches, float switches, and all other electrical devices shall be NEMA 4X enclosures with contact rated not less than NEMA A300.

All switches and other 120-volt devices shall be wired in conduit to a labeled, gasketed, NEMA 4X junction box located on the press frame. The junction box shall include terminal blocks for interface of all factory-wired devices with the instrumentation and controls specified in Divisions 16 and 17.

A mushroom head emergency stop push button station or emergency lanyard shall be provided on each side of the machine. The device shall have a separate manual reset.

M. DRIVE UNIT:

The belts and rollers shall be driven by a variable frequency drive unit to achieve infinitely and uniformly variable speed adjustment while the press is in operation through manual adjustment of a control device located on the control panel. The variable frequency device, complete with 1:1 isolation transformer, shall be provided separately by the belt press manufacturer for installation in the motor control lineup specified.

Drive motors for variable frequency service shall be special Type 2 energy efficient motors as specified in Section 11060. Drive motors for constant speed service shall be Type 2 energy efficient motors.

All portions of the drive unit shall be totally enclosed with all gearing running in oil or grease lubricated and all drive chains and sprockets completely enclosed in a permanently greased housing.

Input power to the drive roller shaft shall be supplied through an A.C., variable frequency drive unit. Speed shall be controlled through cyclical variation in motor current, which is operator set at the control panel. The drive roller speed reduction is obtained through a helical gear reducer.

#### Drive Motor Data:

Quantity per Machine	1
Maximum Horsepower	3 horsepower
Power Requirements	460 VAC, 3 phase, 60 cycle.
Rated Speed	1740 RPM
NEMA Design	B
Insulation Class	F
Enclosure	TEFC/IEEE 841
Service Factor	1.15
Special Features	Severe duty rating

The variable input power shall be transmitted through a helical bevel gear reducer connected to the drive roller. The drive roller shall be constructed as specified under "Rollers" and shall be surfaced with a Buna-N rubber coating to permit slip free transmission of driving torque to the belt.

#### N. ACCESS PLATFORMS:

The belt filter press shall be provided with a complete set of access platforms located to afford operator access to two sides of the press, including to the polymer mixing section.

## 2.06 SPARE PARTS

One set of any tools required for servicing belt filter presses shall be provided. In addition, the following spare parts shall be provided for each pair of presses:

- Two complete sets, replacement belts
- Doctor blades for both thickened and dewatered sludge, including all fasteners, brackets and appurtenances necessary for mounting on the press frame
- Gravity, wedge and shower box seals
- One complete set, water spray nozzles
- One bearing of each size and type used on each machine and subassembly
- One complete set, all belt positioning and tensioning devices

Spare parts shall be protected, labeled, and boxed in accordance with the requirements set forth in paragraph 11000-2.12. Special tools shall be Proto, or equal, with the name of the Owner engraved on each. Tools shall be furnished in a painted metal mechanic's toolbox fitted with a lock hasp. The words "Belt Filter Press Tools" and the name of the Owner shall be neatly stenciled on the cover.

2.07 The Belt Filter Press System shall be provided with control panels as shown on the drawings that will contain the necessary control devices and equipment for controlling the dewatering process as described herein.

#### A. GENERAL CONSIDERATIONS

Each control panel shall accept a single 460 VAC, 60 hertz, 3-phase power input. A main disconnect circuit breaker and flanged operator mechanism shall be included. When the disconnect is in the open position, all power shall be removed from the control system. A VFD will be supplied for each belt drive and the polymer pumps. A single control power transformer shall be included that will provide 120 VAC control power to the entire system. All logic functions for the system shall be performed by an industrial programmable logic controller (PLC) located in the main control panels. A common 120VAC, 1-phase Local Control Panel will be supplied with an Operator Interface Terminal (OIT) located on the door for control of the multiple BFP systems.

Located on the front of the control panel shall be a CONTROL POWER OFF/ON switch. When in the ON position, the CONTROL POWER ON pilot light will be illuminated and control power shall be distributed to the control system. When in the OFF position, the control system shall be held de-energized. Also located on the control panel shall be an EMERGENCY STOP pushbutton. It shall be an illuminated mushroom head style pushbutton that when depressed shall immediately de-energize all moving equipment in the system. An alarm horn shall be included for audible alarm annunciation and an alarm beacon for alarm display.

## B. SYSTEM OPERATION

As a minimum, the following control devices shall be provided on the OIT on the front of the common local control panel for control of each BFP System:

- HAND/OFF/AUTO MODE selection
- HAND MODE indication
- AUTO MODE indication
- AUTO START pushbutton
- AUTO STOP pushbutton
- SYSTEM RESET pushbutton
- ALARM SILENCE pushbutton
- PRESS READY indication
- DEWATERING OFF/ON selection
- WASHDOWN CYCLE ON indication
- BELT INSTALLATION OFF/ON selection
- WASHWATER PUMP START pushbutton
- WASHWATER PUMP STOP pushbutton
- WASHWATER PUMP RUNNING indication
- HYDRAULIC PUMP START pushbutton
- HYDRAULIC PUMP STOP pushbutton
- HYDRAULIC PUMP RUNNING indication
- BELT DRIVE START pushbutton
- BELT DRIVE STOP pushbutton
- BELT DRIVE RUNNING indication
- BELT DRIVE SPEED control (0-100%)
- BELT CONVEYOR START pushbutton
- BELT CONVEYOR STOP pushbutton
- BELT CONVEYOR RUNNING indication
- SLUDGE PUMP START pushbutton
- SLUDGE PUMP STOP pushbutton
- SLUDGE PUMP RUNNING indication
- SLUDGE PUMP SPEED control (0-100%)
- POLYMER PUMP SELECT DEDICATED/SPARE selector switch
- POLYMER PUMP START pushbutton
- POLYMER PUMP STOP pushbutton
- POLYMER PUMP RUNNING indication
- POLYMER PUMP SPEED control (0-100%)
- LOW WASHWATER PRESSURE indication
- LOW HYDRAULIC PRESSURE indication
- BELT MISALIGNED indication
- BELT BROKEN indication
- NO CAKE indication
- EMERGENCY STOPPED indication
- BELT DRIVE FAIL indication
- BELT CONVEYOR FAIL indication
- SLUDGE PUMP FAIL indication

## POLYMER PUMP (D/S) FAIL indication

The control panel shall require the following discrete signal inputs from others. The signals shall be normally open dry contacts and shall close when the equipment is running.

- a) Belt conveyor running and fail
- b) Sludge pump running and fail
- c) Polymer pump D & S running and fail

The control panel shall provide the following discrete signals for use by others. The signals shall be dry contacts.

- a) Sludge pump run (N.O. close to run)
- b) Polymer pump D & S run (N.O. close to run)
- c) Belt conveyor run (N.O. close to run)

The control panel shall require the following analog signals from others.

- a) Sludge pump speed or flow (4-20 mA)
- b) Polymer pump D & S speed (4-20 mA)

The control panel shall provide the following analog signals.

- a) Sludge pump setpoint speed control (4-20 mA)
- b) Polymer pump D & S setpoint speed control (4-20 mA)

## C. SEQUENCE OF OPERATION

The press may be operated in the automatic mode by placing the HAND/OFF/AUTO selection in the AUTO position. The AUTO indicator will illuminate and the operator will select the required sludge pump to operate and press the AUTO START pushbutton. At this time, the washwater pump, washwater valve and hydraulic pump will be energized and a belt tensioning time delay will start.

After the belt tensioning timer times out, the belt drive will be energized and a belt pre-wet time delay will start. The belt conveyor will be energized and after the pre-wet timer times out, the PRESS READY pilot light will be illuminated and, if the DEWATERING OFF/ON selection is in the ON position, the sludge pump and selected polymer pump will be energized.

Pressing the AUTO STOP pushbutton will de-energize the selected sludge pump and polymer pump, illuminate the WASHDOWN ON pilot light and start a wash down time delay and a belt conveyor shutdown timer. After the belt conveyor shutdown timer times out, the belt conveyor will be de-energized. After the wash down timer times out, the belt drive, hydraulic pump, washwater pump and washwater valve will be de-energized.

To operate the press in the manual mode, the operator will place the HAND/OFF/AUTO selector switch in the HAND position. The HAND indicator will be illuminated. The operator will start the washwater pump by pressing the WASHWATER PUMP START pushbutton; start the hydraulic pump by pressing the HYDRAULIC PUMP START pushbutton. Anytime the washwater pump is running, the washwater valve shall be energized.

The operator should not proceed until the belts have been fully tensioned. No interlock is provided to prevent the operator from starting the belt drive in the manual mode. Pressing the BELT DRIVE START pushbutton will energize the belt drive and after a pre-wet time delay will illuminate the PRESS READY pilot light. At this time, the operator will start the belt conveyor by pressing the BELT CONVEYOR START pushbutton. The operator will then start the sludge pump by pressing the SLUDGE PUMP START pushbutton. The operator will then select the polymer pump to operate by pressing the required DED/SP selection and then start the polymer pump by pressing the POLYMER PUMP START pushbutton.

Pressing the respective STOP pushbutton in the reverse order stated above will stop the system.

#### D. FAULTS

When any of the following fault conditions occur, in automatic or manual mode, the appropriate fault indicator will be illuminated, the alarm horn will sound and the belt filter press and associated equipment will be de-energized.

- EMERGENCY STOP
- LOW WASHWATER PRESSURE
- LOW HYDRAULIC PRESSURE
- BELT MISALIGNED
- BELT BROKEN
- BELT DRIVE FAIL
- BELT CONVEYOR FAIL

The following fault conditions will cause the wash down cycle to be initiated in the automatic mode (annunciation only in the manual mode):

- NO CAKE
- SLUDGE PUMP FAIL
- POLYMER PUMP D & S FAIL

#### E. ENCLOSURES

Control panel enclosures material shall be per Section 17000 and 17110. Enclosures shall be manufactured by Hoffman Manufacturing, Rittal or equal.

#### F. WIRING

All power and control wiring shall be 600 volt, type THHN/THWN or MTW insulation stranded copper and shall be sized for the required load, 14 AWG minimum.

#### G. CIRCUIT BREAKERS

The circuit breaker for the main disconnect shall be thermal magnetic molded case units. The circuit breaker shall be Allen Bradley type 1404 or equal.

#### H. MOTOR STARTERS

Motor starters shall be full voltage, non-reversing, IEC style across-the-line units. Coils shall be 120 VAC. The starters shall be Siemens Compact Sirius 3RM1 or equal.

**I. SELECTOR SWITCHES**

All selector switches shall be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10-ampere continuous service. Selector switches shall be Allen Bradley, type 800 H or equal.

**J. PUSHBUTTONS**

All pushbuttons shall be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10-ampere continuous service. Pushbuttons shall be Allen Bradley, type 800 H or equal.

**K. PILOT LIGHTS**

Pilot lights shall be heavy duty, oil tight/watertight, corrosion resistant units rated for NEMA 4X service. Units shall be 120 VAC transformer type. Pilot lights shall be Allen Bradley, type 800H or equal.

**L. TERMINAL BLOCKS**

Terminal blocks shall be high density, spring cage clamp style, with 600volt rating. Terminal blocks shall be Phoenix Contact UK 5 N, or equal.

**M. PROGRAMMABLE LOGIC CONTROLLER (PLC)**

The PLC shall be a modular type with discrete and analog capabilities. The CPU shall have 2MB minimum RAM for user instructions. The unit shall have battery backed RAM and EEPROM backup. The PLC shall be an Allen Bradley CompactLogix 1769-L33ER.

**N. VARIABLE FREQUENCY DRIVE (VFD)**

The VFD shall be UL listed and shall be Allen Bradley Yaskawa V100 with Ethernet IP.

**O. OPERATOR INERFACE TERMINAL (OIT)**

OIT shall be Phoenix Contact 17" Resistive Touchscreen with Windows 10 OS, 2.1GHz I5 Processor, 120GB SSD Storage, Panel Mounted, and 8GB DDR Memory. Model BL2PPC7000 or equal.

**P. FIBEROPTIC MANAGED SWITCH**

1. Industrial Managed switch support layer 2 switching and layer 3 routing
2. Gigabit Ethernet, 1 spare copper port minimum. Fiber ports to match existing plant fiber.
3. Temperature range -40° to 140° F.
4. UL Listed
5. Studio 5000 Add-on Profiles
6. Predefined Logix Tags for monitoring and port control.
7. Rockwell Automation Stratix 5400, 5700, or equal.

Q. UNINTERRUPTIBLE POWER SYSTEM (UPS)

The UPS shall be on-line, computer-grade with electrical isolation including output neutral. UPS shall be packaged for panel enclosure mounting using a back-panel bracket or holder:

1. Nominal input voltage: 120Vac.
2. Nominal output voltage: 120Vac.

The online UPS system shall be provided with integral sealed no maintenance batteries, sized to provide full capacity backup power for 10 minute minimum at connected load with integral battery charger.

The panel supplier shall calculate the required kVA rating at 150 percent of connected load. Submit load calculations, schematic diagrams, and wiring connection diagrams. Provide battery cabling and other required cabling for a complete system.

The UPS shall be mounted within the panel on a pedestal or tray with stainless-steel legs to provide space for wire entry and passage.

The UPS shall be configured with a maintenance bypass switch to allow ease of removal from the panel; to allow the panel to operate on utility power.

Uninterruptible power supply systems shall be as manufactured by Best Power Technology, Inc., Necedah, American Power Conversion, Wisconsin, or equal.

R. DIRECT-CURRENT POWER SUPPLIES

Nominal 24-volt direct-current instrumentation and control power supply:

Convection-cooled linear type or switching type.

Line regulation: 0.4 percent for line variations from 105 to 132 volts

Load regulation: 0.4 percent for load variations from 0 to full load.

1. Ripple and noise: Not exceed 100 mV peak-to-peak.
2. Hold-up time at maximum load: Not less than 16 milliseconds.
3. Continuous duty from 0 to 50 degrees C at rated load.
4. Output electronically current limited.
5. Over-voltage crowbar shutdown.
6. Output voltage:
  - a. Rated 28 Vdc
  - b. Adjustable plus or minus 5 percent
  - c. Set to provide 26.4 volts to the panel direct current bus.
7. Power Supply: TDK-Lambda LZSA series, Phoenix Contact Quint-PS, or equal.
8. Provide dry contact for failure alarm. Dry contact to be wired to input in nearest PLC

## S. SURGE PROTECTION

1. Surge protectors shall be multi-stage, plug-in type selected to protect the equipment. Surge protectors shall be removable without changing the impedance of the circuit. Surge protectors product manufactures shall be:

1. Circuit Components Inc: Din Rail SDD-400 Series for Data or Analog Signals.
2. Joslyn Model 1663-08
3. Taylor 1020FA
4. Phoenix Contact
5. Telematic
6. Edco
7. Or equal.

- B. Provide Type 1 surge protective devices, per NEC Article 285, at the power feed to the panel. Surge Protective Devices (SPD) shall be designed to provide transient voltage protection for a service entrance panelboard. SPD units shall comply with UL 1449 3rd Edition, and shall be listed for such use. SPD units shall be rated for the voltage and phase service of the panel at 120 kA per phase. SPD units shall have a built-in diagnostic package with flashing trouble indicator, a display for the status of each phase, and a counter and display to indicate the number of surges that have caused the device to operate.

1. SPD units shall be Eaton Clipper Power System, Visor Series, Circuit Components Inc, SPD-Series or approved Equal.

- C. Surge arrestors and capacitors shall be provided on the primary winding of isolation transformers supplying power to solid state systems. Surge protectors shall be mounted in a separate , NEMA 1 enclosure adjacent to the transformer and the incoming line passed through this enclosure. Surge arrestors shall be General Electric 9L15EC or equal. Surge capacitors shall be General Electric 9L18B, or equal.

## 2.08 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Operating and maintenance information specified in Section 01730.
2. Certified calculations documenting the structural design of the frame and rollers per requirements specified in paragraphs 11622-2.05 A and -2.05 F.
3. Motor product data as specified in Section 11060.
4. Extended warranty specified in paragraph 11622-1.02 C.

6. Training Certification Form 11000-B as specified in paragraph 11622-3.03.
7. Affidavit as specified in paragraph 11622-3.04.

## PART 3--EXECUTION

### 3.01 GENERAL

Belt filter presses shall be completely factory assembled. Erection shall require only bolting to the foundation and connection of external piping and wiring.

### 3.02 FIELD TESTING AND NONCOMPLIANCE PENALTIES

Following installation but before final acceptance, the belt filter presses will be tested over a minimum period of 4 days, 7 or more hours per day. If the complete performance requirements specified under paragraph 11622-1.01 E are not met, the manufacturer shall make such modifications to the belt filter presses within 4 weeks to meet through-put capacity or other performance requirements. Failure to achieve specified performance criteria within 30 days from availability of feedstock material shall constitute the basis for the Owner to seize the performance bond specified under paragraph 11622-1.02 C.

### 3.03 OPERATIONAL INSTRUCTIONS AND TRAINING

The Contractor, in addition to requirements in other portions of these specifications for installation, testing and start-up, shall provide the services of factory trained instructors from the Manufacturer for the purpose of training the Owner's personnel in the proper operation and maintenance of the equipment. Operational training shall be with the Manatee County Operation's team for a minimum of 2 hours, and be performed for two (2) separate day shift Teams (two separate days) regarding operations and maintenance of the belt filter presses.. Subjects shall include the following:

1. Start-up procedures
2. Shutdown procedures
3. Troubleshooting
4. Selection of proper polymer types and dosages
5. Replacement of dewatering belts
6. Operating adjustments for performance optimization
7. Preventive maintenance

8. Maintenance procedures
9. Emergency procedures
10. Records keeping

The Contractor shall submit a course outline, along with proposed class materials, for review by the Construction Manager at least 60 days prior to the training.

Furthermore, separate training from the Manufacturer shall include the control panels and CompactLogix program for two (2) hours in one location. The training shall also include the managed network switches that are provided by the Manufacturer of the belt filter presses. The control panel and program training shall be considered separate from the operation and maintenance training described in the previous paragraphs.

Training shall be certified on Form 11000-B as specified in Section 01999.

#### 3.04 SUPPLIER OR MANUFACTURER INSPECTION AND AFFIDAVIT:

The Contractor shall arrange for the belt filter press manufacturer to furnish one or more experienced installation engineers to attend the site as often as necessary to inspect and approve support construction for the belt filter presses, belt filter press installation, testing and start-up, and to assist in the training of operators, all as necessary for the belt filter press manufacturer to certify that the belt filter presses are installed correctly.

The Contractor shall assure that the belt filter press manufacturer reviews and accepts the construction of the belt filter press installation at the following stages:

1. When all items of the belt filter press installation have been correctly installed in the manner and to the tolerances prescribed by the belt filter press manufacturer for correct performance.
2. When the belt filter press installation has been satisfactorily tested to the levels of performance necessary to meet the requirements of these specifications. Tests shall include those specified in Section 01660 and paragraph 11622-3.02.
3. When the Owner's operating personnel have received adequate instruction and practical training in the operation and maintenance of the sludge dewatering system. Training shall include the provisions of Section 01664.

Upon completion of item 3 above, the Contractor shall submit an affidavit signed by the belt filter press manufacturer certifying that the supplier or manufacturer has observed and accepts that all stages of construction, installation, testing, and training have been adequately performed. The affidavit shall conform to the form and style of Form 11000-A specified in Section 01999.

Provision of the inspection, approval, and affidavit by the belt filter press supplier or manufacturer shall in no way relieve the Contractor of any responsibilities or requirements of this contract, including system installation, testing, commissioning, and the 365-day guarantee.

**\*\*END OF SECTION\*\***

## SECTION 15050

### PIPING SYSTEMS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies systems of process piping and general requirements for piping systems. Detailed specifications for the components listed on the Piping System Specification Sheets are found in other sections of Division 15. This section shall be used in conjunction with those sections.

###### B. DEFINITIONS:

Pressure terms used in Section 15050 and elsewhere in Division 15 are defined as follows:

1. Maximum: The greatest continuous pressure at which the piping system operates.
2. Test: The hydrostatic pressure used to determine system acceptance.

##### 1.02 QUALITY ASSURANCE

###### A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AASHTO M36/M36M	Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains
ANSI A13.1	Scheme for the Identification of Piping Systems
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.3	Malleable Iron Threaded Fittings Class 150 and 300
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ANSI B16.11	Forged Steel Fittings, Socket Welding and Threaded
ANSI B16.12	Cast Iron Threaded Drainage Fittings
ANSI B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ANSI B31.1	Power Piping
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Qualifications
ASTM A47	Malleable Iron Castings
ASTM A53	Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A105/A105M	Forgings, Carbon Steel, for Piping Components
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A197	Cupola Malleable Iron
ASTM A234/A234M	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A312/A312M	Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A403/A403M	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A536	Ductile Iron Castings
ASTM A570/A570M	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality

Reference	Title
ASTM B88	Seamless Copper Water Tube
ASTM C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C296	Asbestos-Cement Pressure Pipe
ASTM C443-REV A	Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C564	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2513	Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2996	Filament-Wound Reinforced Thermosetting Resin Pipe
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3261	Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D4174	Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems
ASTM D4101	Propylene Plastic Injection and Extrusion Materials
ASTM F441	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
AWWA C105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids
AWWA C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

Reference	Title
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 In. and Larger--Shop Applied
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Services--Sizes 4 In. through 144 In.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C301	Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
AWWA C303	Reinforced Concrete Pressure Pipe--Steel Cylinder Type, Pretensioned, for Water and Other Liquids
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	Disinfecting Water Mains
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water
AWWA M11	Steel Pipe--A Guide for Design and Installation
CISPI 301	Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings
FEDSPEC L-C-530B(1)	Coating, Pipe, Thermoplastic Resin or Thermosetting Epoxy
MIL-H-13528B	Hydrochloric Acid, Inhibited, Rust Removing
MIL-STD-810C	Environmental Test Methods
SAE J1227	Assessing Cleanliness of Hydraulic Fluid Power Components and Systems
UPC	Uniform Plumbing Code

#### B. FITTINGS AND COUPLING COMPATIBILITY:

To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems shall be furnished by the same manufacturers.

## PART 2--PRODUCTS

### 2.01 PIPING MATERIALS

Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, linings and coatings, shall be selected from those listed on the piping system specification sheets. Piping materials shall conform to detailed specifications for each type of pipe and piping appurtenance specified in other sections of Division 15.

### 2.02 PIPING IDENTIFICATION

#### A. PLASTIC CODING MARKERS:

Plastic markers for coding pipe shall conform to ANSI A13.1 and shall be as manufactured by W. H. Brady Company, Seton Name Plate Corporation, Marking Services Inc., or equal. Markers shall be the mechanically attached type that are easily removable; they shall not be the adhesive applied type. Markers shall consist of pressure sensitive legends applied to plastic backing which is strapped or otherwise mechanically attached to the pipe. Legend and backing shall be resistant to petroleum based oils and grease and shall meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810C. Markers shall withstand a continuous operating temperature range of -40 degrees F to 180 degrees F. Plastic coding markers shall not be the individual letter type but shall be manufactured and applied in one continuous length of plastic.

Markers bearing the legends on the background colors specified in the PIPESPEC shall be provided in the following letter heights:

Outside pipe diameter, <sup>a</sup> inches	Letter height, inches
Less than 1-1/2	1/2
1-1/2 through 3	1-1/8
Greater than 3	2-1/4

<sup>a</sup> Outside pipe diameter shall include insulation and jacketing.

In addition, pipe markers shall include uni- and bi-directional arrows in the same sizes as the legend. Legends and arrows shall be white on blue or red backgrounds and black on other specified backgrounds.

#### B. PLASTIC TRACER TAPE:

Tracer tape shall be 6 inches wide, colored the same as the background colors as specified in Table A, paragraph 15050-3.06, and made of inert plastic material suitable for direct burial. Tape shall be capable of stretching to twice its original length and shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or equal.

Two messages shall be printed on the tape. The first message shall read "**CAUTION CAUTION \_\_\_\_\_ PIPE BURIED BELOW**" with bold letters approximately 2 inches high. The blank shall be filled with the particular system fluid such as chlorine, oxygen or sulfur dioxide. The second message shall read "**CALL \_\_\_\_\_**" with letters approximately 3/4 inch high. Both messages shall be printed at maximum intervals of 2 feet.

## 2.03 VALVES

Valves of the same size and service shall be provided by a single valve manufacturer. Packing shall be nonasbestos material. Actual length of valves shall be within 1/16 inch (plus or minus) of the manufacturer's specified length. Flanges shall meet the requirement of ANSI B16.5. Push-on and mechanical joints shall meet the requirements of AWWA C111. Valve operators are specified in Sections 15184 and 15185.

## 2.04 PRODUCT DATA

Product data on piping materials shall be provided in accordance with Section 01300 where specified.

Piping layout drawings shall be transmitted to the Construction Manager a minimum of 2 weeks prior to construction. Drawings shall be original layouts by the Contractor; photocopies of contract drawings are not acceptable.

# PART 3--EXECUTION

## 3.01 INSTALLATION

### A. LOCATION:

Piping shall be provided as specified except for adjustments to avoid architectural and structural features and shall be coordinated with electrical construction.

### B. PIPING SIZES:

Where the size of piping is not specified, the Contractor shall provide piping of the sizes required by UPC. Unless specified otherwise, small piping (less than 1 inch in diameter) required for services not described by UPC shall be 1/2 inch.

### C. PIPE SUPPORT, ANCHORAGE AND SEISMIC BRACING:

1. GENERAL: Piping shall be supported by anchor brackets, guides, saddles or hangers. Acceptable types of supports, guides, saddles, hangers and structure attachments for general pipe support, expansion/ contraction and for seismic bracing, as well as anchorage details, are shown on the drawings. Minimum spacing shall be as specified for supports and for seismic bracing. Where a specific type of support or anchorage is indicated on the drawings, then only that type shall be used there. Piping shall be vertically supported by anchor brackets, guides, saddles or hangers and shall be seismically braced where indicated to resist lateral load. Supports shall be provided on each run at each change of direction. Pipe supports shall be hot-dip or mechanically galvanized. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

2. PIPING CONNECTIONS TO MACHINES: Piping at machine connections shall be aligned in all planes to permit insertion of bolts at bolted connections or coupling screwed connections without using jacks, come-a-longs or other mechanical means to align field piping with the connections at the machines. Bolts shall not be forced into mating flange bolt holes and shall be capable being withdrawn using finger pressure alone. The use of 'dutchmen' mitered sections or similar specials to achieve the required alignment with machine connections is strictly prohibited.

D. ANCHORAGE FOR BURIED PIPING:

All plugs, caps, tees and bends in buried pressure piping systems shall be anchored by means of reaction backing or restrained joints as specified.

E. BEDDING AND BACKFILL:

Bedding and backfill for buried piping shall be as specified.

F. EQUIPMENT CONNECTION FITTINGS

Where shown, equipment connection fittings as specified in Section 15085 shall be provided between field piping systems and equipment inlet and outlet connections.

G. FLEXIBILITY

Unless otherwise specified, piping passing from concrete to earth shall be provided with two pipe couplings or flexible joints as specified in Section 15085.

### 3.02 PIPING IDENTIFICATION

A. PIPE CODING:

After application of the specified coating and insulation systems, exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases and valve boxes shall be

identified with plastic markers as specified in paragraph 15050-2.02 A. Legend markers and directional arrows shall be located at each side of walls, floors and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 50-foot centers.

B. PLASTIC TRACER TAPE:

A single line of tape as specified in paragraph 15050-2.02 B shall be provided 2.5 feet above the centerline of buried (insert required systems) pipe. For (insert required systems) pipelines buried 8 feet or greater below finished grade, contractor shall provide a second line of tape 12 inches below finished grade, above and parallel to each buried pipe. Tape shall be spread flat with message side up before backfilling.

3.03 VALVE IDENTIFICATION

Stainless steel tags bearing the specified valve number stamped in 1/4-inch high letters shall be installed on valve flanges in a position visible from floor level. Flangeless valves 8 inches in diameter and larger shall have tags attached to the valve body by self-tapping corrosion resistant metal screws. Flangeless valves 6 inches in diameter and smaller shall have tags attached to the valve stem by stainless steel wire. Wire shall be 0.063 inch minimum.

3.04 TESTING

A. GENERAL:

Upon completion of piping, but prior to application of insulation on exposed piping, the Contractor shall test the piping systems. Pressures, media and test durations shall be as specified in the PIPESPEC. Equipment which may be damaged by the specified test conditions shall be isolated. Testing shall be performed using calibrated test gages and calibrated volumetric measuring equipment to determine leakage rates. Each test gage shall be selected so that the specified test pressure falls within the upper half of the gage's range. Unless otherwise specified, the Contractor shall notify the Construction Manager 24 hours prior to each test.

Unless otherwise specified, testing, as specified herein, shall include existing piping systems which connect with new pipe systems. Existing pipe shall be tested to the nearest existing valve. Any piping which fails the test shall be repaired. Repair of existing piping will be considered and paid for as extra work.

Where testing existing chlorine and sulfur dioxide systems to the nearest isolation valve, Contractor shall provide a tee in the line adjacent to the valve. The branch outlet on the tee shall be valved and used for cleaning, pressure testing, draining, and drying the line. Unless otherwise indicated, the existing chlorine or sulfur dioxide system shall not be shut down during testing or connecting the tee and valve. Prior to placing the line in service, the valve on the branch outlet shall be plugged or sealed with a blind flange or threaded plug. Contractor shall be responsible for all damage to the existing system as a result of this work.

B. LIQUID SYSTEMS:

Leakage shall be zero at the specified test pressure throughout the specified duration for the following systems: exposed piping, buried insulated piping, and buried or exposed piping carrying liquid chemicals. Testing procedures for chlorine and sulfur dioxide systems are specified in paragraph 15050-3.04 D. Testing procedures for hydraulic and lube oil systems are specified in paragraph 15050-3.04 E. Unless otherwise specified, leakage from other buried liquid piping systems shall be less than 0.02 gallon per hour per inch diameter per 100 feet of buried piping.

3.05 CLEANING AND FLUSHING

A. GENERAL:

Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating or instrumentation equipment. The Contractor may, at his option, clean and test sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full pressure test of the completed system. Unless specified otherwise, piping 24 inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Piping larger than 24 inches in diameter may be cleaned manually or with a cleaning ball or swab.

B. TEMPORARY SCREENS:

Upon completion of the cleaning, the Contractor shall connect the piping systems to related process equipment. Temporary screens, provided with locator tabs which remain visible from the outside when the screens are in place, shall be inserted in pipelines at the suction of pumps and compressors in accordance with the following table:

Equipment suction or piping size, inches	Maximum screen opening, inches
0 – 1	1/16
1-1/4 – 3	1/4
3-1/2 – 6	1/2
Over 6	1

The Contractor shall maintain the screens during testing, initial start-up, and initial operating phases of the commissioning process. In special cases, screens may be removed as required for performance tests. The Contractor shall remove the temporary screens and make the final piping connections after the screens have remained clean for at least 24 consecutive hours of operation. Systems handling solids are exempted.

### C. LIQUID SYSTEMS:

After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water. With temporary screens in place, the liquid shall be circulated through the piping system using connected equipment for a minimum period of 15 minutes and until no debris is collected on the screens. Liquid chlorine and sulfur dioxide lines shall be cleaned in accordance with paragraph 15050-3.05 E.

#### 3.06 PIPING SPECIFICATION SHEETS (PIPESPEC)

Piping and valves for groupings of similar plant processes or types of service lines are specified on individual piping specification sheets (PIPESPECS). Piping services are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Each grouping of services (PIPESPEC) is identified by a piping system number.

### 3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service:	AW--Applied Water	System--9
	BW--Backwash Water	
	CCW--Condenser Cooling Water	
	FW--Filtered Water	
	RW--Raw Water	
	RWR--Reclaimed Water	

Test Requirements:	
Medium:	Water; ref. spec paragraph 15050-3.04 C.
Pressure:	125 psig
Duration:	60 minutes

Gasket Requirements:	
Flange:	Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl:	Nitrile or Neoprene

Exposed Pipe and Valves:  
(See drawings for pipe size and valve type)

(3" and smaller)	
Pipe:	<u>Steel</u> ; ASTM A53, galvanized. Ref. spec Section 15061. <u>Conn</u> ; taper threaded, ANSI B1.20.1. Flanged adapters for 2-1/2 inch, 3 inch valves. <u>Ftgs</u> ; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized.

(2" and smaller)	
Valves:	<u>Ball</u> ; Jamesbury Fig. 351, Nibco T-580, or equal. <u>Globe</u> ; Crane 7TF or 17TF, Lunkenheimer 123 or 214, or equal. <u>Swing check</u> ; Crane 137, Lunkenheimer 230, or equal.

(4" thru 8")	
Pipe:	<u>Steel</u> ; ASTM A53, ERW, Grade B, black, with cement mortar lining. Ref. spec Section 15061. <u>Conn</u> ; grooved mech pipe coupling or flanged. <u>Ftgs</u> ; malleable iron, ductile iron, or steel, per spec Section 15061; ends and lining to match pipe.

(2 1/2" thru 8")

Valves:	<u>Butterfly</u> ; Ref. spec Section 15103. Substitute Type B on 2-1/2-inch lines. <u>Swing check</u> ; spring loaded per spec Section 15118.
(10" thru 24")	
Pipe:	<u>Steel</u> ; same as 8 inch or AWWA C200, 3/16 inch thick, with cement mortar lining. Ref. spec Section 15061. <u>Conn</u> ; same as 8 inch. See Remarks. <u>Ftgs</u> ; steel, ASTM A234, or fabricated steel, AWWA C208. Lining and ends to match pipe.
Valves:	<u>Butterfly</u> ; ref. spec Section 15103. <u>Swing check</u> ; spring loaded per spec Section 15118.
(26" and larger)	
Pipe:	See Remarks
Valves:	See Remarks
<u>Buried and Encased Pipe and Valves:</u> (See drawings for pipe size and valve type. Omit coating on encased pipe.)	
(3" and smaller)	
Pipe:	<u>PVC</u> ; ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch. 80. Ref. spec Section 15064. Provide magnetic tracer tape. <u>Conn</u> ; plain end; solvent weld with threaded or flanged adapters for valves. <u>Ftgs</u> ; PVC, Sch. 80, socket weld.
Valves:	<u>Gate</u> ; ref. spec Section 15101, with extension stem and valve box. Coating M-1 per spec Section 09900.
(4" to 12")	
Pipe:	<u>Ductile iron</u> ; AWWA C151 with cement mortar lining. Ref. spec Section 15062. <u>Conn</u> ; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves. <u>Ftgs</u> ; ductile iron per spec Section 15062; coating, lining and ends to match pipe.
Valves:	<u>Butterfly</u> ; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.
(14" and larger)	
Pipe:	<u>Ductile iron</u> ; same as 12 inch for pipe and ftgs, or <u>Concrete cylinder</u> ; ref. spec Section 15057.

Conn; restrained bell and spigot with O-ring rubber gasket joint. Flanged adapters for valves.

Ftgs; fabricated steel, mortar lined and coated. Ref. spec Section 15057.

Valves:

Butterfly; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline as specified in paragraph 15095-3.03.

### 3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service:	CEN--Centrate	System--15
	CS--Circulating Sludge	
	DS--Digested Sludge	
	DSS--Screened Digested Sludge	
	SN--Supernatant	
	ES--Equalized Sludge	
	F--Float	
	FLT--Filtrate	
	FS--Flotation Sludge	
	TO--Thickener Overflow	

#### Test Requirements:

Medium:	Water; ref. spec paragraph 15050-3.04 C.
Pressure:	100 psig
Duration:	120 minutes

#### Gasket Requirements:

Flange:	Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl:	Nitrile or Neoprene

#### Exposed Pipe and Valves:

(See drawings for pipe size and valve type)

(2" and smaller)

Pipe:	<u>Steel</u> ; ASTM A53, galvanized. Ref. spec Section 15061. <u>Conn</u> ; taper threaded, ANSI B1.20.1. <u>Ftgs</u> ; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized.
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Valves:

Eccentric plug; per spec Section 15110. Install valve with seat upstream.  
Swing check; Lunkenheimer 230, Crane 137, or equal.

(2 1/2" thru 8")

Pipe:	<u>Steel</u> ; ASTM A53, ERW, Grade B, black, no lining. Ref. spec Section 15061. <u>Conn</u> ; butt weld, grooved mech pipe coupling or flanged. <u>Ftgs</u> ; malleable iron, ductile iron, or steel per spec Section 15061; ends to match pipe.
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### 3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping System: 15 (continued)

Valves: Eccentric plug; per spec Section 15110. Install valve with seat upstream.  
Swing check; spring loaded per spec Section 15118.

(10" and larger)

Pipe: Steel; same as 8 inch or AWWA C200, 3/16 inch thick, with lining. Ref. spec Section 15061.  
Conn; butt weld, mech pipe coupling, or flanged. See Remarks.  
Ftgs; steel, ASTM A234, or fabricated steel, AWWA C208; lining and ends to match pipe.

Valves: Eccentric plug; ref. spec Section 15110.  
Swing check; spring loaded per spec Section 15118.

#### Buried and Encased Pipe and Valves:

(See drawings for pipe size and valve type. Omit coating on encased pipe.)

(3" and smaller)

Pipe: PVC; ASTM D1784, Class 12454-B, ASTM D1785, Sch. 80. Ref. spec Section 15064. Provide magnetic tracer tape.  
Conn; plain end; solvent weld with threaded or flanged adapters for valves.  
Ftgs; PVC, Sch. 80, socket weld.

Valves: Eccentric plug; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.

(4" thru 12")

Pipe: Ductile iron; AWWA C151. Ref. spec Section 15062.  
Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves.  
Ftgs; ductile iron per spec Section 15062; coating, lining and ends to match pipe.

Valves: Eccentric plug; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.

(14" and larger)

Pipe: Ductile iron; same as 12 inch for pipe and ftgs or Concrete cylinder; ref. spec Section 15057.

### 3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping System: 15 (continued)

Conn; restrained bell and spigot with O-ring rubber gasket joint. Flanged adapters for valves.

Ftgs; fabricated steel, mortar lined and coated. Ref. spec Section 15057.

Valves: Eccentric plug; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.

#### Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline as specified in paragraph 15095-3.03.

### 3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service:	AL--Alum	System--19
	B--Brine	
	CLS--Chlorine Solution	
	CSO--Caustic Soda	
	FC--Ferric Chloride	
	HOCL--Sodium Hypochlorite (See Remark 1)	
	POL--Polyelectrolyte	
	SDS--Sulfur Dioxide Solution	

#### Test Requirements:

Medium:	Water; ref. spec paragraph 15050-3.04 C.
Pressure:	150 psig
Duration:	120 minutes

#### Gasket Requirements:

Flange:	PTFE bonded EPDM, full-face gaskets, ANSI B16.1.
Push-on/Mech Cpl:	N/A

#### Exposed Pipe and Valves:

(See drawings for pipe size and valve type)

(All sizes)

Pipe:	<u>PVC</u> ; ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch. 80. Pipe and fittings exposed to sunlight shall be painted. Ref. spec Section 15064. <u>Conn</u> ; plain end, solvent weld, flanged for valves 3 inch and larger. <u>Ftgs</u> ; PVC, Sch. 80, solvent weld.
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(4" and less)

Valves:	<u>Ball</u> ; PVC Chemtrol Tru Bloc TU Series, Asahi/America Duo Bloc TU Series, GSR TU Series, or equal, with PTFE seats and EPDM O-rings. <u>Diaphragm</u> ; PVC body, Chemtrol Series PD, Posacon 677, Asahi/America, or equal with EPDM or PTFE diaphragm. <u>Ball check</u> ; PVC body, Chemtrol Series BC, Asahi/America, or equal with EPDM or PTFE seats/seals.
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(5" and larger)

Valves:	<u>Diaphragm</u> ; ITT Dia-Flo 2558-2-M, Hills-McCanna 0649-1-38, or equal. <u>Swing or ball check</u> ; fully lined valve body; fully coated swing check flapper or ball check ball; lining and coating shall be Hypalon or fluorinated ethylene propylene. Valve
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and Primer Co. APCO Series 100R, Peabody Dore Model 770, or equal.

Buried and Encased Pipe and Valves:

(See drawings for pipe size and valve type)

(All sizes)

Pipe:

PVC; same as exposed. Provide magnetic tracer tape.

Conn; same as exposed.

Ftgs; same as exposed.

(2" and less)

Valves:

Ball; same as exposed with extension stem and valve box.

(2 1/2" and larger)

Valves:

Diaphragm; same as exposed with extension stem and valve box.

Remarks:

1. For HOCL service, the following shall apply:
  - a. Ball valves are not permitted on HOCL service.
  - b. Diaphragm valves 4 inches and smaller shall be provided with PTFE diaphragms; valves 5 inches and larger shall be provided with Hypalon or PDVF linings with PTFE diaphragms.

**\*\*END OF SECTION\*\***

## SECTION 15064

### PLASTIC PIPE

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies polyvinylchloride, chlorinated polyvinylchloride, polyethylene, and polypropylene pipe and fittings.

###### B. PIPE DESIGNATIONS:

For use in the Piping System Specification Sheets (PIPESPEC) in Section 15050 and in this section, the following plastic pipe designations are defined:

Designation	Definition
PVC	Polyvinylchloride

##### 1.02 QUALITY ASSURANCE

###### A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials

Reference	Title
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2464	Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM D2657	Heat-Joining Polyolefin Pipe and Fittings
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D4101	Propylene Plastic Injection and Extrusion Materials
ASTM F402	Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings
ASTM F437	Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F438	Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F439	Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F441	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F493	Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

## PART 2--PRODUCTS

### 2.01 PVC PIPE

#### A. PRESSURE PIPE:

PVC material for pipe and fittings shall conform to ASTM D1784, Class 12454-B. Pipe and fittings shall either be in accordance with ASTM D1785 or shall conform to ASTM D2241 for standard dimension ratios: 160 psi pipe--SDR 26; 200 psi pipe--SDR 21; 250 psi--SDR 17. Pressure rating for pipe shall be in excess of test pressure specified in Section 15050. Neoprene gaskets with push-on joints shall conform to ASTM F477.

Schedule 80 PVC socket type fittings shall conform to ASTM D2467. Schedule 40 PVC fittings shall conform to ASTM D2466. PVC solvent weld cement for socket connections shall meet the requirements of ASTM D2564. Schedule 80 PVC threaded fittings shall conform to ASTM D2464. Fittings for gasketed pipe shall be ductile iron or steel push-on IPS-sized pressure fittings rated for use with the specified class of PVC pipe. Unless otherwise specified, fittings shall be lined and coated in accordance with Section 15061 or Section 15062 as applicable.

### 2.02 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Manufacturer's certificates of compliance with the specified standards and Contractor's layout drawings.

## PART 3--EXECUTION

### 3.01 INSTALLATION

PVC pipe 3 inches in diameter and smaller shall be joined by means of socket fittings and solvent welding in conformance with ASTM F402. Solvent-cemented joints shall be made in strict compliance with the manufacturer's/supplier's instructions and recommended procedures. Unless otherwise specified, PVC pipe 4 inches in diameter and greater shall be joined by means of gasketed push-on joints and steel or ductile iron push-on or mechanical joint fittings. Fittings shall be lined and coated as specified in Section 15061 or 15062. Unless otherwise specified, PVC piping exposed to sunlight shall be painted with coating system L-2 as specified in Section 09900.

Connections to different types of pipe shall be by means of flanges, specified adapters or transition fittings. Where sleeve type couplings are used, both shall be uniformly torqued in accordance with pipe manufacturer's recommendation. Foreign material shall be removed from the pipe interior prior to assembly.

### 3.02 TESTING

Testing of plastic piping shall be as specified in Section 15050.

**\*\*END OF SECTION\*\***

## SECTION 15085

### PIPING CONNECTIONS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

This section specifies the following methods of connecting metallic piping: flanges, threading, mechanical couplings, equipment connection fittings, dielectric unions, and welding.

##### 1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B18.2.1	Square and Hex Bolts and Screws Inch Series
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI B31.1	Power Piping
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators Qualifications
ASTM B98	Copper-Silicon Alloy Rod, Bar and Shapes

Reference	Title
ASTM F37	Standard Test Methods for Sealability of Gasket Materials
ASTM F104	Standard Classification System for Nonmetallic Gasket Materials
ASTM F152	Standard Test Methods for Tension Testing of Nonmetallic Gasket Materials
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service-Size 4 in. through 144 in.
AWWA C219	Bolted, Sleeve-Type Couplings for Plain-End Pipe
AWWA C550	Protective Epoxy Coatings for Valves and Hydrants
AWWA C606	Grooved and Shouldered Joints
AWWA M11	Steel Pipe-A Guide for Design and Installation
NSF 61	Drinking Water System Components - Health Effects

### 1.03 SUBMITTALS

In addition to the material listed in the detailed specification, the following submittals shall be provided in accordance with Section 01300:

1. For Equipment Connection Fittings used in pumping applications submit thrust rod stretch calculations in accordance with paragraph 2.01D. and dimensional layout data.

## PART 2--PRODUCTS

### 2.01 FLANGE ASSEMBLIES

#### A. FLANGES:

1. GENERAL: Flanges shall either be flat flanges or convoluted ring flanges as specified in the following paragraphs.

2. FLAT FLANGES: Cast iron flanges shall be faced in accordance with ANSI B16.1. Where companion flanges are used, the flanges on pipe shall be refaced to be flush with the companion flange face. Class 150 and Class 300 forged steel flanges shall be raised face conforming to ANSI B16.5. Lightweight slip-on flanges shall be plain face conforming to AWWA C207, Class B and ANSI B16.5. Unless otherwise specified, steel flanges shall be ANSI B16.5, Class 150 or AWWA C207, Class D. Class E AWWA flanges shall be provided where test pressure exceeds 175 psi. Plain faced flanges shall not be bolted to raised face flanges.

3. CONVOLUTED RING FLANGES: Convoluted ring flanges shall be ductile iron, forged steel or cast stainless steel, designed to bear on hubs welded to the pipe and shall be as manufactured by Improved Piping Products. The Construction Manager knows of no equal. The flange joints shall be rated for not less than 150 percent of the test pressures listed in Section 15050 and shall conform to the requirements of ANSI B 16.5 and AWWA C207. The flange manufacturer shall be prepared to demonstrate, by certified pressure test that the flanges will meet these requirements.

B. GASKETS:

Gasket material shall be as specified in paragraph 15085-2.03.

Gaskets for plain faced flanges shall be the full face type. Thickness shall be 1/16 inch for pipe 10 inches and less in diameter and 1/8 inch for pipe 12 inches and larger in diameter. Unless otherwise specified, gaskets for raised face flanges shall match the raised face and shall be 1/16 inch thick for pipe 3-1/2 inches and less in diameter and 1/8 inch thick for pipe 4 inches and larger.

C. BOLTS:

Flange assembly bolts shall be ANSI B18.2.1 standard square or hexagon head bolts with ANSI B18.2.2 standard hexagon nuts. Threads shall be ANSI B1.1, standard coarse thread series; bolts shall be Class 2A, nuts shall be Class 2B. Bolt length shall conform to ANSI B16.5.

Unless otherwise specified, bolts shall be carbon steel machined bolts with hot pressed hexagon nuts. Bolts for submerged service shall be made of Type 316 stainless steel in conformance with ASTM F593, marking F593F. Nuts for submerged service shall be made of copper-silicon alloy bronze conforming to ASTM B98, alloy C65100, designation H04 or alloy C65500, designation H04. Bolts and nuts for buried service shall be made of noncorrosive high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any other protective coating. Where washers are required, they shall be of the same material as the associated bolts.

## 2.02 EQUIPMENT CONNECTION FITTINGS

Equipment connection fittings shall provide both lateral and angular misalignment adjustment between equipment connection flanges and the connection to field piping systems by providing individually adjustable flexible joints at each connection. In addition, equipment connection fittings shall provide full pressure thrust restraint between the field piping connection and equipment connection flanges.

Equipment connection fittings shall consist of two flanged coupling adapters, a plain end section of pipe and thrust restraint rods and associated fittings designed to transmit thrust without transmitting shear to the thrust restraint rods and without compromising provisions for accommodating angular and parallel misalignment. Materials and features shall conform to the requirements established in this paragraph. Standard "dismantling joints" incorporate only one flanged coupling adapter and are not acceptable substitutes. Equipment connection fittings shall

be Romac ECF Series, or Baker Coupling Company, Los Angeles or equal, modified as specified to provide the required features.

Equipment connection fittings shall each consist of a single sleeve of plain end piping conforming to the requirements of the specified piping system of sufficient length to span the gap between the connection at the equipment and the connection at the field piping with gasketed flange adapters at each end. Thrust restraint shall be provided by means of all threaded rod spanning between flanges and male rod nuts and female washers that are rounded to provide a ball-joint type self aligning feature. All threaded restraint rod shall project through flange and mating flange coupling adapter bolt holes or through holes in restraint lug plates that extend above the flanges and are secured to the flanges with a minimum of two flange bolts. Where the all threaded rods project through flange bolt holes, ball joint type nut and washer combinations and lock washers shall be provided at each face, each end. Where restraint lug plates are employed, ball joint type nuts and washers shall be provided only on the outside faces of the plates and the nuts shall have a self locking feature that prevents nut movement due to vibration or other operational or environmental causes. Double nutting with non-locking nuts shall not be an acceptable method of providing the self locking feature. Thrust rod diameter and material shall be selected to provide sufficient freedom of movement through all bolt holes to allow unrestricted maximum adjustment of equipment connection fittings to accommodate piping misalignment without transmitting any shear to the thrust rods and also to permit full development of thrust restraint at all thrust rod tension take-ups. Design of equipment connection fittings shall conform to AWWA C219.

Thrust rods, restraint lug plates, nuts, washers and lock washers shall be Type 316 stainless steel, all selected to develop full rated piping system pressure thrust forces. Equipment connection fittings for pump applications shall have thrust rod number and diameter selected such that thrust rod stretch under piping system operating pressure does not exceed 2 mils. Calculations shall be submitted. Dry film molybdenum di-sulfide anti-galling compound shall be factory applied to ends of thrust rods, covering all threads subject to nut travel and tightening. Gaskets shall be as specified in paragraph 15085-2.03. Flange gaskets shall be full face type. Follower gaskets shall be compression wedge type.

Sleeves shall be carbon steel or as specified for the specific piping system. Pressure rating of flange adapters shall equal or exceed the pressure rating of mating flanges. All metal portions of equipment connection fittings, with the exception of 316 stainless steel components, shall be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61.

#### A. DISMANTLING JOINTS

Dismantling joints may be used as takedown couplings in accordance with paragraph 15085-3.03. Dismantling joints shall fully restrained double flange fittings consisting of a flange coupling adapter and flanged spool piece that allows for longitudinal adjustment. Thrust restraint shall be provided by means of all threaded rod spanning between flanges and secured to the flanges with a minimum of two flange bolts. Design of equipment connection fittings shall conform to AWWA C219. Sleeves shall be carbon steel or as specified for the specific piping system. Pressure rating of flange adapters shall equal or exceed the pressure rating of mating

flanges. All metal portions of equipment connection fittings, with the exception of 316 stainless steel components, shall be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61. Dismantling joints shall be Romac DJ-400, Smith Blair 975, or Crane-Viking Johnson Dismantling Joint.

## 2.03 GASKETS

Gaskets designated in Section 15050 shall be as follows:

1. EPDM: ethylene-propylene-diene-terpolymer.
2. Neoprene: neoprene.
3. Nitrile: nitrile (Buna N).
4. Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder; ASTM F104 (F712400), 2500 psi (ASTM F152), 0.2 ML/HR LEAKAGE FUEL A (ASTM F37).
5. Compressed gasketing consisting of organic fibers (Kevlar) and SBR binder; ASTM F104 (F712400), 2500 PSI (ASTM F152), 0.1 ml/hr leakage Fuel A (ASTM F37).
6. Gylon gasketing, Garlock Style 3500, 2000 psi (ASTM F152), 0.22 ml/hr Fuel A (ASTM F37).
7. Gylon gasketing, Garlock Style 3510, 2000 psi (ASTM F152), 0.04 ml/hr Fuel A (ASTM F37).
8. Gylon gasketing, Garlock Style 3504, 2000 psi (ASTM F152), 0.12 ml/hr Fuel A (ASTM F37).
9. TFE: noncreeping tetrafluoroethylene (TFE) with insert filler.
10. PTFE bonded EPDM: PTFE bonded to EPDM in full-face gasket having concentric-convex molded rings; Garlock Stress Saver 370 or equal.

## 2.03 PRODUCT DATA

In accordance with Section 01300, the Contractor shall provide for each welder, a welder qualification certificate indicating the welder is certified for pipe welding in accordance with ASME Boiler and Pressure Vessel, Section IX. Each welder's certificate shall be provided to the Construction Manager prior to that welder working on the job.

## PART 3--EXECUTION

### 3.01 PIPE CUTTING, THREADING AND JOINTING

Pipe cutting, threading and jointing shall conform to the requirements of ANSI B31.1.

### 3.02 PIPE WELDING

Pipe shall be welded by ASME-certified welders using shielded metal arc, gas shielded arc or submerged arc welding methods. Welds shall be made in accordance with the requirements of ANSI B31.1 for piping Systems 8, 26, and 28 specified in Section 15050. Welds shall be made in accordance with the requirements of ANSI B31.3 for piping System 20 specified in Section 15050.

Welds for piping systems not specified above shall be made in accordance with AWWA C206.

### 3.03 FLEXIBILITY

Unless otherwise specified, piping passing from concrete to earth shall be provided with two pipe couplings or flexible joints (or a single Flexijoint) as specified on the buried pipe within 2 feet of the structure for 2-inch through 6-inch diameter pipe; within 3 feet of the structure for 8-inch through 24-inch diameter pipe; and within one and one-half pipe diameters of the structure for larger pipe. Where required for resistance to pressure, mechanical couplings shall be restrained in accordance with Chapter 13 of AWWA M11, including Tables 13-4, 13-5 and 13-5A, and Figure 13-20.

### 3.05 EQUIPMENT CONNECTION FITTINGS

Where shown, equipment connection fittings shall be provided between field piping systems and equipment inlet and outlet connections.

**\*\*END OF SECTION\*\***

## SECTION 15094

### PIPE HANGERS AND SUPPORTS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals and install pipe hangers, supports, concrete inserts and anchor bolts including all metallic hanging and supporting devices for supporting exposed piping.

##### 1.02 QUALIFICATIONS

- A. Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for pipe supports shall be five (5) times the ultimate tensile strength of the material.

Note: Lift Stations have their own pipe support hanger and support design and detail, shown in the Utility Standards if not shown on the plans.

- B. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the Contractor shall submit a certification stating that such requirements have been complied with.

##### 1.03 SUBMITTALS

- A. Submit to the County for approval, as provided in the Contract Documents, shop drawings of all items to be furnished under this Section.
- B. Submit to the County, for approval, samples of all materials specified herein.
- C. All pipe hangers, supports, hanger rods, clamps, concrete inserts and wall brackets, etc., whether specified or not, shall be submitted (together with load calculations) to the County for approval, if requested.

#### PART 2 PRODUCTS

##### 2.01 GENERAL

- A. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and secure the pipe in

the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. All pipe supports shall be approved prior to installation.

- B. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties and be in accordance with MSS SP-58.
- C. Hangers and supports shall be spaced in accordance with ANSI B31.1.0 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified herein.
- D. Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by Grinnell Co., Inc., Carpenter and Patterson, Inc., or equal. 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. Any item comparable in type, style, quality, design and performance will be considered for approval.

## 2.02 PIPE HANGERS AND SUPPORTS FOR METAL PIPE

- A. Suspended single pipes shall be supported by hangers suspended by steel rods from galvanized concrete inserts, beam clamps, or ceiling mounting bolts.

The following sizes are minimum requirements and are subject to the County's approval:

- 1. Hanger rods shall be rolled steel machine threaded with load ratings conforming to ASTM Specifications and the strength of the rod shall be based on root diameter. Hanger rods shall have the following minimum diameters:

Pipe Size, Inches	Min. Rod Diameter, In.
Less than 2-1/2	3/8
2-1/2 through 4	1/2
4	5/8
6	3/4
8-12	7/8
14-18	1
20-30	1-1/4

Above 30 See SPECIAL SUPPORTS Paragraph 2.04

- 2. Where applicable, structural attachments shall be beam clamps. Beam clamps, for rod sizes 1/2-inch through 3/4-inch shall be equal to Grinnell

Fig. No. 229, and for rod sizes 7/8-inch through 1-1/4 inches shall be equal to Grinnell Fig. No. 228, or equal.

3. Concrete inserts for pipe hangers shall be continuous metal inserts designed to be used in ceilings, walls or floors, spot inserts for individual pipe hangers, or ceiling mounting bolts for individual pipe hangers and shall be as manufactured by Unistrut Corp., Wayne, Michigan; Carpenter and Patterson, Inc., Laconia, New Hampshire; Richmond or equal and shall be as follows:
  - a. Continuous concrete inserts shall be used where applicable and/or as shown on the Drawings and shall be used for hanger rod sizes up to and including 3/4-inch diameter. Inserts to be used where supports are parallel to the main slab reinforcement shall be Series P3200 by Unistrut Corp., Fig. 1480 Type 2 by Carpenter and Patterson, Inc. or equal. Inserts to be used where supports are perpendicular to the main slab reinforcement shall be Series P3300 by Unistrut Corp., Fig. 1480 Type I by Carpenter and Patterson, Inc., or equal.
  - b. Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8-inch diameter. Inserts shall be Fig. 650 by Carpenter and Patterson, Inc. for hanger rod sizes 1/2-inch through and including 3/4-inch and Fig. 266 by Carpenter and Patterson, Inc., for 7/8-inch hanger rods.
  - c. Ceiling mounting bolts shall be used where applicable and be for hanger rod sizes 1-inch through and including 1-1/4 inches shall be Fig. 104M as manufactured by Carpenter and Patterson, Inc. or equal.
  - d. All pipe hangers shall be capable of vertical adjustment under load and after erection. Turnbuckles, as required and where applied, shall be equal to Grinnell Fig. No. 230.
4. Wall or column supported pipes shall be supported by welded steel brackets equal to Grinnell Fig. 194, 195 and 199 as required, for pipe sizes up to and including 20 inch diameter. Additional wall bearing plates shall be provided where required.
  - a. Where the pipe is located above the bracket, the pipe shall be supported by an anchor chair and U-bolt assembly supported by the bracket for pipes 4 inches and larger or by a U-bolt for pipes smaller than 4-inches. Anchor chairs shall be equal to Carpenter & Patterson Fig. 127. U-bolts shall be equal to Grinnell Fig. 120 and 137.
  - b. Where the pipe is located below the bracket, the pipes shall be supported by pipe hangers suspended by steel rods from the bracket. Hangers and steel rods shall be as specified above.
  - c. Wall or column supported pipes 2-inches and smaller may be supported by hangers equal to Carpenter and Patterson Figures 74, 179 or 237 as required.
5. Floor supported pipes 3-inches and larger in diameter shall be supported by either cast-in-place concrete supports or adjustable pipe saddle supports as directed by the County. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support is provided), and

adjustable pipe saddle type supports shall be used where lateral displacement of the pipes is not probable.

- a. Each concrete support shall conform to the details shown on the Drawings. Concrete shall be poured after the pipe is in place with temporary supports. Top edges and vertical corners of each concrete support shall have 1-inch bevels. Each pipe shall be secured on each concrete support by a wrought iron or steel anchor strap anchored to the concrete with cast-in-place bolts or with expansion bolts. Where directed by the County, vertical reinforcement bars shall be grouted into drilled holes in the concrete floor to prevent overturning or lateral displacement of the concrete support. Unless otherwise approved by the County, maximum support height shall be five (5) feet.
  - b. Concrete piers used to support base elbows and tees shall be similar to that specified above.  
Piers may be square or rectangular.
  - c. Each adjustable pipe saddle support shall be screwed or welded to the corresponding size 150 lb. companion flanges or slip-on welding flanges respectively. Supporting pipe shall be of Schedule 40 steel pipe construction. Each flange shall be secured to the concrete floor by a minimum of two (2) expansion bolts per flange. Adjustable saddle supports shall be equal to Grinnell Fig. No. 264. Where used under base fittings, a suitable flange shall be substituted for the saddle.
  - d. Floor supported pipes less than 3-inches shall be supported by fabricated steel supports.
6. Vertical piping shall be supported as follows:
- a. Where pipes change from horizontal to vertical, the pipes shall be supported on the horizontal runs within two feet of the change in direction by pipe supports as previously specified herein.
  - b. For vertical runs exceeding 15 feet, pipes shall be supported by approved pipe collars, clamps, brackets, or wall rests at all points required to insure a rigid installation.
  - c. Where vertical piping passes through a steel floor sleeve, the pipe shall be supported by a friction type pipe clamp which is supported by the pipe sleeve. Pipe clamps shall be equal to Grinnell Fig. 262.
7. Anchor bolts shall be equal to Kwik-Bolt as manufactured by Hilti Fastening Systems, Tulsa, Oklahoma or Wej-it manufactured by Wej-it Expansion Products, Inc., Bloomfield, Colorado.
8. All rods, hangers, inserts, brackets, and components shall be furnished with galvanized finish.

## 2.03 PIPE HANGERS AND SUPPORTS FOR PLASTIC PIPE

- A. Single plastic pipes shall be supported by pipe supports as previously specified herein.

- B. Multiple, suspended, horizontal plastic pipe runs, where possible, and rubber hose shall be supported by ladder type cable trays such as the Electray Ladder by Husky-Burndy, the Globetray by the Metal Products Division of United States Gypsum, or equal. Ladder shall be of mild steel construction. Rung spacing shall be approximately 18 inches for plastic pipe and 12 inches for rubber hose. Tray width shall be approximately 6-inch for single runs of rubber hose and 12 inches for double runs of rubber hose. 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 equal to Globe Model M-CAC, Huskey-Burndy Model SCR or equal. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe.
- C. Individual clamps, hangers, and supports in contact plastic pipe shall provide firm support, but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

#### 2.04 SPECIAL SUPPORTS

- A. The pipes shall be supported by means of a supporting framework suitably anchored into the floor or curbing. The vertical piping shall be suitably secured to horizontal support members connected at each end to vertical support members and spaced as required to provide a rigid installation.
  - 1. The complete supporting system shall be as manufactured by the Unistrut Corporation, Globe-Strut as manufactured by the Metal Products Division of U.S. Gypsum, or equal.
  - 2. Vertical and horizontal supporting members shall be U-shaped channels similar to Unistrut Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps equal to Unistrut Series P1100M and Series P2558. All components shall be of mild steel.
  - 3. The assemblies shall be furnished complete with all nuts, bolts, and fittings required for a complete assembly.
  - 4. The design of each individual framing system shall be the responsibility of the Contractor. Shop drawings shall be submitted and shall show all details of the installation including dimensions and types of supports.
- B. Any required pipe supports for which the supports specified in the Section are not applicable, including pipe supports for above 30-inch pipe, shall be fabricated or constructed from standard aluminum shapes in accordance with Specifications, concrete and anchor hardware similar to items previous specified herein and shall meet the minimum requirements listed below and be submitted to the approval of the County.

1. Pipe support systems shall meet all requirements of this Section and all related Sections of this Specification.
  2. Complete design details of the entire pipe support systems shall be provided by the Contractor, for approval by the County.
  3. The pipe support system shall not impose loads on the supporting structures, in excess of the loads for which the supporting structure is designed.
  4. Hanger rods for above 30-inch pipe shall be a minimum of 1-1/2 inch diameter and shall not exceed the manufacturer's standard maximum recommended safe load.
- C. Pipe supports in lift stations shall be as shown in the Utility Standards details.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. All pipes, horizontal and vertical, shall be rigidly supported from the building structure by approved supports. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or specified herein. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless it is so indicated on the Drawings, or specifically directed or authorized by the County.
- B. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement, and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces. Prior to installation, all pipe supports shall be approved by the County.
- C. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings, and sleeve type couplings and to minimize all pipe forces to pump housings. Pump housings shall not be utilized to support connecting pipes.
- D. Pipe supports shall be provided as follows:
  1. Cast iron and ductile iron shall be supported at a maximum support spacing of 10 feet-0-inches with a minimum of one support per pipe section at the joints.
  2. Supports for multiple PVC pipes shall be continuous wherever possible. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support spacing shall not exceed five (5) feet.
  3. Support spacing for galvanized steel pipe and copper tubing shall not exceed five (5) feet.
  4. All vertical pipes shall be supported at each floor or at intervals of at least 15 feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to insure rigid construction.

- E. Pipe supports shall not result in point loadings, but shall distribute pipe loads evenly along the pipe circumference.
- F. Effects of thermal expansion and contraction of the pipe shall be accounted for in pipe support selection and installation.
- G. Inserts for pipe hangers and supports shall be installed on forms before concrete is poured. Before setting these items, all drawings and figures shall be checked which have a direct bearing on the pipe locations. Responsibility for the proper location of pipe supports is included under this Section.
- H. Continuous metal inserts shall be embedded flush with the concrete surface.

### 3.02 PRIME COATING

- A. Prior to prime coating, all pipe hangers and supports shall be thoroughly clean, dry, and free from all mill-scale, rust, grease, dirt, paint, and other foreign substances to the satisfaction of the County.
- B. All submerged pipe supports shall be prime coated with TNEMEC 69-1211 Epoxy Primer or equal. All other pipe supports shall be prime coated with TNEMEC 66-1211, or equal.
- C. Finish coating shall be compatible with the prime coating used and shall be applied as specified in the Contract Documents.

**\*\*END OF SECTION\*\***

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## SECTION 15095

### PIPING APPURTENANCES

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE

This section specifies pipeline pressure gages.

###### B. EXCLUSIONS:

Temperature, pressure and flow measuring devices used for instrumentation are specified in Division 17. Instruments specified in Section 17211 are identified in the instrument index in Section 17200.

#### PART 2--PRODUCTS

##### 2.01 PIPELINE THERMOMETERS

###### A. GENERAL:

Pipeline thermometers shall indicate fluid temperatures within the pipeline to an accuracy of plus or minus 2 percent of thermometer full scale.

Pipeline thermometers shall be provided with threaded thermowell mountings, designed to permit removal of the thermometer without depressurization or loss of process fluid. For insulated pipes a thermowell with a lagging extension shall be provided.

##### 2.03 PRESSURE DEVICES

###### A. PRESSURE GAGES:

Unless otherwise specified, pressure gage scales shall be selected so that the normal operating pressure falls between 50 and 80 percent of full scale, shall be 4 1/2-inch, 270-degree movement, 1/2-percent accuracy, full-scale, and suitable for bottom stem mounting. Gages shall have a 316-SS bourdon tube. All gages shall have a 300 series stainless steel case, shatterproof glass, and a 1/2-inch NPT bottom connection.

Pressure gages for air, gas, and low pressure services (0-10 feet) shall be premium grade, heavy-duty bourdon-tube units (bellow type for vacuum) with Delrin bushings and pinion, and stainless steel sector.

Gages on liquid service shall be as noted above, except they shall be provided with an internal pulsation dampening system consisting of either a glycerin fill or a silicone fluid fill. Snubbers or orifices shall not be utilized. Gages shall be Ashcroft Duragauge Fig. 1279, Ametek 1981L, or equal.

#### B. DIAPHRAGM SEALS:

Unless otherwise specified, seals shall be diaphragm type with 1/4-inch flushing connection, Type 316 stainless steel body and Type 316L diaphragm. Fill fluid shall be Silicone DC200 unless otherwise specified. Seal shall be Mansfield and Green Type SG, Ashcroft Type 101, or equal.

#### C. PRESSURE SENSORS

Unless otherwise specified, pressure sensors (tubular chemical seals) shall be the in-line full stream captive sensing liquid type. Wetted parts shall be 316 stainless steel. Flexible cylinder shall be Buna-N unless otherwise specified. Seals shall be rated for 200 psi with 5-inch SC hysteresis. Seals shall be Ronningen-Petter, Red Valve, or equal.

Fill fluid shall be rated for a temperature range of -20 degrees F to 200 degrees F. Capillary tubing shall be armored stainless steel. Fittings shall be provided for vacuum filling of system. Systems that are not factory filled shall be vacuum filled in the field. Filling connections shall be soldered shut after vacuum evacuation and filling.

### 2.03 PRODUCT DATA

Manufacturer's product data shall be provided in accordance with Section 01300.

## PART 3--EXECUTION

**\*\*END OF SECTION\*\***

SECTION 15147  
SOLENOID VALVES

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies 2- and 3-way solenoid valves, direct or pilot operated type, for control of process fluids.

B. TYPE:

Valves with piping connections less than 1-1/2 inches in diameter shall be direct-acting type.

Valves with piping connections 1-1/2 inches in diameter and greater shall be pilot operated globe body type.

C. DESIGN REQUIREMENTS:

Unless otherwise specified, solenoid valves shall be designed to seal or unseal the pressurized (supply) port upon the action specified in the paragraph 1.03, Solenoid Valve Schedule.

Valves shall be listed by Underwriters Laboratories Inc. in accordance with UL 429 and UL 1002. Solenoid valves for gas service shall be approved by Factory Mutual Engineering Corporation. The minimum acceptable operating pressure differential for pilot operated valves shall be 5 psi.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version

associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A48	Gray Iron Castings
UL 429	Electrically Operated Valves
UL 1002	Electrically Operated Valves for Use in Hazardous Locations, Class I, Groups A, B, C, and D, and Class II, Groups E, F, and G

## PART 2--PRODUCTS

### 2.01 MANUFACTURERS

The Owner and Construction Manager believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section.

#### A. DIRECT ACTING TYPE:

Candidate manufacturers include:

1. Automatic Switch Company (ASCO)
2. Honeywell-Skinner
3. or equal

#### B. PILOT TYPE:

Candidate manufacturers include:

1. Cla-Val Co.
2. Golden Anderson
3. or equal

### 2.02 MATERIALS

#### A. DIRECT ACTING TYPE:

Materials of construction shall be as follows:

Component	Material
Body	Brass or stainless steel, Type 304
Seal	Teflon or Buna-N
Disc	Teflon or Buna-N

B. PILOT TYPE:

Materials of construction shall be as follows:

Component	Material
Main valve body	Cast iron, ASTM A48
Pilot control body	Brass

## 2.03 EQUIPMENT

A. GENERAL:

Solenoid valves shall be rated for continuous duty at 24 volts DC or 120 volts AC as indicated. Valves shall be threaded for sizes 2-inch and smaller and flanged for sizes 2-1/2 inch and larger.

B. DIRECT ACTING TYPE AND PILOT TYPE:

Solenoid valves shall be suitable for the area location and usages as indicated in the schedule with fully encapsulated Class H coils. Enclosure type:

1. NEMA 1 general purpose, molded epoxy construction
2. NEMA 4X watertight / dust tight / corrosion resistant
3. NEMA 6P submersible
4. NEMA 7 explosion proof

Unspecified solenoid valves enclosures shall be NEMA 4X.

## 2.04 PRODUCT DATA

Manufacturer's product data shall be provided in accordance with Section 01300.

## PART 3--EXECUTION

Solenoid valves shall be installed in accordance with the manufacturer's recommendations.

**\*\*END OF SECTION\*\***

## SECTION 15400

### PLUMBING

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals necessary for complete installation of a plumbing system complete and ready for use.

##### 1.02 GENERAL

- A. The general arrangement of the plumbing shall be as indicated on the Drawings. Detached drawings of proposed departures shall be submitted to the County for approval prior to the start of work. The Contractor shall carefully examine the Drawings and shall be responsible for the proper fittings of materials and equipment in each building. All work shall comply with local code requirements.
- B. Plumbing fixtures, devices and pipe shall be installed in such a manner to prohibit a cross connection or interconnection between a potable water supply and a polluted supply. The plumbing installation shall further prohibit the backflow of sewage, polluted water, or waste into the water supply system. Potable water hose bibs shall include vacuum breaker installation.
- C. Required materials not covered by the detailed Specifications shall meet the requirements of the local Plumbing Code, other applicable State and Local Ordinances and Codes, and shall conform to accepted plumbing practice.
- D. Drainage connections shall be trapped except as noted. The service line to each item of equipment shall be equipped with a cutoff valve and union for isolation of the item for repair and maintenance. Interference with the operation of other equipment or fixtures during repair or maintenance work is prohibited. The Contractor shall coordinate all work called for in the Contract Documents including, but not limited to furnishing the equipment with the services under this Section of the Specifications.
- E. The Drawings show a general concept of the plumbing system but are not intended to show all of the offsets, fittings and accessories that may be required. The Contractor shall carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly, furnishing such fittings, traps, valves and accessories as may be required to meet such conditions, at no additional cost to the County.

- F. The work shall be carefully laid out in advance and no excessive cutting of construction will be permitted. Damage to buildings, piping, wiring, or equipment as a result of cutting for installation shall be repaired by mechanics skilled in the trade involved, at no additional cost to the County.
- G. Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury. Upon completion of all work, the fixtures, materials and equipment shall be thoroughly cleaned, adjusted and operated.

#### 1.03 SUBMITTALS

- A. The Contractor shall submit to the County for review and approval in accordance with the Contract Documents: complete shop drawings, working drawings, and product data for all materials and equipment furnished under this Section.

#### 1.04 CODES, ORDINANCES AND PERMITS

- A. The Contractor shall comply with all of the laws, ordinances, and codes, rules and regulations of the local and state authorities having jurisdiction over any of the work specified herein. He shall apply and pay for all necessary permits.
- B. If any part of the Plans and Specifications conflict with the laws and codes, the Contractor shall call it to the County's attention prior to the commencement of work.

#### 1.05 GUARANTEE

- A. The Contractor shall warrant all labor and materials free from defects for a period of one (1) year from the date of acceptance and shall, upon notification during this period, promptly repair or replace any defective items of material or equipment at no additional cost.

#### 1.06 ACCESSIBILITY

- A. The Contractor shall inform himself fully regarding the peculiarities and limitations of the space available for the installation of all material in this Contract.
- B. The Contractor shall install the equipment, such as valves, traps, clean-outs, etc., so that it is readily accessible. He shall provide access panels where required. The foregoing shall also apply in general to any part of the system which may be necessary to be reached from time to time for maintenance and operations of the system.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Unless otherwise specified, all materials shall conform to the South Florida Plumbing Code.
- B. The revision of the particular ASTM, SBC or AWWA standard in effect at the time of advertisement for bids shall be the minimum acceptable.
- C. Copper water pipe shall be Type L, hard drawn tubing and fittings shall be cast brass or wrought copper.
- D. A dielectric coupling shall be provided between ferrous and nonferrous materials.
- E. The Contractor shall furnish certified statements from the manufacturer that the material conforms to the requirements specified above.

### 2.02 SOIL, WASTE, DRAIN AND VENT PIPING

Underground soil, waste and drain pipe and fittings shall be coated hub-and-spigot cast iron or cast ductile iron pipe, with dual-tite or tyseal joints. Above-ground soil, waste, drain and vent piping shall be service weight, cast iron soil pipe with No-Hub fittings. Waste arms and condensate waste, from air conditioning equipment, may be DWV copper. Cast ductile iron and galvanized steel pipe rainwater drainage systems shall be provided where shown on the Drawings, and as provided under this Section.

### 2.03 CLEANOUT PLUGS AND TEST TEES

Cleanouts shall be the same sizes as the pipe except that cleanout plugs larger than four inches shall not be required. A cleanout installed in connection with cast iron hub-and-spigot pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place indicated on the drawings, or, if not indicated, to an easily accessible place. All cleanouts extended through all floors shall be provided with cast access boxes which shall be Josam Series #58730 with Nikaloy cover.

### 2.04 FLASHING

Vent pipes and roof drains shall be flashed and made watertight at the roof with not lighter than 4-pound sheet lead. Flashings shall be extended up the vent pipes a minimum of six inches to form counter-flashing or rain guards for pipe. Flashings in connection with cast iron pipe vents shall be turned down into the pipes or hubs. Flashing shields shall extend not less than eight inches from the vent pipes and roof drains in all directions.

### 2.05 TRAPS

Unless otherwise indicated, each fixture and piece of equipment requiring connections to the drainage system shall be equipped with a trap. Traps are specified to be supplied with the fixtures. Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on bell-and-spigot pipe shall be cast iron. Traps installed on threaded pipe shall be recess drainage pattern. All floor drains shall have deep seal traps and be provided with Josam #88250 trap seal primer valve, where a single is required. Where multiple primers are required, see Drawings for primers and detail or as approved, to preclude trap liquid seal evaporation.

## 2.06 SHOWER PAN

The floor of each individual shower shall be made watertight with a metal pan or other approved materials fabricated in place. The metal pan shall be constructed from either 6 pound sheet lead or 16-ounce copper. The sheet metal shall be cut to size and shape of the shower area, allowing six inches for turn-up.

The corners shall be folded, not cut, and the corner seam shall be soldered or burned. The upstands shall be recessed so that the pan will receive any seepage through materials above. The pans shall be coated with two coats of asphalt. Both sides of the pan including upstands shall be coated with asphalt paint. The pan shall be installed and the trap flange shall be countersunk to assure drainage. The trap shall be plugged and the pan filled with water as a test before installing the cement and tile.

## 2.07 DRAINS

Provide floor drains (FD) as manufactured by Josam, Zurn or Wade. All drains shall have nickel-bronze tops. All floor drains shall be as scheduled on the Drawings. Provide flashing clamp devices on all drains.

## 2.08 WATER PIPE, FITTINGS AND CONNECTIONS

- A. All water piping shall be Copper Type "L" except where otherwise noted on the Drawings. Copper pipe where code allows to be under slabs shall be continuous without joints, and encased in plastic pipe sleeves, its total length to include the turn to above slab.
- B. The piping shall be extended to all fixtures, outlets, and equipment from the gate valve. Plugged or capped fittings shall be provided for draining low points of the piping system. Outlets shall be capped or plugged and left ready for future connections.
  - 1. Piping shall be installed as indicated on the Drawings. Pipe shall be cut accurately to measurements established at the building by the Contractor and shall be worked into place without springing or forcing. Care shall be taken not to weaken structural portions of the building. Aboveground piping shall be run parallel with the lines of the building unless otherwise shown or noted on the drawings. Branch pipes from service lines may be taken from top, bottom, or side of main using such crossover fittings as may be required by

structural or installation conditions. Service pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2-inch between finished covering and other work and not less than 1/2-inch between finished covering on the different services. Changes in pipe sizes shall be made with reducing fittings. Use of long screws and bushing will not be permitted.

2. All water piping shall be installed so as to allow complete drainage through hose bibs, or 1/2-inch globe valves.
3. Allowance for expansion and contraction shall be made throughout the system. Horizontal runs over 50 feet long shall be anchored to the wall or to the supporting construction about midway on the run to force the expansion movement to divide equally, half at each end. Sufficient flexibility shall be provided on all branch runouts from mains to risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that the piping will spring enough to allow for expansion without staining.
4. Air chambers shall be provided on all hot and cold supplies near each faucet, control valve, or flush valve, except hose faucets. Chambers shall be self-draining when the system is drained. If not definitely shown on the Drawings, air chambers shall consist of an 18-inch length of pipe one diameter larger than the branch supply, capped. Provide a mechanical shock absorber equal to Zurn Z-200 at any quick-closing valve, and other places air chambers are not approved.

- C. Threaded pipe shall conform to the requirements of other applicable paragraphs and sections of these Specifications. Unions shall be provided where required for disconnection of exposed piping. Unions shall be accessible.

## 2.09 VALVES

- A. Valves shall be provided on all supplies to fixtures and equipment. Valves indicated in connection with runouts, risers, branches, and mains shall be in accordance with this Specification. No valve shall be installed on any line with its stem below the horizontal. All valves shall be gate valves unless otherwise specified or indicated. Valves three inches and smaller shall be all bronze construction. Larger valves shall have iron bodies with brass trim. All valves shall be designed for a minimum working pressure of 125 psig saturated steam. Valves for use with ferrous pipe shall have threaded ends through 2-inch size, and flanged ends for larger sizes. Valves shall be equal to the following figure numbers as manufactured by the William Powell Company:

<u>TYPE</u>	<u>3" &amp; SMALLER SCREWED ENDS</u>	<u>3" &amp; 3-1/2" FLANGED</u>	<u>VALVES FOR COPPER PIPING SWEAT ENDS</u>
Gate	2700	1793	Nibco #S112
Gate (NRS)	2707	1787	Nibco #S113(NRS)

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1. Nonrising stem valves shall be used only where space conditions prevent use of rising stem valves, or where installed underground in valve boxes.
2. Check valves subject to back pressure, pulsations or reversal of flow, shall have provisions for quick closing by means of springs, weight and lever, or as approved.
3. A complete list shall be submitted for written approval. All valves shall be products of the same manufacturer.
4. Valves shall be products of William Powell Co., Crane, or approved equal.

## 2.10 UNIONS

Unions on ferrous pipe three inches in diameter and smaller shall be 150 pounds malleable iron, zinc-coated. Unions on water piping 3-1/2 inches in diameter and larger shall be flanged pattern, 125-pound class, zinc-coated. Gaskets for flanged unions shall be of the best quality fiber, plastic, or leather. Unions shall not be concealed in walls, ceilings, or partitions.

## 2.11 HOSE BIBS

Hose bibs shall be brass, polished chromium plated, as manufactured by Chicago Faucet Company. Potable water bibs shall be No. 952, 3/4-inch or 1-inch with vacuum breaker as noted on the Drawings. Equal by NIBCO, Purtecor Sill Cocks Model 763VB with built-in backflow preventor.

## 2.12 RELIEF VALVE

Provide an approved temperature and pressure relief valve for the electric water heater. Relief valve shall be equipped with manual test lever. Pipe relief valve discharge to building exterior or as approved.

## 2.13 PIPE SLEEVES, HANGERS AND FIXTURE SUPPORT

- A. Pipe sleeves, hangers and fixture support shall be furnished and set, and the Contractor shall be responsible for their proper and permanent location.
  1. Pipe sleeves shall be installed for pipes passing through footings, floors, walls and roof decks constructed with concrete and other cast-in-place materials. Clearance between sleeves and pipe covering and/or pipes shall be approximately 1/2-inch. Construction shall not be cut except where approved by the County. Where cutting of construction is permitted, the construction shall be repaired to match its original condition. Sleeves located in exterior walls, concrete roof slabs, and floors on and below grade shall be sealed to make the space between pipe and sleeve watertight. Sleeves shall not be installed in structural members except where indicated or where the Contractor has received prior approval of the County.

- a. Pipe sleeves shall be installed for pipes that will pass through exterior walls and floors. Sleeves that pass through the floor shall extend 1 to 2 inches above the floor. The space between sleeve and pipe and/or pipe covering shall be sealed with plastic bituminous cement.
  - b. Where plumbing piping (6 inches and smaller) passes through finished floors and the pipe will be exposed, the sleeve shall be fabricated of 3/16-inch (minimum) 316 stainless steel, and the sleeve shall be cut off exactly 1-inch above finished floor unless otherwise noted on the Drawings.
2. Pipe Hangers, Inserts and Supports:
- a. Unless otherwise noted or detailed on the Drawings, pipe hangers and supports shall be Ginnell, ITT or approved equal. Pipe hangers shall be Fig. 107, Fig. 115 or Fig. 138; wall hooks Fig. 168; and brackets Fig. 223. Concrete inserts shall be equal to Fig. 281 and shall be installed before the concrete is poured. Wherever possible, ceiling hangers shall be supported utilizing toggle bolts of an approved type or ceiling flanges Fig. 128 or 128R, or as detailed on the Drawings.
  - b. Horizontal Piping: Hangers and supports shall be installed as specified hereinafter, and at locations not more than three feet from the end of each runout. A hanger shall be installed not over one foot from each change in direction of piping. In lieu of separate hangers, the Contractor may submit for approval by the County a detailed drawing of trapeze hangers. Rings shall have a diameter large enough to include pipe insulation and protective saddle. Hangers for copper piping shall be copper plated.
    - 1) Cast iron soil pipe shall be supported at not more than five foot intervals and supports shall be located near each hub, or joint.
    - 2) Threaded pipe shall be supported at eight foot intervals.
    - 3) Underground piping shall be laid on a firm bed for its entire length, except where support is otherwise provided.
3. Fixtures and equipment shall be supported and fastened in a satisfactory manner. Where secured to solid masonry, fixtures and equipment shall be fastened with brass bolts or machine screws in lead or corrosion-resisting-metal, sleeve type anchorage units or with brass expansion bolts. Expansion bolts shall be 1/4-inch brass bolts with 20 threads to the inch and of sufficient length to extend at least three inches into solid masonry construction, and shall be fitted with loose tubing or sleeves of proper length to ring expansion sleeves into the solid concrete or brick wall. Where secured to cellular masonry construction, fixtures and equipment shall be fastened with 1/4-inch brass toggle bolts or through bolts. Exposed heads of bolts and nuts shall be hexagonal with rounded tops finished and chromium plated; exposed ends of bolts shall be concealed by chromium plated hexagonal nuts. Exposed nuts and heads of screws shall be provided with chromium plated brass washers.

## 2.14 IDENTIFICATION TAGS

Identification tags made of brass, indicating function of the valve, size, and working pressure shall be installed on all valves except valves installed on supplies to plumbing fixtures. Tags shall be two inches in diameter and marking stamped and wired to valve with 0.0808-inch diameter (No. 12 AWG) copper wire. The Contractor shall also provide charts and diagrams of approved size giving the number, location and function of each valve, and distinguishing all pipe lines. Upon completion of the work, the Contractor shall furnish record drawings to the County.

## 2.15 FLOOR, WALL AND CEILING PLATES

Exposed insulated and uninsulated pipes through floors, finished walls, or finished ceilings shall be fitted with chromium plated or enameled cast iron or steel plates. Plates shall be large enough to completely close the hole around the pipes and shall be square, octagonal, or round, with the least dimension not less than 1-1/2 inches larger than the diameter of the pipe. Plates shall be secured in an approved manner.

## 2.16 PIPE INSULATION

- A. The Contractor shall provide insulation for all water lines above floor, the domestic hot water system, heat recovery system air conditioning condensate drain piping and the horizontal waste arm serving electric water cooler(s).
  - 1. Hot water pipe insulation shall be Johns-Manville J-M Micro-Lok fiberglass pipe insulation, Certainteed Corp., or approved equal, finished with standard four ounce canvas jacket. Installation shall be in accordance with manufacturer's published recommendations.
  - 2. Condensate and electric drinking fountain waste shall be insulated with Johns Manville J-M Aerotube, Certainteed Corp., or approved equal.

## 2.17 STRAINERS

Strainers shall be 125-pound cast iron body Y-pattern with removable brass screen basket as manufactured by Sarco Company, or approved equal.

## 2.18 PRESSURE GAUGES

Pressure gauges shall be 4-1/2 inch dial size with bottom or rear connection, weatherproof, as manufactured by Marshalltown, equal to No. 23 or 44, and suitable for the specific service pressure, by Trerice, Series 600 or 615; Ashcroft, or equal. Provide brass shut-off cocks on the stem to each pressure gauge.

## 2.19 PAINTING

Exterior surfaces of piping to be installed in or through concrete shall be given one coat of acid resisting paint having a bituminous base. Pipe hangers, supports, and other iron work concealed or in unfinished spaces shall be thoroughly cleaned and painted with one coat of black asphaltic varnish. Finish painting of exposed pipe, pipe covering, hangers, supports, and other work is specified in the Contract Documents.

## 2.20 TYPES OF FIXTURES AND FIXTURE TRIMMINGS

Provide the fixtures noted on the Drawings complete with all necessary trim.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Drainage and Vent Pipes: Horizontal soil and waste pipes shall have a grade of 1/8-inch per foot except where 1/4-inch per foot is noted on the Drawings. All main vertical soil and waste stacks shall be extended full size to the roofline and above as vents, except where otherwise specifically indicated. Where practicable, two or more vent pipes shall be connected and extended as one pipe through the roof. Vent pipes in roof spaces shall be run as close as possible to the underside of the roof without forming traps in pipes, using fittings as required. Vertical vent pipes may be connected into one main vent riser above vented fixtures. All vent and branch vent pipes shall be so graded and connected as to drip back to the vertical stack by gravity. Cast iron no-hub pipes inside buildings shall be extended six inches above the floor. Roof vents shall be offset to maintain a distance of ten (10) feet minimum from air conditioning outside air intake, or any ventilating opening.
- B. Fittings: Changes in pipe size on soil, waste, and drain lines shall be made with reducing fittings or recessed reducers. All changes in direction shall be made by the appropriate use of 45 degree wyes, long or short sweep 1/4 bends, 1/6, 1/8 or 1/16 bends, or by a combination of those of equivalent fittings. Single and double sanitary tees and 1/4 bends may be used in drainage lines only where the direction of flow is from horizontal to vertical.
- C. Union Connections: Slip joints will be permitted only in trap seals or on the inlet side of the traps.
- D. Joints:
  - 1. Joints in hub-and-spigot cast iron soil, waste and vent pipes, or between cast iron soil, waste, and vent pipes and threaded pipe or caulking ferrules, shall be firmly packed with tarred-twisted jute packing and caulked with lead at least one inch deep.

2. Threaded pipe joints shall be made by use of an approved mechanical cutter and all joints shall be reamed. No more than three threads shall remain exposed after assembly.

### 3.02 TESTS

- A. Soil, waste, vent and water piping shall be tested by the Contractor and approved before acceptance. Underground soil and waste piping shall be tested before backfilling. Equipment required for test shall be furnished by the Contractor at no additional cost to the County.
- B. Drainage and venting system piping shall be tested with water or air before the fixtures are installed. After the plumbing fixtures have been set and their traps filled with water, the entire drainage and venting system shall be submitted to a final test with smoke or peppermint.
  1. Water test shall be applied to the drainage and venting system either in its entirety or in sections. If the entire system is tested, all openings in the pipes shall be tightly closed except the highest opening, and the system shall be filled with water to the point of overflow. If the system shall be tested in sections, each opening except the highest opening of the section under test shall be tightly plugged, and each section shall be filled with water and tested with at least a 10 foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested so that each joint or pipe in the building except the uppermost 10 feet of the system has been submitted to a test of at least a 10 foot head of water. The water shall be kept in the system, or in the portion under test, for at least 15 minutes before the inspection starts; the system shall then be tight at all joints.
  2. If tests are made with air, a pressure of not less than five pounds per square inch shall be applied with a force pump and maintained at least 15 minutes without leakage. A mercury-column gauge shall be used in making the air test.
  3. When the smoke test is employed, the smoke shall be produced by a smoke machine, and a pressure equal to one inch water column shall be maintained for 15 minutes before inspection starts. When the peppermint test is preferred, two ounces of peppermint shall be introduced into each line or stack. Defects discovered shall be eliminated by resetting the fixtures and equipment with new gaskets.
- C. Water System: When the roughing-in is completed and before the fixtures are set, the entire hot and cold water piping system shall be tested at a hydrostatic pressure of not less than 100 pounds per square inch gauge, and proved tight at this pressure for not less than 30 minutes in order to permit inspection of all joints. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately as described for the entire system.

- D. Defective Work: If inspection or test shows defects, such defective work or material shall be replaced and inspection and tests repeated. Repairs to piping shall be made with new material; no caulking or peening of screwed joints or holes will be acceptable.

### 3.03 WATER FOR TESTING

- A. The Contractor shall provide steam and water necessary for testing the piping systems. The Contractor shall make all connections for testing and remove all debris resulting therefrom. The water shall be used in an efficient and economical manner.
- B. Provide all apparatus and all other supplies or materials which may be necessary for testing the systems and operating the apparatus during the period while tests of any kind are being made, or for carrying out the work of the Contract.

### 3.04 CLEANING

- A. At the completion of the work, the Contractor shall clean and polish, ready for use, all fixtures, equipment, apparatus and exposed trim.
- B. The Contractor shall protect this work during construction and all finished work damaged during construction shall be replaced at no additional cost to the County.

### 3.05 PROTECTION

- A. Materials, fixtures, and equipment shall be properly protected at all times and all pipe openings shall be temporarily closed so as to prevent obstruction and damage.

### 3.06 STERILIZATION

The entire potable water collection and distribution system shall be thoroughly sterilized with a solution of not less than 50 parts per million of available chlorine. The sterilizing solution shall be allowed to remain in the system for a period of three hours after which time all valves and faucets shall be opened and the system shall be flushed with clean water until the residual chlorine content is not greater than 0.92 parts per million, unless otherwise directed.

**\*\*END OF SECTION\*\***

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## SECTION 15500

### AIR CONDITIONING SYSTEM

#### PART 1 GENERAL

##### 1.01 SCOPE

Furnish and install a complete air conditioning system for climate control. The system shall be high efficient air conditioning unit manufactured by Carrier, York or approved equal, with a minimum SEER rating of 14. The system shall include all necessary components to insure a complete operable system. The major components shall include inside air handler/evaporator unit, outside condensing unit, duct system, condensate line, thermostat, electrical power and wiring.

##### 1.02 CODES AND STANDARDS

All work performed under this specification shall conform to the requirements of the latest edition of the following codes and standards as modified by local ordinances:

- NFPA Compliance: Comply with applicable provisions of ANSI/NFPA 70 ANational Electric Code@. Also conform to Pamphlet 90A of NFPA.
- Flame-Smoke Ratings: Provide air handling unit thermal insulation with flame-spread index of 25 or less, fuel-contributed index of 50 or less, and smoke-developed index of 50 or less.
- AMCA Standards: Comply with Air Movement and Control Association (AMCA) standards as applicable for testing and rating fans, and testing louvers, dampers and shutters.
- SMACNA Compliance: Comply with Sheet Metal and Air-Conditioning Contractors National Association (SMACNA) duct work construction standards.
- American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Handbook.
- ARI Certification: Provide central station packaged air handling units which comply with Air-Conditioning and Refrigeration Institute (ARI) Standard 430 and display ARI=s certification symbols.
- UL Compliance: Provide electric components for air handling units which have been listed and labeled by Underwriters Laboratories.
- Construction shall comply with ANSI B9.1 safety code.
- Standard Building Code.
- Standard Mechanical Code.
- National Warm Air Heating and Air Conditioning Association - Manual 4.

##### 1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver all components in factory-fabricated protective containers.

- B. Handle all components carefully to avoid damage to components, enclosures and finish. Do not install damaged components; replace and return damaged components to manufacturer.
- C. Store all components in clean dry place and protect from weather and construction traffic.

#### 1.04 SUBMITTALS

- A. Thoroughly coordinated shop drawings shall be submitted for approval.
  - 1. Submit shop drawings and complete performance data for all major pieces of equipment, showing dimensions arrangement, connection sizes, electrical wiring diagram, power requirements and clearances required for access of service. Shop drawings shall include factory certification that the equipment has the required capacity or shall include copies of manufacturers published performance data.
  - 2. Equipment proposed will require complete shop drawings, which clearly show how the equipment fits the available space and in relation to adjacent equipment, with all connections shown such as piping and duct work.
  - 3. Provide submittal data for major component, air distribution devices, installation materials and duct work.
  - 4. Submit for approval complete power and control field wiring diagrams.
  - 5. Submit for approval a drawing indicating location and sizes of all wall penetrations and supports required for this work.
- B. All shop drawings submitted for approval shall be stamped by the Contractor before submission to indicate that the shop drawings are complete, checked and comply with all aspects of the requirements of all Contract Documents.
- C. Shop drawing approvals by the County will not relieve the Contractor from responsibility for his own errors, nor from his responsibility for full compliance with the Contract Documents.
- D. All data and drawings shall be submitted simultaneously in an indexed booklet.
- E. Warranty for the equipment under this Section.

#### 1.05 OPERATING AND MAINTENANCE MANUALS

- A. When the installation is completed, submit to the County, one copy of the following, bound in a hard cover booklet:
  - 1. General operating instructions, including copies of posted specific instructions and automatic control diagrams.

2. Maintenance instructions, followed by tabulated manufacturer=s descriptive literature, shop drawings, performance curves and rating data, spare parts lists and manufacturer=s maintenance manuals.
3. Names, addresses and telephone numbers of local service representatives of the manufacturer=s of the installed equipment.

## PART 2 PRODUCTS

### 2.01 OUTSIDE CONDENSING UNIT

- A. Provide factory assembled self-contained, air cooled condensing unit, complete with compressor section, integral condenser, all necessary controls and interconnecting refrigerant piping. Furnish manufacturer=s five (5) year parts and labor warranty for motor compressor.
- B. All components shall be protected against corrosion and shall be mounted in a steel casing of a minimum of 14-gauge panels with steel angle framing and adequate access panels for inspection and maintenance.
- C. Provide all piping, valves, and fittings required to properly interconnect all system components.
- D. Tubing for coils shall be copper; fins shall be aluminum.

### 2.02 INSIDE AIR HANDLER/EVAPORATOR UNIT

- A. Casing walls shall be fabricated of continuous galvanized steel and coated with baked enamel finish not lighter than 18 gauge. Removable panels shall provide access to the interior of the unit.
- B. Fan and coil sections shall be internally insulated with 1-inch thick, 3 lb. density neoprene coated fiberglass. Insulation shall be secured to the casing with waterproof adhesive and permanent fasteners.
- C. Fan wheel shall be forward curved type, non-overloading, and keyed to the shaft. Fan wheel shall be dynamically and statically balanced at factory.
- D. V-belt driven fan shall be designed for 50 percent overload capacity.
- E. Bearings shall be designed for a minimum of 200,000 hours average life.
- F. Coil section shall encase cooling coils and drain pan. Coils shall be arranged for horizontal air flow. Coil headers, valves and all piping shall be completely enclosed within the insulated casing.
- G. Tubing for coils shall be copper. Fins shall be aluminum.

- H. Drain pan shall be galvanized steel, with a heavy coat of mastic.
- I. Filter Section: Filter section shall be designed to hold throwaway filters.

## 2.03 SHEET METAL DUCTWORK

- A. All round and rectangular sheet metal duct work shall be fabricated from galvanized sheet steel complying with ASTM A 527, Lock forming Quality; with G 90 zinc coating in accordance with ASTM 525. Zinc coating shall be of uniform thickness; free from blisters, slivers and pits; and capable of withstanding normal sheet metal forming operating without flaking or splitting.
- B. Joints, gauge, reinforcement and fabrication techniques shall conform to minimum standards listed in SMACNA AHVAC Duct Construction Standards@ using actual duct dimensions and system pressures.
- C. Ductwork shall be installed in strict accordance with manufacturer=s recommendations and in compliance with SMACNA AHVAC Duct Construction Standards@.
- D. Thermal Insulation:
  - 1. Insulation material shall be similar in all respects to that manufactured by Owens-Corning, Certainteed, Armstrong, or equal. Exterior wrap for sheet metal shall be type 703 FRK 25. Provide and install all thermal insulation for the HVAC system.
  - 2. Except for materials which are subsequently exempted, all other materials used as part of the thermal insulation shall have a fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed.
- E. Components:
  - 1. Provide all adhesives, sealers, vapor barrier coatings, etc., compatible with the material to which they are applied. They shall not corrode, soften, or otherwise attack such material in either the wet or dry state and must be suitable for the service temperature.
- F. Ceiling Diffusers:

Provide adjustable-blade high-performance louver with 6" frame depth, constructed of extruded aluminum.
- G. Sound Adsorption and Isolation:

Neoprene vibration isolation supports shall be provided on the air conditioning unit and other equipment that may transmit noise or vibration to the building structure.

## 2.04 TEMPERATURE CONTROLS

Furnish and install a heavy duty corrosion resistant wall mounted thermostat with locking cover. Use Carrier thermostat control or equal.

## PART 3 TESTING AND BALANCING

- A. The Contractor shall test and balance the air conditioning system.
- B. The term Air conditioning systems@ shall be understood and intended to mean all air conditioning supply systems, and all associated equipment and accessories.

## PART 4 EXECUTION

### 4.01 GENERAL

- A. Install the air conditioning system where indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
- B. Coordinate with other work, including plumbing, ceiling and truss construction, roof decking, electric, piping, and overhead crane system as necessary to interface installation of air handling units with other work.
- C. Install air handling unit on vibration mounts and comply with manufacturer=s indicated installation method.
- D. Spare Parts:
  - 1. Provide one complete extra set of filters for the air handling unit. Install new filters at completion of air handling system work, and prior to testing, adjusting and balancing work.
  - 2. Provide one spare set of belts for the air handling unit.

### 4.02 INSTALLATION

- A. All major components shall be rigidly and strongly supported with suitable braces, tees, or angles to keep them true to shape and prevent buckling.
- B. Pocket joints or bar slips, if used, must be riveted at the corners. Approved means must be provided to prevent pocket and slip joints pulling apart such as riveting on 12-inch centers, clip punching on 8 inch centers or button pressing on 4 inch centers.

Sheet metal screws puncturing ducts will not be allowed in the construction of seams and joints.

- C. Sealing and Leak Testing: All seams, joints, gaps, holes, etc. in the ductwork shall be sealed with mastic and checked for airtightness before insulation is applied.
- D. Ductwork Cleaning: Contractor shall thoroughly clean all ductwork chambers, fans, etc., manually. After this is done, blow out the systems with a built-up velocity so as to properly clean the interior of all ductwork, leaving same free of all foreign matter. The cleaning work shall be done before any painting is done.

**\*\*END OF SECTION\*\***

## SECTION 16000

### GENERAL REQUIREMENTS — ELECTRICAL

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies general requirements for electrical work. Project detailed requirements specified in other sections are subject to the general requirements of this section.

1. Furnish labor, equipment, tools, materials, supplies, and perform operations necessary to install a complete and operable electrical system. Furnish incidental material and perform work shown on the Drawings or in the Specifications.
2. Perform electrical work and provide material and equipment in compliance with applicable National, State, and Local codes, regulations, laws, and ordinances.
3. Obtain electrical permits, arrange for required inspections, correct deficiencies resulting from inspections, and pay permit fees and inspections charges. Pay fines and the cost of extra work incurred by action or inaction of the Contractor, at no additional cost to the Owner.
4. Furnish properly executed certificates of final electrical inspection and approval from the Code Authority Having Jurisdiction (AHJ) at the conclusion of the work, before final acceptance.
5. Adhere to the Area Classification shown for the product required and the installation required. Provide products in Hazardous Classified Areas in accordance with NEC Article 500 for the Class and Division specified or identified and products in corrosive areas in accordance with this specification.
6. Maintain a complete set of Contract Drawings in "Record" condition, available for review by the Owner or Engineer. Mark, initial, and date changes, modifications, or corrections, as they occur. Refer to the Record Drawing specification section requirements.

7. Field verify the exact locations of equipment or equipment terminations since the electrical drawings and schedules included in these Specifications are functional in nature. Use accepted equipment submittals as the basis of the conduit openings and slab penetrations.

**B. DRAWING DEFINITIONS AND REQUIREMENTS:**

1. **ELEMENTARY OR SCHEMATIC DIAGRAM:** Shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement that facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.
2. **ONE-LINE DIAGRAM:** Shows by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and the components, devices or parts used therein. Physical relationships are usually disregarded.
3. **BLOCK DIAGRAM:** Diagram of a system, instrument, computer, or program in which selected portions are represented by annotated boxes and interconnecting lines.
4. **WIRING DIAGRAM OR CONNECTION SYSTEM:** Includes all of the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly. A panel layout diagram shows the physical location of devices and the wiring connections.
5. **INTERCONNECTION DIAGRAM:** Shows external connections between terminals of equipment in panels or electrical assemblies and outside points, such as motors, auxiliary devices, control devices, and instruments. Provides references to connection diagrams that interface to the interconnection diagrams of the continuous line type.

Shows bundled wires as a single line with the direction of entry/exit of the individual wires clearly shown. Shows each wire identification as actually installed. Wireless diagrams and wire lists are not acceptable.

Provides wire identification for each end of the same wire for devices and equipment. Indicates terminal blocks identification actually installed with individual terminal identification.

Shows jumpers, shielding and grounding termination details not shown on the equipment connection diagrams on the interconnection diagrams.

Wires or jumpers shown on the equipment connection diagrams shall not be shown again on the interconnection diagram. Signal and Direct Current (DC) DC circuit polarities and wire pairs shall be shown. Shows spare wires and cables.

6. ARRANGEMENT, LAYOUT, OR OUTLINE DRAWINGS: Shows the physical space and mounting requirements of a piece of equipment and may indicate ventilation requirements, space provided for connections, or the location connections are to be made.
7. DRAWING CROSS-REFERENCING: References each submittal drawing submitted to the associated Contract Document and indicates the one-line diagrams, schematics, control diagrams, block diagrams, and Process and Instrumentation Diagrams (P&IDs) cross-referenced on the submittal drawings.

Internally cross-reference submittal drawings related to the same subject shall be referenced to other submittal drawings. Failure to cross-reference Contract Documents with the submittal shall be cause for rejection of the entire submittal with no further consideration.

## 1.02 QUALITY ASSURANCE

### A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A58.1 / ASCE 7	Minimum Design Load in Buildings and Other Structures, 1982
ANSI/IEEE C57.12.01	General Requirements for Dry-Type Distribution and Power Transformers
ANSI/UL 506	Specialty Transformers
ANSI C80.1	Rigid Steel Conduit - Zinc Coated, 1994
ASTM B3	Standard Specification for Soft or Annealed Copper Wire, 2001
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft, 1999
ASTM B33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes, 2000
ICEA S-68-516 / NEMA WC 70, 71, & 74	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
ICEA S-95-658	Standard for Non-Shielded Power Cables Rated 2000 Volts or Less, 2000
IEEE 81	Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System, 1983
IEEE 383	Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations, 1974 (1992)
JIC EMP-1	Electrical Standard for Mass Production Engineering, 1967
NEMA TC2	Electrical Polyvinyl Chloride (PVC) Conduit, 2003
NEMA 250	Enclosures for Electrical Equipment (1000 Volt Maximum)
NEMA WC-70	Non-Shielded Power Cable 2000V or Less (ICEA S-95-658), 1999 (2001)
NEMA WD-1	General Requirements for Wiring Devices, 1999
NEMA ST20	Dry-Type Transformers for General Application
NFPA 70	National Electrical Code (NEC)
NFPA 70E	National Electrical Safety Code (NESC)
UBC	Uniform Building Code
UL 1	Flexible Metal Electrical Conduit
UL 6	Electrical Rigid Metal Conduit – Steel, 12th Edition, 2000 (2003)

Reference	Title
UL 44	Thermoset-Insulated Wires and Cables, 15th Edition, 1999 (2002)
UL 67	Panelboards, 11th Edition, 1993 (2003)
UL 83	Thermoplastic-Insulated Wires and Cables, 13th Edition, 2003 (2004)
UL 263	Fire Tests of Building Construction and Materials, 13th Edition, 2003
UL 360	Liquid-Tight Flexible Steel Conduit, 5th Edition, 2003
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, 10th Edition, 2002 (2003), Adopted: NEMA AB 1-1999
UL 1277	Electrical Power and Control Tray Cables With Optional Optical Fiber Members, 4 <sup>th</sup> Edition, 2001 (2003)
UL 886	Outlet Boxes and Fittings for Hazardous (Classified) Locations

#### B. LISTED AND LABELED PRODUCTS:

Provide electrical equipment and materials listed or labeled by an independent testing laboratory for the purpose for which they are to be used and provide associated testing laboratory label.

The independent testing laboratory shall be acceptable to the inspection authority having jurisdiction. Test Laboratory examples: Underwriters Laboratories (UL), Electrical Testing Laboratories (ETL), and Canadian Standards Association (CSA).

Include costs and expenses incurred for special inspections in the contract price for electrical products required to undergo a special inspection either at the manufacturer's place of assembly or at the installed location by the local inspection authority when a product is not available with a testing laboratory listing or labeling.

#### C. FACTORY TESTS:

Perform factory tests at the place of fabrication and on completion of manufacture or assembly where specified in the individual product specification section.

1. Include the costs of factory tests in the contract price.
2. Include the costs of Engineer witness of factory tests in the contract price.

### 1.03 SUBMITTALS

The following information shall be provided for all electrical equipment and materials in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole.

If deviations from the specifications are shown, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The OWNER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

Failure to include a copy of the marked-up specification sections, along with justification for requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Catalog cuts of equipment, devices, and materials requested by the individual specification sections.
  - a. Catalog information with technical specifications and application information including ratings, range, weight, accuracy, and other pertinent product information.
  - b. Edit catalog cuts to show only the items, model numbers, and information that apply.
  - c. Assemble catalog cuts in a folder or three ring binders with a cover sheet, indexed by item, and cross-referenced to the appropriate specification paragraph.
3. Arrangement, layout, and outline drawings with dimensions and weight, as appropriate.

4. Control schematics and interconnection wiring diagrams depicting internal and external wire and cable terminations. Drawing cross-reference to specification and Contract Document drawings.
5. Conduit and cable tag numbers, including conduit and cable schedules. County may at its discretion advise the preferred tag numbering system. Coordinate with the County during construction. Provide the tag numbers at no additional cost to the county.

#### 1.04 DRAWINGS

Prepare specified drawings on 11-inch by 17-inch drafting media complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing.

Prepare drawings to reflect the final constructed state of the project installation or supplied equipment. Provide drawing quality, clarity, and size of presentation to permit insertion in operation and maintenance manuals.

#### 1.05 PROJECT / SITE CONDITIONS

##### A. GENERAL:

Unless otherwise specified, equipment and materials shall be sized and derated for the ambient conditions specified in Section 01800, but not less than an ambient temperature of 40 degrees C at an elevation ranging from sea level to one thousand two hundred feet (1,200) feet without exceeding the manufacturer's stated tolerances.

##### B CORROSIVE AREAS:

The following areas are designated as corrosive:

All outdoors and process areas are corrosive.

##### C. HAZARDOUS (CLASSIFIED) AREAS:

The following areas are designated as hazardous (classified) in accordance with the NEC:

a. Sludge Feed Pump Areas and Belt Filter Press Areas: Class I, Division 2, Group D hazardous areas as defined by NFPA 820, latest edition.

##### D. SEISMIC:

Electrical equipment and supports shall be braced in accordance with Florida Building Code.

E. CONSTRUCTION MATERIALS:

Refer to the individual specification section for each component for material composition and installation practices.

Construction materials required for each area classification are listed in the following table that specifies the type of raceway required for each location and application by RACESPEC (Section 16000, paragraph 2.02 K) sheet. Unscheduled conduit shall be galvanized, rigid steel, RACESPEC type GRS.

Location	Application/Condition	RACESPEC
Indoor non-corrosive	Exposed	RAC
Indoor corrosive	Exposed	
Outdoor	Exposed (WWTP)	RAC
Outdoor	Exposed (other)	
Concealed	Embedded in concrete structure or beneath slab-on-grade	PVC4
Underground	Instrumentation, communications and data signals encased in concrete, ductbank	PVC4
Underground	Instrumentation, communications and data signals directly buried	PVC4
Underground	Power directly buried (Non-Power Utility)	PVC4
Non-hazardous	Final connection to equipment and light fixtures	LFS
Hazardous corrosive	Exposed	RAC
Architecturally finished areas	Concealed in framed walls and ceiling spaces (lighting and receptacle circuits only)	RAC
Architecturally finished areas	Final connection to light fixtures	FLEX

Notes:

1. Install conduit connections to control stations, enclosures, and device boxes through threaded hubs.
2. Install flexible conduit for final connections to devices, equipment and motors not exceeding eighteen (18) inches. Limit length to thirty-six (36) inches where flexibility is required.

3. Mount enclosures, device boxes, control stations, and raceway systems with 1/4-inch (minimum) air space between the electrical system and supporting structure.

## 1.06 STORAGE OF MATERIALS AND EQUIPMENT

Store equipment and materials in the factory-sealed container and protect with additional covering and materials to avoid physical damage or weather damage.

## 1.07 ELECTRICAL NUMBERING SYSTEMS

### A. RACEWAY NUMBERS:

Tag raceways with stainless steel tags at both ends at the access locations including manholes, pull boxes, junction boxes, and at the terminations.

Tag raceways with aluminum tags where subject to hydrogen sulfide atmosphere typically found at wastewater treatment facilities.

Raceway numbers are derived from the “Cable and Conduit Schedule” or the ductbank cross-sections. Where raceway numbers are not provided, use the circuit number on the power and control single line diagrams.

### B. WIRE AND CABLE CIRCUIT NUMBERS:

Identify wire and cable circuit numbers at both ends. Refer to the circuit identification/labeling method specified and shown in the drawings to label circuits.

Identify lighting and receptacle branch circuits with the power source and circuit load, at source and destination locations. Identify the load, location, and circuit in typed panel schedules with corrections shown.

Include copies of schematic diagrams, wiring connection diagrams, and interconnection diagrams inside of the equipment enclosure, protected in a plastic container in the equipment print holder.

## PART 2--PRODUCTS

### 2.01 EQUIPMENT AND MATERIALS, GENERAL

Provide new equipment and materials free from defects. Provide material and equipment of the same or a similar type of the same manufacturer throughout the work. Use standard production materials wherever possible.

## 2.02 RACEWAYS, BOXES, AND SUPPORTS

### A. RACEWAYS AND BOXES:

Pullboxes, handholes, and device boxes are generally called boxes herein. Size boxes, manholes, and handholes in accordance with the National Electrical Code. Provide separate raceways for lighting, receptacles, power, control, instrumentation, and signaling systems.

### B. BOXES AND WIREWAYS:

Provide indoor boxes, larger than Ferrous Deep (FD) boxes, constructed of sheet steel and galvanized after fabrication.

Provide boxes located outdoors and in corrosive areas with NEMA-4X rating of stainless steel or nonmetallic material where stainless steel is not compatible.

Provide enclosures rated for outdoor installation with gaskets on the hinged doors or removable covers and sized for conduit hub fittings.

Size and provide wireways at locations above and below boxes, panels and groups of devices. Comply with the NEC sizing for conductor fill requirements. Wireway NEMA type shall match the location and area classification and equipment NEMA enclosure ratings.

Bolt-on junction box covers 3 feet square or larger, or heavier than 25 pounds, shall have a rigid handle. Covers larger than 3 x 4 feet shall be split.

### C. TERMINAL CABINETS:

Provide cabinets located indoors with NEMA-12 Rating. Provide cabinets located outdoors and in corrosive areas with NEMA-4X rating of stainless steel or nonmetallic material where stainless steel is not compatible. Provide cabinets with hinged doors and 2 or 3-point latching with locking features via handle or latching clasps with provisions for padlocks.

Provide adjustable terminal strip mounting accessories and with channel mounted terminal blocks rated 30 amperes, 600 volt AC. Provide No. 8 minimum strap-screw type terminal strip, suitable for ring tongue, locking spade terminals. Provide Phoenix Contact products, or approved equals, with capture feature and terminal identification method per terminal, as specified.

### D. MANHOLES, HANDHOLES AND PULLBOXES:

Manholes, handholes and pullboxes generally called boxes herein, contain wires, cables, and conductors. Provide box dimensions where shown. Provide boxes per NEC sizing rules where the dimensions are not sized or shown.

Provide concrete boxes with covers designed for H-20 loading in traffic areas. Engrave box cover: "ELECTRICAL". Provide boxes with hinged, aluminum checkered plate covers with pull-handle to open in non-traffic areas.

Provide precast Quazite Compsolite cement/polymer products, or approved equals, for handholes, pullboxes, manholes, meter boxes, equipment pads, and vaults where allowed by the electric power utility and for projects where precast concrete is not specifically shown or specified.

#### E. RACEWAY AND BOX SUPPORTS:

Provide hot-dip galvanized framing channel with end caps to support groups of conduit. Provide individual conduit supports that have one-hole galvanized malleable iron pipe straps used with galvanized clamp backs and nesting backs.

Provide stainless steel supports, channel, fittings, all-thread, and fasteners in outdoor locations, in corrosive areas, and as shown. Provide factory end-caps for supports and channels.

Independently support boxes by galvanized brackets, expansion bolts, toggle bolts, or machine or wood screws as appropriate. Wooden or plastic plugs inserted in masonry or concrete shall not be used as a base to secure boxes, nor shall welding or brazing be used for attachment.

#### F. UNDERGROUND MARKING TAPE:

Provide low-density, polyethylene plastic, underground marking tape and install above and centered for early warning protection for digging near electrical ductbanks.

Provide Brady "Identoline"; Services and Materials "Buried Underground Tape"; Somerset (Thomas & Betts) "Protect-A-Line"; or approved equals. Provide tape with nominal dimension of six (6) inches wide, 4-mil thickness.

Provide underground marking tape six (6) inches wide metallic-lined tape with red polyethylene film on top and with clear polyethylene film on the bottom of the tape for installation above and centered on direct buried cables and conduits without ductbank encasement.

Provide black over red marking tape clearly printed with: "CAUTION ELECTRIC LINE BURIED BELOW", or provide OSHA approved marking tape.

#### G. NAMEPLATES:

Provide nameplates for all boxes and enclosures with nameplate wording as shown on the drawings. Provide the tag number or box number with device functional description on device

nameplate. Nameplate wording may be changed without additional cost where changes are made during the submittal process or prior to commencement of engraving.

Provide machine engraved laminated white phenolic nameplates with black lettering for panel-mounted equipment with the instrument tag number/description in 3/32-inch minimum size lettering and attach to the panel or enclosure with a minimum of two self-tapping 316 stainless steel screws. Provide nameplates for power sources indicating the power loads and nameplates for power loads that indicate the power sources, in accordance with these specifications and the NEC.

#### H. RACEWAY MARKERS:

Provide raceway markers: 0.036-inch minimum thickness, solid brass tags or aluminum tags with raceway number or the circuit number, stamped in 3/16-inch minimum height characters and attach tags to the raceway with 316 stainless steel wire. Install raceway markers inside of pull boxes, handholes, manholes, and where entering into electrical equipment enclosures.

Provide raceway markers indicating the power source and circuit number for lighting and receptacle raceways to the associated panelboard. Interior lighting and receptacle raceways do not require raceway markers for conduit between components.

#### I. IDENTIFICATION TAGS:

Provide the following:

1. Equipment: Typical size 1 x 3 inches wide, white with black engraved equipment number and equipment description.
2. Raceway/Conduit: Tags with raceway or conduit number or circuit shown.
3. Instrument: 1.5 inches wide, aluminum tag with instrument number and description.
4. Conductor: Power, control, or instrument cable with the circuit identified as shown; power source or power/control panel identified; power load, equipment, instrument, or device identified; purpose of the conductors identified.
5. Fastener: nylon-coated 48-mil stainless steel wire. Manufacturer: Brady catalog number 23310 or approved equal with double ferrule type brass wire clamps. Manufacturer: Brady number 23312, or approved equal.

J. GENERAL RACEWAY REQUIREMENTS:

Provide additional pullboxes for conduit runs with greater than 360 degrees in any run between pull boxes. Limit maximum conduit runs without additional pullboxes to four hundred (400) feet, less one hundred (100) feet for every 90 degrees for the conduit run change in direction.

Determine conduit routing that conforms to the installation requirements set forth herein and in accordance with the NEC requirements for size and number of pullboxes. The RACESPEC sheets with specified requirements begin on the next page.

K. RACEWAY SPECIFICATION SHEETS (RACESPEC):

Identification:	GRS
Description:	Galvanized Rigid Steel Conduit (GRS)
Compliance:	ANSI, UL 6
Finish:	Hot-dip galvanized after fabrication, inside and outside. Smooth finished surfaces.
Manufacturers:	Allied Tube and Conduit Corp., Wheatland Tube Co., or approved equal.
Minimum size:	Unless otherwise shown: 3/4-inch for exposed; 1-inch for concealed or embedded; 2-inch for ductbank encased.
Fittings:	
Hubs:	Insulated throat with bonding locknut, hot-dip galvanized. The hubs shall utilize a neoprene "O" ring and shall provide a watertight connection. O-Z Gedney, CHM-XXT, or approved equal.
Unions:	Electro-galvanized ferrous alloy type Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or approved equal. Threadless fittings are not acceptable.
Boxes:	
Indoor:	Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square. NEMA-12 welded steel 6 inches square and larger. Door shall have hinges with clamp locks. Boxes in process areas shall be NEMA-4 watertight. Boxes in corrosion areas shall be NEMA-4X.
Outdoor:	Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square. NEMA-4X stainless steel or nonmetallic (as specified) for 6 inches square and larger.
Hazardous:	NEMA Class 7 cast ferrous.

Identification:	GRS
Elbows:	
(3/4" thru 2.5")	Factory fabricated or field bent.
(3" thru 6")	Factory fabricated.
Conduit Bodies:	
(3/4" thru 4")	Malleable iron, hot-dip galvanized, unless otherwise noted. Neoprene gaskets for all access plates. Tapered threads for all conduit entrances.
(5" and 6")	Electro-galvanized iron or cast iron box.
Expansion Fittings:	Expansion fittings in embedded runs shall be watertight and shall be provided with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.
Manufacturers:	Appleton, Crouse-Hinds, Hubbell, O. Z. Gedney, or approved equal.
Installation:	<p>Rigid steel conduit shall be made up tight and without thread compound. Joints shall be made with standard couplings or threaded unions. Steel conduit shall be supported away from the structures using hot-dip galvanized malleable iron straps with nesting backs.</p> <p>Conduit entering boxes shall be terminated with a threaded hub as specified or standard fittings with grounding bushing.</p> <p>Exposed male threads on rigid steel conduit shall be coated with zinc-rich paint.</p>

IDENTIFICATION:	RAC
Description:	Rigid Aluminum Conduit
Materials:	Conduit and fittings: 6063 aluminum alloy with temper designation T-1.
Compliance:	ANSI and UL
Finish:	Smooth finished outside and inside surfaces.
Manufacturers:	Alcoa, Allied Tube and Conduit Corp., Wheatland Tube Co., or equal.
Application /Conditions:	Indoors, corrosive and non-corrosive areas Outdoors, non-corrosive and non-process areas.  Rigid aluminum conduit shall not be installed in concrete, direct buried, or where exposed to severe corrosion, or where exposed to physical damage.
Minimum size:	Unless otherwise specified, 3/4 inch for exposed, 1 inch for inaccessible.
Fittings:	Locknuts: stainless steel. Bushings: non-corrosive cast aluminum alloy, stainless steel, or nonmetallic. Bushings: insulating collar. Grounding bushings: locking type with a feed-through compression lug for securing the ground cables. Threadless fittings: not acceptable.
Manufacturers:	Thomas & Betts, O.Z. Gedney, Crouse-Hinds or equal.
Expansion Fittings:	Expansion fittings shall be watertight with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.
Manufacturers:	Appleton, Crouse-Hinds, Hubbell, O. Z. Gedney, or equal.

Identification:	RAC (continued)
Hubs:	<p>Hubs: threaded non-corrosive cast aluminum alloy with powdered epoxy finish for connection of conduit to junction, device, or terminal boxes.</p> <p>Hubs: insulating bushings with bonding locknut.</p> <p>Hubs: neoprene "O" ring for a watertight connection.</p>
Manufacturers:	O-Z Gedney, CHM-XXT, or equal
Unions:	Unions shall be non-ferrous alloy type.
Manufacturers:	Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or equal.
Boxes:	
Indoor:	<p>Type FD cast aluminum with powdered epoxy finish for device boxes and junction boxes with a dimension less than 6 inches for the longest side.</p> <p>NEMA Class 12 welded aluminum with threaded hubs with a dimension of 6 inches for the longest side and larger.</p> <p>Boxes in wet locations: PVC coated.</p>
Outdoor:	<p>Type FD, PVC coated, cast aluminum for device boxes and junction boxes with a dimension of less than 6 inches for the longest side.</p> <p>NEMA Class 4X welded stainless steel with threaded hubs for a dimension of 6 inches for the longest side and larger.</p>
Corrosive:	NEMA 4X, stainless steel or PVC coated cast aluminum.
Hazardous:	NEMA Class 7 cast aluminum.
Elbows:	
(3/4" thru 1-1/2")	Factory fabricated or field bent.
(2" thru 6")	Factory fabricated only.

Identification:	RAC (continued)
Conduit Bodies:	
(3/4" thru 4")	<p>Oversized conduit bodies: non-ferrous, copper-free aluminum alloy type with powdered epoxy finish and screw taps for fastening covers.</p> <p>Gaskets shall be made of neoprene.</p> <p>Tapered threads for conduit entrances.</p>
(5" and 6")	Cast aluminum box.
Manufacturers:	Appleton, Crouse-Hinds, Hubbell, O. Z. Gedney, or equal.
Installation:	<p>Joints: made with standard couplings or threaded unions. RAC:</p> <ol style="list-style-type: none"> <li>1. Made up tight with thread compound by Ideal, NoAlox anti-oxidant, Crouse-Hinds STL or equal.</li> <li>2. Supported away from the structures and concrete using stainless steel straps with nesting backs.</li> <li>3. Terminate with a threaded hub with a grounding bushing where entering boxes.</li> <li>4. Exposed male threads on rigid aluminum conduit shall be coated with Teflon-rich product.</li> <li>5. Threaded with manufacture approved special dies and bent proper tools.</li> </ol>

Identification:	LFSC
Description:	Liquid-Tight Flexible Steel Conduit
Application:	Final connection to equipment subject to vibration or adjustment.
Compliance:	UL 360
Construction:	Spirally wound galvanized steel strip with successive convolutions securely interlocked and jacketed with liquid-tight plastic cover.
Minimum size:	3/4 inch
Fittings:	Cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit and box connection and insulated throat. Forty-five and 90-degree fittings shall be used where applicable.
Installation:	Do not exceed 36-inch length.

Identification:	PVC4
Description:	Heavy wall thickness for direct bury, concrete encasement or surface mounting where not subject to physical damage. DZYR category per NEC Article 352.
Compliance:	NEMA TC2, UL 651
Construction:	Schedule 40, high-impact, polyvinyl-chloride (PVC)
Minimum size:	3/4 inch exposed; 2-inch embedded or encased
Fittings:	PVC solvent weld type
Boxes:	
Indoor:	NEMA Class 4, nonmetallic
Outdoor and corrosive:	NEMA Class 4X, nonmetallic
Installation:	<p>PVC conduit entering fiberglass boxes or cabinets shall be secured by threaded bushings on the interior of the box and shall be terminated with a threaded male terminal adapter having a neoprene O-ring. Joints shall be made with standard PVC couplings.</p> <p>PVC conduit shall have bell ends where terminated at manholes, handholes, or building walls. Bell ends shall terminate flush at the walls and floors and not extend or protrude.</p>

Raceway Identification:	PGRS
Description:	Rigid Steel Conduit, Corrosion-Resistant, Polyvinyl Chloride (PVC) Coated
Compliance:	ANSI, ETL and UL. The PVC coated rigid galvanized steel conduit shall be stamped with the ETL Verification Mark "ETL Verified to PVC-001".
Finish:	Hot-dip galvanized rigid steel conduit, to which a minimum 40-mil thick PVC coating has been bonded to the outside of the conduit. A 2-mil coat of urethane coating shall be bonded to the inside. Coating shall be free of pinholes. Bond strength shall exceed the tensile strength of the PVC coat. Elbows and fittings shall be factory made and coated.
Fittings: (includes unions, conduit bodies and expansion fittings)	Refer to RACESPEC RMC-Steel for additional requirements. Similarly coated to the same thickness as the conduit and provided with type 316 stainless steel hardware. Conduit and fittings shall be manufactured by the same company.
Hubs:	Hubs for connection of conduit to junction, device, or terminal boxes shall be threaded with the same PVC coating as the conduit and provide a watertight connection.
Boxes:	Refer to RACESPEC RMC-Steel. FD boxes shall be PVC coated.
Elbows:	Refer to RACESPEC RMC-Steel. Elbows shall be PVC coated.
Manufacturers:	PVC coated conduit shall be by Robroy Industries, PLASTI-BOND RED; Occidental Coating Company (OCAL), or approved equal.

Raceway Identification:

PGRS

Installation:

Plastic coated conduit shall be made up tight, threaded, and installed using tools approved by the conduit manufacturer.

Conduit threads shall be covered by a plastic overlap which shall be coated and sealed per manufacturer's recommendations. Painted fittings are not acceptable.

Pipe wrenches and channel locks shall not be used for tightening plastic coated conduits. Damaged areas shall be patched, using manufacturer's recommended material.

## 2.03 CONDUCTORS, WIRE, AND CABLE

Provide products specified.

### A. UNSCHEDULED CONDUCTOR SIZING:

Size conductors, wire, and cables in accordance with the National Electrical Code (NEC) where not specified on the Drawings, and install in the minimum size raceway as specified in the RaceSpecs herein.

### B. CONTROL WIRE COLOR CODING:

Provide control wires with the following colors for the shown voltage:

120 VAC Power, line and load	Black
120 VAC Control	Red
24 VAC	Orange
12 VAC	Brown
Foreign Voltage (AC) (Interlock)	Yellow
AC Neutrals	White
Ground	Green
24 VDC (+ & -)	Violet
12 VDC (+ & -)	Blue
Foreign Voltage (DC)	Violet/white or Blue/White

### C. POWER CONDUCTORS:

Provide power conductors with following colors for the shown voltage:

Wire	480Y/277V, 3Ø	208Y/120V, 3Ø	240/120V, 3Ø
Phase A	Brown	Black	Black
Phase B	Orange	Red	Orange per NEC 408.3(E) and 215.8
Phase C	Yellow	Blue	Blue
Ground	Green	Green	Green
Neutral	White or Gray per NEC 210.4(D)	White	White

Provide black insulation conductors larger than #10 AWG with colored 3/4-inch vinyl plastic tape to identify the phase color at each cable termination. Tape wrap with 25% overlay to provide minimum of three (3) inches of coverage.

D. SCHEDULED AND UNSCHEDULED WIRE AND CABLE:

Provide the insulation and jacket material specified in the CABLESPEC sheets for scheduled and unscheduled (not shown) conductors. Provide stranded copper conductors for all wire and cable.

E. ELECTRICAL ENCLOSURE CONDUCTOR RATINGS:

Provide conductors with 600-volt insulation ratings in panels and other electrical enclosures. Conductors with less than 600-volt insulation ratings are prohibited, unless specifically identified.

Bundle and lace conductors in panels and electrical equipment at intervals not greater than six (6) inches, spread into trees and connected to their respective terminals. Provide lacing using plastic cable ties that are tensioned and cut off using a tool specifically designed for the purpose such as a Panduit GS2B, or approved equal. Other methods of cutting cable ties are prohibited.

Bundle conductors crossing hinges into groups not exceeding ten (10) to fifteen (15) conductors and protected using nylon spiral flexible covers to protect conductors and provide oversized plastic panel wiring duct within panels.

Provide slack in junction boxes, pull boxes, handholes and manholes sufficient to allow cables or conductors to be routed along the walls with the amount of slack equal to largest dimension of the enclosure.

Provide dedicated electrical wireways and insulated cable holders mounted and secured on stainless steel unistrut in manholes and handholes.

F. INSTRUMENT SIGNAL CABLE:

Provide terminal blocks at instrument cable junctions within dedicated terminal boxes provided by the installer. Provide twisted shielded cable with individual shield for each pair. Provide twisted shielded cable multi-pair with overall shield and jacket. Provide triads wherever 3-wire circuits are required. Circuits shall not be made using conductors from different pairs or triads.

Install instrument, signal, and data communication circuits without splices between instruments, terminal boxes, or panels. Shields as a signal path, except for circuits operating at radio frequencies and utilizing coaxial cables are not acceptable. Common ground return conductors for two or more circuits are not acceptable.

Bond shields to the signal ground bus at the control panel. Isolate shields from ground and other shields at other locations by cutting short or taping. Provide terminal strips for signal leads and shield drain wires.

Terminate spare circuits and the shield drain wire on terminal blocks at both ends of the cable run. Shields or drain wires for spare circuit cables shall be bonded at control panel only with the other end insulated by tape cover.

Provide an instrument stand with terminal box mounted approximately three (3) feet above grade to center or as shown. Provide terminal boxes for instrument cable with the cable and conductor labels specified.

Install and terminate conductors for paging, security, data communication, voice communication, and telephone systems in compliance with the manufacturer and the system utility recommendations.

#### G. SPLICING AND TERMINATING MATERIALS:

Use an UL listed tool for the applied compression type of connectors with the correct size and type. Provide tin-plated high conductivity copper connectors. Mechanical clamp, dimple, screw-type connectors are prohibited.

Provide polymeric insulating material over motor terminations with high dielectric strength mastic or material to seal the ends against ingress of moisture and contamination. Cover splices with electrical products designed for the application, and insulate with a heat-shrinkable sleeve or boot.

#### H. FIRE STOP SEALANT MATERIALS:

Provide non-combustible silicone sealant for sealing apertures and cable through-penetrations for electrical conductors meeting UL 263 4-hour time-temperature requirements.

Manufacturer: STI Inc., Pensil Silicone Sealants PEN300 SpecSeal Firestop, or approved equal.

## I. CIRCUIT NUMBERING MARKING SYSTEM:

Identify each power, control, and signal conductor at each terminal connection. Machine print the letters and numbers with black on white alphanumeric characters representing the circuit numbering system.

Identify conductors, including spares. Provide cable markers and wire markers for distribution and utilization equipment circuits identifying the power source and circuit source from which it is served.

Provide the identification system of stainless steel (SS) on both ends of conduits, and vinyl for power cable strap-on cable markers, vinyl multi-conductor control cable strap-on cable markers, and vinyl or polyolefin wire slip-on sleeves and encircle the conductor.

Provide conductor marker used in outdoor, damp, or wet locations on heat-shrinkable polyolefin shrinkable marking sleeves covered with clear heat-shrink sleeve or clear tape cover.

Print conductor markers using the Brady Marker "XC PLUS", the Brady LS2000 printer with the Bradysleeve wire marking system, or Engineer accepted equal.

## J. TERMINAL BLOCKS:

Provide terminal blocks with the following features:

1. Voltage rated: 600 volts.
2. Current rated: match largest conductor connected to the assembly.
3. Integral marking strips.
4. Terminal block assemblies: provide with mounting channels, barriers, and end clamps.
5. Power and grounding terminal blocks: solderless box lug type.
6. Control and signal terminal blocks. Manufacturer: Allen-Bradley 1492-HM1GY, NEMA type, 30-ampere, or approved equal.
7. DIN-rail mount for direct wiring into terminal blocks.
8. Pre-printed snap-in markers.

K. CABLESPEC SHEETS:

The following CABLESPEC sheets are included in this section:

Type	Volt	Product	Purpose
DC1	300	RS-422: 4-PAIR, 24-AWG Unshielded Jacketed Premise Wire	Data Communication Fast Ethernet: 100 Base T Cable, Video, CCTV
DC2	30	RS-485: 24-AWG, Jacketed Premise Wire	Data Communication Remote I/O Cable
DC3	300	Fibers Cable Indoor/Outdoor	Data Communication Fiber Optic Cable Instrument
SIC	600	P-OS: 1-PR#16SH OR 1-TR#16SH	Instrument
MIC	600	SP-OS: MULT-PR#16 Shielded (TC) with Individual Pair Shields and Overall Cable Shield	
XHHW-2	600	XLP Insulated Industrial Grade Conductor	Power, Control, Lighting, & Receptacles
THWN	600	Building Wire	Power
MEPR / CPE	600	Multi-Conductor Jacketed Cable Power Cable Example: 3/C #500 KCMIL with NEC Size Ground	Power may be substituted with single wire cable.
	600	Tray Cable (TC) Rated Control Cable Example: 19/C #14	Control
CORD		Heavy Duty Cable: SJOOW	Portable Items

Cable System Identification:	DC1
Description:	Premise Cable: IEC Category 5 UTP; NEMA WC-63.1 Category 6; Fast Ethernet: 100 Base TX; 4 pair, #24 AWG Cable
Voltage:	300 V RMS -
Conductor Material:	Solid Bare copper
Insulation Material:	FRPO - Flame Retardant Polyolefin / FEP -Fluorinated Ethylene Propylene Color Coded conductor insulation
Jacket:	LS PVC - Low Smoke Polyvinyl Chloride with ripcord Trade Name Example: Flamarrest Sequential Footage Marking: every two feet Jacket Color: Blue
Manufacturer(s):	Cooper Industries – Belden 1585A; or approved equal.
Execution:	
Applications:	Gigabit Ethernet Data Communications LAN, CCTV Fixed. Component or Composite Video, Digital Video, RS-422,
Installation:	Install in accordance with associated equipment manufacturer's instruction.
Testing:	Test in accordance with section 16030.

Cable System Identification:	DC2
Description:	Shielded Data Communication Cable Remote I/O Cable: RS-485 #22 or #24 AWG Copper
Voltage:	30 V RMS
Conductor Material:	Tinned copper
Insulation:	Polyethylene; Trade Name Example: Datalene
Jacket:	PVC or CPE Color: Chrome
Manufacturer(s):	Cooper Industries-Belden YM-29560 or approved equal
Execution:	
Application:	DCU or PLC to Remote I/O - Data Communications Cable
Installation:	Install in accordance with associated equipment manufacturers instruction.
Testing:	Test in accordance with section 16030.

Cable System Identification:	DC3
Description:	Fiber Optic Data Cable; X-Conductor (a shown on drawings): Color Examples: 1-Blue, 2-Orange, 3-Green, 4-Brown, 5-Slate, 6-White; Indoor/Outdoor; Heavy Duty-MFPT; Cable Tray Rated
Material:	62.5/125/250 micron
Jacket:	Chlorinated Polyethylene (CPE) Color: Orange
Type:	NEC (UL): OFNR with industrial cable tray rating IEEE flame test rated: 802.3Z
Manufacturer(s):	Cooper Industries-Belden I100666; or Engineer accepted equal
Execution:	
Application:	Data Communications. (Not Plenum Rated)
Installation:	Install in accordance with Section 16000, paragraph 2.03 and associated equipment manufacturers instruction.
Testing:	Test in accordance with section 16030.

Cable System Identification:	SIC
Description:	Single twisted, shielded pair or triad, 16 AWG, instrumentation and signal cable; UL listed; Cable Tray rated.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded per ASTM B8
Insulation:	15 mil, 90 degree C, polyvinylchloride (PVC) with 4 mil nylon conduit or jacket
Lay:	Twisted on a 2-inch lay
Shield:	100 percent, 1.35 mil aluminum-Mylar tape with a 7-strand tinned copper drain wire
Jacket:	45 mil Polyvinylchloride (PVC)
Flame Resistance:	UL 1277
Manufacturer(s):	Okonite, Okoseal-N type P-OS, Cooper Industries-Belden, or approved equal
Execution:	
Use:	Analog signal cable and RTD device Triad extension cable.
Installation:	Install in accordance with Section 16000, paragraph 2.03.
Testing:	Test in accordance with section 16030.

Cable System Identification:	MIC
Description:	Multiple twisted, shielded pairs, 16 AWG, with overall shield instrumentation cable, UL listed, with number of pairs as shown.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded in accordance with ASTM B8
Insulation:	15 mil, 90 degree C, polyvinylchloride (PVC) with 4 mil nylon conduit or jacket
Lay:	Twisted on a 2-inch lay
Shield:	100 percent, 1.35 mil aluminum-Mylar tape with 18 AWG 7-strand tinned copper drain wire
Overall Shield:	2.35 mil aluminum-Mylar tape with a 7-strand tinned copper drain wire
Jacket:	45 mil polyvinylchloride (PVC)
Flame Resistance:	UL 1277
Manufacturer(s):	Okonite, Okoseal-N type SP-OS, Cooper Industries-Belden, or approved equal.
Execution:	
Installation:	Install in accordance with section 16000.
Testing:	Megger test: use Form in section 01999.

Cable System Identification:	XHHW-2
Description:	Industrial grade single conductor Sizes: 14 AWG through 750 kcmil as shown
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded per ASTM B8
Insulation:	NEC Type XHHW-2; 90 degree C dry and C wet; Cross-Linked Polyethylene (XLP) per ICEA S-66-524 and UL-44; Color in sizes 14, 12 and 10 AWG: Black, Green, Yellow, White, Orange, Brown, Red, Blue
Jacket:	None
Flame Resistance:	UL 83
Manufacturer(s):	Okonite, X-Olene; Cablec, Durasheath XLP; or approved equal.
Uses Permitted:	Power, control, lighting and outlet circuits.
Execution:	
Installation:	Install in accordance with Section 16000, paragraph -2.03.
Testing:	Test in accordance with section 16030.

Cable System Identification:	THWN
Description:	Single conductor lighting and receptacle type indoor branch circuit conductor.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded in accordance with ASTM B-3 or B8.
Insulation:	THWN/THHN, 90 degree C dry, 75 degree C wet, polyvinylchloride (PVC) with nylon jacket per UL 83.  May substitute XHHW2 with XLP insulation without a jacket.
Jacket:	Nylon
Flame Resistance:	UL 83
Manufacturer(s):	Okonite, Okoseal-N, series 116-67-XXXX; or approved equal.
Uses Permitted:	Lighting, receptacle and appliance circuits, power circuits.
Execution:	
Installation:	Install in accordance with section 16000.
Testing:	Megger Test: use Form in section 01999.

Cable System Identification:	MEPR / CPE
Description:	Multiconductor Power Cable with ground conductor sized for the circuit or NEC required custom larger ground conductor sized for multiple-sets of conductors in one circuit  Multiconductor Control Cable with 12-AWG minimum conductor size
Power Cable:	Green ground conductor sized in accordance with the NEC
Ground Conductor Size:	Multiple cable runs of multiconductor power cable shall have the ground conductor sized in accordance with NEC 250-95
Control Cable Type:	ICEA Method 1, E-2: without white neutral conductor, without green ground conductor
Control Cable Identification:	Conductors color coded per ICEA and conductors numbered
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded in accordance with ASTM B8, coated in accordance with ASTM B33
Insulation:	For Power Cable: XHHW, 90 degree C dry, 75 degree C wet, composite of ethylene propylene rubber (EPR) and chlorinated polyethylene (CPE) per ICEA S-68-516 and UL 44  For Control Cable: FR-EP (XHHW-2), 90 degree C dry or wet, ethylene propylene rubber based per ICEA s-68-516 and UL 44.
Jacket:	Chlorinated Polyethylene (CPE)
Flame Resistance:	IEEE 383
Manufacturer(s):	Okonite; Cablec; or approved equal
Execution:	
Installation:	Install in accordance with section 16000.
Testing:	Megger Test: use Form in section 01999.

Cable System Identification:	MEPR / CPE
Cable System Identification:	CORD
Description:	Industrial Grade Flexible Portable Cord: Synthetic Rubber Insulation with Oil-Resistant Thermoset Jacket construction: Type SOOW for 600 Volt circuits; Type SJOOW for 300 Volt circuits
Voltage:	600 V RMS where shown or where unspecified: Type SOOW
Conductor Material:	Flexible rope stranded annealed copper per ASTM B189 and B33.
Insulation:	Insulation: Ethylene propylene (EPR) per ICEA S-68-516 and rated for continuous operation at 90 degrees C. Green used for ground only Color: 2/C Black and White; 3/C Black, White, and Green; 4/C Black, White, Red and Green; 5/C Black, White, Red, Green, and Orange
Jacket:	Heavy-duty Neoprene per ICEA S-68-516. Color: <b>Black</b>
Manufacturer(s):	Okonite: Okocord; American Insulated Wire Cord equal; or Engineer accepted equal.
Execution:	
Installation:	Install in accordance with paragraph 16000-3.01D.
Testing:	Test in accordance with paragraph 16000-3.02.

Cable System Identification:	MXLPE / S / PVC
Description:	1000 Volt Rated - Flexible Motor Supply Shielded Cable
Power Cable:	Multi-conductor shielded motor feeder cable with PVC jacket: 3/C cable with conductors sizes from #16-AWG to #2-AWG with grounding conductor.
Ground Conductor Size:	Sized per NEC 250
Application:	Feeder cable between VFD motor controller and motor.
Conductor Material:	Flexible copper with high strand count
Insulation:	Thermoset Crosslinked Polyethylene (XLPE): 90 degree C dry, 75 degree C wet, per UL 44.
Jacket:	PVC over assembly; jacket thickness per UL 1277 Cable Tray rated UL 1277 Type TC
Shield:	Tinned copper braid and foil
Flame Resistance:	IEEE 383 Fire Test (70,000 BTU) IEEE 1202: Limited Smoke rated and labeled on cable jacket UL 1685: Vertical Tray Flame Exposure Test
Manufacturer(s):	Anixter B2095XX series  Belden 295XX series  LAPPUSA OLFLEX VFD Symmetrical: 1AWG - 500kcmil LAPPUSA OLFLEX Servo 2YSLCY-JB flexible cable
Execution:	
Installation:	Install in accordance with paragraph 16000-3.01D. Install in conduit or cable tray. Not to be used for open wiring installation. Ground shields at both ends. Shield terminating gland may be used at the motor to ensure grounding the shield.
Testing:	Test in accordance with paragraph 16000-3.02.

## 2.04 WIRING DEVICES

Unless specified otherwise, provide UL approved wiring devices for the current and voltage ratings specified and comply with NEMA WD-1 with provisions for back wiring and side wiring with captive held binding screws.

### A. HEAVY DUTY 120V RECEPTACLES:

1. SINGLE PHASE: Duplex 20-amp, NEMA 5-20R accepting NEMA 5-15P and 5-20P plugs. Cooper 5362, Hubbell 5362, or approved equal.
2. GROUND FAULT INTERRUPTING: Ground fault interrupting (GFI) receptacles: duplex, 20 amp, NEMA 5-20R, specification grade that accepts NEMA 5-15P and 5-20P plugs. Provide GFI receptacles outdoors and as shown, UL listed with provisions for testing and resetting. Manufacturer: Hubbell GF-5352-I, or approved equal.
3. THREE-PHASE RECEPTACLES AND BOXES: Cooper Series 309 watertight pin & sleeve receptacles, plugs, and back boxes, or approved equal.

### B. SWITCHES:

1. INDOOR SWITCHES: Quiet AC type, heavy duty, specification grade in accordance with rated capacities as required. Match the switch color and the receptacles color. Manufacturer: Cooper, Hubbell, or approved equal.
2. SWITCHES FOR OUTDOOR AND CORROSIVE AREAS: Provide 20-ampere, push-type switches; Cooper Tap-Action, Hubbell PressSwitch, or approved equal.

### C. DEVICE PLATES:

Provide device plates with switches and receptacles that match the area classification location.

1. INDOOR, ARCHITECTURALLY FINISHED AREAS: Provide switch and receptacle device plates of sheet steel, zinc electroplated with chrome finish. Manufacturer: Crouse-Hinds, Appleton, or approved equal.
2. INDOOR, NON-FINISHED, NON-CORROSIVE: Provide cast covers, Appleton, Crouse-Hinds, or approved equal.

3. INDOOR, NEMA-12 AREAS: In areas designated NEMA-12, or other areas specified provide hinged covers with neoprene gaskets. Manufacturer: Hubbell, Cooper, or approved equal.

4. NEMA 4X - CORROSIVE: In areas designated NEMA-4X, COOROSIVE, or other areas specified provide corrosion-resistant/marine-duty type covers. Manufacturer: Hubbell, or approved equal.

5. IN-USE COVERS: In areas designated NEMA-4X, CORROSIVE, or other areas specified, and in outdoor areas, provide in-use type weatherproof lift covers that maintain weatherproof rating with plug installed for equipment that is cord connected with plug and receptacle. Covers shall be cast aluminum, except in corrosive areas where covers shall be plastic. Manufacturer: Outdoor, NEMA 4X areas: In-use covers shall be Hubbell WP7, WP8, WP26, or equal. CORROSIVE areas; Manufacturer: TayMac Corporation 20510, Carlon E9UXXXX, Hubbell WP826XXX, or approved equal.

6. WET/CORROSIVE SWITCH COVERS: In outdoor, areas, wet areas, areas designated NEMA-4X, CORROSIVE, or other areas specified, provide weatherproof, corrosion-resistant covers for switches to maintain weatherproof rating during operation of switch. Covers shall have flexible bubble of silicone or neoprene rubber for switch operation. Manufacturer: Cooper, Hubbell, or approved equal.

7. HAZARDOUS AREAS: Device plates in hazardous areas shall be cast iron, rated NEMA 7, suitable for use outdoors and in wet areas. Manufacturer: Appleton, Crouse-Hinds, or approved equal.

#### D. PILOT DEVICES:

Provide heavy-duty push buttons, selector switches and indicating lights: 30mm, oil-tight, NEMA 4X. Indicating lights shall be light emitting diode (LED) type lamps. Unless otherwise shown, provide push-to-test type indicating lights. Provide diode isolating type pilot indicating lights specified for remote-test.

Provide 120VAC control units: heavy-duty type Allen-Bradley 800H, or approved equal. For 24VDC: Allen-Bradley 800T, Square-D Class 9001 Type J, or approved equal.

## 2.05 GROUNDING SYSTEM

Provide electrical system grounding electrode conductors, equipment grounding conductors for equipment grounding and raceways, grounding electrodes, grounding electrode conductors, connections, and bonding in compliance with the National Electrical Code-Article 250 and the National Electrical Safety Code.

Provide annealed bare copper, concentric stranded grounding conductors. Provide the minimum sizes per NEC Article 250 for grounding conductors or service entrance conductors, if not sized on the drawings.

Bond grounding conductors entering enclosures together to metallic enclosure and to metallic raceways terminating at the enclosure. Clean the conductor and enclosure metal surface at the point of connection prior to making equipment grounding connections or bond connections.

Provide ground grid components of #4/0 AWG bare copper conductors connected to 10-foot ground rods installed at the four corners of a building, an equipment pad, or as shown on the Drawings.

Make grounding conductor connections to equipment and ground rods by bolted clamps, compression connectors, or exothermic weld connections in accordance with manufacturer's installation and testing instructions. Make connections to buried grounding connections using compression connectors or exothermic weld connections. Make connections at the ground grid test wells using bolted clamps.

Connect the ground grid to the following with grounding conductor specified herein or connect to the ground grid with grounding conductor as shown on the drawings:

1. Building steel columns with #4/0 AWG bare copper
2. Electrical ductbank #4/0 embedded conductor with #4/0 bare copper
3. Electrical distribution or utilization equipment metal enclosures with #4/0 AWG green insulated aluminum
4. Metal enclosure not containing electrical distribution with #4 AWG green insulated aluminum
5. Pump/motor frames with #4 AWG bare aluminum or insulated
6. Lightning and surge arresters using #4 AWG bare or insulated
7. Fences and gates with #4 AWG bare or insulated
8. Ground rods with #4/0 AWG bare copper
9. Power utility service entrance equipment with #4/0 bare copper
10. Equipment ground plate with #4/0 AWG bare copper.
11. Other equipment: provide #1 AWG green insulated copper. Provide ¾" conduit protection where subject to damage.

A. GROUND RODS:

Ground rods: copper-clad steel, three-fourths of an inch in diameter and ten (10) feet long, with threaded end for connectors or installation tools.

B. COMPRESSION CONNECTORS:

Compression connections: cast copper.

Manufacturer: Thomas & Betts Company, or approved equal.

C. BOLTED CONNECTORS:

Bolted connectors: copper. Manufacturer: Burndy, O. Z. Gedney, or approved equal.

D. EXOTHERMIC CONNECTORS:

Exothermic connections copper products. Manufacturer: Cadweld process or approved equal.

E. EQUIPMENT GROUND PLATE:

Provide equipment ground plates embedded flush in equipment pads to provide a bolted connection between a grounding conductors from the equipment frame to the ground grid.

Provide ground plates of copper alloy construction and 1/2 inch, threaded bolt connections and integral #4/0 welding stud. Manufacturer: Cadweld Series B-162, or approved equal.

F. RACEWAY GROUND:

Install metallic conduits to provide a continuous ground path. Use insulated grounding bushings and bond to the ground grid system in compliance with Article 250 of the National Electrical Code.

Provide an equipment-grounding conductor with green insulation in all metallic and non-metallic conduit, raceway, wireway, gutter, or ductbanks.

Provide an equipment grounding conductor with green insulation for sizes up to #6 AWG and provide green color insulation tape band for conductor size #4 AWG and larger.

## 2.06 POWER, CONTROL, AND METERING EQUIPMENT

Comply with the power utility service entrance section standards that include the power utility metering equipment. Coordinate the correct meter socket requirements. Submit proposed equipment to power utility for acceptance prior to submitting to the Engineer. Provide and install equipment according to power utility requirements.

A. METERING EQUIPMENT:

The movement shall be taut-band with an accuracy of plus or minus 1% of full scale. The case shall be black. The scale shall be white with black markings. The length of the scale shall be greater than seven (7) inches over a deflection angle of 250 degrees. The meters shall be manufactured in accordance with applicable requirements of ANSI C39.1.

B. PANELBOARDS:

Provide panelboards: circuit breaker, dead front type with bus bar construction composed of individually mounted circuit breakers with screw-connection, designed to be removed without disturbing other breakers. Provide lockable, hinged door-in-door construction for flush mounted panels and hinged-trim covers for surface mounted panels.

Provide tin-plated copper buss and with the current rating as shown on the panel schedules sized in accordance with UL 67 and withstand rating equal to the interrupting rating of the smallest circuit breaker in the panel. Series rated products are prohibited. Silver plated equipment is prohibited.

Provide panelboards with a separate ground bus and a full capacity neutral bus. Mount neutral bus on insulated standoffs. Provide removable link connector from the neutral bus to the ground bus. Provide listed and labeled panelboard for service entrance disconnect as shown.

Panelboards shall be as manufactured by Square D or equal.

B. COMBINATION MOTOR STARTERS:

Provide NEMA rated for the horsepower for combination motor starters with motor circuit protector and solid-state type overload relay. Provide a reset button located on the unit door exterior.

Provide adjustable motor circuit protector with magnetic only trip setting adjustable over a range of 600- 300% of full load current of the motor served. Field adjust motor circuit protector setting per NEC and manufacture's recommendations. Provide 22,000 symmetrical ampere interrupt rating, where not shown on the power single line diagrams.

Provide solid-state adjustable overload relay to latch in the open position. Provide adjustable trip settings with minimum adjustable range from 85-115% of full load current of motor served. Field adjust overload setting per NEC and manufacture's recommendations.

Provide control power transformers with two primary fuses rated at 100,000 amperes at 600VAC and one secondary fuse rated at 10,000 at 250VAC and sized at 125% of the control circuit full load current. Ground the non-fused leg of the secondary circuit.

Provide switchboard type MTW or SIS control circuit conductors rated 90 degree C above ambient temperature. Conductors shall be identified with tag numbers.

Provide motor contactor “Run” status contact and “Overload” alarm contact. Provide “Hand-Off-Remote” (HOR), “Hand-Off-Auto” (HOA), and other shown selector switches with a “Remote Mode” or “Auto Mode” status contact.

Provide heavy-duty selector-switches and pushbutton and indicating lights with rating to match enclosure type. Provide control devices rated at 600VAC, 10-ampere continuous with

Provide start/stop pushbuttons with “Run” and “Stop” indicating lights including other control devices as shown. Provide push-to-test transformer type pilot lights or LED pilot lights. Lens color as shown on the drawings or as specified herein.

Combination Motor Starters shall be as manufactured by Siemens Compact Sirius 3rm1007-1aa04ms or equal.

#### D. CIRCUIT BREAKERS:

Provide circuit breakers: molded-case type provided for the current ratings and pole configurations as shown or as specified on the panelboard schedule and with a minimum interrupting current rating as shown on drawings or schedules, but not less than 22,000 AIC for 240 volt rated devices or 35,000 AIC for 480 volt rated devices. Series rated branch, main, or other devices are prohibited.

Provide circuit breakers listed in accordance with UL 489 for the service specified and load terminals with solderless connectors. Provide bolt-on type circuit breakers. Provide circuit breakers with machine-printed, circuit number labels indicting the load served.

#### E. DRY-TYPE TRANSFORMERS:

Provide dry-type transformers with primary winding rated 600 volts and less used for power distribution, lighting and control purposes as specified or shown.

Transformers temperature rise based on 40-degree C ambient temperature:

1. 15 kVA and above: Not exceed 115 degree C temperature rise.

2. below 15 kVA: Not exceed 115 degree C temperature rise.

Transformer coils shall be copper. Provide coils impregnated with varnish for 15kVA and above. Provide encapsulated coils for 10kVA and below. Transformers shall have electrically isolated primary and secondary windings. Primary and secondary winding configurations shall be as specified or shown. Provisions shall be made to permit separate grounding of the neutral conductor and the enclosure. Single-phase transformers shall be the four winding type.

Transformers 15 kVA and above shall be provided with two 2-1/2 percent full capacity taps above normal voltage and four 2-1/2 percent full capacity taps below rated voltage on the primary winding. Terminal compartments shall be sized to permit termination of cables specified. Terminal connections shall be made in the bottom third of the enclosure. The terminals shall be copper and sized for the cable specified.

Transformers enclosures:

1. 15 kVA and smaller: weatherproof, nonventilated enclosures.
2. Indoor over 15 kVA: dripproof, ventilated enclosures.
3. Outdoor: weatherproof enclosures.

Transformers 25 kVA and below shall be suitable for wall mounting and include mounting brackets and hardware. Transformers over 25 kVA shall be floor mounting type.

Nameplates shall be provided in accordance with the requirements of paragraph 16000-2.04.

The sound levels shall not exceed the following values:

kVA	dB
0-9	40
10-45	42
50-450	45
225-300	50
500	54

Where shown on drawings, provide non-linear load K-factor rated transformer with K-factor rating required for compliance with IEEE-519. Provide 100 percent non-linear load rated specifically designed to handle non-linear loads with double size neutral for harmonic load.

Transformers shall be as manufactured by Square D or equal.

#### F. LOAD-SWITCHING CONTROL RELAYS:

1. Heavy-duty, machine tool type for switching load such as solenoids, actuators, contactors, motor starter coils, etc and used for remote interlocking.
2. Contacts: 4-pole and field interchangeable to either normally open or normally closed and capable of accepting a 4-pole contact block adder.
3. AC relays: NEMA A600 contact ratings and electrical clearances for up to 600 volts.
4. DC relays: NEMA P300 contact ratings and electrical clearances of up to 250 volts.
5. Manufacturer: Allen Bradley Bulletin-700, Square D Class 8501 Type X, or approved equal.

#### G. LOGIC-LEVEL RELAYS:

Logic-Level switching solid-state logic and signal circuits:

1. Minimum of three (3) Single Pole Dual Throw (SPDT), silver cadmium oxide contacts rated 10-amperes-resistive at 120VAC or 28VDC.
2. Plug-in type with heavy-duty, barrier-protected screw terminal sockets.
3. Clear polycarbonate dust cover with clip fastener.
4. AC models: neon lamp indicator wired in parallel with coil.
5. Manufacturer: Idec Series RH, Square D Class 8501, or approved equal.

#### H. TIMING RELAYS:

1. Multi-function, micro-controller based, socket mounted timing relay.
2. Single functions:
  - a. Delay on Make
  - b. Delay on Break
  - c. Recycle (on time first, equal recycle delays)
  - d. Single shot
  - e. Interval
  - f. Trailing edge single shot
  - g. Inverted single shot

- h. Inverted delay on break
  - i. Accumulative delay on make
  - j. Retriggerable single shot
3. Dual functions:
- a. Delay on make/delay on break
  - b. Delay on make/recycle (on time first, equal recycle delays.)
  - c. Delay on make/interval
  - d. Delay on make/single shot
  - e. Interval/recycle (on time first, equal recycle delays)
  - f. Delay on break/recycle (on time first, equal recycle delays)
  - g. Single shot/recycle (on time first, equal recycle delays)
  - h. Recycle – both times adjustable (on time first)
  - i. Recycle – both times adjustable (off time first)
  - j. Interval/delay on make
  - k. Accumulative delay on make/interval
4. Time delay range, switch selectable:
- a. Single function 0.1 second to 1,705 hours in 8 ranges.
  - b. Dual function 0.1 second to 3,100 minutes in 8 ranges.
  - c. Setting accuracy +/- 1 percent or 50 milliseconds, whichever is greater.
  - d. Repeat accuracy +/- 0.1 percent or 16 milliseconds, whichever is greater.
5. Output: Two Form-C electromechanical isolated contacts rated 10-amperes resistive at 240VAC and 1/3-horsepower at 120 or 240VAC; double pole double throw: Dual Pole Dual Throw (DPDT). Mechanical life: 10,000,000 operations and electrical life: 1,000,000 operations at full load.
6. Mounting: Magnal Plug 11-pin socket
7. Environment: -20 degree-C to +65 degree-C.
8. ABB/SSAC multifunction type TRDU time delay relay with dip-switch function setting with 12VDC, 24VAC, 120VAC, 240VAC inputs as required; Agastat, STA series; or Engineer accepted substitute.

## I. SAFETY DISCONNECT SWITCHES:

Provide safety disconnect switches:

1. Motor horsepower rated, heavy-duty, non-fusible
2. Safety type rated 600 volts AC
3. Ratings and fuse size as shown
4. Rating and fuse size as required by the utilization equipment manufacturer
5. Disconnect "open status" switch rated 1-ampere
6. Switch operator with a positive, quick-make, quick-break mechanism
7. NEMA-4X below grade, outdoors, or corrosive areas, or as shown
8. NEMA-7 hazardous classified areas.
9. Tinplated copper products. Silver-plated products are prohibited.

J. ELAPSED TIME INDICATORS:

Elapsed time indicators shall be panel mounted, non-resettable five-digit, hour indicator, rated 120 volts, 60 Hz.

K. ADJUSTABLE FREQUENCY DRIVES (AFD)/VARIABLE SPEED DRIVES (VFD):

The terms AFD (adjustable frequency drive), ASD (adjustable speed drive), VFD (variable frequency drive), and VSD (variable speed drive) are interchangeable for the purposes of this specification.

Variable speed drives shall be rated for 480 Vac, 6 pulse, using insulated gate bipolar transistors (IGBT) for pulse width modulation technology (PWM)

Provided with the following functional requirements and features:

1. SUPPLY POWER: Operate continuously with supply power of 480 volts plus or minus 10 percent, 60 Hertz plus or minus 3% and remain on line and operate without damage to the AFD or connected load during a supply power under-voltage variation to the drive up to 85% of its nominal value for 30 milliseconds at full load.
2. LOAD: Continuously driving the specified maximum motor load under the conditions:
  - a. Deliver 110 percent of the specified load for up to 60 seconds in variable torque applications.
  - b. Deliver 150 percent of the specified load for up to 60 seconds in constant torque applications.
3. EFFICIENCY: Not less than 95 percent at 60 Hertz output driving the specified maximum load.

4. FREQUENCY AND VOLTAGE REGULATION: Output frequency regulated to within 0.6 Hertz of the signal/output frequency relationship. Output voltage regulated to within 1.0 percent to produce minimum motor heating at any operating frequency within the specified range.
5. Fused control circuit transformer and microprocessor for system logic sequencing functions. Provide fuses with blown fuse indicator lamps.
6. Accept 4 to 20 mA dc input speed reference signal.
7. A 4 to 20 mA dc output signal proportional to inverter output frequency for the speed range specified.
8. Adjustable minimum/maximum frequency limits:
  - a. Minimum frequency shall be adjustable from 6 to 40 Hertz.
  - b. Maximum frequency shall be adjustable from 48 to 66 Hertz.
9. Adjustable and independent timed linear acceleration and deceleration functions, adjustable from 6-20 seconds.
10. Current limiting.
11. Automatic restart.
12. Control Wiring:
  - a. 600volt stranded copper
  - b. 90 degrees C color-coded insulation
  - c. No. 16 AWG
13. Wiring Identification and Termination: Crimp type wire lugs with sleeve type markers at each termination point and numbered terminal blocks for external connections.
14. Electrically isolated auxiliary contacts for ready, running, remote mode status and trouble alarm.
15. Conformal coated terminal blocks for control and signal wires entering and leaving the controller.
16. Control Power: Provide a 120 Vac, triple fused, control power transformer for cooling fans and external control circuits when required. Control circuits shall be isolated from power circuits by distance and by insulated barriers.
17. Provide 120 Vac or 24 Vdc as required for Operator Interface Unit.

18. Fault Alarm: Indicates the cause of any shutdown visible on the AFD keypad/display without opening the AFD enclosure. As a minimum, the following faults shall be alarmed:
  - a. Motor over-temperature
  - b. Motor overcurrent
  - c. Incoming power line over/under/unbalanced-voltage
  - d. AFD over-temperature
  - e. AFD over-voltage
  - f. AFD control failure
19. Control and Monitoring Devices:
  - a. Digital Operator keypad/display, located on door (not dead front).
  - b. Local-Off-Remote door mounted selector switch.
  - c. Manual speed control: potentiometer function.
  - d. Ethernet com card: Si-EN dual port
  - e. Internal terminal strips for remote and local monitoring:
    - Run status
    - Trouble/Fail alarm
    - Auto Mode status
    - Additional devices as indicated on the drawings.
20. Manufacturers:
  - a. Yaskawa V1000, PN VU4A0011FAA FOR 5 HP, VU4A0004FAA FOR 1 HP, with ethernet card SI-EN3/V, and EMC Filter,
  - b. Or approved equal

## 2.07 ELECTRICAL SAFETY MAT

- A. Switchboard matting shall be provided for added protection of operations staff and workers to cover concrete surfaces in front of electrical equipment.
  1. Matting shall meet ASTM D-178 specifications for manufacture of Type II, Class 2: ¼" thickness matting.
  2. Flame and oil resistant tested per ASTM standards.
  3. ASTM certification engraved or stamped on the back surface of the matt.
  4. Matting shall be tested and certified for industrial use. Matt rolls shall be proof testing over the entire surface at 20,000 VAC, and a dielectric test voltage of 30,000 VAC.
  5. The Contractor shall provide matting in the existing electrical rooms in front of all new electrical switchboards.
  6. The Contractor shall provide matting in the front of all interior new control panels.

7. Single piece rolls are preferred to be used in front of long sections of electrical equipment including, but not limited to, switchboards, switchgear, motor control centers, panelboards and control panels.
8. Matting shall be a minimum of 48" wide corrugated black for interior areas.

## 2.07 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Operating and maintenance information as specified in Section 01730.
2. One 11" x 17" set of drawings in a protective covering and shipped with the equipment in the internal equipment pocket at the time of equipment delivery to the project site.
3. Record documents as required.
4. Certificates of final electrical inspection and approval from the Code Authority Having Jurisdiction (AHJ) as specified in Section 16000, paragraph 1.01 A 4.

## PART 3--EXECUTION

### 3.01 GENERAL

#### A. CONSTRUCTION:

Perform the work specified by Contract Documents in accordance with these specifications.

Coordinate the location of electrical material or equipment with the work and adjust conduit location to accommodate equipment in accordance with the accepted submittal drawings from the manufacturer.

#### B. HOUSEKEEPING:

Protect electrical equipment from dust, water and damage. Cover the exterior to keep dry. Electrical distribution equipment such as motor control centers, switchgear, switchboards, panelboards, and other power source buses shall be clean and free of dust and dirt.

Protect electrical equipment temporarily exposed to weather, debris, liquids, or damage during construction as specified in Shipment, Protection, and Storage section. Touch up scratches on equipment as specified in Coating Systems section before final acceptance.

Wipe clean and vacuum equipment on the inside prior to acceptance testing and energization and again prior to detailed inspection and acceptance of the work.

#### C. INSTALLATION:

Perform the installation work specified in accordance with these specifications.

1. Splices are not allowed except by permission. Splices and terminations are subject to inspection prior to and after insulating and may require re-termination after inspection.
2. Lighting and receptacle circuits may be in the same conduit in accordance with derating requirements of the NEC. Lighting and receptacle circuits in conduits with power or control conductors is prohibited.
3. Adhere to the NEC raceway fill limitations. Provide separate conduits for signal and instrument conductors and cables.
4. Install power conductors derived from uninterruptible power supply systems in separate raceways.
5. Provide terminations at 460-volt motors by bolt-connecting the lugged connectors and insulating. Alternately, provide Tyco Electronics GelCap Motor Connection Kit by Raychem, or approved equal.
6. Install pre-approved in-line splices and tees with tubular compression connectors and insulate. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin splicing kits, or approved equals.
7. Provide self-insulating tubular butt-splice type of compression connectors for terminations at solenoid valves, 120-volt motors, and other devices furnished with pigtail leads.
8. Adjust motor circuit protectors in accordance with manufacturer's instructions and NEC requirements.
9. Adjust motor overload device in accordance with manufacturer's instructions and NEC requirements.

#### D. CONDUCTORS, WIRE, AND CABLE INSTALLATION:

Identify conductors at each connection terminal and at splice points with the identification marking system specified.

Install wire and cable into raceways, conduit, cable trays, or wireways without damaging or putting undue stress on the insulation or jacket. Provide manufacture's recommended and UL Listed pulling compounds lubricants for pulling wire and cable. Grease is prohibited.

Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed. Provide wire or cable support where wire or cable exits a raceway. Provide reusable stainless steel Kellums grips or approved equal product where cable support is required and where loads are removable.

Scratch-brush the contact areas and tinplate the connection where flat bus bar connections are made with tinplated or unplated flat bus bar. Provide non-oxide material approved for the function. Torque bolts to the bus manufacturer's recommendations.

Adhere to raceway fill limitations defined by NEC and the following: Lighting and receptacle circuits may be in the same conduit in accordance with de-rating requirements of the NEC. Lighting and receptacle circuits shall not be in conduits with power or control conductors. Signal conductors shall be in separate conduits.

Install pre-approved in-line splices and tees made with tubular compression connectors and insulated as specified for terminations and for motor terminations. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin or approved equal splicing kits.

#### E. RACEWAY INSTALLATION:

Provide additional pullboxes for conduit runs with greater than 360-degrees in any run between pull boxes. Limit maximum conduit runs without additional pullboxes to 400-feet, less 100-feet for every 90-degrees for the conduit run change in direction.

Determine conduit routing that conforms to the installation requirements set forth herein and in accordance with the NEC requirements for size and number of pullboxes.

1. Install exposed conduit either parallel or perpendicular to structural members and surfaces.
2. Route two (2) or more exposed conduits in the same general routing parallel with symmetrical bends.

3. Install exposed conduit on supports spaced not more than ten (10) feet apart.
4. Install conduits out from the wall using framing channel where three (3) or more conduits are located in parallel run.
5. Install conduits between the reinforcing steel in walls or slabs that have reinforcing in both faces. Verify installation method for conduits larger than 2-inch with OWNER prior to installation.
6. Install conduit in slabs that have only a single layer of reinforcing steel, under the reinforcement.
7. Install conduits with large radii under the slab in a one-sack concrete slurry.
8. Route conduit clear of structural openings and shown future openings.
9. Provide conduit roofs or wall penetrations with flashing sealed watertight and fire-stop, as required to maintain the structural rating.
10. Grout conduit into any openings cut into concrete and masonry structures.
11. Cap conduits during construction to prevent entrance of dirt, trash, and water. Cap or plug empty conduit designated as “future”, “spare”, or “empty” and include a pulling line accessible at both ends. Plug threads prior to installation.
12. Terminate exposed conduit stubs for future use with pipe-caps and provide couplings and pipe-plugs where flush with the slab.
13. Determine concealed conduit stub-up locations from the manufacturer's shop drawings.
14. Terminate conduit in equipment with conduit couplings with pipe-plugs flush with structural surfaces for empty conduit.
15. Install conduit horizontally with at least seven (7) feet of headroom clearance.
16. Terminate conduit with fittings that ensure the NEMA rating of the enclosure and provide conduit hubs, as required heretofore.

17. Provide conduit crossing structural joints with structural movement with O-Z "Type DX" or Crouse-Hinds "Type XD," bonded, weather-tight expansion fitting of the same size and type as the conduit, or approved equal.
18. Seal conduits in corrosive areas using removable mastic material.

F. UNDERGROUND RACEWAY INSTALLATION:

Provide excavation, backfilling, and concrete work as specified and shown.

Provide underground conduit installations that conform to the following requirements:

1. Direct bury underground conduits that are not shown to be installed in an electrical ductbank.
2. Underground conduit bend radius: not less than two (2) feet minimum at vertical risers nor less than three (3) feet elsewhere for up to 2-inch diameter conduit.
3. Determine conduit manufacturer's bending radius requirement for 3-inch and larger diameter conduit and use factory "long radius" ells.
4. Underground ductbanks and direct-buried conduits: 2-feet minimum earth cover, except where shown otherwise.
5. Concrete encased conduit:
  - a. Minimum concrete thickness of 2-inches between conduits 2.5-inch and smaller.
  - b. 3-inches between 3-inch conduit and larger or per NEC requirements.
  - c. 1-inch between conduit and reinforcing.
  - d. 3-inches over reinforcing.
  - e. Embed #4/0 bare ground in the concrete encasement and installed with direct buried raceways.
  - f. Standard detail or typical details shown supersede these general requirements.

- g. Provide 3-pounds of red-oxide dye-color per sack of cement for in the concrete encasement for electrical ductbanks.
- h. Provide 467-ASTM coarse aggregate size with 3-cement sacks per cubic yard concrete.
- i. Provide concrete with 28-day, 2000-psi compressive strength unless specified at higher value in the cast-in-place concrete specification.

#### G. CONDUIT SEAL-OFF FITTINGS:

Conduits passing:

- 1. Between Class I, Division 1 area and Class I, Division 2 area; provided with sealing fittings located at the boundary in accordance with NEC Article-500.
- 2. From hazardous or corrosive area into a non-hazardous or non-corrosive area.

Install the seal-off material in the conduit seal-off fittings after inspection.

#### H. ELECTRICAL EQUIPMENT LABELING:

Electrical equipment shall have field marked signs and labeling to warn qualified persons of the potential electric arc flash hazards per NEC Article 110.16 Flash Protection.

Electrical equipment shall have NFPA 70E labels installed stating the results of the Arc Flash analysis. A Short Circuit and Protective Device Coordination Study shall be done by the electrical equipment manufacturer.

Electrical distribution equipment and utilization equipment shall be field labels to identify the power source and the load as specified. Refer to NEC Article 110.22 for Identification of Disconnecting Means installation criteria. Specific information is required such as the equipment tag number and equipment description of both the power source and the load equipment.

#### I. CABLE TRAY

Unless otherwise specified or shown, cable tray installation shall be as follows:

- 1. Cable trays shall be supported at intervals not to exceed 5 feet.
- 2. Corners shall be supported by two supports installed as close as possible to the corner, with one support on each side of the corner.

3. Field cuts on steel cable tray shall be treated with zinc rich paint.
4. Expansion joint splice plates shall be used to allow 1 1/2 inch free movement between adjacent trays when crossing building expansion joint.
5. Cable tray shall have minimum clearance of 3/4 inch from concrete surfaces and minimum spacing of 12 inches from other trays. The top of the tray shall be minimum 9 inches from the ceiling.
6. Signal cable trays shall be provided with solid type covers.
7. Provide each cable tray with No. 2/0 AWG or No. 4/0 AWG minimum bare copper equipment ground conductor attached to the outside of each tray section using UL Listed bolted bronze or brass ground clamp and bond to the ground grid system.
8. Power cables shall be placed in cable trays in accordance with the NEC.
9. Cables shall be arranged in trays for minimum cross-over for entry or exit.
10. Provide cable tray barrier between power and control cables, if not in separate cable trays.
11. Provide cable tray barrier between control and instrument cable in the same cable tray.

### 3.02 TESTING

Provide electrical equipment acceptance tests in accordance with the latest version of NETA Acceptance Testing Specification for electrical distribution and utilization equipment to demonstrate that all electrical equipment is functioning as designed.

Test lighting system for proper function. Test wiring devices for correct connections. Test outlet grounding and polarity using a plug-in test device. Test motor control stations and control devices for proper function.

Test power, control, instrument, and signal conductors to verify free from grounds. Megger test all conductors with the test voltage appropriate to the conductor insulation voltage. Use a 600 or 1000-volt megohmmeter for resistance measurements for 600VAC rated insulation and all motors. Test between conductors and from conductor to ground. Insulation with resistance of less than 10-megohms is not acceptable. Record the insulation resistance measurements in a format similar to or on the Form 16000-A in Section 01999.

Pre-test conductors prior to installation, as appropriate. Replace damaged conductors. Test all conductors after installation.

Measure motors insulation resistance before they are connected. For 50-horsepower and larger motor, measure the motor insulation resistance at the time of delivery and after they are connected. Insulation resistance values less than 10 megohms are not acceptable. Complete the Installed Motor Test Form: 16000-B in Section 01999, for each motor after installation.

### 3.03 FUNCTIONAL CHECKOUT

Prior to energization of equipment, perform a functional checkout of the control circuit. Prior to functional testing, adjust and make protective devices operative by energizing each control circuit and operating each control, status, alarm, protective device, and each interlock to verify that the specified action occurs. Submit a description of his proposed functional test procedures prior to the performance of functional checkout.

Verify motors are connected to rotate in the correct direction by momentarily energizing the motor. Prior to motor rotation test, confirm that the motor, the driven equipment, nor personnel will be damaged by reverse operation.

### 3.04. GROUNDING SYSTEM TESTS

Test each grounding connection to determine the ground resistance per the IEEE Standard 81. Submit a plot of ground resistance readings for each isolated ground rod or ground mat to the OWNER on 8-1/2 x 11 inch size graph paper.

The current reference rod shall be driven at least one hundred (100) feet from the ground rod or grid under test. Make measurements at 10-foot intervals, beginning twenty-five (25) feet from the test electrode and ending seventy-five (75) feet from it, in direct line between the ground rod or center of grid and the current reference electrode.

A grounding system that shows greater than 2-ohm resistance, for the flat portion of the plotted data, is considered inadequately grounded. Add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurements meet the 2-ohm requirement. Additional ground rods and ground grid work will be paid for as extra work. Use of salts, water, or compounds to attain the specified ground resistance is prohibited.

### 3.05 RECORD DOCUMENTS

Provide Record Drawings and documents maintained and annotated during construction. Submit drawings in accordance with Section 01720 and the following.

Include addendum items, requests for information, change orders, and field changes posted or drawn on the Record Drawings. Include the following drawings with the Record Drawings:

1. Interconnection Diagrams specified herein.
2. Original Submittal Drawings specified herein.

Schedule a meeting with the Engineer in the Engineer's office to review the Record Drawings at the end of the project. Make corrections to the Record Drawings prior to re-submitting the Record Drawings to the Engineer.

Submit Record Drawings and Operations and Maintenance (O&M) Manuals to be included in the completed project Record Document Set for the OWNER.

**\*\*END OF SECTION\*\***

## SECTION 16030

### ELECTRICAL ACCEPTANCE TESTING

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

The electrical equipment and conductors to be tested are specified herein and shown on the electrical drawings of the Contract Documents.

The Contractor shall retain an independent InterNational Electrical Testing Association (NETA) member Engineering and Testing Firm (Testing Firm) for specified on-site acceptance testing of the project electrical power distribution system and utilization equipment covered by this contract.

The Testing Firm shall be responsible for the Short Circuit and Protective Device Coordination Report as specified in Section 16431. The Testing Firm shall verify the protective device settings are implemented in accordance with Section 16431. The Testing Firm work includes the ARC-Fault equipment labeling work as specified in Section 16431.

Tests performed by the Testing Firm shall be witnessed by the Owner's Representative. Provide the Construction Manager 30-day advanced notice for Testing Firm tests. Insulation tests by the Contractor typically will not be witnessed. Critical equipment witness testing may be requested by the Construction Manager.

The manufacturer of the electrical equipment supplied for the project shall complete their on-site factory inspection, testing, and setup prior to the Testing Firm's Acceptance Testing and subsequent Protective Device setting verification work. The power monitors shall be set up by the factory representatives and power monitor readings and settings verified by the Testing Firm. Manufacturer work is specified in the respective equipment sections.

The Installation Contractor shall test motors, conductors, and equipment as specified and shown. Contractor shall provide the labor, tools, material, including quality power sources required by the Testing Firm equipment, and other services necessary to provide specified tests and retesting.

Submit proposed electrical test procedures for tests to be performed by the Installing Contractor, other than insulation resistance testing, and proposed test procedures for tests to be performed by the Testing Firm.

## 1.02 QUALITY ASSURANCE

### A. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/NETA ATS	International Electrical Testing Association (NETA) - Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

### B. TESTING FIRM

The Testing Firm and their proposed project team shall possess the following minimum qualifications:

1. Testing Firm shall be an independent testing organization providing unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems to be evaluated.
2. Testing Firm shall be regularly engaged in the testing of electrical equipment, devices, installations, and systems.
3. Testing Firm shall be a “NETA Accredited Company” of the InterNational Electrical Testing Association (NETA providing testing in accordance with ANSI/NETA ATS published specifications or the pre-approved firms that use the NETA methods and published testing specifications.

4. If firm's own published testing specifications are proposed, then submit a copy to the Engineer for acceptance and submit the qualifications of the testing staff.
5. Testing Firm's lead technical person shall be currently certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution systems testing. Submit proof of technical training and certification for performing testing work.
6. Testing Firm's technicians shall be regularly employed, qualified testing staff.
7. The following are pre-qualified Testing Firms:
  - a. Emerson Electrical Reliability Services
  - b. Power Systems Testing Co.

#### C. TESTING FIRM QUALIFICATIONS

For any Testing Firm not pre-qualified, the Contractor shall receive Construction Manager approval of the proposed Testing Firm, their proposed project team, and their test procedures prior to the Pre-Test Submittals.

1. Project Team: Identify lead technical person and testing staff and provide documentation of training and experience demonstrating compliance with the qualifications specified.
2. Testing Firm: Provide reference names and current phone numbers of the Owner, Contractor, Engineer, or Construction Manager that has knowledge of the Firm's work:
  - a. Three projects for Owner completed within the past four years, or
  - b. Three projects for Brown and Caldwell completed within the past four years, or
  - c. Provide references for five recent projects that were completed within the last four years. Provide a description of the scope of the referenced project.
3. For Testing Firm's experience to be judged acceptable, the Contractor shall demonstrate that the proposed Testing Firm's reference projects are of similar scope and size to this project, and in performing these projects the following has been achieved:

- a. Testing Firm's work did not delay the projects or adversely impact the progress of the Contractor's work or the Owner's project.
  - b. Specified requirements were achieved.
  - c. Work was performed in accordance with ANSI/NETA ATS, MTS, or other Engineer accepted testing criteria.
  - d. Submittals approved with two or fewer re-submittals after the initial submittal.
  - e. No warranty claims related to the Testing Firm's work.
4. Provide documentation demonstrating NETA Accreditation and compliance with the qualification specified.

### 1.03 SUBMITTALS

Contractor shall submit the following information in accordance with specification Section 01300:

#### A. TESTING FIRM QUALIFICATIONS:

For any Testing Firm not pre-qualified per paragraph 1.02 B, submit qualifications per paragraph 1.02 C.

#### B. PRE-TEST SUBMITTALS:

1. Description or samples of specified test procedures.
2. Sample test report forms for the specified tests.
3. Preliminary Schedule listing equipment to be tested.
4. Notification form for the work scheduled.
5. Pre-Functional test procedures and testing schedule.
6. Functional test procedures and testing schedule.

#### C. POST-TEST SUBMITTALS:

1. Completed Section 01999-Test Records:

- a. Wire and Cable Resistance Test Data Form: 16000-A
- b. Installed Motor Test Form: 16000-B
- c. Dry Transformer Test Data Form: 16000-
- d. Pad Mounted Transformers
- e. Variable Frequency Drives

- 2. Test Reports specified in Part 3 of this Section.

## PART 2--PRODUCTS

### 2.01 TESTING EQUIPMENT AND INSTRUMENTS

The test equipment, instruments and devices used for testing shall be calibrated to test equipment standards with references traceable to the National Institute of Standards and Technology.

The test equipment, instruments and devices shall have current calibration stickers indicating date of calibration, deviation from standard, name of calibration laboratory and technician, and date of next recalibration.

## PART 3--EXECUTION

### 3.01 GENERAL

The Contractor shall submit a schedule for the Testing Firm work and notify the Construction Manager 30 days prior to commencement of any witnessed testing.

The required tests, including correction of defects where found, and subsequent retesting, shall be completed prior to energizing electrical distribution system, utilization systems, and conductors and completed prior to functional testing. The installation of the protective device, breaker, and relay settings shall be completed and verified.

### 3.02 INSTALLATION CONTRACTOR TESTING

#### A. GENERAL:

Submit all completed test report forms in a 3-ring binder type notebook at the project Substantial Completion date.

#### B. INSULATION RESISTANCE MEASUREMENTS:

1. TESTS: Insulation resistance measurements shall be made on conductors and electrical equipment that will carry current. Where not specified, the minimum acceptable values of insulation resistance shall be in accordance with the applicable NETA-ATS, ICEA, NEMA, or ANSI standards for the equipment or material being tested.

The ambient temperature at which insulation resistance is measured shall be recorded on the test form. A megohmmeter shall be used for insulation resistance measurements.

Refer to specification Section 01999-Reference Forms for the test forms required to document the testing performed by the Installing Contractor.

2. CONDUCTOR AND CABLE TESTS: The phase-to-ground insulation resistance shall be measured for circuits 120 volts and above except lighting circuits. Measurements may be made with motors and other load equipment connected. Insulation resistance measurements shall be recorded on Form 16000-A contained in Section 01999, and submitted. Insulation with resistance of less than 100 megohms is not acceptable.

3. MOTOR TESTS: The Installed Motor Test Form, 16000-B, contained in Section 01999, shall be completed for each motor after installation and submitted. All motors shall have their insulation resistance measured before they are connected.

Motors 50 HP and larger shall have their insulation resistance measured at the time of delivery and when they are connected. Insulation resistance values less than 50 megohms are not acceptable.

Verify that motors are connected to rotate in the correct direction with the load disconnected. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation.

Motor running current shall be measured on each phase with the motor operating under load. Current imbalance shall be less than 5-percent difference between phases.

#### C. POWER DISTRIBUTION EQUIPMENT:

Transformers, panelboards, and other power distribution equipment shall have their insulation resistance measured phase-to-phase and phase-to-ground. Insulation resistance values less than 10 megohms are not acceptable.

#### D. POWER UTILIZATION EQUIPMENT:

Test receptacles and power outlets using a device to verify polarity, grounding, and the correct wiring connections.

E. SIGNAL AND DATA CABLE TESTS:

Signal conductors and shield drain shall be tested for insulation resistance with the other conductors in the cable grounded. Each shield drain conductor shall be tested for continuity. Insulation resistance measurements shall be recorded on Form 17000-A contained in Section 01999, and submitted.

Instruments used for continuity measurements shall have a resolution of 0.1 ohms and an accuracy of better than 0.1 percent of reading plus 0.3 ohms. A 500-volt or 1000-volt meg-ohmmeter shall be used for insulation resistance measurements as appropriate.

F. PRE-FUNCTIONAL CHECKOUT:

Prior to energizing equipment, the Contractor shall perform a pre-functional checkout of the power and the control circuit. Protective devices shall be installed and available for service and calibrated or adjusted with specified setpoints installed. Contractor selected initial setpoints shall be installed and recorded, when specified setpoints are not required from the manufacturer or the Engineer.

Contractor shall submit a description of proposed test and checkout procedures conforming to the following requirements, including a schedule for conducting these procedures, not less than 30 days prior to the performance of pre-functional testing.

Pre-functional checkout shall consist of energizing each control circuit and operating each control device, protective device, monitoring or alarm device, and each interlock and verify the specified action or response occurs. Coordinate testing with the requirements specified in Section 01660 – Equipment and System Performance and Operational Testing.

G. FUNCTIONAL TESTING:

Contractor shall submit a description of proposed functional test and checkout procedures conforming to the following requirements, including a schedule for conducting these procedures, not less than 30 days prior to the performance of functional testing.

Prior to functional testing, all protective devices shall be adjusted and made operative. Prior to energization of associated equipment, perform a functional checkout of all electrical and instrumentation control circuits as specified in the following and in Division 17. Checkout shall consist of energizing each control circuit and operating each control, alarm, safety device, and each interlock, in turn, to verify that the specified action occurs.

Record and submit data sheets as specified. Coordinate testing with the requirements specified in Section 01660 – Equipment and System Performance and Operational Testing.

3.03 TESTING FIRM ACCEPTANCE TESTING REQUIREMENTS

A. ACCEPTANCE TEST REPORTS:

The Contractor shall maintain a written record of all inspection and test results and, upon completion of the project, shall assemble and certify a final test report

A copy of the preliminary test results shall be provided to the Construction Manager at the end of each day of testing.

Furnish two copies of the complete acceptance testing final report to the Construction Manager at Substantial Completion of the project.

B. ACCEPTANCE TEST DOCUMENTATION

The Contractor shall submit test documentation forms and a detailed description of the proposed inspection and test procedures to be performed by the Testing Firm. Testing shall not commence until the Construction Manager has approved the proposed forms and procedures.

The description shall identify the test equipment required for each specified test to be performed. Test report forms shall include the following information:

1. Electrical equipment description.
2. Electrical equipment identification number.
3. Electrical equipment nameplate data.
4. Electrical equipment settings.
5. Time and date of test.
6. Ambient conditions at time of test.
7. Inspection checklist and results.
8. Test results.
9. Test equipment used with manufacture, model number, and calibration date.
10. Remarks about test procedures, results, and suggestions.
11. Name and signature of testing personnel.
12. Name and signature of test witness.

### C. ACCEPTANCE TESTING FIRM TESTS:

Acceptance testing procedures and test results shall be as specified in ANSI/NETA ATS. The following types of equipment and systems shall be inspected and tested by the Testing Firm. Acceptance testing work shall not be limited to equipment shown on the drawings. Refer to Division 16 specification for the electrical equipment specified.

Refer to the electrical drawings for location and identification of the electrical distribution system equipment, utilization equipment, and electrical conductors, included but not limited to:

1. Switchboard Assemblies.
2. Transformers Dry-Type Air-Cooled.
3. Transformers Liquid Filled.
4. Cables Low-Voltage 600 Volt Maximum.
5. Cables Medium-Voltage.
6. Circuit Breakers Low-Voltage, 100A frame and larger.
7. Protective Relays.
8. Instrument Transformers.
9. Metering, include non-utility power metering equipment.
10. Grounding Systems include installed grounding systems and existing grounding systems that are being utilized.
11. Ground Fault Protection Systems.
12. Motors.
13. Motor Starters Low-Voltage.
14. Adjustable Speed Drive Systems and harmonic testing per Section 16000.
15. Surge Protection Devices, include lightning arresters, surge capacitors, and TVSS.
16. Uninterruptible Power Systems (UPS).
17. Manual Transfer Switched (MTS).

### 3.04 ACCEPTANCE TEST VALUES

Minimum acceptable test values shall be as specified in ANSI/NETA ATS. Where acceptance test values are not specified, the equipment manufacturer's recommended test values shall be used. Where acceptance test values are not specified and the equipment manufacturers recommended test values are not available, request acceptance test values from the Construction Manager.

### 3.05 ACCEPTANCE TEST FINAL REPORT

Test report shall be assembled as described in ANSI/NETA ATS. Test results shall be organized by electrical distribution system equipment, project utilization equipment, and electrical conductors with individual tab dividers with labels to identify each group of items and cross-referenced to the Contract Documents. The equipment description, equipment number, and equipment tag number shall be used as shown on the drawings or listed in specifications.

Final Test Reports that are illogically assembled, labeled, and organized shall be returned for rework at no cost to the Owner and resubmitted in an acceptable format.

Deficiencies and non-compliant test results found during acceptance testing shall be identified in the test report and cover letter. The Testing Firm shall certify in the final test report that all deficiencies and non-compliant test results listed have been "corrected" and shall include a description of the resolution for each problem listed.

### 3.06 PROTECTIVE DEVICE FIELD SETTINGS

The Testing Firm shall verify, and certify in the acceptance test final report, that the protective device coordination study settings for new and existing equipment based on the Short Circuit and Protective Device Coordination Report specified in Section 16431 have been implemented and recorded on the Testing Firm's Data Sheets.

### 3.07 ARC FLASH STUDY RESULTS

The Testing Firm shall provide and install labels on the project electrical equipment for personnel protective clothing requirements as specified in Section 16431.

**\*\*END OF SECTION\*\***

## SECTION 16125

### MEDIUM VOLTAGE CONDUCTORS AND CABLE

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

This section specifies conductors and cables rated 5,000 to 15,000 volts used for power distribution circuits and the certified skill set of the termination and splice installer.

##### 1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AEIC CS8	Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 KV
ASTM B3	Soft or Annealed Copper Wire
ASTM B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B189	Lead Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
ICEA S-93-639	Ethylene-Propylene-Rubber-Insulated Wire
IEEE 383	Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations

Reference	Title
IEEE-386	Separable Insulated Connector Systems for Power Distribution Systems Above 600V
NEMA WC7	Cross-Linked-Thermosetting Insulated Wire and Cable for the Transmission and Distribution of Electric Energy
NETA	International Electrical Testing Association Inc. Acceptance Testing or Maintenance Testing
NFPA 70	National Electric Code (NEC)
UL 1072	2001-8000 Volt Non-shielded Solid-Dielectric Single Conductor Power Cable

### 1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (☐) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.  
  
Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. Catalog cuts showing general information of the conductors and cable.
3. Cable pulling data as specified in paragraph 16125-3.02 C.7.

## PART 2--PRODUCTS

### 2.01 CONDUCTORS

General requirements for conductors and cables specified in this section are listed on CABLESPEC sheets in paragraph 16125-3.05. The type, size, and number of conductors shall be as specified on the drawings or schedules.

## 2.02 CABLE TERMINATORS

### A. LUG TYPE:

Terminations shall be made with a tin-plated compression type lug and a compression pressure tool as approved by the manufacturer of the lug. Tool shall be of the hydraulic pump type or the type that crimps to the required size before releasing.

Electrical voltage stresses shall be controlled by high permittivity, high resistivity, heat shrinkable polymeric tubing, seal using heat shrinkable tubing, and heat activated adhesive. Corona extinction level for a completed termination on a cable shall not be less than 1-1/2 times the rated cable phase to ground voltage.

Terminations may be made with cold shrinking preformed assemblies.

### B. SPLICES:

Splices shall be made with a tin-plated copper compression connector and a compression tool as approved by the manufacturer of the connector. Tool shall be of the hydraulic pump type or the type that crimps to the required size before releasing.

Splices shall be sealed with a heat activated adhesive and an outer heat shrinkable jacket tubing. Splices shall provide continuity of the cable shield using a wire mesh and grounding clampers. Electrical voltage stresses shall be controlled by utilization of high permittivity, high resistivity, heat shrinkable polymeric tubing or cold shrinking preformed assemblies.

Splices may be made with cold shrinking preformed assemblies.

### C. LOAD-BREAK CONNECTORS AND BUSHINGS:

Load break connectors and bushings shall be rated:

1. 8.3 kV phase to ground
2. 14.4 kV phase to phase across contact
3. 95 kV BIL; 35 kV, 60 Hertz, 1 minute
4. 11 kV corona extinction
5. 200 amp continuous, 300 amperes, 8 hours
6. 15,000 amperes RMS asymmetrical, 12 cycles
7. 10,000 amperes RMS symmetrical, 30 cycles
8. Comply with the requirements of ANSI C119.2

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9. Connectors and bushings furnished with installation items.

D. NON-LOAD-BREAK CONNECTORS AND BUSHINGS:

Non-load-break connectors and bushings shall be rated:

1. 8.3 kV phase to ground
2. 14.4 kV phase to phase, 95 kV BIL
3. 35 kV, 60 Hertz, 1 minute
4. 11 kV corona extinction
5. 600 amperes continuous
6. 900 amperes, 8 hours
7. 40,000 amperes RMS asymmetrical, 12 cycles
8. 27,000 amperes RMS symmetrical, 4 seconds
9. Comply with the requirements of ANSI C119.2
10. Connectors and bushings furnished with items for a complete installation.

## PART 3--EXECUTION

### 3.01 GENERAL

Each conductor shall be identified at each terminal to which it is connected with a marking system that shall comply with Section 16000.

Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed.

Pulling wire and cable into conduit shall be completed without damaging or putting undue stress on the cable insulation. UL listed and cable manufacture recommended pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable.

Provide a cable support whenever a cable leaves a raceway. Prepare and treat with conductive compound each flat un-plated bus bar connection. Torque bolts to the bus manufacturer's recommendations.

### 3.02 INSTALLATION

#### A. GENERAL:

Conductor installation shall be in accordance with the cable manufacturer's recommendations and the specifications herein.

Qualified cable termination and splice installer shall be certified by the manufacture or a training agency for the products used.

Provide a copy of the installer certification certificate to the Construction Manager prior to performing the work. Copy of the certification shall be present on the project site for review by the Owner.

**B. CABLE PLACEMENT:**

Cable shall be carefully checked and tested to verify the electrical condition, size, and length before being pulled into raceways. Cable pulled into the incorrect raceway or cut too short to rack, train, or splice as specified herein shall be removed and replaced by and at the expense of the Contractor.

1. **CABLE IN MANHOLES:** Cable shall be supported at all times during handling. Cable ends shall be sealed to prevent the entry of moisture or dirt. Cable racks or trays shall be provided for permanent support. Temporary support required during placement shall be with rope slings, timbers, or alternate method acceptable to the Construction Manager.

2. **SUPPORTS:** Cable supports and securing devices shall have bearing surfaces oriented parallel to the surfaces of the cable sheath and shall be installed to provide adequate support without deformation of the cable jackets or insulation.

Adequate cable end lengths shall be provided and properly placed in electrical equipment or manholes to avoid longitudinal strains and distorting pressures on the cable at termination points and duct end bells.

Final inspection shall be made after all cable is in place. Where supports, bushings, and end bells deform the cable jacket, additional supports shall be provided as directed by the Construction Manager.

3. **CABLE RACKS:** Cable racks shall be furnished and installed as required to provide the proper cable support. Cable racks shall be installed and spaced 36 inches apart and bolted to permanent wall surfaces with anchors or continuous slot concrete inserts. Cable racks shall be commercially available for the purpose and non-metal. Cable racks not suited to the installation shall be replaced with commercial products at no expense to the Owner.

**C. CABLE PULLING:**

1. **PULLING LINES:** All raceway cleaning mandrels and cable pulling shall be done with material and pull-line to prevent damage to the raceway. Nylon or stranded steel pulling lines shall not be used. "Fishing" may be done with CO<sub>2</sub>-propelled polyethylene cord.

2. **CABLE GRIPS:** Factory-installed pulling eyes shall be used for pulling cable. Where pulling eyes are not available, woven wire cable grips shall be used to pull all single-conductor cable. When a cable grip or pulling eye is used for pulling, the area of the cable covered by the grip or seal, plus 6 inches, shall be cut off and discarded when the pull is completed. As soon as the cable is pulled into place, the pulling eyes on cable grips shall be removed and the cable shall be resealed.

3. SWIVELS: A reliable, nonfreezing type of swivel, or swivel connection, shall be inserted between the pulling rope and the cable pulling eye, grip, or loop to prevent twisting under strain.

4. REEL INSPECTION AND INSULATION TESTING: Purchase cable with both ends available for insulation resistance testing. Before unreeling, the outside of each cable reel shall be carefully inspected and protruding nails, fastenings, or other objects which might damage the cable shall be removed.

Test the cable on the cable-reel with an insulation tester and record the results. A thorough visual inspection for flaws, breaks, or abrasions in the cable sheath shall be made as the cable leaves the reel, and the pulling speed shall be slow enough to permit this inspection.

Damage to the sheath or finish of the cable shall be sufficient cause for rejecting the cable. Cable damaged during installation shall be replaced by the Contractor and at the expense of the Contractor.

5. FEEDING TUBES: A flexible feeding tube, with a removable nozzle sized to fit the raceway shall be used in pulling cable. The feeding tube shall be long enough to extend from the raceway entrance to the outside of the manhole and arranged so that it will be impossible for the cable to drag across the edge of the manhole ring or any other damaging surface.

Cable pulling into, through, or out of new manholes shall be done with the entire concrete manhole lid cover removed.

6. LUBRICANT: A cable lubricant shall be used on all conductors in all pulls, and shall be of the type, and applied in the quantity, recommended by the cable manufacturer.

7. PULLING TENSION: The pulling tension of the cable shall not exceed the maximum tension recommended by the cable manufacturer. Pulling mechanisms of both manual and power types used by the Contractor shall have the rated capacity (in pounds) clearly marked on the mechanism.

A dynamometer shall indicate the tension on the cable during all pulls and the indicator shall be constantly watched. When excessive strain develops, the pulling operation shall be stopped and the difficulty determined and corrected. Cable shall not be pulled without using equipment monitored by a dynamometer.

The dynamometer shall have a maximum tension indicator to show the maximum tension developed during a pull. The maximum tension for each pull shall be recorded and submitted to the Construction Manager within 5 days after the pull was made.

Consult with the Construction Manager for installations that do not require a dynamometer for short or non-difficult pulls, otherwise pulling without a dynamometer is prohibited.

The information submitted to the Construction Manager shall include the dynamometer reading, the angle alpha, the lubricant used, the actual maximum tension of each pull measured while the cable is in motion, and the tension upon initial start of the pull just before the cable begins to move. The cable play-out reel shall be equipped with a suitable brake and shall be constantly manned during all pulls.

The use of motor vehicles as cable pulling devices is prohibited. Any cable so pulled shall be removed, replaced, and the new cable installed at the Contractor's expense.

8.      SIDEWALL PRESSURE: To avoid insulation damage from excessive sidewall pressure at bends in raceway runs, the pulling tension in pounds exiting a bend shall not exceed 200 times the radius of the bend in feet.

9.      CABLE BENDS: Extreme care shall be exercised during the placement of all cable to prevent tension and bending conditions in excess of the manufacturer's recommendations. The permanent radius of bend after cable installation shall be in accordance with the cable manufacturer's recommendations.

#### D.      MOISTURE SEALS:

Cable ends shall be kept sealed except when termination and splicing work is being performed. Seal with heat-shrinkable caps with the sizes recommended by the cap manufacturer for the cable outside diameter and insulation. Cold seal kit method provided by the manufacture of the kit is an accepted method

Caps shall contain sufficient adhesive that shrinkage of the cap during application results in formation of a positive, watertight seal. Heat-shrinkable caps shall be "Thermofit" as manufactured by Raychem Corporation, or equal.

Before and after pulling, the leading end seal of each length of cable shall be examined and replaced if necessary. All cut cable ends shall be promptly sealed after cutting except those to be spliced or terminated immediately.

#### E.      SPLICES:

Power cable circuits may be spliced only at locations where specified or acceptable to the Construction Manager. Splices shall not be made to utilize short lengths of cable, nor shall they be made to provide correct lengths on cable initially cut too short for a circuit.

### 3.03    TERMINATIONS AND SPLICING

Cable shall be trained into place without bending the cable in a radius less than the manufacturer's recommended minimum bending radius. If the cable is bent to a radius less than the minimum bending radius, the Contractor shall at his own expense, re-terminate the cable at a point at least 6 inches below the bend.

Where the shape and configuration of terminal fittings make workmanlike insulation of the bare connection impractical, the contours of the connection shall be smoothed by filling voids and molding over irregular surfaces with a moldable filler material as recommended by the terminator kit manufacturer before application of the recommended thickness of insulating material.

Terminations shall be in exact conformance with the written instructions accompanying the splicing or terminator kits and work shall only be performed by personnel that are specifically trained and experienced in medium voltage cable termination and splicing.

Special care shall be exercised to ensure that cable insulation is not damaged during stripping back of jacket, semiconductor layers, shields; or penciling operations.

Stripping-back operations involving the cutting of nonmetallic layers of the cable shall be accomplished using a ringing tool. The usage of pocket or jack knives for stripping back or penciling operations is prohibited.

### 3.04 TESTING

#### A. GENERAL:

In addition to the tests specified below, the Contractor shall test conductors and cable in accordance with Sections 16000 and 16030. Cables rated 5 kV and above shall be tested using the DC high potential test method.

#### B. DC HIGH POTENTIAL TESTING:

After insulation resistance testing is completed, a DC high potential test shall be performed on cables. The procedure for DC high potential testing shall be in accordance with Section 16030 as modified below.

The test voltage shall be direct current at 80 percent of final factory DC test voltage or approximately 50 percent of the basic impulse level (BIL) voltage. The test voltage shall not exceed the maximum voltages specified as follows:

Test voltage, kV

Rated circuit: phase-to-phase voltage	Conductor size: AWG or KCMIL	100 percent insulation level	133 percent insulation level
2001-5000	8-1000	25	35
5001-8000	6-1000	35	45
8001-15000	2-1000	55	65

Test voltage shall be applied for 15 minutes on shielded cable and for 5 minutes on nonshielded cable or as recommended in the NETA test procedures.

### Cable Test Report:

The currents resulting from the DC high potential testing shall be recorded and provided to the Construction Manager. Test results shall demonstrate that the leakage current decreases or remains constant after reaching the specified test voltage.

### 3.05 SCHEDULES

A. The following CABLESPEC sheets are included in this section:

1. 5EP-S

### 3.06 CABLE SPECIFICATION SHEET—CABLESPEC

Cable System Identification:	5EP-S
Description:	Single conductor power cable
Voltage:	5,000 volts
Conductor Material:	Single conductor, uncoated copper; Class B stranded in accordance with ASTM B8
Strand shield:	Extruded semi-conducting stress relief layer or extruded non-conducting layer.
Insulation:	Ethylene propylene rubber (EPR), Type MV-105, rated continuous 105 degrees C, emergency 130 degrees C, short circuit 250 degrees C, wall thickness rated for 133 percent insulation level.
Insulation screen:	Extruded semi-conducting stress relief layer.
Shield:	Coated copper tape with minimum 12.5 percent overlap.
Jacket:	Polyvinylchloride (PVC).
Manufacturer(s):	Kerite. Okonite Okoguard-Okoseal Series 114-23-3XXX. General Cable Uniblend EP.
Execution:	
Installation:	Install in accordance with paragraph 16125-3.02.
Testing:	Test in accordance with paragraph 16125-3.04.

**\*\*END OF SECTION\*\***

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## SECTION 16176

### LOCAL CONTROL PANELS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies local control panels used for housing electrical power and control equipment per Panel Schedule herein. Local control panels that include motor controllers and control devices/instruments shall be located in separate compartments.

Vendor and Manufacturer panels specification Sections specify specific requirement for these panel. Contractor custom panels are specified herein and shown on the drawings.

The Vendor / Manufacturer package equipment and Contractor custom field panels shall adhere to the requirements in specifications Sections 16000 for motor starters, controllers, and devices and the circuits shall be arranged for Fail-Safe wiring and electrical operation, as defined hereinafter.

Refer to Instrument and Control Panels – Section 17110 for electronic types of panels that do not contain motor controllers.

Refer to Division 17 for instrumentation included in the panel. Refer to process equipment control descriptions in the Equipment Sections or in Division 17 for system operation and interlock requirements.

###### B. PANEL SCHEDULE:

Refer to Control Panels – Section 17110 for types of panels that contain motor controllers. Any/all power requirements associated with those panels shall conform to this specification.

##### 1.02 QUALITY ASSURANCE

###### A. REFERENCES:

This section contains references and information from the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

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Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NFPA 79	NFPA 79 Electrical Standard for Industrial Machinery
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 6	Industrial Control and Systems: Enclosures
NFPA 70	National Electrical Code (NEC)
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous (Classified) Locations

**B. ASSEMBLY:**

The assembled panels and individual components shall be UL Listed and labeled.

Equipment and components shall be Underwriters Laboratory (UL) listed for the purpose per Section 16000 or UL recognized.

The control panels shall have factory applied UL 508A labels.

The intrinsic safety barriers required within a control panel shall be provide per UL 698A with factory applied labels as required by UL.

**C. FACTORY TESTING:**

Prior to shipment, test the functional operation of the panel, as shown on the drawings, specified in other Divisions, as described in the sequence of operation in the Control Description where provided in Division 17.

**1.03 SUBMITTALS**

The following submittals shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or

marked to indicate requested deviations from specification requirements.

A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

*Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. Arrangement drawings of the panel enclosure indicating the front door and panel equipment arrangement and dimensions, and enclosure type.
3. List of materials and components with the layout drawings.
4. Data on all materials and components.
5. Heat calculations.
6. Nameplate schedule with character size and nameplate size.
7. Submittal drawing required:
  - a. Elementary/schematic diagrams.
  - b. Internal wiring connection diagrams.
  - c. External wiring interconnection diagrams including interlocks.
  - d. Power and control single line diagrams, where motor controllers are included.
8. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required".

## PART 2--PRODUCTS

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## 2.01 GENERAL

Panels shall comprise cabinet enclosures with power products, control products, and instrumentation products as specified in Divisions 11, 13, 14, 15 and herein.

Provide:

1. Separation between the power components (over 120Vac) and the control / instrument components (120Vac and less) by locating the power components and the control / instrument components in separate sections of the cabinet enclosure.
2. Power cabinet section and the control / instrument cabinet section with separate door handles.
3. Separation between the power components and the control / instrument components using barriers.
4. External lockable circuit breaker handle for the main panel disconnect.
5. Individual power and control components with internal circuit breakers, as required.
6. Motor controllers, as required by the equipment specifications.
7. Displays with door-in-door construction accessible by opening the cabinet outer door.
8. Face-mounted equipment flush or semi-flush with flat-black escutcheons.
9. Panel tops of wall-mounted panels: mounted at the same elevation.
10. Panel inner door contains a copy of the record elementary and wiring diagrams.
11. Panel inner door contains a drawing holder.
12. Panel drawings enclosed in a transparent, protective jacket.
13. Panel functions as specified.
14. Panels with floor stands, to raise the top of the panel to 60 inches above the floor or work platform.
15. Wall mounting of panel weighs less than 100 pounds, where wall space is available,

## 2.02 ENCLOSURES

### A. GENERAL:

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Panel enclosures shall comply with the requirements of NEMA 250.

**B. MANUFACTURER:**

The enclosures shall be made by:

1. Hoffmann Enclosures, Inc.
2. Rittal.
3. or equal.

**C. PANEL CLASSIFICATION:**

Enclosures and Devices:

1. NEMA Type-12: Installed indoors shall be a modified NEMA 12 with:
  - a. Piano hinge doors
  - b. Breather drains
  - c. Fans and filters
  - d. Sealing washers for mounting hardware
2. NEMA Type-4X: Installed outdoors or in corrosive areas shall be a modified NEMA 4X stainless steel or non-metallic as shown with:
  - a. Piano hinge doors
  - b. Breather drains
  - c. Sealing washers for mounting hardware
3. NEMA Type-7: Installed in Hazardous Areas shall be NEMA 7 with devices per NEC Article 500 requirements for the hazardous area classification.

**D. SIZE:**

The minimum enclosure area, height by width, shall be twice the sum of the area of the individual components mounted on the back panel. The enclosure depth shall depend on the type of components used but shall be no less than 6 inches.

**E. COLOR:**

Exterior: ANSI 61 grey; NEMA Type 4X stainless steel unpainted with smooth, brushed finish.

Interior: White

## 2.03 HEATING, VENTILATING AND AIRCONDITIONING

Forced air ventilation shall be provided for where specified or shown.

Fans shall be equipped with UL-approved washable filters and provide at least 240 cubic feet per minute (cfm). Noise level at 3 feet from exterior wall and 30 degrees off axis shall not exceed 60 NC units. Fans shall be thermostatically controlled.

Air-conditioners shall be provided where indicated. Supply voltage shall be as specified or as shown on the Drawings.

Closed loop systems will be used where ambient air is excessively hot, humid, dusty or contains other contaminants. Refrigerant shall be environmentally safe.

Air-conditioner NEMA rating shall match the enclosure rating it is installed in. Air-conditioners shall be equipped with UL-approved washable filters.

Outdoor cabinets shall also be provided with thermostatically controlled space heaters. If space heater surface temperature exceeds 120 degrees F, an expanded metal guard shall be provided.

Thermostat manufacturer and model:

1. Hoffman A-TEMNO
2. Honeywell T631B1013
3. Penn Controls A28AA-4
4. Or equal.

## 2.04 PANEL WIRING

### A. INTERNAL WIRING:

Internal wiring shall be single conductor 90 degree C copper wire and UL listed for panel wiring. Wire size shall be in accordance with NEC. Internal wiring shall be color coded as specified in Section 16000.

### B. WIRE MARKERS:

Wire markers shall comply with the requirements specified in Section 16000.

### C. WIRING METHODS:

Plastic wireway with covers shall be used to route groups of wires. Wireway fill shall be sized to provide 75% maximum fill. Plastic spiral wrap shall be used for exposed wires. Wires that cross door hinges shall be enclosed in plastic spiral wrap.

#### D. FAIL-SAFE WIRING

Fail-safe wiring of control relay or other on/off device or instrument provides the condition that will occur upon loss-of-power or internal failure in the device such that the relay is de-energized in the failure or loss-of-power condition such that the control relay contact operation provides for equipment failing in a safe mode.

#### 2.05 ALARM AND TROUBLE DETECTION

The equipment control system shall incorporate a non-energized, open-state, output contact to activate on an alarm or trouble condition or on loss-of-power. Detection of a critical alarm or trouble condition shall cause the control system to initiate the shutdown or the operation of the equipment's controlled components to achieve a "Fail-Safe" condition.

Devices that signal an alarm or a trouble conditions shall latch in the alarm position and require a manual reset at the equipment control panel.

##### A. Alarm and trouble output shall:

1. Open an output dry-contact.
2. Remain open until manually reset.
3. Not indicate abnormal condition when the equipment shutdown manually or automatically.
4. Indicate the alarm at the equipment control panel.

##### B. Fail-Safe Design and Operation:

1. Failure of part of a system shall not result in the failure of the rest of the system.
2. Failure of equipment or process shall not propagate beyond the failing device or equipment component.
3. Control design and operation shall prevent improper system functioning due to a circuit malfunction or operator error.
4. Control system design shall cause the controlled equipment to operate in a safe mode in the event of loss-of-power or the failure of a control system component.

#### 2.06 CONTROL DEVICES

Control devices shall comply with Section 16000.

## 2.07 INDICATING LIGHTS

Indicating lights shall be equipped with colored lenses as specified in Section 16000.

## 2.08 SURGE PROTECTION

Surge protectors shall be provided at panel external terminal blocks signal circuits which extend to field devices. Surge protectors shall be Joslyn Model 1663-08, Taylor 1020FA, Transector, or equal.

## 2.09 TERMINAL BLOCKS

Terminal blocks shall be provided in accordance with Section 16000. The terminal block assembly shall be mounted on channel standoffs. Provide 15 percent, but no less than 8, spare terminals available for future use.

## 2.10 LABELING AND NAMEPLATES

### A. LABELING:

Panel components shall be labeled to match the description on the elementary diagram. Internal components of the panel on the back side of the door shall be labeled with the same description as provided on the front side.

Labeling shall be permanently marked on or near each component. Plastic embossed labels such as "Dymo" tape will not be accepted.

### B. NAMEPLATES:

External door-mounted components and the panel description shall be identified with plastic nameplates provided in accordance with Section 16000.

Machine engraved laminated black phenolic nameplates with white lettering shall be provided for panel mounted equipment. Nameplate engraving shall be as specified and shall carry the instrument tag number in 3/32-inch minimum size lettering on the bottom line. Nameplates shall be attached to the panel with a minimum of two self-tapping 316 stainless steel screws.

The supplier agrees that nameplate wording may be changed without additional cost or project time extension, if changes are during the submittal process and made prior to commencement of engraving.

Machine embossed metallic adhesive labels shall identify tag number of instruments inside panels. Nameplates shall be attached to panel surfaces, not to instruments.

## 2.11 GROUNDING

Panels shall be provided with two copper ground bars:

- A. One bar bonded to the panel frame and to the station ground system, typically located in the power section.
- B. Second (signal) ground bar mounted on insulated stand-offs and bonded to the frame ground bar at one point only, typically located in the control section and bonded to the signal ground bar:
  - a. Signal circuits
  - b. Signal cable shields
  - c. Low-voltage direct current (24Vdc) power supply commons

Surge protectors and separately derived AC power supplies, such as 120Vac receptacles, shall be bonded to the frame ground bar. In panel line-ups exceeding 30-inches width, ground bars shall be 1/4- by 1-inch copper bars extending the entire length of the panel.

Neutrals of locally derived control circuits shall be grounded to the mounting plate using a copper bus or grounding lug.

Provide a grounding lug for a size No. 2 AWG bare copper conductor to connect the panel to the facility ground grid system.

## 2.12 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

- 1. Operations and maintenance information as specified in Section 01730.

## PART 3--EXECUTION

### 3.01 GENERAL

Field verify the following:

- 1. Panel control circuits grounded with one terminal of each load device connected to the grounded conductor.
- 2. Panel signal and control wiring separated and installed in separate wireways with barriers between the power wiring and the signal and control wiring.
- 3. Panel connected to the plant grounding system as specified.
- 4. Panel tops of wall-mounted panels shall be mounted at the same elevation.
- 5. Panel inner door contains a copy of the record elementary and wiring diagrams.
- 6. Panel inner door contains a drawing holder.

7. Panel drawings enclosed in a transparent, protective jacket.
8. Panel functions as specified.
9. Panel mounted with stainless steel unistrut, fittings, and fasteners.

### 3.02 MOUNTING

Control panels supported directly by concrete or concrete block walls shall be spaced out not less than 5/8 inch by framing channel between instrument and wall. Sills shall be leveled so panel structures will not be distorted. Panels shall be shimmed to precise alignment so doors operate without binding and mounted where shock or vibration will impair its operation.

Support systems shall not be attached to handrails, process piping or mechanical equipment. Control panels supported directly by concrete or concrete block walls shall be spaced out from the wall to provide for air circulation around the panels.

Steel used for support of equipment shall be 316 stainless steel. Support systems including panels shall be designed to prevent deformation greater than 1/8 inch under the attached equipment load and an external load of 200 pounds in any direction.

Floor-mounted cabinets, except in dry control rooms or electrical equipment rooms, shall be mounted on 3-1/2-inch minimum height concrete pads or grouted bases as specified.

Panels shall be shimmed to precise alignment so doors operate without binding. Sealant shall be provided under panels not located in dry control or electrical equipment rooms.

Terminals and terminal blocks shall be sprayed with a silicone resin similar to Dow Corning R-4-3117 conformal coating, after all terminations and testing have been completed.

### 3.03 FACTORY TESTING

The control panel shall be assembled, interconnected, and functionally tested at the assembly shop prior to shipment.

The Owner/Engineer/Construction Managers shall have the option of witnessing the functional shop test. The Contractor shall notify the Owner/Engineer/Construction Manager at least two weeks in advance prior of the scheduled functional shop test.

### 3.04 FIELD TESTING

Panels shall be tested in accordance with Section 16030.

**\*\*END OF SECTION\*\***

## SECTION 16262

### MANUAL TRANSFER SWITCHES

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

This section specifies manual-transfer-switches (MTS) rated 600 volts or less for lighting, HVAC, and motor loads with ratings specified on the drawings. Double throw switches will not be acceptable.

##### 1.03 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid or on the effective date of the Agreement if there were no Bids.

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
NEMA ICS 6	Enclosures for Industrial Controls and Systems
NEMA ICS 10-1993	AC Transfer Switch Equipment
NEC Article 702	National Electrical Code: Optional Standby Systems
NFPA 70	National Electrical Code
NFPA 110	Standby Power Systems
UL 508	Industrial Control Equipment
UL 1008	Standard for Manual Transfer Switches

Reference	Title
UL 1087	Molded Case Switches

#### 1.04 QUALITY ASSURANCE

##### A. LISTING, LABELING, AND MANUFACTURING:

The MTS shall conform to Underwriters Laboratory's UL 508 for Industrial Control Equipment and listed or labeled per UL 1008 and 1087. The MTS enclosure shall be per NEMA Standards ICS 6 and ICS 10. The MTS shall conform to NFPA 110 for Emergency and Standby Power System components.

##### B. TESTS AND CERTIFICATION

The complete MTS shall be factory tested to ensure proper operation of the individual components are in compliance with the specification requirements.

##### C. SUBMITTALS:

The following submittals shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

*Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. Arrangement drawings of the transfer switch enclosure indicating the front door and rear panel equipment arrangement and dimensions.

3. List of materials and components shall accompany the arrangement drawing.
4. Elementary and internal connection diagrams.
5. Manufacturers' data marked to indicate momentary, interrupting, and continuous current ratings.

## PART 2--PRODUCTS

### 2.01 MANUFACTURERS

The Owner and Construction Manager believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section.

This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section.

Candidate manufacturers include Emerson (ASCO), Cummins, Caterpillar, GE-Zenith, or equal.

### 2.02 RATING

The voltage, current, frequency and number of poles shall be as specified and shown.

The MTS shall be rated 600 Vac or less and rated to close onto and withstand a fault of 65,000 symmetrical amperes. The MTS shall be labeled with ratings. Series rating components are not acceptable.

Withstand and Closing Ratings: The MTS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the MTS terminals with the type of overcurrent protection shown on the plans.

Provide the following MTS withstand and closing ratings for circuit breakers systems:

MTS Current Rating	Withstand & Closing Rating MCCB	With Current Limiting Fuses
30 – 200	22,000A	200,000
225 – 400	42,000A	200,000
600 – 1200	65,000A	200,000

1600 – 2000	85,000A	200,000
2600 – 3000	100,000A	200,000

## 2.03 FACTORY TESTS

The MTS shall be factory tested to ensure proper operation.

## 2.04 MONITORING – NOT USED

## 2.05 TERMINATIONS

Arrange internal equipment items for power cable top entry and top exit.

Provide copper bus, terminations and connections.

Standard switch configuration:

1. Standby power source lugs: Top
2. Power load lugs: Top
3. Normal power source lugs: Bottom

Provide ground bus and connection lugs.

## 2.06 ENCLOSURE

The enclosure shall be floor or supported from the floor mounted and shall be suitable for locations as indicated on the drawings and as described below:

1. NEMA 1 general purpose enclosure: Surface or flush mounted general purpose enclosures primarily intended for indoor use.
2. NEMA 12 dust-tight enclosures intended for indoor use primarily to provide protection against circulating dust, falling dirt and dripping non-corrosive liquids.
3. NEMA 3R rain-tight enclosures intended for outdoor use primarily to provide protection against rain, sleet and damage from external ice formation.
4. NEMA 4 and NEMA 4X (stainless steel) watertight enclosures intended for indoor or outdoor use primarily to provide protection against windblown dust and rain, splashing rain, hose-directed water, and damage from external ice formation.

The enclosure painted finish shall be per Section 09900, ANSI-61 Gray. Stainless steel enclosures shall not be painted.

## 2.07 NAMEPLATES

The switch shall be identified as indicated on the drawings and nameplates shall be provided in accordance with the requirements of Section 16000.

## 2.08 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Operating and maintenance information including product data specified in Section 01730.
2. Final reviewed submittal, record drawings, MTS factory and field test included in the O&M data.

## 2.09 Options – NOT USED

# PART 3--EXECUTION

## 3.01 FIELD TESTS

The following tests shall be performed on the equipment provided under this section. Tests shall be in accordance with the latest version of UL and NEMA standards.

1. Electrical insulation check to verify the integrity and continuity of the system
2. Visual inspection to ensure that the switch matches the specification requirements and to verify fit and finish meet quality standards
3. Mechanical tests to verify that the switch's power sections are free of mechanical hindrances

The manual transfer switch shall be acceptance field tested in accordance with Section 16030.

**\*\*END OF SECTION\*\***

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## SECTION 16311

### LOW VOLTAGE SWITCHBOARDS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

This section specifies indoor, front accessible, deadfront power distribution switchboards rated 600 volts, 3 phase, 60 hertz, with integral surge protective device (spd) within each switchboard, in accordance with specifications section 16445, surge protection device.1.02 quality assurance.

##### A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI C57.13	Requirements for Instrument Transformers
IEEE	Institute of Electrical and Electronic Engineers
NEMA PB 2	National Electrical Manufacturer Association Deadfront Distribution Switchboards
UL 891	Underwriters Laboratory - Deadfront Switchboards

##### B. LISTED PRODUCTS:

Electrical equipment and materials shall be listed for the purpose per Section 16000.

##### C. FACTORY TESTS

Switchboards shall be tested for operation at the specified voltage and current ratings after assembly. The main circuits shall be given a dielectric test of 2200 volts for 1 minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for 1 minute between live parts and ground.

Instrument transformers shall have ratio and phase angle tests made in conformance with ANSI C57.13.

### 1.03 SUBMITTALS

The following information shall be submitted in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. A copy of the contract document single line diagrams, building plan, and elevation drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "*no changes required*". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
3. Catalog data on all electrical devices and components mounted on or within the switchboard.
4. Manufacturer's data indicating interrupting, withstand, and continuous current ratings of all relevant equipment and components.

5. Arrangement and layout drawings of the switchboard enclosures indicating equipment and bus arrangement and dimensions including areas of permissible cable entries. A list of material and components shall accompany the layout drawings. Include weight and shipping split data.
6. Manufacturer's certification that equipment meets the seismic requirements.

#### 1.04 PROJECT/SITE CONDITIONS

Ambient and seismic conditions shall be as specified in paragraph 16000-1.05.

### PART 2--PRODUCTS

#### 2.01 MANUFACTURERS

Switchboards shall be provided in accordance with UL 891, NEMA PB 2, and as specified. Provide Arc Flash mitigation products that are offered in the manufacturer's literature.

The Owner and Construction Manager believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. Candidate manufacturers include:

- A. Schneider – Square D equal (Basis of design QED-2 Switchboard)
- B. Eaton Cutler-Hammer "Pow-R-Line" with Magnum DS breakers
- B. ABB/General Electric Co. "AV Line" with "Power Break" breakers
- C. Siemens equal
- D. or approved equal

#### 2.02 CONSTRUCTION

##### A. ARRANGEMENT:

Switchboards shall be new, deadfront, indoor type, metal enclosed, self-supporting, and suitable for 600 volts, 3 phase, 3 wire service. Suitable for mounting against a wall without back access.

Switchboards shall be provided with vertical sections bolted together to form rigid units with switching and protective devices of the number, rating, and type specified.

Interconnections, instrumentation, and control wiring shall be completed in the factory so that site work is limited to bolting shipping sections and connecting cable assemblies.

B. STRUCTURE:

Structural members shall be universal frame die formed type, bolted and braced using self-tapping bolts. Cover plates shall be steel having formed edges. Front plates shall be sectionalized and removable. Lifting eyes shall be provided and switchboards shall be capable of being rolled or moved into position and bolted directly to the floor without the use of floor sills. Switchboard enclosure rating shall be NEMA-1.

C. FINISH:

The finish shall comply with Section 16000.

2.03 COMPONENTS

A. BUS BARS:

Buses shall be tin-plated copper of sufficient size to limit the temperature rise to 65 degrees C, based on UL 891.

Unless otherwise specified, buses shall be braced to withstand short circuit stresses up to 65,000 RMS amperes. Main horizontal bus shall be mounted on glass polyester insulators and shall have the continuous capacity specified.

A ground bus having a momentary rating at least equal to the highest momentary rating of any circuit breaker in the assembly shall extend the full length of the switchboard. Ends of the ground bus shall be provided with clamp-type terminals for No. 4/0 AWG bare copper grounding conductors.

B. CIRCUIT BREAKERS:

1. GENERAL: Circuit breakers shall be stored energy type mechanism to provide quick-make, quick-break, trip-free operation:

- a. Insulated case UL listed 100 percent continuous current capacity.
- b. Molded case UL listed 80 percent continuous current capacity.
- c. Ground fault protection shall be provided as specified or indicated.

Circuit breakers shall provide manual switching operation by means of a low-torque handle or pushbutton on the front of the unit. Automatic operation during overload and short circuit conditions shall be provided by solid state or thermal magnetic tripping devices located in the circuit breaker frame as specified on the drawings.

Circuit breakers shall be front accessible, stationary, individually mounted, and shall have short circuit capabilities equal to or greater than the system in which they are installed.

Circuit breakers shall have a minimum interrupting current of 65,000 amperes symmetrical RMS at 480 Vac.

2. Energy Reduction Maintenance Setting (ERMS) System: For circuit breakers 1200 A and above, provide energy reduction maintenance settings (ERMS) system (Square D or engineer approved equal) to temporarily reduce the instantaneous pickup setting of circuit breaker, with local padlockable switch with cover, and blue indication light, unless noted otherwise. Provide all associated components and programming required to monitor the ERMS switch status at the local control panel (LCP) and Central Control Panels via SCADA.

3. STATIC TRIPPING DEVICES: Solid state static tripping devices shall consist of current sensors, logic assembly, magnetic latch release, and required interconnecting wiring. Tripping devices shall be automatic and self-contained within the breaker frame and shall not require any external relaying or power supplies.

Tripping functions shall be field adjustable and contain the following tripping characteristics:

- a. Overload tripping:
  - 1) Adjustable ampere setting
  - 2) Adjustable long-time delay
- b. Short circuit tripping:
  - 1) Adjustable short-time pickup
  - 2) Adjustable short-time delay
  - 3) Adjustable instantaneous pickup
- c. Ground fault tripping:
  - 1) Adjustable ground fault pickup
  - 2) Adjustable ground fault delay

#### C. POWER METERS :

Power Meters shall be provided as shown on drawings, including accessories. These meters shall be network connected to plant SCADA system.

#### D. NAMEPLATES:

In addition to the manufacturer's identification, switchboards shall be provided with phenolic nameplates indicating switchboard, main breaker, and feeder breaker designations as specified. Nameplates shall comply with Section 16000 and the NEC for uniquely labeling the power loads and using equipment Tag Numbers and Tag Descriptions where shown on the drawings or schedules.

E. CONDUCTOR MARKERS:

Conductor markers shall comply with Section 16000.

F. WIRING:

Internal switchboard wiring shall consist of single conductor SIS 90 degree C copper wire and UL listed for panel wiring. The wire shall be sized to suit load requirements. Minimum size shall be No. 14 AWG.

2.04 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Results of breaker setting tests as specified in paragraph 16311-3.02.
2. Operation and maintenance information as specified in Section 16000, including final reviewed submittal.

PART 3--EXECUTION

3.01 PROTECTIVE DEVICE SETTINGS

The protective relays and static tripping devices shall be adjusted to the settings specified in the protective device coordination study in Section 16431 prior to energizing the switchboard.

The instrument transformer ratios and protective devices shown on the drawings are preliminary and are subject to confirmation with the coordination study in Section 16431.

3.02 FIELD TEST

Each switchboard breaker shall be tested in accordance with Section 16030 – Testing.

**\*\*END OF SECTION\*\***

## SECTION 16322

### PAD MOUNT DISTRIBUTION TRANSFORMERS

#### 1.01 DESCRIPTION

This section specifies three-phase, 60-Hertz liquid-filled, self-cooled/forced air-cooled (OA/FA) pad-mounted transformers used for the project power distribution system. Rated kVA capacity, primary and secondary voltages, primary and secondary winding connections, and special features as specified or shown on the Drawings.

#### 1.02 QUALITY ASSURANCE

##### A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI C57.12.00	General Requirements for Distribution, Power, and Regulating Transformers
ANSI C57.12.26	Transformers - Pad Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use With Separable Insulated High-Voltage Connectors, 34,500 Grounded-Y/ 19,920 Volts and Below; 2500 KVA and Smaller
ANSI C57.12.90	Test Code for Distribution, Power, and Regulating Transformers
ANSI / IEEE C62.22	Arrester Ratings

##### B. FACTORY TESTS:

Conduct the following tests on the transformers at the factory in accordance with ANSI C57.12.90.

1. Resistance Measurements of all windings on the rated voltage connection of each unit and at the tap extremes.
2. Ratio Test on the rated voltage connection and on all tap connections.
3. Polarity and phase-relation tests on the rated voltage connection.
4. No-load and excitation current at rated voltage and frequency on rated voltage connection.
5. Impedance and load loss at rated current and frequency on the rated voltage connection and on the tap extremes.
6. Applied potential tests.
7. Induced potential tests.
8. Mechanical leak test on tank and coolers.

### 1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

*Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification*

*requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. Manufacturer's standard literature describing the equipment
3. Nameplate information in accordance with ANSI 57.12.00.
4. Winding basic impulse level ratings.
5. Certified report of the tests listed above.
6. Certification that the insulating fluid furnished is PCB free.
7. Outline and layout drawings indicating equipment arrangement, cable entries, dimensions, and weight.
8. Schematic and wiring diagrams.

## PART 2--PRODUCTS

### 2.01 MANUFACTURERS

Transformers shall be built in accordance with ANSI C57.12.00, and ANSI C57.12.10. Transformers shall be modified to meet specified requirements.

The Owner and Construction Manager believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section.

Candidate manufacturers include:

- A. Square D, Class 7230
- B. Asea Brown Boveri
- C. General Electric
- D. Cooper Power Systems
- E. or equal

### 2.02 CHARACTERISTICS

#### A. RATING:

The self-cooled transformers shall be dual rated, three phase, 60-Hertz with a temperature rise of 55/65 degrees C. The transformers shall deliver the specified kVA rating at the 55 degree

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C temperature rise and 12 percent additional capacity at the 65 degree C rise. The voltages, voltage impedance, and kVA rating shall be as specified or as shown on the Drawings or Schedules.

C. COOLANT:

Furnish vegetable ester oil (e.g. Envirottemp FR3) as a coolant and insulating medium.

D. WINDINGS:

The transformers shall have winding configurations as specified. The primary winding shall be provided with two 2 1/2 percent taps above and below the specified voltage. Provide copper windings.

Provide windings, bushings, terminal compartments, and associated equipment to meet the following BIL requirements.

Primary Rated Voltage	BIL-kV	Secondary Rated Voltage	BIL-kV	
4,160	60	480Y/277	30	

## 2.03 ACCESSORIES

Transformer accessories shall consist of the following: drain, filter, and sampling valve; de-energized tap changer with external operator located in the high voltage compartment ; pressure test connection; 1-inch filling plug and filter press connection in cover; dial-type thermometer; liquid level gage; provisions for lifting and jacking; instruction nameplate; two ground pads; welded-on main tank cover; and surge arresters.

## 2.04 SURGE ARRESTERS

Distribution type, heavy duty surge arresters shall be provided in accordance with the IEEE C62.22 Arrestor Rating requirements for the winding and grounding configurations shown: Bushing with elbow type, gapped, metal oxide varistor (MOV) arrestors.

## 2.05 BUSHINGS AND CONNECTING EQUIPMENT

High voltage termination shall be universal wells for use with terminal inserts and elbow terminators. Low voltage bushings shall be molded epoxy and provided with blade type spade terminals with NEMA standard hole spacing arranged for vertical takeoff. The low voltage neutral shall be an insulated bushing grounded to the transformer tank by removal grounding strap.

The high voltage and low voltage terminations and equipment shall be located side-by-side separated by a steel barrier. When facing the transformer, the low voltage compartment

shall be on the right. Terminal compartments shall be full height, air filled with individual doors. The high voltage door fastenings shall not be accessible until the low voltage door has been opened. The low voltage door shall have a three-point latching mechanism with vault type handle having provisions for a single padlock and be secured by a guarded penta-head captive bolt.

The doors shall be equipped with lift-off type stainless steel hinges and door stops to hold the doors open when working in the compartments. The front sill of the compartment shall be removable to allow the transformer to be rolled or skidded into position over conduit stubs. ANSI tank grounding provisions shall be furnished in each compartment.

## 2.07 FINISH

The finish shall comply with paragraph 16000-2.01. Outdoor enclosures shall be factory painted with ANSI 61, light gray.

## 2.08 NAMEPLATES

Nameplates shall be provided in accordance with the requirements of paragraph 16000-2.04.

## 2.09 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

1. Operation and maintenance information as specified in Section 01730 including:
  - a. Complete reviewed submittals.
  - b. Manufacturer's maintenance instructions.
  - c. Coolant manufacturer name and type.

## PART 3—EXECUTION

### .01 INSPECTION

Physically inspect the transformer upon receipt. Document in writing and with photographs any damage discovered. Arrange for repair as directed by the Construction Manager or Engineer of any damage discovered.

### 3.02 INSTALLATION

Install and connect the transformer as shown in the Construction Documents and in accordance with the Manufacturer's recommendations.

### 3.03 TESTING

Transformers shall be tested in accordance with Section 16030 - Testing.

**\*\*END OF SECTION\*\***

## SECTION 16431

### ARC FLASH ANALYSIS, SHORT CIRCUIT STUDY, AND PROTECTIVE DEVICE COORDINATION REPORT

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. GENERAL:

This section specifies that the Contractor subcontract an independent full member NETA Engineering and Study Firm / Testing Firm to prepare:

1. Electrical equipment short circuit study (SCS) for all facility new and existing equipment.
2. Protective device coordination study (PDCS) report for all equipment in the facility electrical distribution power system.
3. Arc flash analysis (AFA) and labeling for all equipment.

The Testing Firm shall be as described in Section 16030 and shall also be responsible for the electrical testing described therein.

###### B. SCOPE:

The Short Circuit and Protective Device Coordination Report shall include analysis including Utility Company equipment that affect the installed equipment's short circuit ratings, protective device ratings and protective device settings.

Report shall also include analysis of the equipment's short circuit ratings, protective device ratings and protective device settings affected by the installed equipment.

Report shall include the results of the arc flash hazard analysis study for energized electrical equipment in accordance with the methods outlined in IEEE Standard 1584 and stated hereinafter.

Work shall include the fabrication of signs with the arc flash hazard study results and the installation of the signs on the equipment in accordance with NFPA 70E Table 3-3.9.3 that includes the personnel protective equipment (PPE) risk category, the energy available, and the clothing recommendation.

Scope of work described above and herein shall utilize standard industry power distribution modeling software to provide analysis and produce reports. The Engineering and Study Firm shall use the latest version of SKM Power Tools.

## 1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEEE 141	Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
NETA ATS	Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, 1999

## 1.03 SCHEDULE

The report shall be completed, submitted to the Engineer for acceptance and reworked to include the Engineer comments and corrections, as required. The report shall be approved by the Engineer prior to purchase and fabrication of electrical equipment including switchgear.

A copy of the Construction Manager accepted report shall be sent by the Contractor to all affected manufacturers prior to fabrication.

## 1.04 SUBMITTALS

The report specified in this Section shall be provided in accordance with Section 01300.

## PART 2--PRODUCTS

### 2.01 REPORT

The product shall be a certified report summarizing the short circuit and coordination study and conclusions or recommendations which may affect the integrity of the electric power distribution system. As a minimum, the report shall include the following:

1. The equipment manufacturer's information used to prepare the study.
2. Power Utility Company system information applicable to the project.
3. Short circuit calculations listing short circuit levels at each bus. Provide a sketch of the bus and use both the project term and the bus-code-name to identify the bus, branches, sources, loads. Base the system on the Project One-Line diagram.
4. Coordination study time-current curves including the instrument transformer ratios, model numbers of the protective relays, and the relay settings associated with each breaker.
5. Comparison of short circuit duties of each bus to the interrupting capacity of the equipment protecting that bus.
6. Data used as input to the report that includes cable impedances, source impedances, equipment ratings for the equipment being purchased for the project, etc.
7. Assumptions made during the study. Provide three (3) copies of the final SKM model (all SKM and associated files) of the system as a part of the report on CD/DVD.

## PART 3--EXECUTION

### 3.01 GENERAL

Provide a short circuit and coordination study on the electrical power distribution system as specified and as described in Section 6.1 of NETA ATS. The studies shall be performed in accordance with IEEE Standards 141 and 242 and shall utilize the ANSI method of short circuit analysis in accordance with ANSI C37.010.

The studies shall be performed using actual equipment data for both existing and new equipment. The coordination study shall use the data from the same manufacturer of protective relay devices as being provided by the switchgear manufacturer.

For new equipment, the Contractor shall provide copies of final reviewed equipment submittals upon request by the Study Firm.

For existing equipment, the Study Firm shall provide **all** onsite investigation to identify loads and power distribution equipment data.

Any power distribution equipment outages shall be scheduled in advance and coordinated with the Owner to limit process outages as required per plant process capacities, refer to Sections 01015, 01040, and 16000.

### 3.02 QUALIFICATIONS

The short circuit and coordination report shall be performed by the Testing Firm as described in Section 16030. The studies shall be signed by the professional electrical engineer responsible for the studies and registered to practice engineering in the state in which the project is located.

### 3.03 SHORT CIRCUIT STUDY

The Contractor shall be responsible to obtain and verify all data needed to perform the study. As a minimum, the short circuit study shall include the following:

#### A. One-Line Diagram

1. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.
2. Type designation, current rating, range or adjustment, manufacturer's style and catalog number for all protective devices.
3. Power, voltage ratings, impedance, primary and secondary connections of all transformers.
4. Type, manufacturer, and ratio of all instrument transformers energizing each relay.
5. Nameplate ratings of all motors and generators with their subtransient reactances. Transient reactances of synchronous motors and generators and synchronous reactances of all generators.
6. Sources of short circuit currents such as utility ties, generators, synchronous motors, and induction motors.
7. Significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc.

8. Emergency as well as normal switching conditions, as applicable.
9. The time-current setting of existing adjustable relays and direct-acting trips, as applicable.

B. Impedance Diagram

1. Available MVA, voltage, and impedance from the power utility company.
2. Local generated capacity impedance.
3. Bus impedance.
4. Transformer and/or reactor impedances.
5. Cable impedances.
6. Equipment impedances.
7. System voltages.
8. Grounding scheme for the project: resistance grounding, solid grounding, or no grounding.

C. Calculations

1. Determine the paths and situations where short circuit currents are the greatest.
2. Study shall address bolted faults and calculate the 3-phase and line-to-ground short circuits of each case.
3. Calculate the maximum and minimum fault currents.

### 3.04 ARC FLASH ANALYSIS

The Contractor shall be responsible to obtain and verify all data needed to perform the study. The arc flash analysis study shall include the following IEEE Standard 1584 nine step analysis process:

1. Collect system and installation data.
2. Determine modes of operation.
3. Determine bolted fault current.
4. Determine arc fault current.
5. Determine protective device characteristic and arc fault duration.
6. Document system voltages and equipment class.

7. Select working distances.
8. Calculate incident energy.
9. Calculate the arc flash protection boundary.

### 3.05 PROTECTIVE DEVICE COORDINATION STUDY

As a minimum, the coordination study for the power distribution system shall include the following on 5-cycle, log-log graph paper:

1. Time-current for each protective relay or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and the tap and time dial settings shall be specified.
2. Time-current curves for each device shall be positioned to provide for maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the Construction Manager shall be notified as to the cause.
3. Time-current curves and points for cable and equipment damage.
4. Circuit interrupting device operating and interrupting times.
5. Indicate maximum fault values on the graph.
6. Sketch of bus and breaker arrangement.

### 3.06 IMPLEMENTING PDCS SETTINGS AND ARC FLASH SIGN INSTALLATION

The Testing Firm shall implement the protective device coordination study settings on new and existing equipment as required in Section 16030, based on the Engineers accepted Protective Device Coordination Report specified herein and submit a final amended report of the Record As-Built electrical equipment protective device settings subsequent to start-up and testing.

The Testing Firm shall work with the Contractor and the Study Firm for implementing the Arc Flash Hazard sign installation requirements for electrical equipment as specified in NEC Article 110.16 Flash Protection and NFPA 70E.

**\*\*END OF SECTION\*\***

## SECTION 16445

### SURGE PROTECTIVE DEVICES

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

Surge Protective Devices (SPD) replaces the Transient Voltage Surge Suppressors (TVSS) based on the National Electrical Code requirements.

###### A. SCOPE:

Provide SPD with electrical characteristics and ratings for service entrance equipment, switchboards SWBD-7 and SWBD-8, integral to the Switchboards, specified in the Division 16 electrical distribution equipment specification sections or indicated on the Drawings. Provide SPD with the same voltage, phase, 3 or 4 wire system as the host electrical equipment.

###### B. EQUIPMENT LIST:

##### 1.02 QUALITY ASSURANCE

###### A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI / Underwriters Laboratories 1449 3rd Edition	Surge Protective Devices
Underwriters Laboratories 1283 3rd Edition	Electromagnetic interference filter for noise attenuation
MIL STD 220A, Rev A, Change Notice #2	Method of Insertion Loss Measurement
National Electrical Code 2008 Article 285	Surge-Protective Devices (SPDs), 1 kV or Less
NEMA LS-1	National Electrical Manufacturers Association: Low Voltage Surge Protective Devices
C-UL	Canadian Underwriters Laboratories
ANSI / IEEE C62.41	American National Standards Institute/Institute of Electrical and Electronic Engineering Inc.

### 1.03 RELATED SPECIFICATIONS

#### A. Division 16:

1. Section 16311 - Switchboards
2. Section 16000 - Panelboards

### 1.04 SUBMITTALS

#### A. The following information shall be submitted to the Engineer:

Submittals and transmittal procedures for submittals are defined in Section 01300. Submittals should be required for the following conditions:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole.
2. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The

remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

3. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "*no changes required*". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review."
5. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL).
6. Compliance: File number verified on UL's website or other NRTL's website, with the following information:
  - a. Model number
  - b. SPD Type
  - c. System voltage, phases
  - d. Protection modes
  - e. Voltage Protection Rating (VPR)
  - f. Nominal Discharge Current (In).
7. Drawings showing unit dimensions, weights, installation instruction details, and wiring configuration for sidemount SPD mounted external to electrical assembly.

## 1.05 PRODUCT DATA

- A. The following information shall be submitted:
  1. Final Record as-built drawings and information.

## 1.06 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

- B. The manufacturer shall be ISO 9001 or ISO 9002 certified for the equipment specified herein.
- C. The manufacturer shall have produced similar electrical equipment for a minimum period of five years.

#### 1.07 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions.
- B. One copy of manufacturer's instructions shall be included with the equipment at time of shipment.

#### 1.08 OPERATION AND MAINTENANCE MANUALS

- A. Operation and maintenance manuals shall be provided with each SPD shipped.

### PART 2--PRODUCTS

#### 2.01 MANUFACTURERS

The listing of manufacturers does not imply acceptance of products that do not meet the specified ratings, features, and functions. Manufacturers listed shall meet the specifications in their entirety.

Products in compliance with the specification and manufactured by others not named will be considered if pre-approved by the Engineer ten days prior to bid date.

- A. ABB
- B. Eaton Cutler-Hammer
- B. General Electric
- C. Siemens
- D. Accepted equal

#### 2.02 SURGE PROTECTIVE DEVICES

- A. ELECTRICAL REQUIREMENTS:
  - 1. Refer to drawings for operating voltage and unit configuration.

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2. Maximum Continuous Operating Voltage (MCOV): Not be less than 125% of the nominal system operating voltage.
3. SPD suppression system include thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and other distribution levels.
4. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may lead to system upset or create environmental hazards.
5. SPD shall protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

Configuration	Protection modes			
	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

6. Nominal Discharge Current (In): SPDs applied to the distribution system shall have a 20kA In rating that include Types 1 and 2 or operating voltage. SPD's with "In" that is less than 20kA, shall be rejected.
7. Voltage Protection Rating (VPR): The maximum VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

**B. SURGE PROTECTIVE DEVICE DESIGN:**

1. SPD's containing replaceable modules, replaceable fuses, replaceable batteries, requiring maintenance, or requiring diagnostic test kit shall not be accepted.
2. **BALANCED SUPPRESSION PLATFORM:** The surge current shall be equally distributed to MOV components for equal stressing with equal impedance paths to each matched MOV.

3. ELECTRICAL NOISE FILTER: EMI/RFI noise rejection filter for noise attenuation of line noise of 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.
4. INTERNAL CONNECTIONS: Plug-in component modules or printed circuit boards shall not be used as surge current conductors. Components shall be soldered, hardwired with connections utilizing low impedance conductors.
5. MONITORING DIAGNOSTICS: SPD monitoring:
  - a. STATUS: Green / red solid-state indicator light for status of the protection on each phase.
    - (1) For wye configured units, provide indicator lights for status of protection elements and circuitry in the L-N and L-G modes and in the N-G mode.
    - (2) For delta configured units, provide indicator lights status of protection elements and circuitry in the L-G and L-L modes.
    - (3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode.
    - (4) Status indicators indicate the protection on each phase or mode. If power is removed from any one phase, the indicator lights shall indicate the status of the protection on other phases and protection modes.
  - b. REMOTE ALARM: Provide Form C dry contacts (one NO and one NC) for remote annunciation. Both contacts change state under fault condition.
  - c. AUDIBLE ALARM AND SILENCE BUTTON: Audible alarm activates upon fault conditions. Alarm silence button silences the audible alarm.
  - d. SURGE COUNTER: LCD display indicates number of surges and trigger each time a surge event with a peak current magnitude of a minimum of  $50 \pm 20A$  occurs. A reset pushbutton allows the surge counter to be zeroed and contains a mechanism to prevent accidental resetting of the counter.
6. Overcurrent Protection:

- a. The unit shall contain thermally protected MOVs shall disconnect the MOV(s) from the system during a thermal runaway condition.
- 7. DESIGN: SPD's components and diagnostics shall be contained within one discrete assembly.
- 8. Safety Requirements:
  - a. SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts.
  - b. SPD's designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit and required conductors be factory installed.
  - c. Sidemount SPD's shall be factory sealed in order to prevent access to the inside of the unit with factory installed phase, neutral, ground and remote alarm contacts shall have conductors protruding outside of the enclosure for field wiring.

## 2.03 SYSTEM APPLICATION

- A. SPD include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- B. The minimum surge current capacity:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations, Switchboards, Switchgear, MCC, Main Entrance	250 kA	125 kA
	High Exposure Roof Top Locations and Distribution Panelboards	160 kA	80 kA
A	Branch Locations: Panelboards, MCCs, Busway	120 kA	60 kA

- C. SPD's installed on the line side of the service entrance disconnect: Type 1.
- D. SPD's installed on the load side of the service entrance disconnect: Type 1 or 2.

## 2.04 PANELBOARDS

- A. SPD application includes lighting and distribution panelboards, tested for application within ANSI/IEEE C62.41 Category B environments.
1. SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
  2. SPD's installed following the load side of the main breaker and in main lug only panelboards installed following the incoming main lugs.
  3. SPD interfaced to the panelboard via a direct bus bar connection. Or SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors integrally to the SPD and located directly adjacent to the 30A circuit breaker.
  4. SPD shall be mounted within the panelboard by the manufacturer.
  5. SPD shall be of the same manufacturer as the panelboard.
  6. Panelboard including the SPD shall be UL67 listed.
- B. SIDEMOUNT MOUNTING (SPD mounted external to electrical assembly):
1. Lead length between the breaker and suppressor shall be short as possible.
- C. SWITCHGEAR, SWITCHBOARD, MCC AND BUSWAY REQUIREMENTS:
1. Service entrance located SPD's shall be tested within ANSI/IEEE C62.41 Category C environments.
  2. SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway.
  3. SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer.
  4. Locate SPD on the load side of the main disconnect device, close to the phase conductors and the ground/neutral bar.
  5. SPD connected through a disconnect (30A circuit breaker) located in immediate proximity to SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD shall be as short as possible per the factory specifications.
  6. Monitoring and diagnostic features shall be visible on the front of equipment.

## 2.05 ENCLOSURES

### A. Enclosed equipment shall have enclosures:

1. NEMA 1: Constructed of polymer for units integrated within electrical assemblies or steel for sidemount units for indoor use that provide protection against the ingress of solid foreign objects and falling dirt.
2. NEMA 4: Constructed of steel intended for either indoor or outdoor use to provide protection against access to hazardous parts; to provide protection from the ingress of rain, sleet, snow, splashing water, and hose directed water; and undamaged by the external formation of ice on the enclosure on sidemount units.
3. NEMA 4X: Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection on sidemount units.

## PART 3--EXECUTION

### 3.01 GENERAL

Host equipment Manufacturer's representative shall visit the site, verify installation and testing, and verify that the SPD equipment and SPD installation meets intent of the Contract Documents and manufacturer's warranties and that the guarantees are in effect.

### 3.02 INSTALLATION

- A. Install according to manufacturers recommendations.
- B. Lead lengths shall not exceed manufactures recommendation.
- C. Electrical equipment manufacturer shall authorize and perform bus taps connections, as necessary.

### 3.03 TRAINING

Provide a minimum of 1-hours of training for similar SPD systems and conforming to the requirements of Section 01664. Training shall be certified on Form 11000-B specified in Section 01999.

### 3.04 WARRANTY

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The manufacturer shall provide a ten year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and applicable national or local code.

**\*\*END OF SECTION\*\***

## SECTION 17000

### GENERAL REQUIREMENTS FOR INSTRUMENTATION AND CONTROL

#### EPART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies general requirements which are applicable to providing a complete, functional process control system for the SWWRF and SEWRF Belt Filter Press Rehabilitation. The requirements of this section are applicable to all work specified in Division 17 of these specifications.

Electrical requirements applicable to this work include those specified in Section 16000 for general electrical requirements; and Section 16176 for control panels.

###### B. DESCRIPTION OF WORK:

1. INSTRUMENTATION AND CONTROL SYSTEM: Currently there are individual BFP control panels which utilize relay logic to start and stop the booster pumps, hydraulic pumps, belt drives, and washwater solenoid. The work at SWWRF consists of replacing the existing Belt Filter Control Panels and Sludge Pump Control Panels with new Control Panels and adding a new Control Panel for the existing Unloading Conveyor. The New Vendor Supplied SP6-1 and SP6-2 Control Panels located in the Electrical Room will have PLCs that will take the place of the relay logic and be capable of starting and stopping all of the BFPs, sludge pumps, conveyors and polymer feed pumps. SP6-1 (SWR85-VCP-101) and SP6-2 (SWR85-VCP-102) will include motor starters and VFDs for the BFP equipment and also VFDs for the polymer pumps. The PLCs will be Allen Bradley Compactlogix PLC with Ethernet Communication. The Control Panels will not include an operator interface since the nearby SW OPS has a Citect Client Computer. SP6-1 will include a Fiber Ethernet Managed switch and Fiber Optic Patch Panel to connect back to the existing Plant network via new Systems Integrator (SI) provided Fiber Optic Patch Panel in existing panel SP-6. The SI shall add a managed ethernet switch in SP-5. The catwalk near the Belt Filter Presses will include a Vendor supplied control panel (SWR85-VCP-103) which will include a Vijeo Citect Scada Client. The operator will be able to view and control the process from the Scada Client. SWR85-VCP-103 will not include a PLC. SP6-2 and SWR85-VCP-103 will connect via Cat 6 copper cable to SP6-1 ethernet switch. SI shall supply and install 8 new security cameras to provide live monitoring of the BFPs and the Truck Loading Area. The cameras will be similar to the existing Axis Communications cameras at the SEWRF. These security cameras will all connect to the SP6-1 48VDC Power Over Ethernet Network Switch provided by the SI to the Panel Vendor for installation in SP6-1. Vendor shall provide minimum 8"x8" clear space for the POE switch. SI

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and Vendor shall coordinate in regards to the POE switch prior to FAT. The SP6-1 POE switch will then connect to the SP6-1 FOPP. Fiber and Copper Ethernet connections between equipment located inside the VCP shall be by the Vendor. SP6-2 shall include reversing motor starter for the underloading conveyor shown on the drawings. The panel shall include an undercurrent sensing relay with time delay to alarm if an undercurrent is sensed on the conveyor motor starter. Two new Vendor supplied sludge pump control panels (SWR82-VCP-101 and SWR82-VCP-102) will replace the existing Sludge Pump control panels. Each Sludge Pump panel will include 3 VFDs with Ethernet Communication cards. VFD programming shall be provided by the Vendor and coordinated with the Owner and Vendor. The VFDs will be each have a CAT 6 ethernet connection to the new managed switch installed in existing SP-5. The systems integrator shall supply and install 6 new magnetic flow meters to replace the existing sludge pump doppler flowmeters. The SI shall also install 5 additional undercurrent sensing relays in the existing Conveyor Control Panel for each of the 5 conveyor motor starters. The SI shall add auxiliary contacts to the existing Conveyor Control Panel HOA switches and modify wiring to allow for conveyors to receive start command in Automatic from SCADA. SI shall provide and install two new 65" smart tvs installed on the back wall of the Admin Building OPS control room. SI shall provide and install a new fiber optic ethernet switch for connection. SI shall add NIC card and GPU to existing workstation in Admin Building OPS control room. Workstation shall be connected to the fiber optic ethernet switch. SI shall install new pressure switches/gauges (Vendor Provided) for the sludge pumps, polymer pumps, and washwater valves. A new Vendor supplied polymer mixing panel (SWR85-VCP-300) will replace the existing polymer mixing system. The SI shall coordinate with the Vendor for required signals to SCADA.

The work at SEWRF consists of replacing the existing Belt Filter Control Panels with new Control Panels. There will be one new Vendor supplied BFP control panel SP9 (SER85-VCP-101) in the Electrical Room for all 4 BFPs (3 existing and 1 future). The Control Panel will include an Allen Bradley Compactlogix PLC and a Vijeo Citect SCADA Client (operator interface). Currently there are individual BFP control panels which utilize relay logic to start and stop the booster pumps, hydraulic pumps, belt drives, and washwater solenoid. The new PLC will take the place of the relay logic and be capable of starting and stopping all of the BFPs, sludge pumps, conveyors, and polymer feed pumps. The Control Panel will include the motor starters and VFDs only for the BFP equipment (no polymer VFDs are included). The Control Panel will be located where the 3 existing BFP control panels are. SP9 control panel shall be maximum 60" width (so all 3 existing BFP control panels do not have to be removed at the same time to install SP9) in order to have at least one BFP fully operational at all times. The catwalk will include a local BFP control panel (SER85-VCP-102) which will include a Vijeo Citect Scada Client. The operator will be able to view and control the process from the Scada Client. SER85-VCP-102 will not include a PLC. SP9 (SER85-VCP-101) shall connect back to the existing network via FiberOptic cable to a new Fiber Optic Patch Panel (SI Provided and installed) in existing panel SP-4. SER85-VCP-102 shall connect via Cat6 copper cable to the ethernet switch in SER85-VCP-101. The SI shall modify PLC programming in existing panel SP-3 PLC to include message instructions to SP9 for sludge pump monitoring and controls as shown on the Drawings. SI and Vendor Programmer shall coordinate for the sludge pump controls.

For both SWWRF and SEWRF, the Systems Integrator/Vendor shall field verify and match BFP, Sludge Pump, and Polymer Pump control panels functionality in the new control panels to provide a fully functional system to replace the existing systems. The SI/Vendor shall

field verify all I/O prior to doing submittals and shall provide CAD files. The Contractor shall prepare a construction sequence plan to remove the existing systems and keep systems running as required by the Owner, while the new systems are built.

2. PROGRAMMING: General programming requirements description shall be provided per Section 17990. BFP Vendor shall provide programming control strategy documents for the new BFP control panel PLCs. New BFP control panel PLCs will be programmed by the BFP Control Panel Vendor and shall be coordinated with the Owner for seamless operation with Plant SCADA. PLC Programming shall include logic to monitor fault status of the respective Control Panel managed network switch. The existing Vijeo Citect Scada screens and Historian shall be updated by the Owner to include any alarms, equipment status, controls, and tags from the BFPs and ancillary equipment. Existing panel SP-3 sludge pump controls/ messaging programming modifications shall be by the SI. Owner shall install the SCADA software, load the Owner provided updated SCADA Screens to all new SCADA clients, and update any existing SCADA clients with the updated screens. Vendor programmers, SI, and Owner shall all coordinate for fully functional system. Owner shall update the SCADA system with alarms/status from the Dry Polymer System. The SCADA system will pull this information directly from the Dry Polymer Panel PLC. Owner and Vendor Programmer shall coordinate regarding tagging and alarms/status/controls between SCADA and the Dry Polymer PLC. SI shall install and configure the camera software on the existing Admin Building Workstation for camera image display on the two new 65" TVs.

#### C. DEFINITIONS:

1. GENERAL: Definitions of terminology related to Instrumentation and Industrial Electronic Systems used in the specifications shall be as defined in IEEE 100, ISA S51.1, and NEMA ICS 1.

2. TWO-WIRE TRANSMITTER: A transducer which derives operating power supply from the signal transmission circuit and requires no separate power supply connections. A two-wire transmitter produces a 4 to 20 milliamper current regulated signal in a series circuit with a 24 volt direct current driving potential and a maximum circuit resistance of 600 ohms.

3. FOUR-WIRE TRANSMITTER: A transducer which derives operating power from separate power supply connections. A four-wire transmitter produces a 4 to 20 milliamper current regulated signal in a series circuit with a maximum circuit resistance of 600 ohms. Four-wire transmitters typically require 120Vac or 24Vdc input power supply.

4. GALVANIC ISOLATION: Electrical node having no direct current path to another electrical node. Galvanic isolation refers to a device with electrical inputs and/or outputs which are isolated from ground, the device case, the process fluid, and separate power supply terminals. Inputs and/or outputs may be externally grounded without affecting the characteristics of the devices or providing path for circulation of ground currents.

5. PANEL: An instrument support system which may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process

control systems including consoles, cabinets and racks. Panels provide mechanical protection, electrical isolation, and protection from dust, dirt, moisture, and chemical contaminants which may be present in the atmosphere.

6. DATA SHEETS: Data sheets shall refer to ISA S20 or ISA TR20.00.01.

7. SIGNAL TYPES: Used in systems specified in Division 17:

- a. LOW-LEVEL ANALOG: Signal with full output level of 100 millivolts or less including thermocouples and resistance temperature detectors.
- b. HIGH-LEVEL ANALOG: Signals with full output level greater than 100 millivolts but less than 30 volts, including 4 20 mA transmission.
- c. DIGITAL CODE: Coded information from the output of an analog to digital converter or digital transmission terminal.
- d. PULSE FREQUENCY: Counting pulses emitted from speed or flow transmitters.
- e. MODULATED SIGNALS: Signals from modems or low level audio signals. Normal signal level: plus 4 dBm to minus 22 dBm. Frequency range is 300 to 10,000 Hertz.
- f. DISCRETE CONTROL OR EVENTS: Dry contact closures and signals monitored by solid state equipment, relays, or control circuits.
- g. LOW VOLTAGE DISCRETE CONTROL OR EVENTS: Dry contact closures and signals monitored by solid state equipment, relays, or control circuits operating at less than 30 volts and 250 milliamperes.
- h. HIGH-LEVEL AUDIO SIGNALS: Audio signals exceeding plus 4 dBm, including loudspeaker circuits.
- i. RADIO FREQUENCY SIGNALS: Continuous wave alternating current signals with fundamental frequency greater than 10 kilohertz.

8. SYSTEMS INTEGRATOR: A firm engaged in the business of detailed control system design and engineering, instrumentation component purchase, system and panel assembly, programming, and implementing the specified process control and industrial automation systems.

## 1.02 QUALITY ASSURANCE

### A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
ISA S5.4	Instrument Loop Diagrams
ISA S20	Specification Forms For Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology
ISA TR20.00.01	Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations
NEMA ICS 1	General Standards for Industrial Control and Systems

### B. SYSTEMS INTEGRATOR RESPONSIBILITY:

#### 1. GENERAL

- a. The specified control system and instrumentation integration including panel building, instrument calibration, testing, start-up, operational testing, and training shall be performed by a Systems Integrator staffed with qualified personnel, possessing necessary equipment and experience in performing similar installations.

- b. The control system components shall, as far as practical, be of one manufacturer.
- c. The components, modules, devices, and control system equipment shall be recognized industrial quality products. Recognized commercial or office grade products are prohibited.
- d. The overall system performance shall be demonstrated to and accepted by Owner.
- e. The application software packages shall be latest versions available, or compatible with existing software currently in use, as specified in Section 17316.

## 2. SYSTEMS INTEGRATOR QUALIFICATIONS:

- a. The following Systems Integrators are pre-qualified to perform the work specified in Division 17 without the need to provide Evidence of Experience:
  - 1) BCI, Tampa FL
  - 2) CEC, Warren Michigan
  - 3) Curry Controls, Lakeland FL
  - 4) Southern Flow, Alpharetta, GA
  - 5) Revere Controls, Birmingham AL
- b. Contractor-proposed PCSI shall be evaluated based on submittal of the following Evidence of Experience:
  - 1) Submit evidence of experience in performing three similar successful projects in the last five years with one project currently in progress or competed within the last two years.
  - 2) Submit project descriptions with contact names, addresses, and telephone numbers from the project Owner, General Contractor, and Principal Design Firm.
  - 3) Submit organization chart and resumes for proposed project personnel.
  - 4) Submit Training and Certification information. Completion of the following training courses or appropriate portions thereof or possession of the following

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certifications included with the Systems Integrator's personnel experience requirements described above:

- a) Project manager: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.
  - b) Systems engineer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Engineering Skills Training program.
  - c) Programmer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.
  - d) Field instrument technician: Certified Control Systems Technician (CCST) registration or completion of the relevant core courses in the Technical Skills Training program.
  - e) Certified training programs, as offered by ISA.
- 5) Submit financial data for Systems Integrator division when subsidiary to a parent corporation. Include two years of financial data.
- a) Financial Statement.
  - b) Balance Sheet.
  - c) Dun & Bradstreet Report.

3. PRE-SUBMITTAL CONFERENCE:

- a. Schedule a pre-submittal conference with the Owner and Construction Manager within 30-calendar days after Contract award to discuss the work, equipment, submittal format, and establish the framework for project coordination and communication.
- b. Provide materials 10-days prior to the conference:

- 1) Instrument Index that lists the devices and instruments specified in Division 17 identify each by tag number, description, function, manufacturer, and model number.
- 2) Product descriptive literature with a statement that the item is as specified.
- 3) Proposed equal products with comparative listing of the published specifications for the specified item and the proposed item.
- 4) Project schedule with deliverables and milestones.
- 5) Project Control System Block Diagram, when specified.
- 6) Sample portion of documented PLC and Operator Interface program, when specified.
- 7) Sample Spec. 16176 and 17110 control panel schematic diagram proposed for this project, when specified. Sample can be a copy from a previous project provided that it represents the format being proposed for this project.
- 8) Sample analog and discrete loop diagrams proposed for this project, when specified. Sample can be a copy from a previous project provided that it represents the format being proposed for this project.
- 9) A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each requested deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

- c. The pre-submittal conference will not replace the Product and Shop Drawing Submittal review process.

#### C. PROCESS EQUIPMENT COORDINATION

1. Division 17 specified equipment shall be coordinated for proper operation with equipment related process equipment specified in other Divisions.
2. Equipment shall be integrated, furnished, and installed in conformance with the drawings, specifications, and the recommendations of the equipment manufacturer and the related processes equipment manufacturers.
3. Systems Integrator shall obtain manufacturer's technical information for items of equipment not provided with, but directly connected to, the control system. Provide the necessary coordination and components for correct signal interfaces between specified equipment and the control system.
4. Systems Integrator shall coordinate with project subcontractors and equipment suppliers.
5. Systems Integrator shall provide installation supervision for the duration of the project.
6. Conflicts between the plans, specifications, manufacturer/vendor drawings and installation instructions, etc., shall be presented to the Construction Manager for resolution before proceeding.

#### D. FACTORY ACCEPTANCE TEST (FAT):

Refer to Section 17030.

### 1.03 ENVIRONMENTAL CONDITIONS

#### A. GENERAL:

Specified data communication and process control equipment shall suitable for operation in indoor locations and in outdoor locations. Ambient conditions are specified in Section 01800.

#### B. CORROSIVE LOCATIONS:

Corrosive locations shall be as specified in Division 16.

#### C. HAZARDOUS (CLASSIFIED) AREAS:

Hazardous areas shall be as specified in Division 16.

D. SEISMIC:

Equipment and supports shall be braced per Section 01900.

1.04 FUNCTIONAL REQUIREMENTS

A. GENERAL:

The instrumentation and control system functions are shown on the drawings and specified in subsequent sections of Division 17. The Systems Integrator drawings and integration practices shall be as defined in IEEE 100, ISA S51.1, and NEMA ICS 1. The Systems Integrator shall match the functionality of the existing systems and shall coordinate with the BFP vendor to provide the required process functions for their equipment.

B. SUBMITTAL DRAWINGS:

1. GENERAL: The drawings included in the project manual are functional in nature and do not show exact locations of equipment or interconnections between equipment. The Contractor's Systems Integrator shall prepare detailed installation drawings as specified below.

Drawings prepared in AutoCAD version 2017 with borders and title blocks identifying the project, system, revisions to the drawing, and type of drawing. Each revision of a drawing shall include the date and description of the revisions. Drawing prints shall be 11" x 17" with a minimum lettering size of 1/8".

Diagrams shall carry a uniform and coordinated set of wire numbers and terminal block numbers in compliance with panel wiring, Section 16176 and Section 17110, to permit cross-referencing between contract documents and the drawings prepared by the Contractor.

2. CONNECTION DIAGRAMS: Show components of a control panel in an arrangement similar to the actual layout of the panel including internal wiring between devices within the panel. Show terminal blocks used for internal wiring or field wiring, identified as such. Indicate insulation color code, signal polarities, and wire numbers and terminal block numbers.

3. INTERCONNECTION DIAGRAMS: Show panels, panel devices, and field devices with wire numbers, cable numbers, raceway numbers, terminal box numbers, terminal block numbers, panel numbers, and field device tag numbers.

4. ELEMENTARY OR SCHEMATIC DIAGRAM: Shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. Provide schematics for internal panel power distribution, lighting, and any panel HVAC.

5. ARRANGEMENT, LAYOUT, OR OUTLINE DRAWINGS: Show the dimensioned external and interior control panel views with components and Bill of Material. Provide panel heat load calculations, and indicate cooling or ventilation provisions as required.

6. NETWORK BLOCK DIAGRAM: A network block diagram is a diagram of the overall SCADA system, with annotated boxes to show the primary network components (controllers, hubs, switches, computers, displays), and annotated interconnecting lines that show the system communication media and communication protocols.

## 1.05 SUBMITTALS

The following information shall be provided in accordance with and Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole.

If deviations from the specifications are indicated, and therefore requested by the Contractor, each requested deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

*Failure to include a copy of the marked-up specification sections, along with justification for requested deviations from the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. Detailed product literature, showing product specifications and model number breakdown. Mark to denote features and options included. Include only the applicable pages.
3. Manufacturer's installation manual excerpts, as to be used for this project:
  - a. Installation details/drawings.
  - b. Electrical connection diagrams
  - c. Calibration procedures.

4. Drawings and diagrams specified in paragraph 17000-1.04 B.
5. Nameplate list with material, tag number and description as specified herein.
6. Systems Integrator Evidence of Experience per paragraph 17000-1.02 B 3.
7. Data Sheets in accordance with ISA 20 for each instrument. Identical instruments may be submitted with one common ISA Data Sheet and accompanying tag list.

Review the submittal requirements specified in other Division 17 Sections.

## PART 2--PRODUCTS

### 2.01 GENERAL

#### A. MATERIALS AND QUALITY:

Equipment material shall be new, free from defects, and industrial-grade, as specified. Each type of instrument, instrument accessory, and device used throughout the work shall be manufactured by one firm, where possible.

Electronic equipment shall be of solid-state construction with printed or etched circuit boards of glass epoxy of sufficient thickness to prevent warping.

#### B. ENCLOSURES:

Table A specifies the instrument and control panel enclosure material and minimum NEMA rating for the location and application.

Table A

Location	Enclosure Material and NEMA Rating
Indoor: Architecturally Finished Area	NEMA 12: mild steel
Indoor: Electrical Room	NEMA 12: mild steel
Indoor: Process Areas	NEMA 4X: 316 Stainless Steel
Indoor: Corrosive Area	NEMA 4X: 316 Stainless Steel
Outdoor: Corrosive Area	NEMA 4X: 316 Stainless Steel

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Outdoor: Non-Corrosive Areas	NEMA 4X: 316 Stainless Steel
Corrosive Area (Hypochlorite)	NEMA 4X: Non-metallic
Hazardous Area:	NEMA 7: Galvanized Malleable Iron or Aluminum or NEMA 4X and UL listed or FM Approved for the Hazardous Area.
Hazardous and Corrosive Area	NEMA 7: Iron or Aluminum with factory applied corrosion resistant coating or NEMA 4X and UL listed or FM Approved for the Hazardous Area.

## 2.02 NAMEPLATES

Nameplates shall be provided for all field mounted instrument, analyzer, or equipment specified in Division 17. Nameplate lettering shall include the equipment or instrument loop title and the instrument or equipment tag number, where nameplate engraving is not specified or shown. Nameplates shall be machine engraved black phenolic with white 5/32-inch high lettering, as minimum, unless otherwise specified or shown. Nameplate wording may be changed without additional cost or time, if changes are made prior to commencement of engraving.

Nameplates shall be attached to support hardware with a minimum of two self-tapping type 316 stainless steel screws in a readily visible location so the nameplate will remain to identify the service when the device is removed. Field instrument nameplates shall be attached with braided stainless steel straps where not stand mounted.

## 2.03 PRODUCT DATA

The following Product Data shall be provided in accordance with Section 01300.

1. Record drawings specified by paragraph 17000-1.04 B and the schedules included in Division 17 shall be provided in accordance with Section 01720 in the latest AutoCAD format and PDF format on CD.  
  
Provide record drawing prints of all drawings following project start-up, but prior to acceptance of the work showing the final constructed state of the instrumentation and control systems.
2. Operating and maintenance information shall be provided in accordance with Section 01730. Include the following in each Operation and Maintenance manual:
  - a. Final reviewed Submittals, including revised as-built record drawings.
  - b. Manufacturer's operation and maintenance instructions, edited for this project.

- c. Written record of menu configuration, jumpers, switch settings, and other configurable parameters for each instrument.

## PART 3--EXECUTION

### 3.01 INSTALLATION

#### A. GENERAL:

Equipment shall be installed in locations that are accessible for operation and maintenance services. Equipment not accessible shall be reinstalled at no cost to the Owner.

Installation, calibration, settings, and testing procedures are specified in Section 17000, Section 17200 – Instrument Index Part 3 Execution, and subsequent sections of Division 17

#### B. FIELD EQUIPMENT:

Equipment shall be provided with ports and adjustable items accessible for in-place testing and calibration. Install equipment between 48 inches and 60 inches above the floor or permanent work platform. Equipment shall be mounted to avoid shock or vibration that may impair operation. Equipment shall be mounted for unobstructed access and walkways. Equipment support systems shall not be attached to handrails, process piping or mechanical equipment.

Instruments and cabinets supported by concrete walls shall be spaced 5/8 inch by framing channel between instrument or cabinet and wall. Block wall shall have additional installation supports, as required, to avoid damage to the wall. Equipment supports shall be hot-dip galvanized after fabrication or shall be 316L stainless steel, as shown or specified.

Support systems including panels shall be designed in accordance with Section 01900 to prevent deformation greater than 1/8 inch in any direction under the attached equipment load and under an external load of 200 pounds.

In wet or outdoor areas, conduit penetrations into instrument housing shall be made through the bottom (preferred) or side of enclosures to minimize water entry from around or from inside of conduits. Provide conduit hubs for connections and waterproof mastic for moisture sealant.

Nameplates shall be provided for all field mounted equipment. Nameplates shall be attached to support hardware with a minimum of two self-tapping Type 316 stainless steel screws in a readily visible location, but such that if the field device is changed out, the nameplate will remain to identify the service.

#### C. ELECTRICAL POWER CONNECTIONS:

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Equipment electric power wiring shall comply with Division 16. Power disconnect switches shall be provided within sight of equipment and labeled to indicate the specific equipment served and the power source location. "Within sight of" is defined as having an unobstructed view from the equipment served and within 50 feet of the equipment served.

Equipment power disconnect switches shall be mounted between 36 inches and 72 inches above the floor or permanent work platform. Where equipment location requirements cannot be met by a single disconnect switch, provide two disconnect switches: one at the equipment and one at the work platform.

Provide a surge arrestor on each 120 volt AC disconnect switch serving equipment located outdoors. Surge arrestor shall be Telematic, LP Series or equal.

#### D. SIGNAL CONNECTIONS:

Equipment electric signal connections shall be made on terminal blocks or by locking plug and receptacle assemblies. Flexible cable, receptacle and plug assemblies shall be used where shown or specified.

Jacketed flexible conduit shall be used between equipment and rigid raceway systems. Flexible cable assemblies may be used where plug and receptacle assemblies are provided and the installation is not subject to mechanical damage in normal use. The length of flexible conduit or cord assemblies shall not exceed 2 feet, except where sufficient length is required to allow withdrawal of instruments for maintenance or calibration without disconnection of conduit or cord assemblies.

### 3.02 FIELD TESTS AND INSPECTIONS

#### A. DELIVERY INSPECTION:

The Contractor shall notify the Owner's Representative upon arrival of any material or equipment to be incorporated into the work. The Contractor shall remove protective covers or otherwise provide access in order that the Owner's Representative may inspect such items.

#### B. INSPECTION AND INSTALLED TESTS:

Refer to Section 17030 – Process Instrumentation and Control System Testing.

#### C. CLEANING:

1. Execute final cleaning prior to final project assessment.
2. Clean surfaces exposed to view, remove temporary labels, stains, and foreign substances.

3. Replace filters of operating equipment.
4. Remove waste and surplus materials, rubbish, and construction facilities from site.

**\*\*END OF SECTION\*\***

## SECTION 17030

### PROCESS INSTRUMENTATION AND CONTROL SYSTEM TESTING

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

This section specifies Contractor and Systems Integrator performance in testing and documentation of process instrumentation and control system materials and equipment (PICS).

The term instrumentation covers field and panel instruments, analyzers, primary sensing elements, transmitters, power supplies, and monitoring devices.

Provide the labor, tools, material, power, and services necessary to provide the process instrumentation and control system inspection and testing specified herein. Coordinate all testing with Section 01660 and 17990:

- A. Factory Acceptance Testing (FAT)
- B. Pre-Operational Performance Testing Sequence:
  - 1. Wiring Testing
  - 2. Network and Bus Cable System Inspection and Testing
  - 3. Piping Testing
  - 4. Installation Inspection
  - 5. Instrumentation Calibration
  - 6. Loop Testing
- C. Functional Testing Sequence:
  - 1. Process Control Strategy Testing
  - 2. Control System Closed Loop Commissioning
  - 3. Functional Checkout
- D. Operational Testing:

## 1. System Acceptance Testing (SAT)

### 1.02 QUALITY ASSURANCE

#### A. PICS TESTING MANAGER:

Not Required

#### B. REFERENCES:

This section contains references to the following documents with additional references listed in Section 17000.

All references shall be to the current edition of the document unless specifically stated otherwise. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no bids). If referenced documents have been discontinued by the issuing organization, reference to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ISA RP7.1	Pneumatic Control Circuit Pressure Test
ISA S51.1	Process Instrumentation Terminology

#### D. PROJECT LABELING

The items specifying project labeling herein shall include the following as a minimum: Owner's name, facility name, project name, and project number.

### 1.03 SUBMITTALS

Submittal material, to be submitted in accordance with Section 01300, shall consist of the following:

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A. QUALIFICATION SUBMITTAL:

Provide the following submittal in accordance with Section 01300-Submittals:

1. Proposed process area and process system breakdowns.
2. Example test forms per paragraph 17030-3.01 D, revised to show Project Labeling per paragraph 17030-1.02 D.
3. Example I/O interface summary per paragraph 17030-2.02 D.

B. NETWORK TESTING QUALIFICATION SUBMITTAL:

1. Qualifications of independent industrial network testing firm and staff performing the inspection and testing.

C. DEFINITION SUBMITTAL:

Provide the following submittal after review of the Qualification Submittal. Separate submittals may be provided for each process area:

1. Control descriptions per paragraph 17030-2.02 C.
2. I/O Interface Summaries per paragraph 17030-2.02 D.
3. Testing status spreadsheets per paragraph 17030-2.02 A. 3.
4. Test procedures per paragraph 17030-3.01 D.
5. Proposed test forms per PART 3 of this Section 17030, detailed for each test for this project.
6. Certified Factory Calibration Reports.
7. Provide a copy of this specification and the referenced and applicable sections with addenda updates included with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
8. Provide a copy of Section 17200 Instrument Index with Addenda updates included, marked to indicate requested deviations from specified requirements.

9. Provide a copy of all referenced and applicable Instrumentation Drawings with addenda updates included, marked to indicate requested deviations from specified requirements.
10. Provide a copy of all referenced and applicable Electrical Drawing's Control Diagrams with addenda updates included, marked to indicate requested deviations from specified requirements.
11. Failure to include a copy of the specifications and drawings with the submittal shall be cause for rejection of the entire submittal with no further consideration.

## PART 2--PRODUCTS

### 2.01 TESTING DOCUMENTATION

#### A. CONTROL DESCRIPTION

Provide a control description outlining operation for each process area's system. The Control Description Specification Section 17900 may be used as a basis.

#### B. I/O INTERFACE SUMMARY

Provide I/O spreadsheets for each process area's system. Spreadsheets to include the following for each I/O point:

1. Signal number/tag
2. Annotation description that may be logically abbreviated and that is subject to approval.
3. Complete physical I/O channel designation and addressing or communication I/O register designation.
4. True/False status designations for digital I/O.
5. Process range; engineering units and any multipliers; and raw signal range count for analog I/O.
6. Signals: Fixed point and scaled at the Controller with minimum four significant implied digits of scaling. E.g.: 0 to 1400 at Controller for a pH range of 0 to 14 at Operator Interface.
7. Provide Operator Interface scaling to display decimal digits required.

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## C. INSTRUMENT INDEX

Provide a detailed Instrument Index. The Instrument Index from Section 17200 may be used as a basis. Provide details on calibration ranges, setpoints, and deadbands.

## 2.02 PRODUCT DATA

Provide the following product data submittal after completion of testing.

The following information shall be provided in accordance with specification Section 01300:

1. Completed test forms per PART 3. Separate submittals may be provided for each process area.
2. Documentation of network data communication nodes for network type instruments, devices, and variable frequency drives.

## PART 3—EXECUTION

### 3.01 GENERAL

#### A. GENERAL REQUIREMENTS:

Materials, equipment, and construction included under this specification shall be inspected in accordance with this section and subsequent sections of this division. Testing shall be performed by the Contractor in accordance with this and subsequent sections of this division.

No required test shall be applied without prior notice to the Construction Manager. Between 60 and 70 days before the commencement of any testing activity, the Contractor shall provide a detailed step-by-step test procedure complete with forms for the recording of test results, testing equipment used, and a place for identification of the individual performing or, if applicable, witnessing the test.

Provide detail assistance to the Contractor in generating form 01660-A, customized for this project. Submit detailed form prior to testing per the requirements of Section 01660.

#### B. TECHNICIAN QUALIFICATIONS:

Field instruments and analyzers shall be calibrated and set up by a certified instrument technician qualified to calibrate the instrumentation.

Technicians shall be qualified by completion and certification from training courses offered by The Instrumentation, Systems, and Automation Society (ISA), the instrumentation

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and analyzer manufacturer's training courses, or technician training courses at a recognized trade school that specializes in instrumentation calibration.

#### C. TEST EQUIPMENT AND MATERIALS:

Provide test equipment to conduct the specified tests that simulate inputs and read outputs with a rated accuracy at the point of measurement at least three times greater than the component under test.

Test instruments shall have a current calibration sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required. Certified calibration reports traceable to the National Institute of Standards and Technology shall be included with the final test report.

Provide a documenting calibration system to conduct process instrumentation calibration activities that consist of a documenting process calibrator and an instrumentation data management software system that captures the calibration results and electronically document instrument data, date of calibration, calibration procedures, and as-found and as-left instrument calibration data.

Calibration files shall be submitted with the final test report in hard copy and electronic formats that does not require specialized equipment or software to read and print the files.

Provide buffer solutions and reference fluids for tests of analytical equipment.

Provide a communications and software package to record final configuration parameters and settings for variable frequency drives with the parameters acquired by connection to the network that record the configuration settings without manual data entry or transcription of values.

Vendor software tools may document the systems where a licensed copy of the identical software including connectors, cables, keys, interface cards and devices required for operation is submitted with the final documentation files.

#### D. FIELD TEST PROCEDURE DOCUMENTATION:

Test procedures submitted for approval between 60 and 70 days before the commencement of testing activity, complete with forms for the recording of test results, testing equipment used, and a place for identification of the individuals performing and witnessing the test.

Test procedures for each analog and discrete loop in the process control system shall be organized and assembled in separate volumes for each process area. Final test records shall be submitted in electronic form by scanning and converting the records and files to Adobe PDF format, to preserve actual signatures and signoffs.

Test procedure documentation shall include a detailed, step-by-step description of the required test procedure, panel and terminal block numbers for points of measurement, input test values, expected resultant values, test equipment required, process setup requirements, and safety precautions.

Test report forms for each loop, including forms for wiring, piping, and individual component tests, shall be included with the test procedure documentation. The actual test results shall be recorded on these forms and a final test report assembled as specified in paragraph 17030-3.05.

Test report forms shall be preprinted and completed to the extent possible prior to commencing testing. Test report forms that document the field test procedures shall include the following information:

1. Project name
2. Process area associated with the equipment under test.
3. Instrument loop description.
4. Instrument loop identification number.
5. Instrument nameplate data.
6. Instrument setup and configuration parameters.
7. Time and date of test.
8. Inspection checklist and results.
9. Reference to applicable test procedure.
10. Expected and actual test results for each test point in the loop including programmable controller data table or register values.
11. Test equipment used.
12. Space for remarks regarding test procedure or results, unusual or noteworthy observations, etc.
13. Name, date, and signature of testing personnel.

E. PERFORMANCE DEVIATION TOLERANCES:

Tolerances shall be specified in Division 17. Where tolerances are not specified, refer to the manufacturer's published performance specifications.

Overall accuracy requirements for loops consisting of two or more components shall be the root-summation-square (RSS) of the component accuracy specifications. Tolerances for each required calibration point shall be calculated and recorded on the associated test report form.

F. INSTALLED TESTS:

The Contractor's Quality Assurance Manager shall coordinate, manage, and supervise the quality assurance program that includes:

1. Testing plan with the sequence for the test work.
2. Calibration program for all instruments and analyzers.
3. Documentation program that records tests results.
4. Performance testing program systems.

Test forms provided shall conform to the requirements of reference forms 17000-A through 17000-K included in Section 01999. Additional or detailed forms shall be developed as necessary to suit complex instrumentation. Usage of terms used on test forms shall comply with ISA S51.1.

G. WITNESSING:

The Engineer reserves the right to observe factory and field instrumentation testing and calibration procedures. The Engineer shall be notified prior to testing, as specified herein.

3.02 FACTORY TEST

A. FACTORY ACCEPTANCE TEST (FAT):

1. GENERAL: Control system equipment shall be subject to a Factory Acceptance Test with the factory acceptance tests and subsequent retests witnessed by the Construction Manager and Owner. For SWWRF, FAT required for SP6-1 (SWR85-VCP-101), SP6-2 (SWR85-VCP-102), and SWR85-VCP-103. For SEWRF, FAT required for SP9 (SER85-VCP-101) and SEW85-VCP-102. Control system panel programmable logic controllers shall be loaded with the PLC software, Operator Interface software and the programming and graphic configuration application software at the control system equipment supplier's factory prior to the FAT.

Equipment, panel instruments, panels, or cabinets shall be inspected with factory testing performed. Provide written notice to the Engineer thirty working days before the commencement of the FAT activity and include:

- a. Schedule for the FAT.
- b. Location of the FAT.
- c. Testing equipment used.
- d. Detailed test procedure with forms for the recording of test results.
- e. Sign-off spaces for the individuals performing and witnessing the tests.

2. FACTORY ACCEPTANCE TEST PROCEDURES: Panels provided shall be interlocked or networked as applicable, operated, and checked-out by the equipment supplier prior to the FAT. Submit certification indicating that the panels are ready for the FAT.

The FAT shall include the following:

- a. Visual inspection of equipment, instruments, control panels, and graphic displays.
- b. Validation of each input loop and output loop by simulated signals for analog inputs and by shorting discrete inputs.
- c. Validation shall include:
  - 1) Monitoring state changes on operator interface screens based on the inputs state change.
  - 2) Observation of online PLC programming application software with the associated PLC outputs state change.
  - 3) Outputs triggered by operator interface software devices (pushbuttons, sliders, manually-entered values, etc.)
  - 4) Calibration and operation of instruments on or in the control panels.
- d. Repair of loops which do not pass validation.
- e. Retest of the FAT at no additional cost.

Panels that pass the FAT may be shipped to the site upon shipping schedule and storage accommodation approval by the Construction Manager.

### 3.03 PRE-OPERATIONAL PERFORMANCE TESTING

#### A. GENERAL REQUIREMENTS:

In general, tests shall be performed in the following order:

#### B. WIRING TESTS:

Electrical power and signal cable ring-out and resistance testing. Conducted in accordance with Sections 16000 and 16030. Wiring tests shall not be conducted until cables have been properly terminated, tagged and inspected.

1. Power and Control: Per Section 16030.

2. Signal: Test form 17000-A.

#### C. NETWORK AND BUS CABLE INSPECTION AND TESTING:

Inspected and tested by independent industrial network testing firms.

Proprietary bus systems may be tested by the manufacturer's qualified field services technician. Manufacturer's sales personnel are not considered to be qualified technicians unless qualifications are documented and certified by the manufacturer.

Standardized networks and buses may be tested by a qualified independent network testing service. The following types of cabling and networks shall be tested and certified by the independent industrial network testing firm:

1. Ethernet system cabling
2. Other networks provided as a part of a packaged monitoring or control system.

Control and instrumentation bus cabling shall be tested and verified using the standards that apply to the specific cable and bus type as follows:

1. Ethernet Category 5E and Category 6: per TIA/EIA-568B standards

PRE-ACTIVE TESTING: Prior to energizing, cabling shall be inspected and tested to verify the following:

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- a. Media type and specifications.
- b. Physical routing and project specific cable identification tagging.
- c. Correct termination installation and connection of conductors to pins at terminations.
- d. Record cable run length and compare to the manufacturer or industry standards to verify lengths are within specifications.
- e. Locations and values of network termination resistance.
- f. Integrity and grounding of cable shields.
- g. Values of transient protection (surge) elements.
- h. Firmware revision level of network devices available prior to energization.
- i. Settings of dip switches and configuration parameters.

ACTIVE SYSTEM TESTING: After the cable or network system has been activated for testing, provide diagnostic monitoring and signal analysis for the bus network system to evaluate network and bus integrity and data transfer quality. The following parameters shall be measured, verified, and recorded:

- a. Node addressing.
- b. Signal attenuation before and after any repeater device and at the farthest point in the network.
- c. Total network trunk voltage and current loading as applicable.
- d. Baud rate, message traffic rate, percent bandwidth used, error rate, lost packet count.
- e. Firmware revision level of the network devices.
- f. Pre-active and active testing shall fall within the specified range of values established by the referenced standards.
- g. Correct the functionality of networks and devices connected to the network.

#### D. PIPING TESTS:

1. Pneumatic Piping Systems: Pneumatic piping systems shall be tested for leaks in compliance with ISA RP7.1, except performed at ten times the normal system operating pressure. Test form 17000-B.
2. Liquid Piping Systems: Tested for leaks in compliance with Section 15050.

E. INSTRUMENT AND COMPONENT INSPECTION:

1. Compare and validate instrument type and nameplate data with the drawings, specifications, and data sheet.
2. Validate instrument identification tag.
3. Confirm instrument installation conforms to drawings, specifications, and manufacturer's instructions.
4. Verify proper conductor termination and tagging.
5. Visual check for physical damage, dirt accumulation, and corrosion.
6. Verify including isolation amplifiers, surge protection, and safety barriers are properly installed.
7. Report deficiencies identified within 24 hours of discovery. No instrument or system component shall be tested until all deficiencies are addressed.

F. INSTRUMENTATION CALIBRATION:

1. Instruments and final elements shall be field calibrated in accordance with the manufacturer's recommended procedures and tested in accordance with the Contractor's test procedure.
2. Individual Component Calibration and Testing shall not commence until Instruments and Component Inspections are completed and documented to the satisfaction of the Engineer.
3. Analog instrument calibrated at 0, 10, 50, 90, and 100 percent of the specified full scale range. Each signal sensing trip and process sensing switch shall be adjusted to the required setting. Test data recorded on test forms as specified herein

4. Final element alignment tested and adjusted to verify that each final element operates smoothly over the full range in response to the specified process control signals
5. Test data shall be entered on the applicable test forms at the time of testing: Alarm trips, control trips, and switches shall be set to initial values specified in Section 17200 Instrument Index at this time. Final elements shall be checked for range, dead-band, and speed of response.
6. Any component that fails to meet the required tolerances shall be repaired or replaced by the manufacturer. Repeat the specified tests until the component is within tolerance.
7. Install a calibration sticker on each instrument following successful calibration that indicates the date of calibration, the name of the testing company, and personnel who calibrated the instrument.
8. Test forms 17000-C through 17000-I.
9. CERTIFIED TEST REPORTS: Field test and inspection activities include verification of instrument parameter setup, verification of instrument zero, and performance at three operating points within the instrument range. Instrument which fail to demonstrate proper performance shall be returned for re-calibration or replaced as agreed depending on the impact to the project as determined by the Construction Manager.

Where instrument field calibration is not feasible, certified factory calibration reports may be submitted that includes the name and address of the laboratory that conducts the calibration testing. Certified factory test reports may be submitted for the following instrument types in lieu of field calibration:

F. LOOP TESTING:

1. Loop Testing shall not commence until the Individual Component Calibration and Testing has been completed and documented to the satisfaction of the Engineer.
2. Each instrument loop shall be tested as an integrated system. Check operation from field instruments to transmitter to receiving components to the vendor panel or the Plant Control System Operator Interface Station. Test signals shall be injected at the process impulse line connection where

the measuring technique permits, and otherwise at the most primary signal access point.

3. Testing of loops with an interface to a programmable logic controller shall include verification of the programmable logic controller input/output assignment and verification of operation of the input/output system and processor. Inspect the data table or register in the programmable logic controller memory to verify proper operation.
4. If the output control or monitoring device fails to indicate properly, corrections to the loop circuitry or device shall be made. The test shall be repeated until devices and instruments operate as required.
5. Correct loop circuitry and repeat the test until the instruments operate properly.

### 3.04 FUNCTIONAL TESTING

#### A. PROCESS CONTROL STRATEGY/FUNCTIONAL TESTING:

1. Control Strategy Testing shall not commence until the Loop Testing has been completed and documented to the satisfaction of the Engineer.
2. Control Strategy Testing is performed by the Programmer and consist of installing and debugging the PLC control logic program, verifying the interface points between the PLCs and field devices and equipment, and exercising the control strategies. Control Strategy Testing will be performed on one PLC at a time.
3. Provide qualified personnel to immediately correct any deficiencies in the Work that may be encountered during Control Strategy Testing. Failure of the Contractor to provide such personnel in a timely manner may prolong the time allotted to complete Control Strategy Testing.

#### B. CONTROL SYSTEM CLOSED LOOP TESTING:

1. Closed-Loop Commissioning shall not commence until the Control Strategy Testing has been successfully completed and documented to the satisfaction of the Engineer
2. Closed-loop commissioning tests, performed as part of the system tests, shall demonstrate stable operation of each loop under operating conditions. Tests shall include adjustment of loop tuning parameters.

3. Tuning parameters: gain (or proportional band), integral time constant, and derivative time constant for each control loop, adjusted to provide 1/4-amplitude damping, unless otherwise specified.
4. The loop response to a step disturbance shall be provided for each loop. Two graphs shall be made for cascaded control loops, one showing the secondary loop response with its set point in manual, and the second showing overall loop response.
5. Control loops with "batch" features shall be adjusted to provide optimum response following start-up from an integral action saturation condition.
6. Graph recording shall be provided showing the response and made at sufficient speed and amplitude to show 1/4 amplitude damping. Label to show loop number and title, and settings of parameters and set point.
7. Where a loop is controlled under the direction of a programmable logic controller, the Engineer will perform the necessary adjustment of loop tuning parameters and setpoints; Contractor shall record the loop response, adjusting final elements, and assuring total integrated loop performance as specified.

#### C. FUNCTIONAL CHECKOUT:

Conducted to verify the operation of discrete and hardwired control devices. Exercise the operable devices and energizing the control circuit. Operate control element, alarm device, and interlocks to verify the specified action occurs.

### 3.05 OPERATIONAL TESTING

System Acceptance Test (SAT) shall be performed after component and subsystem tests have been completed. The test of the completed system shall be performed in full operation and shall demonstrate that all functional requirements of this specification have been met. SAT shall demonstrate the following:

1. Each component of the system operates correctly with all other components of the system.
2. Analog control loops operate in a stable manner.
3. Hard-wired and software equipment interlocks perform correctly.
4. Process control sequences perform correctly.
5. PLC application program performs monitoring and control functions correctly.

6. Operator interface graphics represent the monitoring and control functions correctly.

**\*\*END OF SECTION\*\***

## SECTION 17110

### INSTRUMENT AND CONTROL PANELS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies requirements for panels, cabinets, and consoles for instrument, and control equipment for the SWWRF and SEWRF Belt Filter Press Rehabilitation Project per the Panel Schedule herein.

Provide the instrument, control, and monitoring features indicated on the P&ID and electrical drawings. Panels shall be arranged to separate control and instrument devices from power wiring. Panel shall be arranged for dedicated field wiring terminations rated for 600 Vac or less for power, control, and instrument signal wiring shall be fabricated by a UL-508A recognized facility and shall bear the appropriate UL 508A Industrial Control Panel label. Panels for Hazardous (Classified) Locations shall bear the appropriate UL 698A label.

Transmitters, Analyzers, signal conditioning modules and other equipment or devices as specified in the other Division 17 sections.

Panels that contain programmable logic controllers (PLC) and operator interface terminal (OIT) units shall be as indicated in the Panel Schedule. Specific panel devices are specified herein and in Section 16000.

PLC and OIT shall comply with the specified products in Division 17. Panels that do not comply with the specified products and specified logic method, hardwired or PLC logic, shall not be accepted. Cost to retrofit the panel as specified shall be borne by the panel supplier. Corrections or modifications to UL 508A Industrial Control Panels shall be transported to the panel supplier's facility for corrections, testing, relabeling and inspection.

Field modifications require a UL inspector site inspection for approval of panel corrections and to re-label the panel after the field modifications are completed.

Refer to Section 16000 for requirements for VFDs, motor controllers, and motor starters located inside of Control Panels as shown on the electrical drawings and P&IDs.

###### B. PANEL SCHEDULE:

	Panel No.	Spec / P&ID	Features *	Enclosure Type	Panel Title	Notes
1	SP9 (SER85- VCP-101)	17110 / I-10- 601 & 602	1, 4, 6, V	NEMA-12	Main BFP Panel	Dewater Bldg Elec Room
2	SER85- VCP-102	17110 / I-10- 602	6, V	NEMA-4X	Local BFP Panel	Dewater Bldg BFP Catwalk
3	SP6-1 (SWR85- VCP-101)	17110 / I-10- 603 & 604	1, 4, 5, V	NEMA-12	Main BFP Panel 1	Dewater Bldg Elec Room
4	SP6-2 (SWR85- VCP-102)	17110 / I-10- 605 & 606	1, 4, V	NEMA-12	Main BFP Panel 2	Dewater Bldg Elec Room
5	SWR85- VCP-103	17110 / I-10- 604	6, V	NEMA-4X	Local BFP Panel	Dewater Bldg BFP Catwalk
6	SWR82- VCP-101	17110 / I-10- 604	3, V	NEMA-4X	BFP Sludge Pumps Panel 1	Digester Bldg
7	SWR82- VCP-102	17110 / I-10- 606	3, V	NEMA-4X	BFP Sludge Pumps Panel 2	Digester Bldg
8	SWR85- VCP-300	17110 / I-10- 606	1, 2, 4, V	NEMA-4X	Polymer Mixing Panel	Dewater Bldg

**\*FEATURES Legend**

V\* - Vendor/ Manufacture Panel per equipment specification requirements

1\* - Programmable Logic Controller (PLC) or Remote I/O devices

2\* - Panel mounted Operator Interface Terminal (OIT)

3\* - Hardwired control logic required

4\* - Laptop Shelf

5\* - 48VDC Power Supply (200 watt minimum) for POE switch.

6\* - Plant SCADA

**C. PANEL DESIGN:**

1. **GENERAL:** Panel hardware and software is specified in other Division 17 sections.

2. CONTROL POWER DISTRIBUTION: Panel containing 120-volt powered equipment shall use the din-rail power distribution method with fuses and blown fuse indication. Power is restricted to 120 Vac and 24 Vdc.

3. POWER SUPPLIES: Panel containing direct current powered instruments or serving as the termination point for transmission loop powered field instruments shall contain direct current power supply system as specified herein.

4. AIR SUPPLIES: Not Used.

5. ELECTRICAL CONTROL DEVICES: Pushbuttons, indicating lights, relays, and similar equipment located in panels specified in this section shall comply with the requirements of Section 16175.

6. UNINTERRUPTIBLE POWER SUPPLIES: Panel mounted 120 Vac input and 120 Vac output are specified herein. Each PLC shall include a UPS in the respective Control Panel.

## 1.02 QUALITY ASSURANCE

### A. REFERENCES

This section contains references to the following documents that are part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid or on the effective date of the Agreement if there were no Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
EIA RS-310C	Racks, Panels, and Associated Equipment
NEMA 250	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

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Reference	Title
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous (Classified) Locations

This Section references other sections with associated work specified therein:

1. Section 01660 specifies Equipment and System Performance and Operational Testing with reference to Contractor's Quality Assurance Manager that is responsible for startup commissioning of system including mechanical, HVAC, electrical, and instrumentation system.
2. Section 16000 specifies raceways, conductors, and device requirements.
3. Section 17030 Instrumentation and Control System Testing
4. Section 17310 Programmable Logic Controller, Operator Interface Stations, and software requirements.
5. Section 17900 Control Specifications.

**B. LISTED PRODUCTS:**

Equipment and components shall be Underwriters Laboratory (UL) listed for the purpose per Section 16000 or UL recognized.

The control panels shall have factory applied UL 508A labels. Where intrinsic safety barriers are used within a control panel, provide UL 698A factory applied label as required by UL.

**C. FACTORY TESTING:**

Prior to shipment, the manufacturer shall test the functional operation of the control panel as described in the control description Section 17030.

**D. SHIPMENT, PROTECTION AND STORAGE:**

Equipment shipment, protection and storage shall conform to the requirements specified in Section 01605.

**E. WARRANTY:**

As specified in the General Conditions.

### 1.03 SUBMITTALS

#### A. GENERAL:

Submittals and transmittal procedures for submittals are defined in Section 01300. Submit In accordance with the procedures set forth in Sections 00710 and 01300 that include drawings, information and technical data for equipment and as required in Section 17000. Submittal information shall be included in one complete submittal.

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Owners Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

*Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. A marked copy of specification section 17000.
3. A marked copy of specification section 17030.
4. A marked copy of specification section 17000.
5. A marked copy of specification section 01660.
6. A marked copy of specification section 16176.
7. A copy of the contract document Process and Instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required".

*Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*

8. Marked contract document Control Schematic diagrams related to the submitted equipment.
9. Marked contract document Control Single Line diagrams related to the submitted equipment.
10. Marked product literature of all the enclosure electrical devices and components mounted on or within the control panel.
11. List of miscellaneous items, cables, spare and replenishment parts, and chemicals to be provided, including MSDS information.
12. Dimensioned drawings:
  - a. Exterior panel and layout
  - b. Interior devices and layout
  - c. Door-in-door construction devices, where required
13. Panel assembly drawings including sections showing clearances between face and rear mounted equipment.
14. Nameplate engraving schedule:
  - a. Indicate engraving by line
  - b. Character size
  - c. Nameplate size
  - d. Panel and equipment tag number and description
15. Heat load calculations for each cabinet based on the highest ambient temperature listed in Section 17000 for the area in which the subject panel will be located.
16. Wiring drawings:
  - a. Schematic diagrams
  - b. Internal wiring diagrams
  - c. Connection diagrams

#### 1.04 ENVIRONMENTAL CONDITIONS

Refer to Section 17000.

## PART 2--PRODUCTS

### 2.01 FABRICATION

#### A. GENERAL:

Panels shall be designed for the seismic requirements of Section 17000. Structures, equipment, and devices shall be braced to prevent damage from specified forces. Equipment panels shall be capable of operation following a disturbance.

Nameplates with tag number and equipment description shall identify face-mounted instruments. Instruments shall be mounted for access to components and ease of removal. Cutouts for future equipment shall be blanked off with suitable covers. Instrument tag numbers shall be identified on the panel rear.

Face-mounted equipment shall be flush or semi-flush with flat-black escutcheons. Face-mounted instruments that are more than 6 inches deep, weigh more than 10 pounds, or exert more than a 4 ft-lb moment force on the face of the panel shall be supported underneath at the rear by a 1-inch x 1/8-inch thick steel angle.

Panels less than 60 inches high shall be provided with floor stands to raise the top of the panel to 60 inches above the floor or work platform. Panels that weigh less than 100 pounds may be wall mounted.

Panels with specified requirements including stainless steel or aluminum mounting requirements that are indicated on the project drawings or on the project details take precedence over the panel types or panel features indicated herein.

#### B. PANEL LAYOUT:

1. Provide minimum of 20 percent spare terminal blocks, with a minimum of 10 analog, discrete, power.
2. Separation between the power components (over 120Vac) and the control / instrument components (120Vac and less) by locating the power components and the control / instrument components in separate sections of the cabinet enclosure.
3. Separation between the power components and the control / instrument components using barriers.
4. External lockable circuit breaker handle for the main panel disconnect for 3-phase panels.
5. Individual power and control components with internal circuit breakers, as required.
6. Motor controllers, as required by the equipment specifications.
7. Face-mounted equipment flush or semi-flush with flat-black escutcheons.
8. Panel tops of wall-mounted panels: mounted at the same elevation.

9. Panel inner door contains a copy of the record elementary and wiring diagrams, or reference as allowed per NEC Article 409.
10. Panel inner door contains a drawing holder.
11. Panel drawings enclosed in a transparent, protective jacket.
12. Panel functions as specified.
13. Panels with floor stands, to raise the top of the panel to 60 inches above the floor or work platform.
14. Wall mounting of panel weighs less than 100 pounds, where wall space is available.

C. ENCLOSURES:

1. Panel enclosures shall comply with the requirements of NEC Article 409 and NEMA 250.
2. Manufacturer:
  - a. Hoffmann Enclosures, Inc.
  - b. Rittal
  - c. or equal.

## 2.02 HEATING, VENTILATING AND COOLING

Forced air ventilation shall be provided for panels where indicated in the Panel Schedule and if the cabinet's heat load calculations indicate that the interior temperature of the cabinet will exceed 115 degrees-F, under worst case conditions.

Ventilation for panel racks shall be venturi fans provided on 5-1/2-inch high-notched panel. Ventilation for consoles shall be similar to that for panel racks except EIA RS-310 mounting is not required. Fans shall be equipped with UL-approved washable filters and provide at least 240 cubic feet per minute (CFM). Fans shall be thermostatically controlled. Noise level at 3 feet from exterior wall and 30 degrees off axis shall not exceed 60 NC units.

Outdoor panels shall also be provided with thermostatically controlled space heaters. Space heater surface temperature that exceeds 120 degrees F requires an expanded metal guard. Thermostats shall be Honeywell T631B1013, Penn Controls A28AA-4, or equal.

Panel air conditioning cooling requirements shall be a cooling system that does not exchange cabinet interior air with ambient air. The cooling system shall be either a closed glycol loop heat exchange system or a CFC-free refrigeration system as required for the specified equipment and instrument complement and ambient temperature conditions.

Panel air conditioner shall be NEMA rated based on the installed area environment and the coils shall be Heresite, or equal coated and protected from corrosion.

## 2.03 PROTECTION COATING AND FINISH

Panels located outdoors or located in corrosive areas shall be bottom coated with waterproof coatings.

## 2.04 NAMEPLATES

External door-mounted components and the panel description shall be identified with plastic nameplates. Machine embossed metallic adhesive labels shall identify tag number of instruments inside panels. Nameplates shall be attached to panel surfaces, not to instruments.

The machine engraved laminated black phenolic nameplates with white lettering shall be provided for panel-mounted equipment. Nameplate engraving shall include the instrument tag number and description in 3/32-inch minimum size lettering.

The machine embossed metallic adhesive labels shall identify tag number of instruments inside panels. Nameplates shall be attached to panel surfaces, not to instruments.

The nameplates shall be attached to the panel with a minimum of two self-tapping 316 stainless steel screws. Provide RTV sealant for nameplates for NEMA-4X stainless steel panels.

The nameplate wording may be changed without additional cost or time prior to commencement of engraving. Submit nameplate legend with the panel submittal.

## 2.05 PANEL FEATURES

### A. INTERCONNECTION WIRING:

#### Panel Interconnecting Wiring:

1. Panel control wiring: Single conductor stranded copper NFPA No. 70 Type MTW No. 16 AWG minimum, with an exception for factory supplied PLC wiring harnesses that are U.L. approved.
2. Panel instrument wiring: Twisted No. 16 AWG shielded pair or tri conductors.
3. Panel power wiring: Conductors specified in Division 16 and meet the NFPA No. 70 NEC requirements for power including phase, grounded, and grounding conductors.
4. Wiring shall be supported independently of terminations by lacing to panel support structure or by slotted flame retardant plastic wiring channels.

5. Wiring channels shall comply with UL 94, Type V.
6. Wiring channel fill shall not exceed 50 percent.
7. Plastic spiral wrap shall be used for exposed wires. Wires that cross door hinges shall be enclosed in plastic spiral wrap.

**B. CONDUCTOR IDENTIFICATION:**

Wiring shall be tagged at terminations with machine printed plastic sleeves with three-part wire numbers for instrument and control panel internal conductors:

1. Part-1: Prefix of the wire number shall be the instrument loop number or equipment tag number.
2. Part-2: Code letter and wire colors per the following tables.
3. Part-3: Number that identifies individual circuit conductor Rung Number.

Code	120 Vac Conductor	Color
L	Power	Black
C	Control	Red
N	Neutral	White
PG	Ground	Green

Code	V dc Conductor	Color
PS	24 Vdc Power	Blue
PS	12 Vdc Power	Violet
S+	Signal (+)	Black
SG	Signal Ground	White
EG	Equipment Ground	Green
FV	Panel Foreign Voltage	Yellow

**C. CONDUCTOR INSTALLATION AND PROTECTION:**

1. Power and control wiring shall be carried in covered channels separate from low voltage signal circuits. An interior steel barrier shall be provided between AC control devices and the electronic equipment.
2. Terminal blocks shall be strap screw type rated for 600 volts. Each terminal trip shall have a unique identifying alphanumeric code at one end and a vinyl-marking strip running the entire length of the terminal strip with a unique number for each terminal. Numbers shall be machine printed and 1/8 inch high.
3. No more than two connections shall be made to one terminal.
4. Wire connectors shall be locking fork tongue or ring tongue insulated crimp type terminals.
5. Terminal blocks shall be;
  - a. Buchanan 0621-1
  - b. Allen-Bradley 1492-HM1 600 V 30-amperes, finger-safe terminal block.
  - c. Allen-Bradley 1492-CD3 600 V 35-amperes with #8 screw terminal block for ring or spade terminals.
  - d. Phoenix Contact or Weidmuller equal products.

D. FIELD WIRING:

Field wiring shall be connected to separate dedicated terminal blocks in a dedicated part of the panel where the field cables enter the panel.

E. FUSE AND FUSE HOLDERS:

1. Fuses for 120 Vac circuits shall have a minimum of 12,000-amperes interrupting capacity and blown fuse indicators.
2. Fuses for 24 Vdc circuits shall be fast acting glass tube type rated 1/8 or 1/10 amp for 4-20 mA loops.
3. Fuses for 24 Vdc circuits shall be 1/2 amp for the power supply to individual instruments.
4. Fuse holders shall be tip-out or draw-out type.
5. Provide Phoenix Contact or equal products.

F. CONTROL POWER:

120 Vac control power source: Single power source for all control and DC power. Dual power sources, one for control power and one for DC power. Dual power sources, one for PLC and DC power and one for PLC output and input control power.

1. Provide control power transformers, as required for the load.
2. Provide direct current power supplies, as required for the load.
3. Provide UPS for PLC and derived loop power as defined above, as required for the load.

G. PANEL POWER:

Panel power source:

1. Provide a 120 Vac circuit for the panel light, receptacle, heating, fan, heat exchanger, or air conditioner cooling load as required.
2. Provide a 120 Vac circuit for air conditioning load as required.

H. ACCESSORIES:

1. Panels greater than 24" high x 24" wide shall include GFCI convenience receptacles and fluorescent utility lights.
2. Receptacles and utility lights shall not be powered by the UPS, where included.
3. Print pocket.
4. Fold-up shelf of sufficient size, sufficient weight capacity, and the proper angle for supporting a laptop computer.

I. Fail-Safe Wiring:

Fail-safe wiring of control relay or other on/off device or instrument provides the condition that will occur upon loss-of-power or internal failure in the device such that the relay is de-energized in the failure or loss-of-power condition such that the control relay contact operation provides for equipment failing in a safe mode.

## 2.06 ALARM AND TROUBLE DETECTION

- A. The equipment control system shall incorporate a non-energized, open-state, output contact to activate on an alarm or trouble condition or on loss-of-power. Detection of a critical alarm or trouble condition shall cause the control system to initiate the shutdown or the operation of the equipment's controlled components to achieve a "Fail-Safe" condition.
- B. Devices that signal an alarm or a trouble conditions shall latch in the alarm position and require a manual reset at the equipment control panel.
- C. Alarm and trouble output shall:
  - 1. Open an output dry-contact.
  - 2. Remain open until manually reset.
  - 3. Not indicate abnormal condition when the equipment shutdown manually or automatically.
  - 4. Indicate the alarm at the equipment control panel.
- D. Fail-Safe Design and Operation:
  - 1. Failure of part of a system shall not result in the failure of the rest of the system.
  - 2. Failure of equipment or process shall not propagate beyond the failing device or equipment component.
  - 3. Control design and operation shall prevent improper system functioning due to a circuit malfunction or operator error.
  - 4. Control system design shall cause the controlled equipment to operate in a safe mode in the event of loss-of-power or the failure of a control system component.

## 2.07 SURGE PROTECTION

A. Surge protectors shall be multi-stage, plug-in type selected to protect the equipment. Surge protectors shall be removable without changing the impedance of the circuit. Surge protectors product manufactures shall be:

- 1. Circuit Components Inc: Din Rail SDD-400 Series for Data or Analog Signals.
- 2. Joslyn Model 1663-08
- 3. Taylor 1020FA
- 4. Phoenix Contact

5. Telematic
6. Edco
7. Or equal.

B. Provide Type 1 surge protective devices, per NEC Article 285, at the power feed to the panel. Surge Protective Devices (SPD) shall be designed to provide transient voltage protection for a service entrance panelboard. SPD units shall comply with UL 1449 3rd Edition, and shall be listed for such use. SPD units shall be rated for the voltage and phase service of the panel at 120 kA per phase. SPD units shall have a built-in diagnostic package with flashing trouble indicator, a display for the status of each phase, and a counter and display to indicate the number of surges that have caused the device to operate.

1. SPD units shall be Eaton Clipper Power System, Visor Series, Circuit Components Inc, SPD-Series or approved Equal.

C. Surge arrestors and capacitors shall be provided on the primary winding of isolation transformers supplying power to solid state systems. Surge protectors shall be mounted in a separate, NEMA 1 enclosure adjacent to the transformer and the incoming line passed through this enclosure. Surge arrestors shall be General Electric 9L15EC or equal. Surge capacitors shall be General Electric 9L18B, or equal.

## 2.08 PANEL GROUNDING

- A. Each panel shall be provided with two copper ground bars.
  1. One bar (NEC required) shall be bonded to the panel or panel frame or back-plate and to the facility grounding system.
  2. Second (signal) ground bar shall be mounted on insulated stand-offs and shall be bonded to the panel ground bar only at one point.
- B. Signal circuits, signal cable shields, and low-voltage DC power supply commons shall be bonded to the signal ground bar.
- C. Field analog wiring shields shall only be grounded at the signal ground bar. Test to verify that single ground point at panel signal ground bar.
- D. Surge protectors and separately derived AC power supplies shall be bonded to the frame ground bar.
- E. Panels exceeding 36-inches width shall contain ground bars shall be 1/4- by 1-inch copper bars extending the entire length of the panel interior at the bottom of the panel.

## 2.09 PANEL DRAWING PROTECTION

Provide wiring diagrams in accordance with Section 01300. Provide a panel-wiring diagram and schematic for each panel in a plastic bag or plastic container to avoid water damage and aging.

## 2.10 DIRECT-CURRENT POWER SUPPLIES

Nominal 24-volt direct-current instrumentation and control power supply:

1. Convection-cooled linear type or switching type.
2. Line regulation: 0.4 percent for line variations from 105 to 132 volts
3. Load regulation: 0.4 percent for load variations from 0 to full load.
4. Ripple and noise: Not exceed 100 mV peak-to-peak.
5. Hold-up time at maximum load: Not less than 16 milliseconds.
6. Continuous duty from 0 to 50 degrees C at rated load.
7. Output electronically current limited.
8. Over-voltage crowbar shutdown.
9. Output voltage:
  - a. Rated 28 Vdc
  - b. Adjustable plus or minus 5 percent
  - c. Set to provide 26.4 volts to the panel direct current bus.
10. Power Supply: TDK-Lambda LZSA series, or equal.
11. Provide dry contact for failure alarm. Dry contact to be wired to input in nearest PLC

## 2.11 UNINTERRUPTIBLE POWER SYSTEM (UPS)

The UPS shall be on-line, computer-grade with electrical isolation including output neutral. UPS shall be packaged for panel enclosure mounting using a back-panel bracket or holder:

1. Nominal input voltage: 120Vac.
2. Nominal output voltage: 120Vac.

The online UPS system shall be provided with integral sealed no maintenance batteries, sized to provide full capacity backup power for 10 minute minimum at connected load with integral battery charger.

The panel supplier shall calculate the required kVA rating at 150 percent of connected load. Submit load calculations, schematic diagrams, and wiring connection diagrams. Provide battery cabling and other required cabling for a complete system.

The UPS shall be mounted within the panel on a pedestal or tray with stainless-steel legs to provide space for wire entry and passage.

The UPS shall be configured with a maintenance bypass switch to allow ease of removal from the panel; to allow the panel to operate on utility power.

Uninterruptible power supply systems shall be as manufactured by Best Power Technology, Inc., Necedah, American Power Conversion, Wisconsin, or equal.

## 2.12 UNDERCURRENT SENSING RELAY

Undercurrent sensing relays shall be provided and installed inside the existing Conveyor Control Panel for each of the SWWRF Conveyor Motor Starters. In addition SP6-2 (SWR85-VCP-102) shall include an undercurrent sensing relay for the second unloading conveyor motor starter:

1. Adjustable current switch.
2. Power induced from monitored conductor.
3. Temperature range 5° to 140° F.
4. UL Listed
5. Status LEDs for local indication.
6. Low setpoint, minimum trip as low as .5Amps
7. Max Status Output N.O. 1Amp @ 30VAC/DC
8. Veris H608 Series, or equal.

## 2.13 FIBEROPTIC MANAGED SWITCH

1. Industrial Managed switch support layer 2 switching and layer 3 routing
2. Gigabit Ethernet, 1 spare copper port minimum. Fiber ports to match existing plant fiber.
3. Temperature range -40° to 140° F.
4. UL Listed
5. Studio 5000 Add-on Profiles
6. Predefined Logix Tags for monitoring and port control.
7. Rockwell Automation Stratix 5400, 5700, or equal.

## 2.14 SPARE PARTS

The following spare parts shall be provided:

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1. Ten each of each type of light bulb used in the panels.
2. Five each of each type and rating of fuse used in the panels.
3. Five each of each type primary protector surge suppressor used in the specified panels.
4. Two each of each type of surge protective device used in the specified panels.

## 2.15 PRODUCT DATA

The following data shall be provided in accordance with Section 01300:

1. Manufacturer's operation and maintenance information as specified in Section 01730. Manual shall include final reviewed submittal and separate record of all final configuration, jumper, and switch settings.
2. Test results as specified in Section 17030-Part 2.
3. Manufacturer's certification for the performance of features of the specified equipment that cannot be readily inspected.
4. Special requirements for delivery of the information such as time, manner, place, or quantity.
5. Installation and training forms specified in Part 3.

## PART 3--EXECUTION

### 3.01 GENERAL

Floor mounted cabinets shall be mounted and shimmed to precise alignment so doors operate without binding. Sealant shall be provided for conduit entering the panels.

Floor-mounted panels except in dry control rooms or electrical equipment rooms shall be mounted on 3-1/2-inch minimum height concrete pads or grouted bases as specified. Coating shall be provided for outdoor panels in contact on concrete. Field panels and cabinets shall be mounted in compliance with paragraph 17000-3.01 B.

Terminals and terminal blocks shall be sprayed after all terminations have been completed with a silicone resin similar to Dow Corning R-4-3117 conformal coating.

Provide panels with the Record As-built schematic, connection, and interconnection diagrams mounted behind plexiglass holder on the inside of the door. Place documentation in a water proof clear bag in the panel document holder.

Verify that all panels have been labeled with Arc Flash warning labels per NEC 110.16. Provide labels, with Arc Flash protection boundary and PPE levels.

### 3.02 OUTDOOR PANEL SHADE COVERS

Fabricate the custom aluminum panel shade cover and mount the panels facing away from the prevailing sun or wind.

Provide Sun/Rain covers per Electrical Detail for outdoor vendor, manufacture, and custom panels. Fabricate based upon known panel dimensions or accepted submittal drawing dimensions.

### 3.03 PANEL POWER SUPPLY

Power supply and conditioning equipment shall be mounted and connected in compliance with the manufacturer's instructions.

Line side disconnect switches shall be provided for power supply and conditioning equipment. Line and load side overcurrent protection shall be provided for power supply and conditioning equipment in compliance with NFPA 70. Disconnect switches shall comply with Section 16175.

Small power supply and conditioning equipment may be mounted in the panel served. Larger units shall be mounted adjacent to the equipment served. Where unconditioned power is brought into control panels, it shall be enclosed in metallic raceways within the panel.

Power supply and conditioning equipment larger than 5 kVA load capacity supported from surfaces other than concrete shall be provided with sound isolators.

Final raceway connections shall be a flexible conduit in compliance with Division 16.

### 3.04 MOUNTING

- A. Control panels supported directly by concrete or concrete block walls shall be spaced out not less than 5/8 inch by framing channel between instrument and wall. Sills shall be leveled so panel structures will not be distorted. Panels shall be shimmed to precise alignment so doors operate without binding and mounted where shock or vibration will impair its operation.

- B. Support systems shall not be attached to handrails, process piping or mechanical equipment. Control panels supported directly by concrete or concrete block walls shall be spaced out from the wall to provide for air circulation around the panels.
- C. Steel used for support of equipment shall be 316 stainless steel. Support systems including panels shall be designed to prevent deformation greater than 1/8 inch under the attached equipment load and an external load of 200 pounds in any direction.
- D. Floor-mounted cabinets, except in dry control rooms or electrical equipment rooms, shall be mounted on 3-1/2-inch minimum height concrete pads or grouted bases as specified.
- E. Panels shall be shimmed to precise alignment so doors operate without binding. Sealant shall be provided under panels not located in dry control or electrical equipment rooms.
- F. Center-line of wall-mounted panels shall be 48 inches above the floor.
- G. Panel tops of wall-mounted panels shall be mounted at the same elevation.

### 3.05 FACTORY TESTING

The control panel shall be assembled, interconnected, and functionally tested at the assembly shop prior to shipment. The Owner/Engineer shall have the option of witnessing the functional shop test. The Contractor shall notify the Owner/Engineer at least two (2) weeks in advance prior of the scheduled functional shop test.

### 3.06 FIELD TESTING

Field verify the following for Instrument and Control Panels:

1. Control circuits grounded with one terminal of each load device connected to the grounded conductor.
2. Control contacts installed in the ungrounded side of the circuit.
3. Signal and control wiring installed in separate wireways.
4. Barriers between the power wiring and the signal and control wiring.
5. Connected to the plant grounding system, as specified.
6. Inner door contains a copy of the Record elementary and wiring diagrams.
7. Inner door contains a protected drawing holder.

8. Drawings enclosed in a transparent, protective jacket.
9. Panel Functions as specified.
10. Mounted with stainless steel unistrut, fittings, and fasteners.
11. Tested in accordance with Section 16030 and Section 17030.

**\*\*END OF SECTION\*\***

## SECTION 17200

### INSTRUMENT INDEX

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies the Instrument Index and general requirements applicable to process instrumentation and analyzer systems consisting of process sensors, process indicators, signal conditioning module, control and monitoring devices, transmitters, and accessories.

The Contractor shall provide, calibrate, and test the complete process instrumentation and analyzer systems and place in operation and test the system. Testing includes tuning loops and making final adjustments to instruments and analyzers during facility start-up.

The Contractor shall provide the services of certified instrument technicians for testing and adjustment activities as specified in Section 17000.

The Contractor shall examine the mechanical drawings and specifications to determine actual locations, sizes, materials and ratings of process connections. Process taps shall be indicated on pipe shop drawings as specified in paragraph 15050-2.04.

##### 1.02 REFERENCES

Refer to Section 17000 – General Requirements for Instrumentation and Control.

Refer to Section 17030 – Process Instrumentation and Control System Testing.

##### 1.03 SUBMITTALS

Refer to Sections 17000 and 17030.

#### PART 2--PRODUCTS

##### 2.01 INSTRUMENT INDEX

The Instrument Index, paragraph 17200-3.03, lists instruments and analyzers required for the project. Instrument functions specified on this list shall be provided by the Contractor.

Additional instrumentation devices such as process taps, seals, and other items required to complete the instrument loops due to characteristics of the equipment selected by the Contractor and

not specified in the instrument index or on the contract drawings shall be provided at no additional cost to provide a complete working system.

## PART 3--EXECUTION

### 3.01 GENERAL REQUIREMENTS

Materials, equipment, and installation shall be tested and inspected per Sections 17000, 17030, and this section.

Provide buffer solutions and reference fluids for analytical equipment test procedures.

### 3.02 INSTALLED EQUIPMENT - TESTS AND INSPECTION

A. Refer to Section 17030 – Process Instrumentation and Control System Testing.

### 3.03 INSTRUMENT INDEX

The following is an index of the instrumentation equipment, analyzers, and devices.

#### A. DESCRIPTION OF HEADINGS:

##### 1. TAG NUMBER:

Tag Number appears as a heading (PREFIX and NUMBER) and consists of a two, three or four letter prefix indicating the instrument function followed by a number identifying the process loop with which the instrument is associated. Tag Number provides an identification of the instrument, analyzer, or device.

##### 2. DESCRIPTION:

Provides the functional description of the instrument, analyzer, or device.

##### 3. P&ID NUMBER:

Lists the Process and Instrumentation Diagram on which the instrument, analyzer, or device appears.

##### 4. SPECIFICATION:

Provides the specification reference and “INSTRUSPEC” designation for the instrument, analyzer, or device.

##### 5. SIZE:

Provides the application data relative to sizing the instrument; flow tube diameter, probe length, associated pipe sizes, etc.

6. **RANGE:**  
Provides the calibrated instrument range for each application.
7. **SETPOINT:**  
Provides the calibrated switch setpoint.
8. **COMMENTS:**  
Provides the features, interlocks, and information applicable to the instrument, analyzer, or device.

TAG NO.	DESCRIPTION	P&ID	SPEC	RANGE	SETPOINT	COMMENTS
SWR85-PSL-103	BFP 3 WASHWATER PRESSURE SWITCH	I-10-603	17216/PS	N/A	85 PSI – LOW PRESSURE	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PSL-106	BFP 6 WASHWATER PRESSURE SWITCH	I-10-603	17216/PS	N/A	85 PSI – LOW PRESSURE	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PI-103	BFP 3 WASHWATER PRESSURE	I-10-603	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PI-106	BFP 6 WASHWATER PRESSURE	I-10-603	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PSH-301	POLYMER PUMP 1 PRESSURE SWITCH	I-10-604	17216/PS	N/A	90 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PSH-302	POLYMER PUMP 2 PRESSURE SWITCH	I-10-604	17216/PS	N/A	90 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PSH-303	POLYMER PUMP 3 PRESSURE SWITCH	I-10-604	17216/PS	N/A	90 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PSH-304	POLYMER PUMP 4 PRESSURE SWITCH	I-10-604	17216/PS	N/A	90 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PI-301	POLYMER PUMP 1 PRESSURE	I-10-604	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PI-302	POLYMER PUMP 2 PRESSURE	I-10-604	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PI-303	POLYMER PUMP 3 PRESSURE	I-10-604	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR8-PI-304	POLYMER PUMP 4 PRESSURE	I-10-604	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED

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TAG NO.	DESCRIPTION	P&ID	SPEC	RANGE	SETPOINT	COMMENTS
SWR82-PSH-101	SLUDGE PUMP 1 PRESSURE SWITCH	I-10-604	17216/PS	N/A	85 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-PSH-102	SLUDGE PUMP 2 PRESSURE SWITCH	I-10-604	17216/PS	N/A	85 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-PSH-103	SLUDGE PUMP 3 PRESSURE SWITCH	I-10-604	17216/PS	N/A	85 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-PI-101	SLUDGE PUMP 1 PRESSURE	I-10-604	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-PI-102	SLUDGE PUMP 2 PRESSURE	I-10-604	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-PI-103	SLUDGE PUMP 3 PRESSURE	I-10-604	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-FE/FIT101	SLUDGE PUMP 1 FLOW	I-10-604	17212/FM	0-300 GPM	N/A	6" PIPE DIAMETER
SWR82-FE/FIT102	SLUDGE PUMP 2 FLOW	I-10-604	17212/FM	0-300 GPM	N/A	6" PIPE DIAMETER
SWR82-FE/FIT103	SLUDGE PUMP 3 FLOW	I-10-604	17212/FM	0-300 GPM	N/A	6" PIPE DIAMETER
SWR85-PSH-305	POLYMER PUMP 5 PRESSURE SWITCH	I-10-606	17216/PS	N/A	90 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PSH-306	POLYMER PUMP 6 PRESSURE SWITCH	I-10-606	17216/PS	N/A	90 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PSH-307	POLYMER PUMP 7 PRESSURE SWITCH	I-10-606	17216/PS	N/A	90 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PSH-308	POLYMER PUMP 8 PRESSURE SWITCH	I-10-606	17216/PS	N/A	90 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PI-305	POLYMER PUMP 5 PRESSURE	I-10-606	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PI-306	POLYMER PUMP 6 PRESSURE	I-10-606	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR85-PI-307	POLYMER PUMP 7 PRESSURE	I-10-606	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED

TAG NO.	DESCRIPTION	P&ID	SPEC	RANGE	SETPOINT	COMMENTS
SWR8-PI-308	POLYMER PUMP 8 PRESSURE	I-10-606	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, DIAPHRAGM SEAL REQUIRED
SWR82-PSH-104	SLUDGE PUMP 4 PRESSURE SWITCH	I-10-606	17216/PS	N/A	85 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-PSH-105	SLUDGE PUMP 5 PRESSURE SWITCH	I-10-606	17216/PS	N/A	85 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-PSH-106	SLUDGE PUMP 6 PRESSURE SWITCH	I-10-606	17216/PS	N/A	85 PSI – HIGH PRESSURE	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-PI-104	SLUDGE PUMP 4 PRESSURE	I-10-606	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-PI-105	SLUDGE PUMP 5 PRESSURE	I-10-606	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-PI-106	SLUDGE PUMP 6 PRESSURE	I-10-606	17211/PG	0-150 PSI	N/A	VENDOR SUPPLIED,, ANNULAR SEAL REQUIRED
SWR82-FE/FIT104	SLUDGE PUMP 4 FLOW	I-10-606	17212/FM	0-300 GPM	N/A	6" PIPE DIAMETER
SWR82-FE/FIT105	SLUDGE PUMP 5 FLOW	I-10-606	17212/FM	0-300 GPM	N/A	6" PIPE DIAMETER
SWR82-FE/FIT106	SLUDGE PUMP 6 FLOW	I-10-606	17212/FM	0-300 GPM	N/A	6" PIPE DIAMETER

**\*\*END OF SECTION\*\***

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## SECTION 17211

### PROCESS TAPS AND PRIMARY ELEMENTS

#### **PART 1** GENERAL

##### 1.01 DESCRIPTION

This section specifies requirements for instrumentation elements that quantitatively convert the measured variable energy into a form suitable for measurement and process measurement accessories. Application requirements are specified in Section 17200.

###### A. SCOPE

1. This section specifies requirements for instrumentation elements which form a part of the process control systems specified in Section 17000 and Section 17200 – Instrument Index. Application requirements are specified in the instrument schedule, paragraph 17200-3.03.

###### B. OPERATING REQUIREMENTS:

1. The devices specified in this section quantitatively convert the measured variable energy into a form suitable for measurement and process measurement accessories.

##### 1.02 REFERENCES

References are listed in Section 17000. They are a part of this section as specified and modified.

##### 1.03 SUBMITTALS

Submittals shall be provided as specified in paragraph 17200-1.03.

#### **PART 2** PRODUCTS

##### 2.01 INSTRUMENTATION SPECIFICATION SHEETS (INSTRUSPEC)

General requirements for primary elements specified in this section are specified on the INSTRUSPEC sheets in paragraph 17211-3.04.

##### 2.02 VALVES

###### A. ISOLATION VALVES

1. Valves shall be full port ball valves with ASTM A276, Type 316 stainless steel trim and body and with Teflon seats and packing. Valves shall be Parker CPI, Whitey, Hoke, or equal.

#### B. GAGE VALVES

1. Gage valves shall be machined from ASTM A276, Type 316 stainless steel bar stock and shall be provided with 1/2-inch NPT connections and integral bleed plug. Valves shall be Anderson, Greenwood & Company M9 VIS-44, Hoke 6801L8Y, or equal.

#### C. ROOT VALVES

1. Root valves shall be ASTM A276, Type 316 stainless steel bar stock with 1/2-inch NPT male process connection and three 1/2-inch NPT female instrument connections. One instrument connection shall be provided with an ASTM A276, Type 316 stainless steel bleed valve. ASTM A276, Type 316 stainless steel plugs shall be provided for unused ports.
2. Lagging type units shall be provided for insulated vessels and pipes.
3. Root valve manufactures: Anderson, Greenwood & Company M5 VIS-44, Hoke 6802L8Y, or equal.

#### D. MANIFOLDS

1. Manifolds shall be three-valve bar-stock type. Manifold body shall be machined from ASTM Type 316 stainless steel bar stock. Valves shall be globe configuration with 316 stainless steel ball seats and Teflon stem packing.
2. Manifolds shall be designed for direct mounting to differential pressure transmitters in place of the flanges normally furnished. Fabricated manifolds or manifolds employing needle or soft seat valves are not acceptable. Purge taps, 1/8-inch NPT shall be furnished on manifolds where water purge is specified.
3. Manifold manufacturers: Anderson Greenwood AX3T VIS-4, Hoke GP831211F8YL, or equal.

### 2.03 TUBING AND TUBING FITTINGS

#### A. STAINLESS STEEL TUBING

1. Tubing shall be seamless annealed ASTM A269 Type 316 stainless steel 1/2-inch and 3/8-inch tubing shall have a wall thickness of 0.035 inches and 1/4-inch tubing shall have a wall thickness of 0.028 inches.

#### B. PLASTIC TUBING

1. Tubing shall be extruded from high molecular weight, low density polyethylene compound. Tubing shall be 1/4-inch outside diameter and shall be black, unless otherwise specified or shown. Tubing shall meet the standard ASTM #D-1693 test for stress cracking of base materials. Wall thickness shall be 0.040 inches plus or minus 0.005 inches. Maximum working pressure shall be 80 psig, at 100 degrees F, or higher.
2. Tubing manufacturers: Dekoron "P", Parker Hannifin "E", or equal.

C. TUBING FITTINGS:

1. Tubing fittings shall be Type 316 stainless steel and shall be the double-ferrule swage type. Flare, ball sleeve compression or single-ferrule swage type are not acceptable.
2. Fitting manufactures: Crawford "Swagelok", Hoke "Gyrolok", or equal.

2.04 CHEMICAL SEALS

A. DIAPHRAGM SEALS

1. Seal shall be the diaphragm type with flushing connection, Type 316 stainless steel body and Type 316L diaphragm with 1 inch process connection unless otherwise specified.
2. Diaphragm seal manufactures: Mansfield and Green Type SG, Ashcroft Type 101, or equal.

B. ANNULAR SEALS

1. Seal shall be the in-line full stream captive sensing liquid type. Metallic wetted parts shall be Type 316 stainless steel. Flexible cylinder shall be Buna-N unless otherwise specified. Seals shall be rated 200 psig with not more than 5-inch water column (WC) hysteresis.
2. Annular seal manufactures: Ronningen-Petter Iso-Ring, Red Valve series 40, or equal.

C. FILL FLUID

1. Chemical seals and associated instruments shall be factory filled as follows:
2. Instrument side of seal, capillary tubing, and instrument shall be evacuated to an absolute pressure of 1.0 Torr or less; filled; and sealed. Provide silicone oil fill fluid, unless otherwise recommended by the seal manufacture.
3. Chemical seal manufacture: Dow Corning DC200, Syltherm 800, or equal.

## 2.05 BUSHINGS AND THERMOWELLS

Bushings or thermowells shall comply with ASME B40.200. Temperature taps shall be 1/2-inch NPT, and lagging extensions shall be provided on insulated vessels or pipes. Thermowells and bushings shall be machined from Type 316 stainless steel bar stock unless otherwise specified.

## 2.06 PURGE ASSEMBLIES

The purge assembly for air or water for flushing seals on sludge level measurement applications with a choice of Buna, Viton, Etylene Propylene O-Rings.

### A. AIR

1. Air purge assembly shall consist of a constant-differential relay, needle valve, check valve and 0.2 to 2.0 standard cubic feet per hour rotameter.
2. Assembly manufacturer: ABB Purgemaster Series 10A6100, or equal.

### B. WATER

1. Water purge assembly shall consist of a strainer, constant-differential regulator, needle valve, check valve, and 20 to 200 cc/m rotameter. Provide 155 micron wye-type strainer.
2. Strainer manufacturer: ASCO 8600A2, Crane, or equal.
3. Assembly manufacturer: ABB Purgemaster Series 10A6100, or equal.

## 2.07 PRODUCT DATA

### A. GENERAL

1. In accordance with drawings, information, and technical data for all equipment as, required in Section 17000 and this section shall be provided. All required product data for this section shall be included in one complete package.

### B. ADDITIONAL INFORMATION

The following product data shall be provided:

1. Flow calculation for each differential-type flow element.
2. Record documentation shall include the data sheets specified in this section.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

#### **A. PROCESS CONNECTIONS**

1. Process taps shall comply with API RP551. Root valves shall be provided at taps, except temperature taps and pump discharge pressure taps. Process connections shall be arranged such that instruments may be readily removed for maintenance without disruption of process units or draining of large tanks or vessels.
2. Unions or flange connections shall be provided as necessary to permit removal without rotating equipment. Where process taps are not readily accessible from instrument locations, a block valve shall be provided at the instrument. Block valves shall also be provided for each instrument where multiple instruments are connected to one process tap.

#### **B. ELECTRICAL CONNECTIONS**

1. Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 2 feet.

### **3.02 INSTALLATION**

#### **A. GENERAL**

1. General requirements for the installation of primary elements specified in this section are listed on INSTRUSPEC sheets and the specific application specified in Section 17200 – Instrument Index.

#### **B. PROCESS CONNECTIONS**

Where process taps are not readily accessible from instrument locations, an isolation valve shall be provided at the instrument.

Isolation valves shall be provided for each instrument where multiple instruments are connected to one process tap.

Pipe between the process connection and instruments shall be 1/2-inch stainless steel with treatment material for easy removal, as specified herein.

2. **SAFETY INSTRUMENTS:** No valves shall be installed at pressure taps for safety instruments. Safety instruments shall not be connected to the same process tap as instruments used for control, indication, or recording except when annular chemical seals are used.

3. ROOT VALVES: Root valves shall be provided at all process taps, except as follows:

- a. Temperature taps, where valves are unnecessary.
- b. Pump discharge pressure taps where no instrument is permanently installed.
- c. Isolation valves shall be provided.
- d. Process taps for safety instruments.
- e. Where gauge valves are provided.
- f. Where chemical seals are used.

4. GAUGE VALVES: Gauge valves shall be provided for each pressure gauge tap except where chemical seals are used.

#### C. TUBING

1. Tubing shall be installed on supports spaced not more than 3 feet apart and shall run parallel or perpendicular to walls structural members, or intersections of vertical planes and the ceiling. Unless otherwise shown, tubing shall follow building surfaces closely or shall be carried in trays or conduit.
2. Tubing shall not be supported from piping or equipment except at process taps or connections to the device served. Tubes supported directly on concrete surfaces shall be spaced at least 1/8 inch from the concrete. Tubing support shall be one-hole malleable iron clamps with clamp backs as required. Bends shall be formed to uniform radii without flattening.
3. Ends of tubing shall be square-cut and de-burred before installation in fittings. Fittings shall be used for splices, connections, and turns near final connections. Bulkhead fittings shall be used when tubing enters a panel.

#### D. ELECTRICAL CONNECTIONS

1. Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 2 feet.

### 3.03 TESTING

Applicable testing requirements are specified in paragraph 17200-3.02.

### 3.04 PROCESS CONNECTIONS

Process connection piping and tubing shall be tested in accordance with Section 15050.

### 3.05 INSTRUSPECS

Instrument Specification Sheets (INSTRUSPECS) included in this Section 17211 are shown below.

### 3.06 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

- A. Instrument Identification: PG
- B. Instrument Function: Pressure measurement
- C. Instrument Description: Pressure gauge
- D. Power Supply: N/A
- E. Signal Input: N/A
- F. Signal Output: N/A
- G. Process Connection: 1/2-inch male NPT
- H. Product Requirements: Pressure gages shall be 4-1/2-inch premium grade with bourdon tube element, 270-degree milled stainless steel movement, phenolic case, and shatterproof glass window. Accuracy shall be 1 percent of span or better. All exposed metal parts shall be stainless steel. Gauges located on a pump discharge shall include a snubber.
- I. Pressure gage manufactures:
  - 1. Ashcroft Duraguage Figure 1279
  - 2. Ametek 1981L
  - 3. or equal.

### 3.07 EXECUTION

- A. Installation: Install in accordance with manufacturer's instructions and the recommendations of API RP551 to the specified requirements.
  - 1. Root valves shall be provided at all process pressure taps except taps made for safety instruments. Gage valves shall be provided at the instrument where the instrument is not within sight of the root valve or where two or more instruments are connected to a single tap.
  - 2. Safety instruments shall not be connected to the same process tap as instruments used for control, indication, or recording. Unless otherwise specified, pressure

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instruments shall be located as close as practical to the process tap but shall be positioned to permit observation and maintenance. Pressure gages may be supported from the process tap if this location permits observation from the floor or a permanent work platform. Pressure instruments shall be installed in such a manner that blowout discs are not obstructed.

- B. Application/Calibration: Application, calibration, and set points shall be as specified in paragraph 17200-3.03.

**\*\*END OF SECTION\*\***

## SECTION 17212

### TRANSMITTERS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

This section specifies requirements for process parameter transmitters, associated indication devices, and accessories.

The application requirements are specified in the Instrument Index - Section 17200.

##### 1.02 REFERENCES

References shall be as specified in Section 17000.

##### 1.03 SUBMITTALS

Submittals shall be provided as specified in Sections 01300 and 17000, including:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Referenced and applicable sections to be marked up and submitted include:
  - a. Section 01664 - TRAINING
  - b. Section 01730 – OPERATING AND MAINTENANCE INFORMATION
  - c. Section 17000 - GENERAL REQUIREMENTS FOR INSTRUMENTATION AND CONTROL
  - d. Section 17200 – INSTRUMENT INDEX

A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the*

*marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. A copy of the contract document Control Diagrams and Process and Instrumentation Diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "*no changes required*". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
3. Marked Contract Document Mechanical and/or Electrical Plan drawings, sections, and details showing sensor installation locations and details. *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
4. Marked product literature of all equipment and features to be provided.
5. Installation drawings for only the transmitters, sensors, and mounting accessories to be provided.
6. Electrical and signal connection drawings for only the transmitters and sensors to be provided.
7. List of miscellaneous items, cables, spare parts, that will be provided in accordance with INSTRUSPEC sheet requirements.
8. Marked product literature for surge protectors.

## PART 2--PRODUCTS

### 2.01 GENERAL

Measuring elements and transmitters shall comply with the following requirements:

1. Measured parameter output indicators complying with paragraph 17212-2.02 shall be provided with any transmitter that does not include an integral indicator. Indicators, whether integral or separate, shall be calibrated in process units, and engraved on the indicator scale plate.
2. The two-wire type transmitters shall have operating power derived from the signal transmission circuit.

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3. Transmitters shall meet specified performance requirements with load variations within the range of 0 to 600 with the power supply at a nominal 24 volts DC with the default range of 0 to 100% corresponding to 4 to 20 ma.
4. Transmitter output shall increase with increasing measurement.
5. Time constant shall be adjustable from 0.5 to 5.0 seconds for transmitters used for flow, level transmitters used for flow measurement, or pressure measurement.
6. Transmitter output shall be galvanically isolated via electro-mechanical or optical technology.
7. Transmitter enclosures shall be rated NEMA 250, Type 4, unless otherwise specified.
8. Transmitters located outdoors shall be provided with surge protectors:
  - a. Signal: Emerson/Rosemount Model 470 D, Emerson/EDCO SS64-036-2, CCI SPN-42 FS28 Series, or accepted equal.
  - b. AC Power: UL 1449, LED indicator, screw terminal connections, NEMA 4X. EDCO HSP121A or accepted equal.
9. Two-wire transmitter located in a facility area classified as hazardous per the NFPA and the NEC shall be made safe by means of an intrinsic safety barrier as specified in paragraph 17212-2.03.
10. Four-wire transmitters shall be isolated from the process and power or provided with a loop-powered signal current isolator as specified in paragraph 17212-2.05 connected in the output signal circuit.

## 2.02 PROCESS PARAMETER OUTPUT INDICATOR

Provide digital LED or LCD indicators that integral to the instrument housing where available from the manufacturer. Displays shall be scaled in engineering units, over the calibrated range of the instrument. Calibrate the indicator scale in process units.

Analog output indicators shall be 2.5-inch milli-ammeter with 90-degree movement enclosed in a NEMA 7/9 rated meter case. Provide indicators with accuracy within two percent of span. Provide a diode to maintain loop continuity for indicator removal.

## 2.03 INTRINSIC SAFETY BARRIERS

Intrinsic safety barriers for two-wire transmitters shall be of the active, isolating, loop powered type. Barrier shall be Stahl Series 9000, Accepted equal.

## 2.04 INSTRUMENTATION SPECIFICATION SHEETS (INSTRUSPEC)

General requirements for instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 17212-3.03.

Application requirements are specified in the Instrument Index, paragraph 17200-2.03, and/or on the drawings.

## 2.05 SIGNAL CURRENT ISOLATOR

Isolator shall provide galvanic isolation of milliampere transmission signals from transmitters. Isolator shall be housed in a NEMA 250, Type 4/7 conduit body and derive operating power from the signal input circuit.

Input and output signals shall be 4 to 20 milliamperes, and error shall not exceed 0.1 percent of span. Input resistance shall not exceed 550 ohms with an output load of 250 ohms.

Isolator shall be Moore Industries SCX 4-20mADC to 4-20mADC / 5.5VPL / -RF DIN rail mounted with maximum 250 ohm output impedance, Phoenix Contact, or equal.

## 2.06 PRODUCT DATA

The following data provided in accordance with Section 01300:

1. Operating and maintenance information as specified in paragraph 17000-2.03. Include final reviewed submittal and separate record of all final configuration, jumper, and switch settings for each transmitter.
2. Test results as specified in Section 17030-Part 2.

# PART 3--EXECUTION

## 3.01 INSTALLATION

Installation requirements are specified in paragraph 17000-3.01.

### A. Process Connections:

1. General:
  - a. Process connections shall be arranged such that instruments may be readily removed for maintenance without disruption of process units or draining of large

tanks or vessels. Unions or flange connections shall be provided as necessary to permit removal without rotating equipment.

- 1) Where process taps are not readily accessible from instrument locations, an isolation valve shall be provided at the instrument.
- 2) Isolation valves shall be provided for each instrument where multiple instruments are connected to one process tap.
- 3) Pipe between the process connection and instruments shall be 1/2-inch stainless steel with treatment material for easy removal, as specified herein.

2. Safety Instruments:

- a. No valves shall be installed at pressure taps for safety instruments. Safety instruments shall not be connected to the same process tap as instruments used for control, indication, or recording except when annular chemical seals are used.

3. Root Valves:

- a. Root valves shall be provided at all process taps, except as follows:
  - 1) Temperature taps, where valves are unnecessary.
  - 2) Pump discharge pressure taps where no instrument is permanently installed. Isolation valves shall be provided.
  - 3) Process taps for safety instruments.
  - 4) Where gauge valves are provided.
  - 5) Where chemical seals are used.

4. Gauge Valves:

- a. Gauge valves shall be provided for each pressure gauge tap except where chemical seals are used.

B. Tubing:

1. Tubing shall be installed on supports spaced not more than 3 feet apart and shall run parallel or perpendicular to walls structural members, or intersections of vertical planes and the ceiling. Unless otherwise shown, tubing shall follow building surfaces closely or shall be carried in trays or conduit.
2. Tubing shall not be supported from piping or equipment except at process taps or connections to the device served. Tubes supported directly on concrete surfaces shall be spaced at least 1/8 inch from the concrete. Tubing support shall be one-hole malleable iron clamps with clamp backs as required. Bends shall be formed to uniform radii without flattening.
3. Ends of tubing shall be square-cut and de-burred before installation in fittings. Fittings shall be used for splices, connections, and turns near final connections. Bulkhead fittings shall be used when tubing enters a panel.

C. Electrical Connections:

1. Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 2 feet.

### 3.02 TESTING

Testing requirements are specified in Section 17030.

### 3.03 INSTRUMENT SPECIFICATION (INSTRUSPEC) SHEETS

General requirements for instruments specified in this section are listed on INSTRUSPEC sheets herein. Application requirements are specified in the Instrument Index, paragraph 17200-3.03, and/or on the drawings. INSTRUSPEC sheets for the transmitters listed in the following Table A are included in this paragraph:

Table A: Process Monitors and Indicating Transmitters

INSTRUSPEC Symbol	Instrument Description	Instrument Function
FM	Magnetic Flow Transmitter	Flow Measurement

### 3.04 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

Instrument Identification:	FM
Instrument Function:	Flow Measurement
Instrument Description:	Magnetic Flow Metering System
Signal Input:	Process
Signal Output:	Analog signal as specified in paragraph 17212-2.01
Process Connection:	Flange, ANSI B16.5, Class 150, raised face.
Product Requirements:	<p>Magnetic flow meter provided as a system consisting of a flow tube with separate or integral converter / indicating transmitter, as scheduled in the Section 17200 Instrument Index, complete with interconnecting cables</p> <p>Remote mounted indicating transmitter for full-scale flow rates from 1.0 to 30 feet per second. System error shall not exceed the greater of 0.5 percent of flowrate or 0.1 foot per second from 3 to 30 feet per second.</p>

Flow Tube:	<p>Flow tubes manufacturer shall provide grounding rings fabricated from the same metal as for the electrodes below.</p> <p>Flow tube sizes below 2 inches may be wafer-style ductile-iron or full-body flanged construction.</p> <p>Electrodes: 316L stainless steel unless otherwise specified in Section 17200.</p>
Instrument Identification:	<p>FM (continued)</p> <p>Liner: Hard Rubber unless otherwise specified in Section 17200.</p>
Transmitter:	<p>Contain electronics associated with the magnetic flow meter system. Enclosure rating NEMA-4, cast aluminum or metal compartment for power, field connections and calibration adjustments separate from digital circuitry.</p> <p>Means to calibrate the metering system without use of external calibration units. Transmitter self-diagnostics. Traceability certificate of actual flow lab certification provided with each flowtube.</p> <p>Integral 4-digit LCD flow indication calibrated in process units. Data retained in non-volatile memory.</p>
Execution:	
Installation:	Install in accordance with manufacturer's instructions and the specified functional requirements.
Cable:	Signal cable between the flow tube and transmitter provided by the system manufacturer with sufficient length of cable for continuous installation between the flow tube and the transmitter.

Manufacturers:

ABB Magmaster MFE  
Siemens Sitrans FM Mag 5100W  
Endress + Hauser Promag 50W/53W  
Accepted equal.

**\*\*END OF SECTION\*\***

SECTION 17216  
PROCESS SWITCHES

**PART 1** GENERAL

1.01 DESCRIPTION

This section specifies requirements for process activated switches, devices, and accessories.

A. SCOPE

This section specifies requirements for instrumentation devices, which form a part of the process control systems. Application requirements are as specified in the Instrument Index, paragraph 17200-3.03.

B. OPERATING REQUIREMENTS

The devices specified in this section quantitatively convert the measured variable energy into a form suitable for process measurement and control.

1.02 QUALITY ASSURANCE

A. MANUFACTURER

Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.

B. INSTALLER

Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled, Certified Technicians specified in Section 17000, who are regularly engaged in such activities involving systems of similar complexity.

C. REFERENCES

References are listed in Section 17000 and are a part of this section as specified and modified.

1.03 ENVIRONMENTAL CONDITIONS

Equipment provided under this section shall be suitable for operation under ambient conditions described in paragraph 17000-1.03.

## 1.04 SUBMITTALS

Submittals shall be provided as specified in Sections 01300 and 17000, including:

1. A copy of this specification section, referenced and applicable sections, with addendum updates included and with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Referenced and applicable sections to be marked up and submitted include:

- a. Section 01664 - Training
- b. Section 01730 - Operating and Maintenance Information
- c. Section 17200 - Instrument Index

A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Systems Integrator, then each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Systems Integrator with the specifications.

*Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. A copy of the contract document Control Diagrams and Process and Instrumentation Diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal.

If no changes are required, the drawing or drawings shall be marked "no changes required". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*

3. Marked Contract Document Mechanical and/or Electrical Plan drawings, sections, and details showing sensor installation locations and details.

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*Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*

4. Marked product literature of all equipment and features.
5. Installation details for the process switches and mounting accessories.
6. Electrical and signal connection drawings for process switches and devices.

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

Process switches and devices shall comply with the following requirements:

1. Contact outputs used for alarm actuation shall be normally-closed or normally-opened as required by the process condition to open to initiate the alarm.
2. Contact outputs used to control equipment shall be normally-opened and shall close to start the equipment.
3. Contacts monitored by solid state equipment such as programmable controllers or annunciators shall be hermetically sealed and rated for switching currents from 20 to 100 mA at 24 volts DC.
4. Contacts, monitored by electromagnetic devices such as mechanical relays, shall be rated as NEMA ICS 2, designation B300.
5. Double barriers provided between switch elements and process fluids such that failure of one barrier will not permit process fluids into electrical enclosures.
6. Switch electrical enclosures rated as NEMA 250, Type 4 minimum.
7. Switch contacts located in Class I, Division 1 areas and monitored by solid-state circuits shall be made safe by intrinsic safety barriers as specified in paragraph 17120-2.04.
8. Switch range shall be selected so that the specified set point is at least 30 percent but not more than 70 percent of the span, between the upper range limit and the lower range limit.

### **2.02 INSTRUMENTATION SPECIFICATION SHEETS (INSTRUSPEC)**

General requirements for instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 17216-3.03.

Application requirements are specified in the Instrument Index, paragraph 17200-3.03, and/or on the drawings.

## 2.03 PRODUCT DATA

The following data shall be provided in accordance with Section 01300:

1. Operating and maintenance information as specified in paragraph 17000-2.03. Include final reviewed submittal and separate record of all final and switch settings.
2. Test results as specified in Section 17030-Part 2.

## PART 3 EXECUTION

### 3.01 INSTALLATION

Installation requirements are specified in paragraph 17000-3.01.

### 3.02 TESTING

Testing requirements are specified in Section 17030.

### 3.03 INSTRUMENT SPECIFICATION (INSTRUSPEC) SHEETS

General requirements for instrumentation specified are listed on INSTRUSPEC sheets herein. INSTRUSPEC sheets for the process switches listed in the following Table A are included in this paragraph:

Table A: Process Switches

INSTRUSPEC Symbol	Instrument Description	Instrument Function
PS	Pressure Switch	Pressure Measurement

### 3.04 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

Instrument Identification:	PS
Instrument Function:	Pressure Measurement
Instrument Description:	Pressure Switch
Signal Input:	Process
Signal Output:	As specified in paragraph 17216-2.01
Process Connection:	1/2-inch female NPT
Product Requirements:	<p>Pressure switch shall consist of a pressure transducer and a precision switch. Pressure transducer shall be the diaphragm piston type with wetted materials as recommended by the switch manufacturer. Piston backed by a cylinder disc to permit 10 times over-range pressure without affecting calibration.</p> <p>Range spring and piston shall be isolated from process fluids by the diaphragm. Switch provided with two 3/4-inch conduit connections. Switch assembly housing shall be cast aluminum rated types 3, 4, and 7D per NEMA ICS6. Systems Integrator shall select pressure transducer so that set point falls between 30 and 70 percent of maximum range.</p> <p>Approximate set point and, if applicable, reset point indicated on calibrated scales. Repeatability and sensitivity shall be 1.0 percent of operating range. Unless otherwise specified, switches nonadjustable deadband type.</p>
Approved Manufacturers:	Ashcroft, United Electric or equal.
Execution:	<p>Installation: Install in accordance with manufacturer's instructions and to the specified requirements.</p>
Application/Calibration:	Application, calibration, and set points as specified in paragraph 17200-3.03.

**\*\*END OF SECTION\*\***

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## SECTION 17310

### PROGRAMMABLE LOGIC CONTROLLER (PLC)

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE

This Section specifies requirements for small programmable logic controllers (PLC) designed to execute discrete and continuous control logic with high reliability in industrial applications. Enclosures and components are specified in Section 17110 – Instrument and Control Panels.

All PLCs provided for this project shall comply with the requirements of this Section. PLCs provided with equipment specified in Divisions 11, 13, 14, and 15 are provided and programmed by the Equipment Manufacturer.

###### B. GENERAL REQUIREMENTS

General requirements shall be as specified in Sections 17000 and 17110.

##### 1.02 QUALITY ASSURANCE

###### A. REFERENCES

This Section contains references to the following documents or documents listed in Sections 16000, 17000, and 17110. They are a part of this Section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this Section as if referenced directly. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the

document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEC 61131-3	Programmable Controllers – Part 3: Programming Languages
NEMA IA 2.2	Programmable Controllers – Equipment Requirements and Tests
NEMA IA 2.3	Programmable Controllers – Programming Languages

B. SYSTEMS INTEGRATOR

Responsibilities and qualifications shall be as specified in Section 17000.

C. FACTORY ACCEPTANCE TESTS

Factory Acceptance Tests are specified in Section 17030 and scheduled in Paragraph 1.01

B.

1. Submit factory test forms for approval prior to tests.
2. Provide all expenses for one Owner staff member and one Engineer staff member to witness factory testing. Travel shall be during business hours on weekdays.

1.03 SUBMITTALS

The following information shall be provided in accordance with Sections 01300 and 17000:

A. SHOP DRAWINGS

Submit under Section 17110, including:

1. A copy of this Specification Section, with addendum updates included, and all referenced and applicable Sections, with addendum updates included, with each paragraph check-marked to indicate Specification compliance or marked to indicate requested deviations from Specification requirements. A check mark shall denote full compliance with a paragraph as a whole.

If deviations from the Specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the Specifications.

*Failure to include a copy of the marked-up Specification Sections, along with justification(s) for any requested deviations to the Specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. Submittal requirements per Section 17110 for the equipment specified herein.
3. PLC Input/Output (I/O) loop diagram drawings.
4. Internal power distribution schematic diagram drawings.
5. PLC power supply loading calculations.
6. List of spare parts to be provided.

**B. FACTORY ACCEPTANCE TEST SCHEDULE AND FORMS**

Submit under Section 17030 and per the requirements of this Section.

**C. OPERATING AND MAINTENANCE INFORMATION**

Operating and maintenance information shall be provided in accordance with Section 01730, including the following for the PLC system:

1. Manufacturer, Representative, and Supplier contact information.
2. Manufacturer instruction manuals shall include only the following as applicable to the PLC system:
  - a. Safety Precautions.
  - b. Environmental Conditions.
  - c. Troubleshooting guides and diagnostic techniques.
  - d. Component connection diagrams.
  - e. Removal and replacement instructions.

3. Warranty information.
4. Final reviewed submittal.
5. As-built drawings with record of switch and jumper settings for all components.
6. List of spare parts provided.

## PART 2--PRODUCTS

### 2.01 GENERAL

#### A. MANUFACTURER

The Owner and Construction Manager require the specified Manufacturer to provide the equipment and/or products to be furnished under this Section. The Owner and Construction Manager believe the Manufacturer is capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed to mean that the named Manufacturer's standard product will comply with the requirements of this Section.

Manufacturers and models shall be as specified for the purpose of compatible and efficient utilization of existing equipment, supplies, and personnel training and experience, no substitutions are permitted.

#### B. MATERIALS

Equipment and/or products shall be new and unused at the time of system assembly.

C. Controller conforming to NEMA IA 2.2, and with required memory and functional capacity to perform specified sequence of operation with scheduled input and output points.

1. RFI/EMI Susceptibility: MIL STD 461B CS02.
2. Showering Arc Test: NEMA Pub No ICS2-230.42.
3. Surge Withstand: ANSI C37.90a.
4. RFI Immunity: IEC 801-3.
5. Ground Continuity: IEC 801-5.
6. Electrostatic Discharge: IEC 801-2.
7. Electromagnetic Field: IEC 61000-4-3.
8. Fast transients: IEC 61000-4-4.

## 2.02 PROGRAMMABLE LOGIC CONTROLLER

- A. Manufacturer: Allen-Bradley Compactlogix.
- B. NEMA IA 2.3 and IEC 61131-3 compliant program editor with program written in Ladder Logic or Function Block Language. Program to be written using the same type of software as is specified below.
- C. Networking Connections: As shown. Provide all communication interfaces, network cables, taps, terminators, power supplies, and accessories for a complete operating network.
  - 1. Ethernet/IP
- D. Processor: 1769-L33ER with Ethernet port and serial port dedicated solely for programming use, minimum 200k bytes (8 bit) for IEC 1131 control programs, and 24k words (16 bit) for storage of data in battery-backed RAM memory. Provide additional serial communications adapters required for other serial interfacing. Include real-time clock.
- E. Input and Output Modules:
  - 1. Discrete Inputs: 120 Vac, 16 channel.
  - 2. Discrete Outputs: Relay output, 16 channel isolated
  - 3. Analog Inputs: 4-20 mAdc/1-5 Vdc, isolated channel-to-channel, 4 channel.
  - 4. Analog Outputs: 4-20 mAdc, 4 channel.
  - 5. I/O module terminations: By Manufacturer to match module.
  - 6. I/O module interface modules: Provide as necessary including cabling to interface all I/O to processor.
  - 7. Spare Input/Outputs: The greater of a minimum one channel or 15 percent of each type provided per control panel.
- F. Power Supplies: 24 Vdc. Refer to Section 17110 for power supply.
- G. Miscellaneous: Provide all cables, taps, terminators, power supplies, and accessories for a complete operating PLC system.

## 2.04 PROGRAMMING SOFTWARE

### A. PROGRAMMABLE LOGIC CONTROLLER

1. Manufacturer: Allen-Bradley Studio 5000 Ver. 24, RSLinx, and network module software.
2. Licenses: Provide 1 License. Request Owner / City licensee information prior to ordering for registration. Provide one PC to PLC programming cable for each license

## 2.05 SPARE PARTS

The following spare parts shall be provided, refer to Paragraph 1.01 B for schedule.

### A. PROGRAMMABLE LOGIC CONTROLLER

1. One of each unique processor.
2. One of each unique communication card.
3. One for each ten, minimum of one for each unique I/O card.
4. One of each unique power supply.
5. One of each unique pre-fabricated cable.

## 2.06 CONTROL PANEL FABRICATION

- A. Refer to Section 17110.
- B. Detail shop drawings showing field connections and any terminal block jumpering required.
- C. Terminate all used and spare I/O wiring to terminal blocks.
- D. Create wire markers with “to-from” component name, PLC slot/base, or terminal column number and terminal number information identical at each end.
- E. Provide terminal Blocks for field connections to PLC Discrete Inputs:
  1. One fused terminal with LED for each group of 8 inputs, connected to control power.
  2. Fused terminal connected to eight terminal blocks to provide power to

each field input circuit.

3. One terminal per PLC input.
4. One common terminal for each group of 8 inputs, connected to control power common.

F. Provide terminal Blocks for field connections to PLC Discrete Outputs:

1. One fused terminal with LED for each output, connected to control power.
2. Two terminals per PLC relay output. Provide interposing relay for each solid-state PLC output. Connect output and control power common to relay coil. Provide two terminals for relay contact, normally opened unless otherwise noted.
3. One common terminal for each output, connected to control power common.

G. Provide terminal Blocks for field connections to PLC Analog Inputs:

1. One fused terminal with LED for each input, connected to +24 Vdc.
2. Two terminals per PLC input.
3. One common terminal for each input, connected to 24 Vdc common.
4. One ground terminal for each input shield, connected to signal ground bus.
5. Two surge protecting terminals for each field mounted instrument or equipment, grounded to the frame ground bus.

H. Provide terminal Blocks for field connections to PLC Analog Outputs:

1. One fused terminal with LED for each output, connected to +24 Vdc.
2. Two terminals per PLC output.
3. One common terminal for each output, connected to 24 Vdc common.
4. One ground terminal for each output shield, connected to signal ground bus.
5. Two surge protecting terminals for field mounted equipment, grounded to the frame ground bus.

## 2.07 PRODUCT DATA

The following Product Data shall be provided in accordance with Section 01300.

### A. FACTORY ACCEPTANCE TEST RESULTS

Submit under Section 17030 and per the requirements of this Section.

### C. PLC PROGRAM

Provide the as-built programmable controller program on a CD, prepared using the software type specified in Part 2. Provide 2 copies. Label the CD to include:

1. Owner's name, facility name, project name and project number as shown on the drawings.
2. "Application Programs For (equipment and/or PLC name)".
3. Programming software name and revision.
4. Supplier name and program revision date.

## PART 3--EXECUTION

### 3.01 INSTALLATION

Refer to Section 17110.

Connect input and output devices to the PLC via control panel terminal blocks, not directly to the PLC.

### 3.02 FIELD INSPECTION AND TESTING

Refer to Section 17110.

### A. EQUIPMENT MANUFACTURER AND SYSTEMS INTEGRATOR

The supplier of each PLC system shall provide a qualified service representative to perform the following:

1. Inspect the PLC installation including I/O and network systems, hardware

configuration switch and jumper settings.

2. Monitor all PLC system diagnostic indicators, both hardware and software, and certify that the PLC system performance meets or exceeds the Manufacturer's published specifications.
3. Assist in all testing.
4. Modify PLC programs as required.
5. Certify in writing to the Construction Manager that the PLC system has been installed and configured in accordance with the Manufacturer's published guidelines. Equipment Manufacturer certification requirements are per the associated equipment Specification.

B. CONTRACTOR

Fault or trouble conditions shall be investigated and resolved by the Contractor to the satisfaction of the PLC supplier.

3.03 TRAINING

A. OPERATIONS AND TROUBLESHOOTING

Equipment Manufacturer training is per the associated equipment Specification.

**\*\*END OF SECTION\*\***

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## SECTION 17315

### PROCESS CONTROL SYSTEM DEVELOPMENT AND PROGRAMMING

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies the general requirements applicable to the development and programming of the process control system graphical operator interface, historical data management system, and process control logic.

See Section 17000 1.01 B.2 for programming requirements.

##### 1.02 QUALITY ASSURANCE

###### A. IMPLEMENTATION PLAN MEETINGS:

The Systems Integrator shall include as work of this section of the specifications the requirement for two (2) meetings to be held at the project site. The primary function of the meetings shall be to solicit input from the Owner regarding the implementation of the process control system and coordination with the Vendor programmer.

The Systems Integrator shall have in attendance at each meeting a representative who is responsible for the preparation of the Process Control System Implementation Plan. The BFP Vendor PLC Programmer is required at these meetings for proper coordination between the SI, Owner, and Vendor. The preliminary schedule and agenda for each of the meetings shall be as described below. The specific dates for each of the meetings shall be scheduled by the Systems Integrator and approved by the Construction Manager.

The Construction Manager shall be provided with two (2) weeks minimum advanced written notice of proposed scheduled meeting dates. The System Integrator shall prepare a detailed meeting agenda and submit it to the Construction Manager with the notice of proposed scheduled meeting dates.

1. Meeting-1 shall be held within sixty (60) days of receipt of Notice to Proceed. The purpose of this meeting shall be to begin preparation of the Process Control System Implementation Plan. The System Integrator/ Vendor shall be prepared to present the capabilities of the proposed process control system software and the alternatives available for each of

the major areas of implementation described by the Process Control System Implementation Plan.

2. Meeting-2 shall be held within thirty (30) days of completion of the Engineer's review of the Process Control System Implementation Plan submittal. The purpose of this meeting shall be to discuss the submittal review comments and resolve any related issues.

### 1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Process Control System Implementation Plan

## PART 2--PRODUCTS

### 2.01 PRODUCT DATA

The following data shall be provided in accordance with Section 01300:

#### A. PROCESS CONTROL SYSTEM DEVELOPER'S GUIDELINES:

The Process Control System Implementation Plan shall be modified and updated during the course of development of the process control system control logic to reflect the conventions and standards used in the final system development. Upon final acceptance of the work, the updated implementation plan shall be re-published and submitted as the Process Control System Developer's Guidelines.

#### B. PROCESS CONTROL SYSTEM CONFIGURATION REPORT:

Report documenting the final configuration of the process control system including the following:

1. Hardware Configuration: Final switch settings and jumper positions shall be documented for all process control system components including processors, communications adapter modules, motor controllers and adjustable frequency drives, power metering systems, etc.
2. Process Control Logic: Bound hard copy of the annotated process controller program listing. The program listing for each processor shall be separately bound and shall have tab dividers for each program file listing. Program listing shall include cross references.

## PART 3--EXECUTION

### 3.01 PROCESS CONTROL SYSTEM IMPLEMENTATION PLAN

#### A. GENERAL:

The Systems Integrator shall prepare an implementation plan for the process control system development and programming work. The implementation plan shall establish guidelines for development of programmable logic controller (PLC) process control logic and shall insure the consistent application of conventions and methods through the course of development. The implementation plan shall specifically address the following:

1. Tag database structure and configuration.
2. Tag naming conventions.
3. Process control system configuration.
4. PLC program file organization.
5. PLC data file organization.

#### B. TAG DATABASE STRUCTURE AND CONFIGURATION:

The implementation plan shall define how the tag database will be organized to logically associate tags with specific input/output types, functions, or process areas.

#### C. TAG NAMING CONVENTIONS:

A tag naming convention shall be established which provides a structured organization to the tag database facilitating tag searches and substitutions during system development and provide for effective and efficient design, management and operation of the process control system. The tag naming convention shall be developed to take full advantage of the capabilities of the process control system software and not impose any artificial constraints in the operation or management of the process control system. Tag names shall minimally be comprised of the following information:

1. Equipment type designation.
2. Equipment loop number.
3. Signal type designation.

#### D. GRAPHICAL OPERATOR INTERFACE STANDARDS:

Not Required since Owner is responsible for the SCADA Graphics Updates.

#### E. PROCESS CONTROL LOGIC CONFIGURATION:

Guidelines shall be developed which define the organization and structure of the process control logic and data memory within the process controller. These guidelines shall address the following:

1. Structure of the control logic including the use of subroutines and the allocation of memory to accommodate modifications and expansion of the control logic.
2. Methodology for handling common control functions shall be standardized such that similar functions are implemented in a consistent manner across the entire project. Standardized routines for motor control, VFD control, instrument data handling, alarm management, etc. shall be developed and reviewed by the Owner prior to final programming.
3. Assignment of data storage memory including data formats and method of documenting memory mapping.
4. Methodology for implementing peer to peer communications including allocation of memory or register addresses in such a way as to organize data for optimum efficiency of data exchanges between peer processors.

#### F. PROCESS CONTROL STRATEGIES:

Process control strategies shall be reviewed with the Owner and refinements made as agreed to by the Systems Integrator and Vendor Programmer. Modifications to the control strategies that are determined to be a change in scope will be addressed by change order. The final process control strategies shall be incorporated into the Implementation Plan.

#### 3.02 TAG DATABASE DEVELOPMENT

Not Required since Owner is responsible for the SCADA Updates.

#### 3.03 GRAPHICAL OPERATOR INTERFACE DEVELOPMENT

Not Required

#### 3.04 PROCESS CONTROL LOGIC DEVELOPMENT

The process control system control logic development shall include the preparation of control logic required to implement the specified control strategies and support the specified operator interface functions.

A. ORGANIZATION:

The control logic shall be organized in a hierarchical structure which correlates to the actual process relationships. Individual control logic program files shall be prepared for each system or equipment item and shall be organized by process area. Data table files shall be similarly organized by process area. Data types shall be consistently applied throughout the control logic in accordance with the Process Control System Implementation Plan.

The control logic and data table organization shall facilitate the addition of future control logic.

B. DOCUMENTATION:

All control logic shall be completely annotated down to and including the instruction level. Each rung or statement of control logic shall be provided with annotation specific to its function. Each program file shall have a title and a detailed description of the control strategy represented by the control logic. Terminology consistent with the Process Control System Implementation Plan shall be applied throughout.

**\*\*END OF SECTION\*\***

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## SECTION 17316

### PROCESS CONTROL SOFTWARE SYSTEMS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies software systems for the process control system real-time human-machine interface (HMI) and historical data management system. The programming and configuration of these software systems shall be performed in accordance with Specification 17315.

##### 1.02 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Manufacturer's product literature for all software systems.
2. Manufacturer's recommended hardware requirements for optimum operation of each software system.
3. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

## PART 2--PRODUCTS

### 2.01 ACCEPTABLE PRODUCTS

This specification is based on Vijeo Citect products and, by virtue of this reference, establishes the level of performance, functionality, and quality for any products offered in lieu of the referenced products including the named manufacturers. Upon election to use products of another manufacturer, named or otherwise, the Contractor shall be responsible for all changes required in hardware and software configuration to provide the established level of performance and quality.

The process control software systems are listed in the “Proposed Major Equipment Supplier List” in the Contract Documents. The acceptable manufacturers of process control software systems are as follows:

- A. Real-time Human-Machine Interface
  - 1. Vijeo Citect Version 8
  - 2. Vijeo Citect Mobility Solution
- B. Process Database System
  - 1. Confirm existing database system with owner.

### 2.02 SOFTWARE LICENSING

All process control system software products shall be licensed in the Owner’s name and supplied by the Systems Integrator. The number of licenses for each process control system server application including communication drivers shall be as required to implement the process control system as specified herein and detailed on the Drawings. The number of licenses for process control system client applications shall be as specified in Table 2.02:

Table 2.02

<u>Software Application</u>	<u>Number of Licensed Copies</u>	<u>Notes</u>
Citect Control Client Softkey License from BCI (Site ID 35189)	1 for SWWRF 2 for SEWRF	5000 Tag count
Citect Anywhere License	1 for SWWRF	5 User

## PART 3--EXECUTION

### 3.01 PROCESS CONTROL SOFTWARE SYSTEM PROGRAMMING

Process control system software shall be programmed and configured by the Owner.

### 3.02 TRAINING

Not Required since SCADA programming is by the Owner.

**\*\*END OF SECTION\*\***

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## SECTION 17318

### INDUSTRIAL COMPUTER WORKSTATIONS AND DISPLAYS

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies industrial computer software and hardware systems for Vendor Supplied Control Panels.

##### 1.02 QUALITY ASSURANCE

###### A. REFERENCES:

Refer to paragraph 17000-1.03 A.

###### B. SYSTEMS RESPONSIBILITY:

Refer to paragraph 17000-1.03 B.

##### 1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. Manufacturer's product literature for all software systems, marked to show products included.

3. Manufacturer's product literature for all hardware components, marked to show products included.
4. Proposed schedule of procurement, installation, and testing of products provided.
5. List and quantities of spares if applicable.

## PART 2--PRODUCTS

### 2.01 INDUSTRIAL COMPUTER WORKSTATIONS

#### A. HEAVY DUTY INDUSTRIAL PC HARDWARE:

Panel Vendor provided panel mounted Phoenix Contact workstations with factory installed components, licensed in the Owner's name:

1. IP65 (front), IP20 (back)
2. Operating temperature: 0 to 50 degrees C.
3. Processor Controller:
  - a. 2.10/2.9 GHz I5 Processor with fully sealed IP20 convection booster.
  - b. 8 GByte DDR4 RAM.
  - c. 128 GByte Hard Disk Drive, solid state.
  - d. Two Gigabit Ethernet LAN port.
  - f. Four USB ports.
  - g. Two RS-232 serial ports.
4. Minimum 17" SXGA diagonal color display, 1280 by 1024 pixel resolution.
5. Resistive touch-screen.
6. Power: 24 Vdc.

7. Battery Backed Realtime Clock
8. Quantity of 4: One workstation required for SWR85-VCP-103, two workstations required for SER85-VCP-101/ SER85-VCP-102, and one spare.

B. OPERATING SYSTEM SOFTWARE:

Provide one of the following for each workstation, licensed in the Owner's name. Request licensee name and address from the Construction Manager prior to ordering.

1. Windows 10 IOT Enterprise (64-Bit)

2.02 WORKSTATION SOFTWARE

A. GENERAL:

All software products shall be licensed in the Owner's name. Request licensee name and address from the Construction Manager prior to ordering. Provide latest versions.

B. OIS SOFTWARE:

Refer to Section 17316 for required SCADA Runtime Software.

C. OFFICE SOFTWARE:

Not Required

2.03 SOURCE QUALITY CONTROL

The Owner and Construction Manager require the specified manufacturers to provide the equipment and/or products to be furnished under this section. The Owner and Construction Manager believe the manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed to mean that the named manufacturer's standard product will comply with the requirements of this Section. Manufacturers shall be as specified for the purpose of compatible and efficient utilization of existing equipment, supplies, and personnel training and experience.

2.04 PRODUCT DATA

The following data shall be provided in accordance with Section 01300.

A. OPERATION AND MAINTENANCE INFORMATION:

One set of all software and hardware manuals shall be provided at time of delivery to the Owner, including maintenance information. Include written warranty and final reviewed submittal.

PART 3--EXECUTION

3.01 GENERAL

Provide workstations and equipment as shown. Troubleshoot and repair any intermittent or inoperative network connections.

3.02 SOFTWARE INSTALLATION

- A. Industrial Computer Workstation (ICW) operating system software shall be pre-loaded by the workstation manufacturer.
- B. SCADA software and application will be installed by the Owner.

3.03 APPLICATIONS CONFIGURATION

- A. ICW operating system software will be configured by the Vendor.
- B. SCADA software will be configured by the Owner.
- C. Managed network switches will be configured by the Vendor. Vendor and Owner shall coordinate regarding configuration requirements.

3.04 SPARE WORKSTATION: One spare. See 2.01A of this section.

**\*\*END OF SECTION\*\***

## SECTION 17715

### SECURITY SURVEILLANCE SYSTEM

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

###### A. SCOPE:

This section specifies requirements for providing the security video surveillance system for the SWWRF Belt Filter Press Rehabilitation project by the Systems Integrator (SI).

##### 1.02 QUALITY ASSURANCE

###### A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
NEMA ICS 1	General Standards for Industrial Control and Systems
NECA-1	National Electrical Contractors Association – Standard Practices for Good Workmanship in Electrical Contracting
NFPA-70	National Electrical Code (NEC)
NEMA 250	Enclosures for Electrical Equipment (1000 Volt Maximum)

NEMA WD-1	General Requirements for Wiring Devices
UL 67	Panelboards

B. WARRANTY:

In addition to the guarantee specified in the General Conditions.

1.03 SUBMITTALS

Submittals and transmittal procedures for submittals are defined in Section 01300.

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

*Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration."*

Referenced and applicable sections to be marked up and submitted include: Sections: 01660, 01664, 16030, 17030.

2. A copy of the contract documents and drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review. Drawings to be marked up and submitted include:

- a. I-00-601 Network Diagram

3. Marked Product literature showing features, options provided, dimensions, clearances, and installation instructions.

## PART 2--PRODUCTS

### 2.01 MANUFACTURERS

#### Camera Manufacturers:

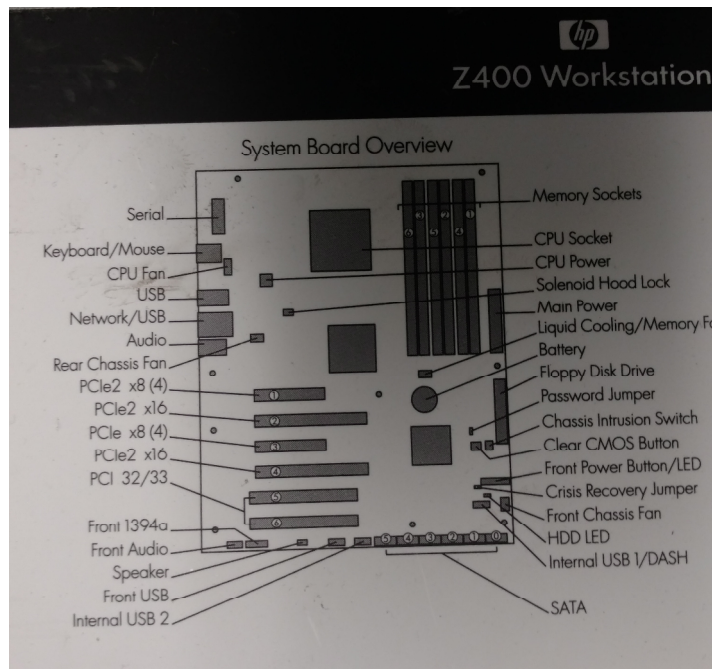
1. Axis Communications Model M3026-VE 3MP Outdoor Dome Camera
2. Approved equal.

### 2.02 SYSTEM EQUIPMENT

#### A. SURVEILLANCE SYSTEM EQUIPMENT:

The security video surveillance system shall incorporate the following hardware and software:

1. Video Control Center (VCC): Software e.g. Axis Companion to manage configuration and monitor system. Contractor to field verify existing Camera software at SEWRF and implement similar software at SWWRF. Software to be installed and configured on existing Operator Workstation in Admin Building Operations Room. SI shall provide and install NIC (network interface card) and Graphics card into existing Operator Workstation (System Board Overview shown below).. Coordinate installation and configuration with Owner.



2. The surveillance system shall provide single mode of video image collection:
  - a. Live Mode: On demand video streaming from all of the new cameras to the VCC.
    - 1) Supports video streaming over low bandwidth networks beginning at 2400 baud.
3. 48VDC Industrial Gigabit Ethernet POE managed switch din rail mounted with fiber ports to match existing fiber. Include sufficient POE ports for all new cameras. Provide Stratix 5400 series, Moxa or equal.

### 2.03 CAMERA EQUIPMENT:

- A. Quantity of Cameras: 8. See Drawings for locations.
- B. Camera features:
  1. Fixed Iris, IR corrected 2.0mm, 106° Viewing Angle
  2. f/2.0 Aperture
  3. Angle Adjustmet Pan: +/- 175°, Tilt: 70°, Rotation +/- 175°

4. 2048 x 1536 to 160 x 120 Resolution
5. H.264 Main Profile, MJPEG Compression
6. IP66 and Nema 4X rated
7. -22 to 122°F Operating Range
8. Power Over Ethernet IEEE 802.3af/802.3a Type 1, Class 2

#### 2.04 ELECTRICAL ENCLOSURES AND AUXILIARY DEVICES:

Not Used.

#### 2.05 CAMERA DISPLAYS:

##### A. SWWRF Operations Office Displays and accessories:

1. 65" 4K UHD 7 Series Smart TV 2018. Quantity of 2 Displays.
2. Samsung UN65NU7100, or equal
3. 50' Cable Matters HDMI Extenders over CAT6 Ethernet Cable, Quantity of 2.
4. Echogear full motion articulating TV wall mount bracket. Model EGLF2 or equal. Quantity of 2.

#### 2.06 MANUFACTURER OR VENDOR SERVICES:

A. Provide Manufacturer's or Vendor's personnel to provide on-site services to the Contractor.

##### B. Provide expenses for onsite services to include:

1. Installation supervision
2. Testing
3. Commissioning
4. Training: Specified in 3.03.

##### C. Provide Extended Warantee and Support to include:

1. Annual hardware and software maintenance program.
2. Periodic software updates to the Video Control Center software and REV firmware.
3. Factory telephone support.

#### 2.07 SPARE PARTS

Not Required.

## 2.08 PRODUCT DATA

1. Manufacturer's operation and maintenance information as specified in Section 01730. Manual shall include final reviewed submittal and separate record of all final configuration, jumper, and switch settings.
2. Test results.
3. Installation and training forms specified in Part 3.

## PART 3--EXECUTION

### 3.01 INSTALLATION

The equipment shall be installed and tested in accordance with the manufacturer's written recommendations by a qualified, factory trained manufacturer's representative.

The equipment shall be fabricated in accordance with NEMA ICS and installed in accordance with NECA-1 procedures.

Install cameras similar to existing camera installation at SEWRF. See picture below for installation example.

Camera displays shall be mounted on the back wall of the SWWRF Operations Office. SI and Owner shall coordinate regarding the installation and configuration of the displays and accessories for fully functional system. Camera Displays shall connect to SP6-1 POE switch via CAT 6 Copper Cable.

SI to supply the POE managed switch to the BFP Vendor for installation inside SP6-1 (SWR85-VCP-101). POE switch configuration by the SI. SI and BFP Vendor shall coordinate prior to POE switch configuration.



### 3.02 FIELD TESTING

Testing shall conform to the requirements of Section 01660.

Performance tests shall be conducted during field testing to measure the following characteristics camera control, alarms, etc.

### 3.03 TRAINING

Not Required.

**\*\*END OF SECTION\*\***

## SECTION 17765

### FIBER OPTIC COMMUNICATION EQUIPMENT

#### PART 1--GENERAL

##### 1.01 SCOPE

Provide the fiber optic appurtenances required to complete the fiber optic cabling system. Section 16000 specifies requirements for fiber optic data communication cables including installation, terminations, and testing.

##### 1.02 QUALITY ASSURANCE

###### A. REFERENCES:

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/ICEA S-87-640	Standard for Optic Fiber Outside Plant Communications Cable.
BELLCORE GR-20-CORE	Generic Requirements for Optical Fiber and Optical Fiber Cables
BELLCORE GR-409-CORE	Generic Requirements for Intrabuilding Fiber Cable
BELLCORE GR-487-CORE	Generic Requirements for Electronic Equipment Cabinets
BELLCORE GR-771-CORE	Generic Requirements for Fiber Optic Splice Closures
ISO-9001	Quality Management Systems
NFPA 70	National Electric Code (NEC)
TIA/EIA-455-86	FOTP-86 Fiber Optic Cable Jacket Shrinkage
TIA/EIA-455-107A	FOTP-107 Determination of Component Reflectance or Link/System Return Loss Using a Loss Test Set

Reference	Title
TIA/EIA-492AAAC	Detail Specification for 850 nm Laser-Optimized, 50µm Core Diameter/125 µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers
TIA/EIA-598-B	Standard for Optical Fiber Cable Color Coding

### 1.03 SUBMITTALS

The following information shall be submitted for review in accordance with Section 01300:

#### A. Product literature, submit complete under Section 17110:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

*Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. A copy of the contract document drawings showing fiber optic system terminations and appurtenances, marked to show specific changes necessary for the supplied equipment.

If no changes are required, the drawings shall be marked “*No Changes Required.*”

3. Manufacturer's catalog literature and catalog data sheets for the following items, marked to indicate products proposed, as applicable to the project:
  - a. Fiber optic patch cords

- b. Fiber optic termination panels
- 4. Shop drawings:
  - a. Termination panel fabrication and layout drawings with complete list of materials and nameplate engraving list.
  - b. Interconnection cable diagrams for the complete system, showing each fiber and color in each cable. Each termination point shall be clearly marked.

## PART 2--PRODUCTS

### 2.01 FIBER OPTIC CABLE PATCH CORDS

#### A. GENERAL:

Provide preparation for the connections including polishing, connectors, hardware, cleaving tool, continuity tester, visual fault locator, and supplies for installation of connectors. Terminations shall be ST type. Fusion-spliced pigtails are not acceptable.

Fiber optic cable connections shall be provided with ceramic ferrules, polycarbonate not acceptable.

#### B. MULTIMODE PATCH CORD CHARACTERISTICS:

Patch cords shall be 3.0 mm single coated duplex fiber with jacket and connectors on both ends. Attenuation shall be a maximum of 0.3 dB. Provide length required for connection from patch panel to equipment. Color: Orange.

### 2.02 FIBER OPTIC PANELS

#### A. GENERAL:

Fiber optic patch panels shall consist of a system of components for routing, supporting, and terminating the fiber optic cables specified herein. Terminations shall be ST type. Fiber optic cable connections shall be provided with ceramic ferrules, polycarbonate not acceptable. New FOPPs shall be installed inside SWWRF New SP6-1 (SWR85-VCP-101); part of Vendor Control Panel, SEWRF New SP9 (SER85-VCP-101); part of Vendor Control Panel, and SEWRF Existing Scada Panel SP-4; provided by Systems Integrator.

#### B. DESCRIPTION:

Provide the following:

1. Wall-mounted type fiber optic patch panels constructed of aluminum or steel with removable hinged metal doors.
2. Mounting hardware, cable clamps and grommets, cable routers, storage decks, connector racks, and items for a complete system.
3. With a machine printed port labeling system.
4. Cable routers and storage decks to retain cables' minimum bending radius.
5. Sufficient quantity of ports to terminate the number of fiber strands specified and blank covers for unused port spaces.
6. One port for each fiber in accordance with the specified cable type.

Panel shall be Corning Cable Systems ICH or equal.

## 2.03 PRODUCT DATA

The following information and product data specified under individual specification sections shall be provided in accordance with Section 01300.

1. Manufacturer's operation and maintenance information as specified in Section 01730. Manual shall include final reviewed submittal.

## PART 3--EXECUTION

### 3.01 INSTALLATION

Patch panels and patch cords shall be installed in accordance with the manufacturer's instructions.

**\*\*END OF SECTION\*\***

## SECTION 17995

### CONTROL STRATEGIES

#### PART 1--GENERAL

##### 1.01 DESCRIPTION

- A. These control strategies are not intended to apportion work or responsibility for work among subcontractors, suppliers and manufacturers, but are offered as a guide for programming, startup, and checkout. They describe how the system is to operate, and do not necessarily include every component required to make the system function.
- B. For the purposes of this section, "Existing" refers to those structures, devices, or items of equipment which were a part of the process system prior to the work done under this Contract.
- C. Control strategies describe sequential and interlocking control functions, analog control functions, color-graphic video display HMI Computers and Operator Interfaces and alarm and event logging. All control functions shall be programmed in the PLCs and HMI computers shall perform supervisory functions.
- D. The Owner will configure and update HMI computer screens/ SCADA System to match the existing HMI process graphic displays, equipment status and alarming requirements for the abnormalities of the process and malfunctions of equipment.

#### PART 2--(DELETED)

#### PART 3--EXECUTION

##### 3.01 CONTROL STRATEGIES

The following control strategies are included in this section and describe general control features for all systems.

- 1 Discrete Point Status
- 2 Analog Point Status
- 3 General Ready, Running and Failure System
- 4 SCADA Inputs and Outputs Distribution and Control Requirements
- 5 General Recording System
- 6 General Contact/Logic System
- 7 General Process Control Function (Analog) System

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- 8 Trend Plots
- 9 Color Notation for Dynamic Objects on Control Graphic Display Screens
- 10 Digital Alarm System
- 11 Digital Status System
- 12 Adjustable Frequency Drive Alarms
- 13 Power Monitoring System

## **CONTROL STRATEGY 1**

### **DISCRETE POINT STATUS**

#### **Reference Drawings**

All P&IDs.

#### **System Components**

In accordance with P&IDs.

#### **Description**

The status of each discrete input point shall be maintained in the SCADA system database. The status of each logical discrete point shall also be maintained in the SCADA system database. Logical points are points which depend upon the status of one or several discrete input points.

For example, an equipment failed logical status will result from a loss of ready status when running. Loss of ready status when NOT running will not result in a failed logical status.

#### **SCADA**

Calculate and maintain the status of all discrete and logical discrete status points in the SCADA system database.

END OF CONTROL STRATEGY 1

## **CONTROL STRATEGY 2**

### **ANALOG POINT STATUS**

#### **Reference Drawings**

All P&IDs.

#### **System Components**

In accordance with P&IDs.

#### **Description**

Analog input points shall be checked for the following status conditions:

- Failed: Point value is less than or greater than the specified value range typically less than 3.6 milliamps (mA) and greater than 21.6 mA.
- Low Alarm: Point value is equal to or less than a predetermined alarm value.
- High Alarm: Point value is equal to or greater than a predetermined alarm value.
- Normal: Point value is within the predetermined low and high alarm values.

An analog point which is in alarm status shall not be changed to normal status until the point value changes by the predetermined deadband value for the point.

### **SCADA**

Failed, high alarm, low alarm, and deadband values shall be maintained in the SCADA system database. These limits may be changed via the SCADA programmer.

Point status shall be maintained in the SCADA system database. Discrete alarm outputs shall be driven from the point status.

END OF CONTROL STRATEGY 2

## **CONTROL STRATEGY 3**

### **GENERAL READY, RUNNING AND FAILURE SYSTEM**

Each motor-driven piece of equipment shall have “READY” and “RUNNING” status inputs to the SCADA system. A “READY” status indicates that there are no interlocks preventing the remote starting of this equipment. If the equipment is equipped with one or more HAND-OFF-AUTO switches, the “READY” status will not indicate “READY” status unless all the switches are in the AUTO position. If a “RUNNING” input status occurs and the “READY” status does not occur, the SCADA system shall identify that the motor is operating in the HAND mode.

The run time shall be calculated and stored for all equipment being monitored. This function shall be equivalent to a conventional elapsed time meter to include the tenth of an hour digit and shall include: Today’s Total and Yesterday’s Total and Cumulative Total. An adjustable timer shall be available to set a flag for maintenance of equipment. A summary of equipment requiring maintenance shall be printed out upon plant operator request.

The failure of driven equipment shall be monitored by the SCADA system. Equipment shall be considered failed under the following conditions:

1. The equipment is in AUTO and the SCADA system attempts to operate the equipment and it does not respond within a defined time period.
2. The equipment is in AUTO and running and for whatever reason other than the SCADA system requesting the equipment to “STOP,” the equipment stops.

In addition, specific equipment is required to provide a “Trouble” or “Fault” input into the SCADA system. This input shall be added to the internal logic described in items 1 and 2 above so that any one of these events shall trigger a “FAIL” alarm.

The SCADA system shall be used to the extent that it shall facilitate sequencing of the equipment. The plant operator shall be able to bypass the sequencing and START/STOP the equipment and OPEN/CLOSE valves and gates on a “MANUAL” procedure from the hand switches when desired. Interface to the SCADA system shall be through I/Os or workstations or laptops.

**END OF CONTROL STRATEGY 3**

## **CONTROL STRATEGY 4**

### **SCADA INPUTS AND OUTPUTS DISTRIBUTION AND CONTROL REQUIREMENTS**

#### **Reference Drawings**

Various P&IDs

#### **Description**

SCADA system I/O assignment shall be as shown on the P&IDs.

Upon failure of a process equipment, SCADA system shall start the next available unit, as described in the applicable control strategy.

Upon failure of a PLC input/output module, SCADA system shall skip equipment controlled by PLC input/output module and go to next process unit in the lead-lag sequence.

For example two pumps' input/outputs shall be equally distributed to two different I/O modules. If three pumps are required and only two input modules and two output modules are available, then as a minimum, two pumps shall be assigned to one set of input/output modules while the third pump shall be assigned to the second set of input/output modules.

Note that "pumps" are used to describe the I/O distribution requirements. The concept shall be extended to all process equipment including, valves, gates, instruments for level, flow, pressure, etc.

**END OF CONTROL STRATEGY 4**

## **CONTROL STRATEGY 5**

### **GENERAL RECORDING SYSTEM**

#### **Reference Drawings**

All P&IDs

#### **Description**

HMI workstations shall generate reports based upon process variables (pressure, flow, temperature, level and analytical) and equipment status (speed, and motor current) in real-time and from recent historical data.

All motors greater or equal to 40 HP shall be included under this recording requirement. All instruments shown on the P&IDs with PIRxxxx, FIRxxxx, TIRxxxx, LIRxxxx, and AIRxxxx shall also be included under this recording requirement (where xxxx indicates instrument tag number).

END OF CONTROL STRATEGY 5

## **CONTROL STRATEGY 6**

### **GENERAL CONTACT/LOGIC SYSTEM**

#### **Reference Drawings**

All P&IDs

#### **Description**

All digital/logic control functions shall be provided as required and shall include but not be limited to the following:

- Digital/Logic Functions--The ability to perform logic and sequencing functions shall be supported to provide control interlocks, event sequencing and other logic operations.
- Boolean Algebra requirements--AND gate, OR gate, NAND gate, NOR gate, XOR gate, and NXOR gate.
- Logic requirements--Logic switch, logic compare, bi-directional time delay, and on-off with feedback.
- Ladder Logic requirements--NO contact, NC contact, energize coil, latch/unlatch coil, retentive timer on/off delay, up/down counter, counter/timer reset, ladder execution control, immediate input, and immediate output.

END OF CONTROL STRATEGY 6

## **CONTROL STRATEGY 7**

### **GENERAL PROCESS CONTROL FUNCTION (ANALOG) SYSTEM**

#### **Reference Drawings**

All P&IDs

#### **Description**

All analog control functions shall be provided as required and shall include but not be limited to the following:

- Proportional-Integral-Derivative (PID) Control--Standard controller functions with balanceless, bumpless transfer from manual to automatic, manual overrides, external reset and output summing capabilities. Provision for cascade, ratioing gain, bias, lead-lag, dead-time, feedforward and feedback control shall be available.
- HMI display system shall have a common PID controller operator interface for all equipment utilizing PID control. Controller operator interface shall include alphanumeric and graphic indication of the following features as a minimum:
  - ID of controlled equipment
  - ID of process variable input
  - Controller setpoint value
  - Process variable value
  - Controller output value
  - Setpoint adjustment interface
  - Indication if setpoint is under local or remote control
  - Local/Manual control output adjustment interface
  - Indication if control output is under local/manual control or under control of process controller.
- Computational Functions--On-line mathematical functions shall be available to provide real-time computational capability of control variables for use in feed-forward and other advanced control functions.
- All setpoints for alarm and control shall be adjustable from password-protected HMI Computer screens.

Appropriate control action(s) shall be provided as needed.

END OF CONTROL STRATEGY 7

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## **CONTROL STRATEGY 8**

### **TREND PLOTS**

#### **Reference Drawings**

All P&IDs

#### **Description**

HMI workstations shall graphically plot trends of process variables (pressure, flow, temperature, level and analytical), controller setpoints and outputs, and equipment status (speed and motor current) in real-time and from historical data. The plant operator shall be able to select the plotting interval, within the limits of the actual data collection. Four trends per display view shall be possible.

In addition to the plotted data, a trend shall include:

- Time
- Date
- Tag number
- Plotting interval
- Time at start
- Time at latest value

END OF CONTROL STRATEGY 8

## CONTROL STRATEGY 9

### COLOR NOTATION FOR DYNAMIC OBJECTS ON CONTROL GRAPHIC DISPLAY SCREENS

#### Reference Drawings

All P&IDs  
All control strategies

#### Description

All dynamic objects on control graphic display screens shall be provided with multiple-color display to identify status as tabulated below:

Equipment	Status	Required color
Motor	Running	Red
Motor	Ready	Green
Valve	Open position	Red
Valve	Closed position	Green
Gate (both slide and sluice)	Open position	Red
Gate (both slide and sluice)	Closed position	Green
All	Abnormal condition	Amber (Yellow)

END OF CONTROL STRATEGY 9

## **CONTROL STRATEGY 10**

### **DIGITAL ALARM SYSTEM**

#### **Reference Drawings**

All P&IDs, electrical control diagrams, and vendor drawings

#### **System Components**

In accordance with P&IDs.

#### **Description**

All digital input alarms shall be provided as shown on P&IDs or listed in the instrument index (Section 17200) whether or not specific control strategies are provided. Whenever a P&ID is not shown with any On/Off, Start/Stop, Open/Close or analog modulation control, no specific control strategy will be written even if a digital alarm system is shown on the drawing. For this condition, control strategy 10 shall be applicable. Digital inputs can be from field instruments (level switches, pressure switches, etc.), local control panels (relay outputs, alarm module outputs, switches), and packaged systems (designated terminals with packaged units). A manual reset is required at the equipment control panel; Reset from SCADA is not acceptable.

On a power failure, equipment shall return to the ready state when power is returned. Given the process condition, the lead piece of equipment shall start if called for. The lag and lag-lag, etc., starting sequence shall be staggered at 15-second intervals (adjustable) depending on the process. Operations shall designate this time during startup.

END OF CONTROL STRATEGY 10

## **CONTROL STRATEGY 11**

### **DIGITAL STATUS SYSTEM**

#### **Reference Drawings**

All P&IDs, electrical control diagrams, and vendor drawings

#### **System Components**

In accordance with P&IDs.

#### **Description**

All digital input status shall be displayed on HMI screens as required by the reference drawings and specifications regardless whether or not specific control strategies are provided. Each digital input shall be shown in its appropriate process screen and/or equipment status screen. Digital inputs can be originated from field instruments (motorized actuators, HVAC related air handling units, power management related contact inputs, level switches, pressure switches, etc.), local control panels (relay outputs, alarm module outputs, switches), and packaged systems (designated terminals with packaged units).

All equipment HOA selector switch Auto mode status contact is to be monitored by the PLC. When the HOA switch is not in the Auto mode the SCADA system shall display “Not in Auto” for that respective piece of equipment.

END OF CONTROL STRATEGY 11

## **CONTROL STRATEGY 12**

### **ADJUSTABLE FREQUENCY DRIVE ALARMS**

#### **Description**

Each adjustable frequency drive shall be provided with direct one on one hard-wired interfaces to the SCADA system. This interface shall provide control and monitoring of the adjustable frequency drive and the driven equipment including the motor.

#### **SCADA Annunciation**

The SCADA system shall display or annunciate (as indicated) the following conditions for each adjustable frequency drive and its driven equipment:

Off -	Display
Running -	Display
Speed Feedback -	Display
Failure -	Annunciate
High Pressure -	Annunciate

END OF CONTROL STRATEGY 12

## **CONTROL STRATEGY 13**

### **POWER MONITORING SYSTEM**

#### **Reference Drawings:**

All P&IDs, electrical control diagrams, and vendor drawings.

#### **System Components:**

In accordance with contract drawings, P&IDs and as called out in the specifications.

#### **Description:**

There are a number of power monitor units within Switchboards that use a MODBUS TCP/IP network connection. These PMUs contain information such as power quality monitoring features that may be used for diagnostic information. Where the PMUs are used this information shall be extracted from the device using the network connection and displayed on the SCADA screen and used for alarming where appropriate. In addition to the status and control signals shown on the P&IDs, at a minimum the following information shall be extracted from these devices using the MODBUS TCP/IP network:

- Current, each phase
- Average Current
- Voltage, each phase
- Average Voltage
- KW, each phase
- Average KW
- KVA, each phase
- Average KVA
- Power Factor, each phase
- Average Power Factor
- Total KWH (previous day)
- Frequency

END OF CONTROL STRATEGY 13