



MANATEE COUNTY GOVERNMENT

INVITATION FOR BID (IFB) #11-2873DC SOUTHWEST WATER RECLAMATION FACILITY (SWWRF) CLARIFIER 1 AND 2 REHABILITATION

Manatee County, a political subdivision of the state of Florida, (hereinafter "Manatee County" or the "County" or "Owner") will receive sealed bids from individuals, corporations, partnerships, and other legal entities organized under the laws of the state of Florida or authorized to conduct business in the state of Florida.

INFORMATION CONFERENCE AND SITE VISIT

In order to insure that all prospective bidders have sufficient information and understanding of the County's needs, **an Information Conference will be held October 19, 2011 at 10:00 A.M. at the Southwest Water Reclamation Facility, 5101 65th Street West, Bradenton, Florida 34210. All interested bidders are encouraged to attend.** An inspection of the project site will be conducted during this time.

DEADLINE FOR CLARIFICATION REQUESTS: October 24, 2011 at 8:00 A.M.

TIME AND DATE DUE: November 16, 2011 at 3:00 P.M. at Manatee County Purchasing, 1112 Manatee Avenue West, Suite 803, Bradenton, Florida 34205.

Important Note: A prohibition of Lobbying has been enacted. Please review paragraph A.24 carefully to avoid violation and possible sanctions.

**FOR INFORMATION CONTACT:
DEBORAH CAREY-REED, CPPB
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AUTHORIZED FOR RELEASE: 

IFB #11-2873DC
SWWRF CLARIFIER 1 AND 2 REHABILITATION

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SECTION 00010
INFORMATION TO BIDDERS

A.01 OPENING LOCATION

These bids will be publicly opened at Manatee County Purchasing, 1112 Manatee Avenue West, Suite 803, Bradenton, Florida 34205 in the presence of County officials at the time and date stated, or soon thereafter. All bidders or their representatives are invited to be present.

A.02 BID AND PROPOSAL DOCUMENTS

Bids and Proposals on <http://www.mymanatee.org>.

Bid or Proposal documents and the Notices of Source Selection related to those Bids or Proposals are available for download in a portable document format (.PDF) file on the Manatee County web page on the Purchasing tab under "Bids and Proposals." You may view and print these files using Adobe Acrobat software. You may download a free copy of this software (Adobe) from the County's web page if you do not have it.

Manatee County collaborates with the Manatee Chamber of Commerce on distributing solicitations using the RFP Tool web page on the Chambers website: <http://www.Manateechamber.com> to post Bid and Proposal documents in a portable document format (.PDF) file. This step is in addition to the posting on Manatee County Government web pages.

Manatee County may also use an internet service provider to distribute Bids and Proposals. A link to that service <http://www.DemandStar.com>, is provided on this website under the Tab "DemandStar". Participation in the DemandStar system is not a requirement for doing business with Manatee County. Note: The County posts the Notice of Source Selection seven calendar days prior to the effective date of the award.

IT IS THE RESPONSIBILITY OF EACH VENDOR, PRIOR TO SUBMITTING THEIR BID or PROPOSAL, TO CONTACT MANATEE COUNTY PURCHASING (see contact information on cover page of this document) TO DETERMINE IF ADDENDA WERE ISSUED AND TO MAKE SUCH ADDENDA A PART OF THEIR BID or PROPOSAL.

A.03 BID AND PROPOSAL FORM DELIVERY REQUIREMENTS

Any bids or proposals received after the stated time and date will not be considered. It shall be the sole responsibility of the bidder or proposer to have their bid or proposal delivered to Manatee County Purchasing for receipt on or before the stated time and date. If a bid or proposal is sent by U.S. Mail, the bidder or proposer shall be responsible for its timely delivery to Purchasing. Bids or proposals delayed by mail shall not be considered, shall not be opened at the public opening, and arrangements shall be made for their return at the respondent's request and expense.

A.04 DEADLINE FOR CLARIFICATION REQUESTS

October 24, 2011 at 8:00 A.M. shall be the deadline to submit all inquiries, suggestions, or requests concerning interpretation, clarification or additional information pertaining to the Invitation for Bids to Manatee County Purchasing.

This deadline has been established to maintain fair treatment for all potential bidders, while maintaining the expedited nature of the Economic Stimulus that the contracting of this work may achieve.

A.05 CLARIFICATION & ADDENDA

Each bidder shall examine all Invitation for Bids documents and shall judge all matters relating to the adequacy and accuracy of such documents. Any inquiries, suggestions or requests concerning interpretation, clarification or additional information pertaining to the Invitation for Bids shall be made through Manatee County Purchasing. The County shall not be responsible for oral interpretations given by any County employee, representative, or others. The issuance of a written addendum is the only official method whereby interpretation, clarification or additional information can be given.

If any addenda are issued to this Invitation for Bid, the County will Broadcast the addenda on the Demand Star distribution system to "Planholders" on this web service, and post the documents on the Purchasing web page at <http://www.mymanatee.org> which can be accessed by clicking on the "Purchasing" button and then clicking on the "Bids and Proposals" button. It shall be the responsibility of each bidder, prior to submitting their bid, to contact Manatee County Purchasing (see contact on page 1) to determine if addenda were issued and to make such addenda a part of their bid.

A.06 SEALED & MARKED

One original and two copies of your bid shall be submitted in one sealed package, clearly marked on the outside "Sealed Bid #11-2873DC SWWRF Clarifier 1 and 2 Rehabilitation" with your company name. Address package to:

Manatee County Purchasing
1112 Manatee Avenue West, Suite 803
Bradenton, Florida 34205

A.07 LEGAL NAME

Bids shall clearly indicate the legal name, address and telephone number of the bidder. Bids shall be signed above the typed or printed name and title of the signer. The signer must have the authority to bind the bidder to the submitted bid.

A.08 BID EXPENSES

All expenses for making bids to the County are to be borne by the bidder.

A.09 IRREVOCABLE OFFER

Any bid may be withdrawn up until the date and time set for opening of the bid. Any bid not so withdrawn shall, upon opening, constitute an irrevocable offer for a period of 90 days to sell to Manatee County the goods or services set forth in the attached specifications until one or more of the bids have been duly accepted by the County.

A.10 RESERVED RIGHTS

The County reserves the right to accept or reject any and/or all bids, to waive irregularities and technicalities, and to request resubmission. Also, the 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 the County. Any sole response received by the first submission date may or may not be rejected by the County depending on available competition and current needs of the 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 conforms closest

A.10 RESERVED RIGHTS (cont'd)

to or most exceeds the quality of goods and/or services set forth in the attached specifications or otherwise required by the County, and who is fit and capable to perform the bid as made.

To be responsive, a bidder shall submit a bid which conforms in all material respects to the requirements set forth in this Invitation For Bid. To be a responsible bidder, the bidder shall have the capability in all respects to perform fully the contract requirements, and the tenacity, perseverance, experience, integrity, reliability, capacity, facilities, equipment, and credit which will assure good faith performance. Also, the 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 the 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.11 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 any Manatee County procurement shall be in accordance with Manatee County Code of Laws, as amended. Any actual or prospective bidder who is aggrieved in connection with the solicitation or award of a contract may protest to the Board of County Commissioners of Manatee County as required in Manatee County Code of Laws.

A protest with respect to this Invitation For Bid shall be submitted in writing prior to the scheduled opening date of this bid, unless the aggrieved person did not know and could not have been reasonably expected to have knowledge of the facts giving rise to such protest prior to the scheduled opening date of this bid. The protest shall be submitted within seven calendar days after such aggrieved person knows or could have reasonably been expected to know of the facts giving rise thereto.

A.12 CODE OF ETHICS

With respect to this bid, if any bidder violates or is a party to a violation of the Code of Ethics of Manatee County per Manatee County Purchasing Code of Laws, Article 3, Ethics in Public Contracting, and/or the State of Florida per Florida Statutes, Chapter 112, Part III, Code of Ethics for Public Officers and Employees, such bidder may be disqualified from performing the work described in this bid or from furnishing the goods or services for which the bid is submitted and shall be further disqualified from submitting any future bids for work or for goods or services for Manatee County.

The County anticipates that all statements made and materials submitted in a bid will be truthful. If a bidder is determined to be untruthful in its bid or any related presentation, such bidder may be disqualified from further consideration regarding this Invitation For Bid.

A.13 COLLUSION

By offering a submission to this Invitation For Bid, the bidder certifies that the bidder has not divulged, discussed or compared their bid with other bidders, and has not colluded with any other bidder or parties to this bid whatsoever. Also, bidder certifies, and in the case of a joint bid each party thereto certifies as to their own organization, that in connection with this bid:

A.13 COLLUSION (cont'd)

- a. any 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. any 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 the 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, principal or principals is/are named therein and that no person other than therein mentioned has any interest in this bid or in the contract to be entered into; and
- e. no person or agency has been employed or retained to solicit or secure this contract upon an agreement or understanding or a commission, percentage, brokerage, or contingent fee excepting bona fide employees or established commercial agencies maintained by bidder for purpose of doing business.

A.14 BID FORMS

Bids must be submitted on attached County forms, although additional pages may be attached. Bidders must fully complete all Bid Form pages of the Bid submitted. Bid Forms must be executed by an authorized signatory who has the legal authority to make the offer and bind the company. Bidders must fully comply with all bid specifications, terms, and conditions. Failure to comply shall result in contract default, whereupon, the defaulting vendor shall be required to pay for any and all reprocurement costs, damages, and attorney fees as incurred.

A.15 DISCOUNTS

Any discounts must be incorporated in the prices bid; and not shown separately. The prices as shown on the bid form shall be the price used in determining award(s).

A.16 TAXES

Manatee County is exempt from Federal Excise and State Sales Taxes. (F.E.T. Exempt Cert. No. 59-78-0089K; FL Sales Tax Exempt Cert. No. **51-02-027548-53C**); therefore, the vendor is prohibited from delineating a separate line item in his bid for any sales or service taxes. Nothing herein shall affect the vendor's normal tax liability.

A.17 MATHEMATICAL ERRORS

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. All bids shall be reviewed mathematically and corrected, if necessary, using these standards.

A.18 DESCRIPTIVE INFORMATION

Unless otherwise specifically provided in the specifications, all equipment, materials and articles incorporated in the work covered by this contract shall be new and of the most suitable grade for the purpose intended. Unless otherwise specifically provided in the specifications, 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.19 UNBALANCED BIDDING PROHIBITED

Manatee 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 specifications 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 the 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, etc., which the bidder obtained and upon which the bidder relied upon to develop the bid. The County reserves the right to reject as non-responsive any presumptive unbalanced bids where the bidder is unable to demonstrate the validity and/or necessity of the unbalanced unit costs.

A.20 FRONT END LOADING OF BID PRICING PROHIBITED

Prices offered for performance and/or acquisition activities to 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 end loaded. Front end loaded bids could reasonably appear to be an attempt to obtain unjustified early payments creating a risk of insufficient incentive for the Contractor to complete the work or otherwise creating an appearance of an under-capitalized bidder.

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

A.21 WITHDRAWAL OF OFFERS

Vendors may withdraw offers as follows: a) Mistakes discovered before the opening of a solicitation may be withdrawn by written notice from the bidder submitting the offer. This request must be received in the office designated for receipt of offers in the solicitation document prior to the time set for delivery and opening of the offers. A copy of the request shall be retained and the unopened offer returned to that vendor. b) After the responses to a solicitation are opened or a selection has been determined, but before a contract is signed, a vendor alleging a material mistake of fact may be permitted to withdraw their offer if: (1) the mistake is clearly evident on the solicitation document; or (2) the bidder submits evidence which clearly and convincingly demonstrates that a mistake was made. Request to withdraw an offer must be in writing and approved by the Purchasing Official.

A.22 MODIFICATION OF BID SPECIFICATIONS

If a bidder wishes to recommend changes to the bid specifications, the bidder shall furnish in writing, data and information necessary to aid the County in evaluating the request to modify the specifications. The County is not obligated to make any changes to the bid specifications. Unless an addendum is issued, the bid specifications shall remain unaltered. **Bidders must fully comply with the bid specifications, terms, and conditions.**

A.23 AMERICAN DISABILITIES ACT

The Board of County Commissioners of Manatee County, Florida, does not discriminate upon the basis of any individual's disability status. This non-discrimination policy involves every aspect of the 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 first page of this bid document at least twenty-four (24) hours in advance of either activity.

A.24 LOBBYING

After the issuance of any Invitation For Bid, prospective bidders, or any agent, representative or person acting at the request of such bidder shall not contact, communicate with or discuss any matter relating in any way to the Invitation For Bid with any officer, agent or employee of Manatee County other than the Purchasing Official or as directed in the Invitation For Bid. This prohibition begins with the issuance of any Invitation For Bid, and ends upon execution of the final contract or when the invitation has been canceled. Violators of this prohibition shall be subject to sanctions as provided in the Manatee County Code of Laws.

The County reserves the right to amend or to add to the names listed as persons to contact. All amendments or additions to the names listed as persons to contact shall be issued by Purchasing, in writing.

A.25 DRUG FREE WORK PLACE

The Manatee County Board of County Commissioners adopted a policy regarding bidders maintaining a Drug Free Work Place, prohibiting the award of bids to any person or entity that has not submitted written certification to the County that it has complied with those requirements [Manatee County Code of Laws]. A Drug Free Work Place Certification Form is attached to this bid for this purpose.

A.26 PUBLIC CONTRACTING AND ENVIRONMENTAL CRIMES CERTIFICATION

A person or affiliate who has been placed on the State's convicted vendor list following a conviction for a public entity crime, as that term is defined in Florida Statute s. 287.133, may not submit a bid, proposal, or reply on a contract to provide any goods or services to a public entity; may not submit a bid, proposal, or reply on a contract with a public entity for the construction or repair of a public building or public work; may not submit bids, proposals, or replies on leases of real property to a public entity; may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity; and may not transact business with any public entity in excess of the threshold amount provided in Florida Statute s. 287.017 for CATEGORY TWO for a period of 36 months following the date of being placed on the convicted vendor list. In addition, the Manatee County Code prohibits the award of any contract to any person or entity who/which has, within the past five years, been

convicted of, or admitted to in court or sworn to under oath, a public entity crime or of an environmental law that, in the reasonable opinion of the Purchasing Official, establishes reasonable grounds to believe the person or business entity will not conduct business in a responsible manner. To ensure compliance with the foregoing, the Code requires all persons or entities desiring to contract with the 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 persons(s) affiliated with the entity, does not have such a record and is therefore eligible to seek and be awarded business with the 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.

A.27 EQUAL EMPLOYMENT OPPORTUNITY CLAUSE

Manatee County, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 and the Regulations of the Department of Commerce (15 CFR, Part 8) issued pursuant to such Act, hereby notifies all vendors that it will affirmatively ensure that in any contract entered into pursuant to this advertisement, minority business enterprises will be afforded full opportunity to submit bids in response to this advertisement and will not be discriminated against on the grounds of race, color or national origin in consideration for an award.

A.28 MBE/WBE

The State of Florida, **Office of Supplier Diversity** provides the certification process and the database for identifying certified MBE/WBE firms. This service may be directly accessed at: <http://www.osd.dms.state.fl.us/iframe.htm>. If you have any questions regarding this State service, please contact their office at (850) 487-0915.

A.29 DISCLOSURE

Upon receipt, all inquires and responses to inquires related to this Invitation for Bid become "Public Records" and are subject to public disclosure consistent with Chapter 119, Florida Statutes. **Bids become "Public Records" 30 days after the bid opening or if an award decision is made earlier than this time as provided by Florida Statute 119.071.** No announcement or review of the bid documents shall be conducted at the public opening of the bids.

Based on the above, Manatee County will receive bids at the date and time stated, and will make public at the opening the names of the business entities of all that submitted an offer and any amount presented as a total offer without any verification of the mathematics or the completeness of the offer. Upon the expiration of the statutory term for exemption the actual documents may be inspected or copied. When County staff have completed a mathematic validation and inspected the completeness of the offers, a tabulation shall be posted on www.mymanatee.org.

SECTION B

BASIS OF AWARD

B.01 BASIS OF AWARD

Award shall be to the most responsive, responsible bidder meeting specifications and having the lowest Total Bid Price for **Bid “A,”** or the lowest Total Bid Price for **Bid “B,”** for the requirements listed on the Bid Form for the Work as set forth in this Invitation For Bid. Bid Prices shall include costs for furnishing all labor, equipment and/or materials for the completion of the Work in accordance with and in the manner set forth and described in this Bid Document to the County's satisfaction within the prescribed time. **Note: Inspection of the site is a prerequisite to be considered for award of this bid.**

Two schedules for Completion of the Work shall be considered. Each bid for completion by the specific stated time shall be offered as a separate Total Bid Price. The County has the sole authority to select the bid based on the Completion Time which is in the best interest of the County. Only one award shall be made.

In evaluating bids, the 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 bids are equal with respect to price, quality and service, the bid received from a local business shall be given preference in award. Whenever two or more bids which are equal with respect to price, quality and service are received, and both bids or neither of these bids are received from a local business, the award shall be determined by a chance drawing conducted by Manatee County Purchasing and open to the public.

Local business is defined as a business duly licensed and authorized to engage in the sale of goods and/or services to be procured, which has a place of business in Manatee County with full time employees at that location.

B.02 QUALIFICATIONS OF BIDDERS

Each bidder must secure all licenses required (in accordance with Chapter 489 Florida Statutes) for the Work which is the subject of this bid; and, upon request, shall submit a true copy of all applicable licenses. **The contractor shall be certified in Florida as a General Contractor or as a Utility Underground Contractor with a minimum of three years experience in water treatment plant related construction to be considered for award of this project**

Manatee County will not consider award to any contractor who has failed to meet a project completion date within the past five years.

B.02 QUALIFICATIONS OF BIDDERS (cont'd)

To demonstrate qualifications to perform the Work, each bidder must be prepared to submit within five days of County's request; written evidence such as financial data, previous experience, present commitments and other such data as may be requested. Bidder must be able to provide evidence of Bidder's qualification to do business in the state of Florida. Each bidder shall submit as a portion of their bid a completed Contractor's Questionnaire included as Section 00430.

B.03 SUBCONTRACTORS

A complete list of all subcontractors proposed for any portion of the Work may be requested of any bidder deemed necessary by the County. Subcontracts shall be awarded only to those subcontractors considered satisfactory by the County.

Subcontractors shall be bound by the terms and conditions of this contract insofar as it applies to their Work, but this shall not relieve the prime contractor from the full responsibility to the County for the proper completion of all Work to be executed under this contract.

The employment of unauthorized aliens by any vendor is considered a violation of Section 274(e) of the Immigration and Employment Act. If the vendor knowingly employs unauthorized aliens, such violation shall be cause for unilateral cancellation of this agreement.

B.04 PREPARING CONTRACT

A written notice confirming award or recommendation thereof will be forwarded to the successful bidder accompanied by the required number of unsigned counterparts of the agreement. Within ten (10) days thereafter, successful bidder shall sign and deliver the required number of counterparts of the agreement with any other required documents to County. (Note: Contract must be approved by Manatee County to be valid.)

B.05 BE GREEN

All Vendors/Bidders/Quoters/Proposers (*as applicable*) are encouraged to use as many **environmentally preferable** "green" products, materials, supplies, etc. as possible in order to promote a safe and healthy environment. **Environmentally preferable are products or services that have a reduced adverse effect on the environment.** Provide detail of your organization's initiative and its ability to meet the goal of environmental sustainability as an attachment to your bid submittal.

B.06 INSPECTION OF THE SITE

Inspection of the site is a requirement to be considered for award of this contract. Prior to the submission of a bid, each bidder shall visit the site to become familiar with all conditions that may affect the work required to completely execute the full intent of these specifications. **For coordination of site inspection**, bidders shall contact the Owner's Representative, **Tom Birk, at 941-792-8811 extension 5179**.

SECTION 00030
GENERAL TERMS AND CONDITIONS

C.01 CONTRACT FORMS

The agreement resulting from the acceptance of a bid shall be in the form of the agreement stated in this bid.

C.02 ASSIGNMENT OF CONTRACT

Contractor shall not assign, transfer, convey, sublet or otherwise dispose of this Contract or of his right, title, or interest therein, or his power to execute such Contract, or to assign any monies due or to become due thereunder to any other person, firm or corporation unless first obtaining the written consent of the County. The giving of such consent to a particular subcontractor assignment shall not dispense with the necessity of such consent to any further or other assignment.

C.03 COMPLETION OF WORK

The Work will be substantially complete and ready for occupancy within the specific calendar days from the date the Contract Time commences to run (upon issuance of Notice to Proceed). Two bids shall be considered based on **330** calendar days and based on **365** calendar days. The County has the sole authority to select the bid based on the Completion time which is in the best interest of the County. Only one award shall be made.

C.04 LIQUIDATED DAMAGES

If the Contractor refuses or fails to prosecute the Work, or any separable part thereof, with such diligence as will hinder its completion within the time specified, the County may seek damages. The actual damages for delay will be impossible to determine and in lieu thereof, the Contractor shall pay to the County the sum of **\$1,148** as fixed, agreed, and liquidated damages for each calendar day of the delay until the Work is finally accepted by the County and the Contractor and his Surety shall be liable for the amount thereof.

C.05 PAYMENT

Contractor shall submit an application, on a form provided or approved by the County, of an approximate estimate of the proportionate value of the Work done, items and locations of the Work performed up to and including the last day of the period then ending. The County will then review said estimate and make any necessary revisions. The amount of said estimate after deducting any required retainage and all previous payments shall be due and payable to the Contractor within 20 days after the pay estimate has been approved by the County; or within 25 business day if County's consultant approval is required.

It is the Contractor's responsibility for the care of any stored materials. Any damage to or loss of said materials is the responsibility of the Contractor. Any requests for payment of materials stored on site must be accompanied with a paid receipt. The Contractor warrants and guarantees that title to all work, materials and equipment covered by any application for payment, whether incorporated in the project or not, will pass to the County at the time of payment free and clear of all liens, claims, security interests and encumbrances (hereafter referred to as "Liens").

C.05 PAYMENT (cont'd)

The Contractor agrees to furnish an affidavit stating that all laborers, materialmen, and subcontractors have been paid on the project for Work covered by the application for payment and that a partial or complete release of lien, as may be necessary, be properly executed by the materialmen, laborers, subcontractors on the project for Work covered by the application for payment, sufficient to secure the County from any claim whatsoever arising out of the aforesaid Work.

When the Contractor has completed the Work in compliance with the terms of the Contract Documents, he shall notify the County in writing that the project is ready for final inspection. Upon completion of final inspection, the County will notify Contractor of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies. When all such errors have been corrected, a final reinspection will be made. The process will be repeated until, in the opinion of the County, the project has been completed in compliance with the terms of the Contract Documents.

When final acceptance has been made by the County, the County will make final payment of the Contract amount, plus all approved additions, less approved deductions and previous payments made. The Contract will be considered complete when all work has been finished, the final inspection made, approved as-builts received, and the project finally accepted in writing by the County. The Contractor's responsibility shall then terminate except as otherwise stated.

C.06 RETAINAGE

A **retainage** of 2.5% of the total contract amount shall be withheld from payments after 75% completion of the Work. Upon substantial completion, this retainage shall be reduced to 1% of the total contract amount plus such amount as the County may reasonably deem necessary to repair, replace, complete or correct any damaged, defective, incorrect or incomplete work. Upon final acceptance, the remaining retainage shall be included in the final payment.

C.07 WARRANTY AND GUARANTEE PROVISIONS

All work, materials, and equipment furnished as defined herein shall be guaranteed and warranted by the contractor for a minimum period of three (3) years from final acceptance by the Owner, unless otherwise specified, to be free from defects due either to faulty materials or equipment or faulty workmanship. All materials, equipment, and workmanship furnished and installed by the contractor is warranted and guaranteed by the contractor to be such as to meet the required standards and to accomplish the purposes and functions of the project as defined, detailed, and specified herein. The Owner shall, following discovery thereof, promptly give written notice to the contractor of faulty materials, equipment, or workmanship within the period of the guarantee and the contractor shall promptly replace any part of the faulty equipment, material, or workmanship at his own cost. These warranty and guarantee provisions create no limitations on the Owner as to any claims or actions for breach of guaranty or breach of warranty that the Owner might have against parties other than the contractor, and do not constitute exclusive remedies of the Owner against the contractor.

C.08 ROYALTIES AND PATENTS

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

C.09 AUTHORIZED PRODUCT REPRESENTATION

The contractor, 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 perform accordingly may, in the County's sole discretion, be deemed a breach of contract, and shall constitute grounds for the County's immediate termination of the contract.

C.10 REGULATIONS

It shall be the responsibility of the bidder to assure compliance with any OSHA, EPA and/or other federal or state of Florida rules, regulations or other requirements, as each may apply.

C.11 CANCELLATION

Any failure of the contractor to furnish or perform the Work (including, but not limited to, commencement of the Work, failure to supply sufficient skilled workers or suitable materials or equipment) in accordance with the contract, the County may order the stop of the Work, or any portion thereof, until the cause for such order has been eliminated. If the contractor persistently fails to perform the Work in accordance with the contract, the County reserves the right to terminate the contract. The County reserves the right to cancel all or any undelivered or unexecuted portion of this contract with or without cause.

C.12 INDEMNIFICATION

The contractor covenants and agrees to indemnify and save harmless the County, its agents and employees, from and against all claims, suits, actions, damages, causes of action, or judgments arising out of the terms of the resulting agreement for any personal injury, loss of life, or damage to the property sustained as a result of the performance or non-performance of services or delivery of goods; from and against any orders, judgments, or decrees, which may be entered against the County, its agents or employees; and from and against all costs, attorney's fees, expenses and other liabilities incurred in the defense of any such claim, suit or action, and the investigation thereof. Nothing in the award, resulting agreement, contract or Purchase Order shall be deemed to affect the rights, privileges and immunities of the County as set forth in Florida Statute Section 768.28.

C.13 MANUALS, SCHEMATICS, HANDBOOKS (if applicable)

All manuals, schematics and handbooks shall be provided which are applicable to the equipment delivered. An operators manual, parts manual and technician manual must also be provided. Parts lists (manuals) must include OEM part numbers for items not manufactured by the bidder. Vendor shall furnish two (2) copies of each.

C.14 INSURANCE

The contractor will not commence work under a contract until all insurance under this section and such insurance coverage as might be required by the County has been obtained. The contractor shall obtain, and submit to Purchasing within ten calendar days of request, at his expense, the following minimum amounts of insurance (inclusive of any amounts provided by an umbrella or excess policy):

a. Workers' Compensation/Employers' Liability

Part One - There shall be no maximum limit (other than as limited by the applicable statute) for liability imposed by Florida Worker's Compensation Act or any other coverage required by the contract documents which are customarily insured under Part One of the standard Worker's Compensation Policy.

Part Two - The minimum amount of coverage required by the contract documents which are customarily insured under Part Two of the standard Workers' Compensation Policy shall be:

<u>\$100,000</u>	(Each Accident)
<u>\$500,000</u>	(Disease-Policy Limit)
<u>\$100,000</u>	(Disease-Each Employee)

b. Commercial General Liability

The limits are to be applicable only to work performed under this contract and shall be those that would be provided with the attachment of the Amendment of Limits of Insurance (Designated Project or Premises) endorsement (ISO Form CG 25 03) to a Commercial General Liability Policy with the following minimum limits.

General Aggregate:

Products/Completed Operations Aggregate	<u>\$1,000,000</u>
Personal and Advertising Injury	<u>\$300,000</u>
Each Occurrence	<u>\$300,000</u>
Fire Damage (Any One Fire)	\$ Nil
Medical Expense (Any One Person)	\$ Nil

c. Business Auto Policy

Each Occurrence Bodily Injury and	
Property Damage Liability Combined	<u>\$300,000</u>
Annual Aggregate (if applicable):	<u>\$1,000,000</u>

d. Owners Protective Liability Coverage

The minimum OPC Policy limits per occurrence and, if subject to an aggregate, annual aggregate to be provided by the contractor shall be the same as the amounts shown above as the minimum per occurrence and general policy aggregate limits respectively required for the Commercial General Liability coverage. The limits afforded by the OPC Policy and any excess policies shall apply only to the County and the County's officials, officers, agents and employees and only to claims arising out of or in connection with the work under this contract.

C.14 INSURANCE (cont'd)e. Property Insurance

If this contract includes construction of or additions to above ground buildings or structures, contractor shall provide "**Builder's Risk**" insurance with the minimum amount of insurance to be 100% of the value of such addition(s), building(s), or structure(s).

f. Installation Floater

If this contract does not include construction of or additions to above ground building or structures **but does involve** the installation of machinery or equipment, contractor shall provide an "**Installation Floater**" with the minimum amount of insurance to be 100% of the value of such addition(s), building(s), or structure(s).

g. Certificates of Insurance and Copies of Policies

Certificates of Insurance in triplicate evidencing the insurance coverage specified in the six above paragraphs a., b., c., d., e. and f., shall be filed with the Purchasing Official before operations are begun. The required certificates of insurance shall name the types of policy, policy number, date of expiration, amount of coverage, companies affording coverage, and also shall refer specifically to the bid number, project title and location of project.

Insurance shall remain in force at least one year after completion and acceptance of the project by the County, in the amounts and types as stated herein, with coverage for all products and services completed under this contract.

ADDITIONAL INSURED: - The contractor shall name Manatee County as additional insured in each of the applicable policies.

If the initial insurance expires prior to the completion of operations and/or services by the contractor, renewal certificates of insurance and required copies of policies shall be furnished by the contractor and delivered to the Purchasing Official 30 days prior to the date of their expiration. Nothing herein shall in any manner create any liability of the County in connection with any claim against the contractor for labor, services, or materials, or of subcontractors; and nothing herein shall limit the liability of the contractor or contractor's sureties to the County or to any workers, suppliers, materialmen or employees in relation to this contract.

C.15 BID BOND/CERTIFIED CHECK

By offering a submission to this Invitation For Bid the bidder agrees, should the bidder's bid be accepted, **to execute the form of contract and present the same to Manatee County for approval within ten days after being notified of the awarding of the contract**. The bidder further agrees that failure to execute and deliver said form of contract within ten days will result in damages to Manatee County and as guarantee of payment of same a bid bond/certified check shall be enclosed within the submitted sealed bid in the amount of five (5%) percent of the total amount of the bid. The bidder further agrees that in case the bidder fails to enter into a contract, as prescribed by Manatee County, the bid bond/certified check accompanying the bid shall be forfeited to Manatee County as agreed liquidated damages. If the County enters into a contract with a bidder, or if the County rejects any and/or all bids, accompanying bond will be promptly returned.

C.16 PERFORMANCE AND PAYMENT BONDS

The successful bidder shall furnish surety bonds as security for faithful performance of the contract awarded as a result of this bid, and for the payment of all persons performing labor and/or furnishing material in connection therewith. Surety of such bonds shall be in an amount equal to the bid award (100% each) and from a duly authorized and nationally recognized surety company, authorized to do business in Florida, satisfactory to this County. The attorney-in-fact who signs the bonds must file with the bonds a certificate and effective dated copy of power-of-attorney. (Reference Florida Statute 255.05)

Furnishing the performance and payment bonds shall be requisite to execution of a contract with the County. Said performance and payment bonds will remain in force for the duration of the contract with the premiums paid by the contractor. Failure of successful bidder to execute such contract and to supply the required bonds shall be just cause for annulment of the award. The County may then contract with another acceptable bidder or readvertise this Invitation For Bid. If another bidder is accepted, and notice given within 90 days after the opening of bids, this acceptance shall bind the bidder as though they were originally the successful bidder.

Failure of the County at any time, to require performance by the contractor of any provisions set out in the contract will in no way affect the right of the County, thereafter, to enforce the provisions. Bonds to remain in effect for one year after final payment becomes due.

SECTION 00100
INSTRUCTIONS TO BIDDERS

D.01 THE WORK

The Work is generally described as the rehabilitation of Clarifiers 1 and 2, including electrical and instrumentation work at the Southwest Water Reclamation Facility, and all related work as outlined in this Invitation For Bid document. Construction and record drawings are required of the successful bidder and shall fully meet the requirements of all current federal, state and county laws, rules, regulations and standards, with the most stringent applying.

NOTE: The Manatee County (Building Department) permit has been applied for with a remaining balance due of \$350 to be paid for by the Contractor.

D.02 SUBCONTRACTORS, SUPPLIERS AND OTHERS

The identity of subcontractors, suppliers, and other persons and organizations (including those who are to furnish the principal items of material and equipment) may be requested by the Owner for each bid item from any of the bidders; and the bidder shall respond within five days after the date of such request. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such subcontractor, supplier, persons or organization if requested by Owner. If Owner, after due investigation has reasonable objection to any proposed subcontractor, supplier, other person or organization, Owner may request the apparent successful bidder to submit an acceptable substitute without an increase in Contract Price or Contract Time.

If apparent successful bidder declines to make any such substitution, Owner may award the contract to the next lowest qualified bidder that proposes to use acceptable subcontractors, suppliers, and other persons who Owner does not make written objection to. Contractor shall not be required to employ any subcontractor, supplier, other person or organization who contractor has reasonable objection to. Subcontractors shall be bound by the terms and conditions of this contract insofar as it applies to their Work, but this shall not relieve the prime contractor from the full responsibility to the Owner for the proper completion of all Work to be executed under this contract.

D.03 BIDS

Bids are to be submitted in triplicate, one original and two copies, upon the County supplied forms. All blank spaces must be filled in as noted with amounts extended and totaled and no changes shall be made in the wording of the forms or in the items mentioned therein. In the event a change is made in your submittal, the bidder shall write their initials by the change. Any bid may be rejected which contains any omissions, alterations, irregularities of any kind, or which shall in any manner fail to conform to bid requirements.

D.03 BIDS (cont'd)

A bid made by an individual, either in his/her own or proper person or under a trade or firm name, shall be executed under the individual's signature. If made by a partnership, the bid shall be executed by two or more of the general partners. If made by a corporation, the bid shall be executed by its President or other legally authorized corporate officer or agent.

D.04 EXAMINATION OF CONTRACT DOCUMENTS AND SITE

It is the responsibility of each bidder before submitting a bid, to (a) examine the Bid Documents thoroughly; (b) visit the site 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 Bid Documents; and (e) notify Owner of all conflicts, errors, or discrepancies in the Bid Document. The accuracy of the existing utility locations shown on the plans is approximate and without expressed or implied warranty. 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 site 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 Contract Documents.

Owner will provide each bidder access to the site to conduct such explorations and tests. Bidder shall fill all holes, clean up and restore the site 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 contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by Owner unless otherwise provided in the Contract Documents.

SECTION 00300
(Submit in Triplicate)
BID FORM

For: IFB #11-2873DC SWWRF CLARIFIER 1 AND 2 REHABILITATION

BID "A" TOTAL BID PRICE: \$ _____ (330 calendar day completion)

BID "B" TOTAL BID PRICE: \$ _____ (365 calendar day completion)

Two schedules for Completion of the Work shall be considered. Each bid for completion by the specified stated time shall be offered as a separate "Total Bid Price." The County has the sole authority to select the bid based on the Completion Time which is in the best interest of the County.

We, the undersigned, hereby declare that we have carefully reviewed the bid documents, and with full knowledge and understanding of the aforementioned herewith submit this bid, meeting each and every specification, term, and condition contained in the Invitation For Bids.

We understand that the bid specifications, terms, and conditions in their entirety shall be made a part of any agreement or contract between Manatee County and the successful bidder. Failure to comply shall result in contract default, whereupon, the defaulting contractor shall be required to pay for any and all reprocurement costs, damages, and attorney fees as incurred by the County.

Communications concerning this Bid shall be addressed as follows:

Person's Name: _____

Address: _____ Phone: _____

Date: _____ EMAIL: _____

COMPANY'S NAME: _____

AUTHORIZED SIGNATURE(S): _____

Name and Title of Above Signer(s)

CO. MAILING ADDRESS: _____

TELEPHONE: (_____) _____ FAX: (_____) _____

Acknowledge Addendum Nos. _____ Dated: _____

BID FORM

For: SWWRF CLARIFIER 1 AND 2

BID FORM "A" (330 Calendar Days Completion)

	DESCRIPTION	EST QTY	UNIT COST	EXTENDED COST
1.	Mobilization / Demobilization	LS		\$
2.	Miscellaneous Work and Cleanup	LS		\$
3.	Clarifiers	LS		\$
4.	Electrical and Instrumentation	LS		\$
5.	Grout for Clarifier Floor Repair	800 SF	\$	\$
6.	Clarifier Concrete Repair	100 SF	\$	\$
7.	Epoxy Injection for Concrete Crack Repair	200 LF	\$	\$
8.	Discretionary Work			\$50,000.00
	TOTAL BID "A" 330 days completion			\$
	PRODUCT			MANUFACTURER
	CLARIFIER			

BIDDER: _____

BID FORM

For: SWWRF CLARIFIER 1 AND 2

BID FORM "B" (365 Calendar Days Completion)

	DESCRIPTION	EST QTY	UNIT COST	EXTENDED COST
1.	Mobilization / Demobilization	LS		\$
2.	Miscellaneous Work and Cleanup	LS		\$
3.	Clarifiers	LS		\$
4.	Electrical and Instrumentation	LS		\$
5.	Grout for Clarifier Floor Repair	800 SF	\$	\$
6.	Clarifier Concrete Repair	100 SF	\$	\$
7.	Epoxy Injection for Concrete Crack Repair	200 LF	\$	\$
8.	Discretionary Work			\$50,000.00
	TOTAL BID "B" 365 days completion			\$
	PRODUCT			MANUFACTURER
	CLARIFIER			

BIDDER: _____

SWORN STATEMENT
THE FLORIDA TRENCH SAFETY ACT

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 IFB No. 11-2873DC SWWRF Clarifier 1 and 2 Rehab.
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 the 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 Owner and Engineer, 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:

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

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

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: _____

SECTION 430
CONTRACTOR'S QUESTIONNAIRE
(Submit in Triplicate)

The Bidder warrants the truth and accuracy of all statements and answers herein contained. (Include additional sheets if necessary.) This questionnaire to be completed and submitted with your bid.

1. LICENSE # and COMPANY'S NAME: _____
- CO. PHYSICAL ADDRESS: _____
- STATE OF INCORPORATION, IF APPLICABLE: _____
- TELEPHONE NUMBER: (____) _____ FAX: (____) _____
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 venturers and the same if any venturer is a corporation for each such corporation, partnership, or joint venture:

4. Your organization has been in business (under this firm's name) as a _____
for how many years? _____ Is this firm in bankruptcy? _____
5. Describe and give the date and owner of the last three projects you've completed which are similar in cost, type, size, and nature as the one proposed. Include contact name and phone number:

6. 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.

7. Have you ever failed to complete work awarded to you? Or provide projects not completed within contract time. If so, state when, where (contact name, address, phone number) and why?

8. Have you ever been debarred or prohibited from bidding on a governmental entity's construction project? If yes, name the entity and describe the circumstances:

9. Name three individuals, governmental entities, or corporations for which you have performed similar work and to which you refer. Include contact name and phone number:

1. _____

2. _____

3. _____

10. What specific steps have you taken to examine the physical conditions at or contiguous to the site, including but not limited to, the location of existing underground facilities?

Have you visited the site? _____ Date of inspection: _____

11. What specific physical conditions, including, but not limited to, the location of existing underground facilities have you found which will, in any manner, affect cost, progress, performance, or finishing of the work?

12. Will you subcontract any part of this Work? If so, describe which major portion(s):

13. If any, list (with contract amount) WBE/MBEs to be utilized:

14. What equipment do you own to accomplish this Work?

BIDDER: _____

15. What equipment will you purchase/rent for the Work? (specify which)

16. List the following in connection with the Surety which is providing the Bond(s):

Surety's Name: _____

Surety's Address: _____

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

Phone: (_____) _____

SECTION 00491

Drug Free Work Place Certification**SWORN STATEMENT PURSUANT TO SECTION 6-101(7)(B),
MANATEE COUNTY PURCHASING CODE****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 _____
[print individual's name and title]_____
for _____
[print name of entity submitting sworn statement]

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: _____.)

I understand that no person or entity shall be awarded or receive a county contract for public improvements, procurement of goods or services (including professional services) or a county lease, franchise, concession or management agreement, or shall receive a grant of county monies unless such person or entity has submitted a written certification to the County that it will provide a drug free work place by:

(1) providing a written statement to each employee notifying such employee that the unlawful manufacture, distribution, dispensation, possession or use of a controlled substance as defined by § 893.02(4), Florida Statutes, as the same may be amended from time to time, in the person's or entity's work place is prohibited specifying the actions that will be taken against employees for violation of such prohibition. Such written statement shall inform employees about:

- (i) the dangers of drug abuse in the work place;
- (ii) the person's or entity's policy of maintaining a drug free environment at all its work places, including but not limited to all locations where employees perform any task relating to any portion of such contract, business transaction or grant;
- (iii) any available drug counseling, rehabilitation, and employee assistance programs; and
- (iv) the penalties that may be imposed upon employees for drug abuse violations.

(2) Requiring the employee to sign a copy of such written statement to acknowledge his or her receipt of same and advice as to the specifics of such policy. Such person or entity shall retain the statements signed by its employees. Such person or entity shall also post in a prominent place at all of its work places a written statement of its policy containing the foregoing elements (i) through (iv).

(3) Notifying the employee in the statement required by subsection (1) that as a condition of employment the employee will:

- (i) abide by the terms of the statement; and

DRUG FREE (Cont'd)

- (ii) notify the employer of any criminal drug statute conviction for a violation occurring in the work place no later than five (5) days after such a conviction.
- (4) Notifying the County within ten (10) days after receiving notice under subsection (3) from an employee or otherwise receiving actual notice of such conviction.
- (5) Imposing appropriate personnel action against such employee up to and including termination; or requiring such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a federal, state, or local health, law enforcement, or other appropriate agency.
- (6) Making a good faith effort to continue to maintain a drug free work place through implementation of sections (1) through (5) stated above.

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 CONTRACT OR BUSINESS TRANSACTION SHALL PROVIDE FOR SUSPENSION OF PAYMENTS, OR TERMINATION, OR BOTH, IF THE CONTRACTING OFFICER OR THE COUNTY ADMINISTRATOR DETERMINES THAT:

- (1) Such person or entity has made false certification.
- (2) Such person or entity violates such certification by failing to carry out the requirements of sections (1), (2), (3), (4), (5), or (6) or subsection 3-101(7)(B); or
- (3) Such a number of employees of such person or entity have been convicted of violations occurring in the work place as to indicate that such person or entity has failed to make a good faith effort to provide a drug free work place as required by subsection 3-101(7)(B).

[Signature]

STATE OF FLORIDA

COUNTY OF _____

Sworn to and subscribed before me this _____ day of _____, 200____ by _____

Personally known _____ OR Produced identification _____
[Type of identification]

Notary Public Signature
My commission expires _____

[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.

SECTION 00491

PUBLIC CONTRACTING AND ENVIRONMENTAL CRIMES CERTIFICATION**SWORN STATEMENT PURSUANT TO ARTICLE 6,
MANATEE COUNTY PURCHASING CODE**

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 _____
[print individual's name and title]

_____ for _____
[print name of entity submitting sworn statement]

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: _____

I understand that no person or entity shall be awarded or receive a county contract for public improvements, procurement of goods or services (including professional services) or a county lease, franchise, concession or management agreement, or shall receive a grant of county monies unless such person or entity has submitted a written certification to the County 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 the County's Purchasing Director, 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 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.

CRIMES (Cont'd)

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 the County's Purchasing Director. Upon presentation of such satisfactory proof, the person or entity shall be allowed to contract with the County.

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 CONTRACT OR BUSINESS TRANSACTION SHALL PROVIDE FOR SUSPENSION OF PAYMENTS, OR TERMINATION, OR BOTH, IF THE CONTRACTING OFFICER OR THE COUNTY ADMINISTRATOR DETERMINES THAT **SUCH PERSON OR ENTITY HAS MADE FALSE CERTIFICATION.**

[Signature]

STATE OF FLORIDA
COUNTY OF _____

Sworn to and subscribed before me this _____ day of _____, 20____ by _____

Personally known _____ OR Produced identification _____
[Type of identification]

Notary Public Signature
My commission expires _____

[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.

SECTION 00491

MANATEE COUNTY LOCAL PREFERENCE LAW AND VENDOR REGISTRATION**VENDOR REGISTRATION**

All vendors are encouraged to register with Manatee County using the on-line "Vendor Registration" web page on www.mymanatee.org.

Enclosed is a copy of the current Manatee County law that details the County's Local Preference and definition of a Local Business.

If you assert that your firm meets the stated definition of a Local Business, we ask that in addition to registering on the County's Web page, you fill out the attached "**Affidavit As To Local Business Form**" that is included in this section of the bid, have the completed document notarized, and mail the original to the following address: Manatee County Administration Center, 1112 Manatee Avenue West, Suite 803, Bradenton, FL 34205.

Your cooperation in registering your business with Manatee County will enhance our opportunities to identify sources for goods and services, plus identify Local Businesses. This information is used for soliciting quotations up to \$250,000.00 and for competitive solicitations of larger purchases.

You will note that Manatee County collaborates with the Manatee Chamber of Commerce, posting bids on www.manateechamber.com as well as using the same vendor categories for registration.

Our staff can assist you with your registration as needed. Our office hours are 8:00 A.M. to 5:00 P.M., Monday through Friday on regular business days. Please call (941)749-3014 if you wish to have a purchasing staff member assist you.

Quick steps to on line registration:

www.mymanatee.org

A link to "Purchasing" is listed under the "Quick Links" on page one of this County Web Site.

On the left hand side of the Purchasing Web page, click on "Vendor Registration."

This will bring up the Vendor Registration form for on-line input. Please note that the definition of a "Local Business" changed on March 17, 2009. The Web page will be updated to include the current Law which has been provided in this section of the bid.

Thank you for reviewing this information and considering registering your business with Manatee County. Registration is not mandatory, however, by taking the time to register, you are helping the County to provide timely notifications of quotation, bid, and proposal opportunities to your business.

SECTION 2-26-6 LOCAL PREFERENCE, TIE BIDS, LOCAL BUSINESS DEFINED

1. Whenever a responsible local business bidder and a responsible non-local business bidder are found, upon the opening of bids, to have both submitted the lowest responsive bid, the bid of the local bidder shall be awarded the contract. Should more than one responsible local business bidder match the responsible non-local business bidder's lowest responsive bid, or should no responsible local business bidder match the lowest responsive bid but two or more responsible non-local business bidders submit lowest responsive bids for equal amounts, then the award of the contract shall be determined by a chance drawing, coin toss, or similar tie-breaking method conducted by the purchasing office and open to the public. Any bidders seeking to be recognized as local businesses for purposes of this local business preference provision may be required by the terms of the bid announcement to certify they meet the definition of local business set forth in this section, and to register as a local business with the county in the manner prescribed by the county to facilitate the county's ability to track the award of contracts to local businesses and to allow the county to provide future notifications to its local businesses concerning other bidding opportunities.
2. Nothing herein shall be deemed to prohibit the inclusion of requirements with respect to operating and maintaining a local place of business in any invitation for bids when the bidder's location materially affects the provisions of the services or supplies that are required by the invitation.
3. Local business is defined as a business legally authorized to engage in the sale of the goods and/or services to be procured, and which certifies within its bid that for at least six (6) months prior to the announcement of the solicitation of bids it has maintained a physical place of business in Manatee, Desoto, Hardee, Hillsborough, Pinellas or Sarasota County with at least one full-time employees at that location.
4. **Each solicitation for bids made by the county shall contain terms expressly describing the local business preference policies of the county, and shall provide that by electing to submit a bid pursuant to a request for bids, all bidders are deemed to understand and agree to those policies.**
5. For all contracts for architecture, professional engineering, or other professional services governed by Florida Statute § 287.055, the Consultants' Competitive Negotiation Act, the county shall include the local business status of a firm among the factors considered when selecting which firms are "most highly qualified." In determining which firm is the "most qualified" for purposes of negotiating a satisfactory contract, preference shall be given to a local business where all other relevant factors are equal.
6. Local preference shall not apply to the following categories of contracts:
 - a. Goods or services provided under a cooperative purchasing agreement or similar "piggyback" contract;
 - b. Contracts for professional services subject to Florida Statute § 287.055, the Consultants' Competitive Negotiation Act, except as provided for in subsection (e) above;

- c. Purchases or contracts which are funded, in whole or in part, by a governmental or other funding entity, where the terms and conditions of receipt of the funds prohibit the preference;
- d. Purchases or contracts made pursuant to a non-competitive award process, unless otherwise provided by this section;
- e. Any bid announcement which specifically provides that the general local preference policies set forth in this section are 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.

7. To qualify for local preference under this section, a local business must certify to the County that it:

- a. Has not within the five years prior to the bid announcement admitted guilt or been found guilty by any court or state or federal regulatory enforcement agency of violation of any criminal law, or a law or administrative regulation regarding fraud;
- b. Is not currently subject to an unresolved citation or notice of violation of any Manatee County Code provision, except citations or notices which are the subject of a current legal appeal, as of the date of the bid announcement;
- c. Is not delinquent in the payment of any fines, liens, assessments, fees or taxes to any governmental unit or taxing authority within Manatee County, except any such sums which are the subject of a current legal appeal.

Ref: Ordinance 09-21 and 09-23 **PASSED AND DULY ADOPTED** in open session, with a quorum present and voting, on the 17th day of March, 2009.

**MANATEE COUNTY GOVERNMENT
AFFIDAVIT AS TO LOCAL BUSINESS
(Complete and Initial Items B-F)**

8. **AUTHORIZED REPRESENTATIVE**

I, [name] _____, am the [title] _____

and the duly authorized representative of: [name of business] _____, and that I possess direct personal knowledge to make informed responses to these certifications and the legal authority to make this Affidavit on behalf of myself and the business for which I am acting; and by electing to submit a bid pursuant to this Invitation for Bids, shall be deemed to understand and agree to the local business preference policies of Manatee County; and that I have the direct knowledge to state that this firm complies with all of the following conditions to be considered to be a Local Business as required by the Manatee County Code of Law, Section 2-26-6.

9. **PLACE OF BUSINESS:** I certify that the above business is legally authorized to engage in the sale of goods and/or services and has a physical place of business in Manatee, DeSoto, Hardee, Hillsborough, Pinellas or Sarasota County with at least one (1) fulltime employee at that location. The physical address of the location which meets the above criteria is: _____ [Initial] _____

10. **BUSINESS HISTORY:** I certify that business operations began at the above physical address with at least one fulltime employee on [date] _____ [Initial] _____

11. **CRIMINAL VIOLATIONS:** I certify that within the past five years of the date of this Bid announcement, this business has not admitted guilt nor been found guilty by any court or local, state or federal regulatory enforcement agency of violation of any criminal law or administrative regulation regarding fraud. [Initial] _____

12. **CITATIONS OR CODE VIOLATIONS:** I certify that this business is not currently subject to any un-resolved citation or notice of violation of any Manatee County Code provision, with the exception of citations or notices which are the subject of a legal current appeal within the date of this bid announcement. [Initial] _____

13. **FEES AND TAXES:** I certify that within this business is not delinquent in the payment of fines, liens, assessments, fees or taxes to any governmental unit or taxing authority within Manatee County, with the exception of those which are the subject of a legal current appeal. [Initial] _____

Each of the above certifications is required to meet the qualification of "Local Business" under Manatee County Code of Law, 2-26-6.

Signature of Affiant _____

STATE OF FLORIDA
COUNTY OF _____

Sworn to (or affirmed) and subscribed before me this _____ day of _____, 20_____, by (name of person making statement).

(Notary Seal) Signature of Notary: _____

Name of Notary (Typed or Printed): _____

Personally Known _____ OR Produced Identification _____ Type of Identification Produced _____

Submit executed copy to Manatee County Purchasing, Suite 803, 1112 Manatee Avenue W., Bradenton, FL 34205

SECTION 00500
FORM OF AGREEMENT
BETWEEN THE
COUNTY OF MANATEE, FLORIDA
AND THE CONTRACTOR AS IDENTIFIED BELOW
ON THE BASIS OF A STIPULATED UNIT COST CONTRACT PRICE

THIS AGREEMENT is made and entered into by and between the COUNTY OF MANATEE, a political subdivision of the state of Florida, hereinafter referred to as the "OWNER" and _____, hereinafter referred to as the "CONTRACTOR," duly authorized to transact business in the state of Florida, with offices located at _____ (Phone: _____).

Article 1. WORK

CONTRACTOR shall furnish all labor, materials, supplies, and other items required to complete the Work for IFB No. **11-2873DC SWWRF Clarifier 1 and 2 Rehabilitation** in strict accordance with specifications and any duly authorized subsequent addenda thereto, all of which are made a part hereof.

Article 2. ENGINEER

The County of Manatee, Project Management Division, is responsible as the OWNER and Carollo, hereinafter referred to as the ENGINEER, is responsible for technical/engineering reviews and decisions in ensuring the Work is completed in accordance with the Contract Documents. All communications involving this project during construction will be addressed to:

County of Manatee
Project Management Division
Attn: Jeff Streitmatter, P.E., Sr. Proj Eng
IFB #11-2873DC
1112 Manatee Avenue West
Bradenton, Florida, 34205
Phone: 941-708-7450 extension 7335

Carollo
401 North Cattlemen Road
Suite 306
Sarasota, Florida 34232
Phone: 941-371-9832
Fax: 941-371-9873

Where the terms ENGINEER and/or OWNER are used in the Contract Documents, it shall mean the OWNER'S project management team.

Article 3. CONTRACTOR'S REPRESENTATIONS

In order to induce OWNER to enter into this Agreement, CONTRACTOR makes the following representations:

- 3.1 CONTRACTOR has familiarized itself with the nature and extent of the Bid Documents, Work, site, locality and all local conditions and laws and regulations that in any manner may affect cost, progress, performance or furnishing of the Work.
- 3.2 CONTRACTOR has studied carefully all drawings of the physical conditions upon which CONTRACTOR is entitled to rely.
- 3.3 CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies which pertain to the physical conditions at or contiguous to the site or which otherwise may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Bid Documents; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by CONTRACTOR for such purposes.
- 3.4 CONTRACTOR has reviewed and checked all information and data shown or indicated on the Bid Documents with respect to existing underground facilities at or contiguous to the site and assumes responsibility for the accurate location of said underground facilities. Any additional examinations, investigations, explorations, tests, reports, studies or similar information or data in respect of said underground facilities conducted by the CONTRACTOR will be done at the CONTRACTOR's expense.
- 3.5 CONTRACTOR has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the IFB terms and conditions.
- 3.6 CONTRACTOR has given OWNER written notice of all conflicts, errors or discrepancies that have been discovered in the Bid Documents and the written resolution thereof by OWNER is acceptable to CONTRACTOR.

3.7 CONTRACTOR shall schedule and perform the Work subject to OWNER's approval and shall hold OWNER harmless from all liabilities incurred due to CONTRACTOR's failure to coordinate with the OWNER.

Article 4. CONTRACT DOCUMENTS

The Contract Documents which comprise the entire Agreement between OWNER and CONTRACTOR concerning the Work consist of the following:

- 4.1 This Agreement and Bid Document IFB #11-2873DC
- 4.2 Performance and/or other Bonds and Insurance Certificate(s)
- 4.3 Drawings (attached by reference)
- 4.4 Addenda numbers __ to __, inclusive.
- 4.5 CONTRACTOR's Bid Form and any other information submitted by Contractor prior to Notice of Award.
- 4.6 The following which may be delivered or issued after the effective date of the Agreement and are not attached hereto: all written Change Orders and other documents amending, modifying, or supplementing the Contract Documents.
- 4.7 The documents listed in paragraphs above are attached to this Agreement (except as noted otherwise above). There are no Contract Documents other than those listed above in this Article 4.

Article 5. MISCELLANEOUS

- 5.1 Terms used in this Agreement are defined in Article 1 of the General Conditions.
- 5.2 No assignment by a party hereto of any rights under or interest in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation, monies that may become due and monies that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law); and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignee from any duty or responsibility under the Contract Documents.

5.3 OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements and obligations contained in the Contract Documents.

The OWNER will pay, and the CONTRACTOR will accept in full consideration for the performance of the Work (**IFB No. 11-2873DC SWWRF Clarifier 1 and 2 Rehabilitation**), subject to additions and deductions as provided therein, the sum of _____ Dollars and _____ Cents (\$) for Bid "____" based on Completion Time of -- calendar days and the sum of \$1,148 as liquidated damages for each calendar day of delay.

CONTRACTOR

BY: _____
Signature

Type Name and Title of Signer

The foregoing instrument was acknowledged before me this ____ day of _____, 20____, by _____, who is personally known to me or who has produced _____ as identification.
(impress official seal)

Notary Public, State of Florida
My commission expires: _____

COUNTY OF MANATEE, FLORIDA

On Behalf of the County Administrator,
Manatee County Government

DEPARTMENT

BY: _____
Signature

Name & Title of Signer

Date _____

SECTION 00700
GENERAL CONDITIONS

ARTICLE I - DEFINITIONS

Whenever used in the Bid Documents, the following terms have the meaning indicated which are applicable to both the singular and plural thereof:

Addendum - Written or graphic instruments issued prior to the opening of bids which clarify or change the bidding documents or the contract documents.

Agreement - The written Agreement between Owner and Contractor covering the Work to be performed; other contract documents are attached to the Agreement and made a part thereof as provided therein.

Written Amendment - A written amendment of the contract documents, signed by Owner and Contractor on or after the effective date of the Agreement and normally dealing with the non-engineering or non-technical rather than strictly work related aspects of the contract documents.

Application for Payment - The form accepted by Project Representative which is to be used by Contractor in requesting progress or final payments and which is to include such supporting documentation as is required by the contract documents.

Award - Acceptance of the bid from the person, firm, or corporation which in the Owner's sole and absolute judgment will under all circumstances best serve the public interest. Award shall be made in accordance with Manatee County Code of Laws.

Bid - The offer of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

Bidder - One who submits a bid directly to the Owner, as distinct from a sub-bidder, who submits a bid to a Bidder.

Bidding Documents - Consists of the Invitation For Bid, which includes but is not limited to: the bid form, drawings, technical specifications, terms and conditions, and the proposed contract documents (including all Addenda issued prior to receipt of bids); and becomes a part of the Agreement.

Bonds - Performance and payment bonds and other instruments of security.

Change Order - A document recommended by Project Representative which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work, or an adjustment in the contract price or the contract time, issued on or after the effective date of the Agreement.

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.

Contract Documents - The Agreement, Addenda (which pertain to the contract documents), Contractor's bid (including documentation accompanying the bid and any post-bid documentation submitted prior to the Notice of Award), the bonds, the specifications and the drawings, together with all amendments, modifications and supplements issued on or after the effective date of the Agreement.

Contract Price - The monies payable by Owner to Contractor under the contract documents as stated in the Agreement.

Contract Time - The number of days or the date stated in the Notice to Proceed for the completion of the Work.

Contractor - The person, firm or corporation with whom Owner has entered into an Agreement.

Days - All references to days are to be considered calendar days except as specified differently.

Defective - An adjective which when modifying the work refers to work that is unsatisfactory, faulty or deficient, or does not conform to the contract documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the contract documents, or has been damaged prior to Project Representative's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner).

Drawings - The drawings which show the character and scope of the Work to be performed and which have been prepared or approved by Engineer and are referred to in the bidding and contract documents.

Effective Date of the Agreement - The date indicated in the Agreement on which it becomes effective (date of execution).

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 the 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.

Float or Slack Time - The time available in the progress schedule during which an unexpected activity can be completed without delaying substantial completion of the Work.

Field Order - A written order issued by Project Representative which orders minor changes in the Work, but which does not involve a change in the contract price or the contract time.

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.

Non-prejudicial Delay - Any delay impacting a portion of the Work within the available total float or slack time and not necessarily preventing completion of the Work within the contract time.

Notice of Award - The written notice to the successful contractor stating Award has been approved by the Purchasing Official in accordance with Manatee Code of Law, Chapter 2-26, Manatee County Purchasing Ordinance.

Notice of Intent to Award - The written notice to the apparent low bidder stating Award has been recommended with final Award to be authorized by Ordinance 08-43, Manatee County Purchasing Code.

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 (ten days from date of such notice) Contractor's obligations under the contract documents.

Owner - Manatee County, Florida, Board of County Commissioners.

Preconstruction Conference - Prior to starting the Work, a meeting scheduled by Owner with Contractor to review the Work schedules, to establish procedures for handling shop drawings and other submissions, for processing periodical pay estimates, and such other matters as may be pertinent to the project.

Prejudicial Delay - Any excusable or compensable delay impacting the Work and exceeding the total float available in the progress schedule, thus preventing completion of the Work within the contract time unless the Work is accelerated.

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.

Project - The total construction of which the Work to be provided under the contract documents may be the whole or a part as indicated elsewhere in the contract documents.

Project Representative - The authorized representative of Owner who is assigned to the project or any part thereof.

Schedule of Values - Unit Prices shall be established for this contract by the submission of a schedule of values. The Contractor shall submit a Schedule of Values within ten days of Notice to Proceed date. The Schedule shall include quantities and prices of items equaling the Total Bid Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will 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.

Shop Drawings - All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for Contractor to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a supplier and submitted by Contractor to illustrate material or equipment for some portion of the Work.

Specifications - Those portions of the contract documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

Subcontractor - An individual or corporation having a direct contact with Contractor or with any other subcontractor for the performance of a part of the Work at the site. Such person or firm has contractual relations with the Contractor, not with the Owner.

Substantial Completion - The Work (or a specified part thereof) has progressed to the point when, in the opinion of the Engineer as evidenced by Engineer's definitive certificate of Substantial Completion, it is sufficiently complete in accordance with contract documents so that the work can be utilized for the purposes for which it is intended; or if there be no such certificate issued, when final payment is due.

Successful Bidder - The lowest qualified, responsible and responsive bidder to whom an award is made.

Supplier - A manufacturer, fabricator, supplier, distributor, materialman or vendor.

Underground Facilities - All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments and any encasement containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

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

Work - The entire completed construction or the various separately identifiable parts thereof required to be furnished under the contract documents. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the contract documents.

Work Directive Change - A written directive to contractor, issued on or after the effective date of the Agreement and signed by Owner and recommended by 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 to emergencies. A work directive change may not change the contract price 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 price or contract time.

ARTICLE 2 - PRELIMINARY MATTERS

Computation of Time: 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.

- 2.1 The Contractor must submit a proposed schedule of the Work at the preconstruction conference. The purpose of this schedule is to enable the Owner to govern the Work, to protect the functions of the local government and its citizens and to aid in providing appropriate surveillance. The Owner shall have the right to reschedule work provided such rescheduling is in accord with the remainder of terms of the contract. The schedule shall show, as 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 Owner, after necessary rescheduling and obtaining additional information for specific purposes, shall review and approve the schedule. The Contractor shall also 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 under the contract, 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.
- 2.2 A Notice to Proceed may be given at any time within thirty (30) days after the effective date of the Agreement. The contract time will commence at the time specified in such notice. 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 date on which the contract time commences to run.
- 2.3 If at any time the materials and appliances to be used appear 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 his efficiency or to improve the character of his work and the Contractor shall conform to such an order. The failure of the Owner to demand any increase of such efficiency or any improvement shall not release the Contractor from his obligation to secure the quality of work or the rate of progress necessary to complete the Work within the limits imposed by the contract. The Owner may require the Contractor to remove from the Work such employees as the Owner deems incompetent, careless, insubordinate or otherwise objectionable, or whose continued employment on the Work is deemed to be contrary to the Owner's interest.
- 2.4 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 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, RE-USE

3.1 The contract documents comprise the entire Agreement between Owner and Contractor concerning the work. The contract documents are complementary; what is called for by one is as binding as if called for by all. The contract documents will be construed in accordance with the laws and ordinances of the state of Florida and Manatee County.

Should a conflict exist within the Contract Documents, the precedence in ascending order of authority is as follows: 1) Standard Printed Technical Specifications, 2) Special Conditions, 3) General Conditions and 4) Drawings. Note: Computed dimensions shall govern over scaled dimensions.

3.2 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, 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, Contractor or Engineer, or any of their agents or employees from those set forth in the Contract Documents.

3.3 The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

- 3.3.1 A Formal Written Amendment
- 3.3.2 A Change Order
- 3.3.3 A Work Directive Change
- 3.3.4 An Administrative Contract Adjustment

3.4 In addition, the requirements of the contract documents may be supplemented and minor variations and deviations in the Work may be authorized in one or more of the following ways:

- 3.4.1 A Field Order
- 3.4.2 Engineer's approval of a Shop Drawing or sample.

ARTICLE 4 - CONTRACTOR'S RESPONSIBILITIES

- 4.1 Contractor shall keep on the Work at all times during its progress a competent resident superintendent; who shall be the Contractor's representative at the site and shall have authority to act on behalf of Contractor. All communications given to the superintendent shall be as binding as if given to Contractor.
- 4.2 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 will not permit overtime work or the performance of work on Saturday or Sunday or legal holiday without Owner's written consent given after prior notice to Engineer (at least 72 hours in advance).
 - 4.2.1 Contractor shall pay for all additional engineering charges to the Owner for any overtime work which may be authorized. Such additional engineering charges shall be a subsidiary obligation of Contractor and no extra payment shall be made by Owner on account of such overtime work. At Owner's option, overtime costs may be deducted from Contractor's monthly payment request or Contractor's retainage prior to release of final payment.
- 4.3 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.
- 4.4 All materials and equipment shall be of good quality and new, except as otherwise provided in the contract documents. If required by 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.
- 4.5 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. Nothing in the Contract Documents shall create any contractual relationship between Owner or Engineer and any such subcontractor, supplier or other person or organization, nor shall it create any obligation on the part of Owner to pay or to see to the payment of any monies due any such subcontractor, supplier or other person or organization.

4.6 **Permits:** 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.

4.7 During the progress of the Work, Contractor shall keep the premises free from accumulation of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work, Contractor shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery and surplus materials and shall leave the site clean and ready for occupancy by Owner. Contractor shall restore to original conditions all property not designated for alteration by the Contract Documents.

4.8 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.

4.9 **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:

- 4.9.1 all employees on the Work and other persons and organizations who may be affected thereby;
- 4.9.2 all the work and materials and equipment to be incorporated therein, whether in storage on or off the site; and
- 4.9.3 other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities not designated for removal, relocation or replacement in the course of 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 way for the public and preservation of the Owner's business, taking into full consideration all local conditions. Contractor's duties and responsibilities for the safety and protection of the work shall continue until such time as all the work is completed.

4.10 **Emergencies:** In emergencies affecting the safety or protection of persons or the work or property at the site or adjacent thereto, Contractor, without special instruction or authorization from Engineer or Owner, is obligated to 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 contract documents 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.

4.11 For substitutes not included with the bid, but submitted after the effective date of the Agreement, Contractor shall make written application to 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 provisions 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 Engineer in evaluating the proposed substitute. Engineer may require Contractor to furnish at Contractor's expense, additional data about the proposed substitute. In rendering a decision, Owner/Engineer and Contractor shall have access to any available float time in the construction schedule. In the event that substitute materials or equipment not included as part of the bid, 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.

4.11.1 If a specific means, method, technique, sequence of procedure of construction is indicated in or required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to Engineer if Contractor submits sufficient information to allow Engineer to determine that the substitute proposed is equivalent to that indicated or required by the Contract Documents.

4.11.2 Engineer will be allowed a reasonable time within which to evaluate each proposed substitute. Engineer will be the sole judge of acceptability and no substitute will be ordered, installed or utilized without 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.

4.11.3 Contractor shall reimburse Owner for the charges of Engineer and 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.

4.12 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 will 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 will be held responsible for the preservation of all stakes, marks and if for any reason any of the stakes or marks or batter boards become destroyed or disturbed, they will be immediately and accurately replaced by the Contractor.

- 4.13 The Contractor has, by careful examination, satisfied himself as to the nature and location of the Work and all other matters which can in any way affect the Work under this contract, including, but not limited to details pertaining to boring, as shown on the drawings, are not guaranteed to be more than a general indication of the materials likely to be found adjacent to holes bored at the site of the work, approximately at the locations indicated. The Contractor shall examine boring data, where available, and make his own interpretation of the subsoil investigations and other preliminary data, and shall base his bid on his own opinion of the conditions likely to be encountered. In no event shall an extension of time be considered for any conditions that existed at the time of bidding, nor shall the Contractor receive extra compensation for completion of the project as intended by the drawings and in keeping with the Contact Documents. No verbal agreement or conversation with any officer, agent or employee of the Owner, before or after the execution of this contract, shall affect or modify any of the terms or obligations herein contained.
- 4.14 If the Contractor, in the course of the Work, finds that the drawings and/or technical specifications cannot be followed, he 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 risk.

ARTICLE 5 - OWNER'S RESPONSIBILITIES

- 5.1 Owner shall furnish the data required of Owner under the Contract Documents promptly and shall make payments to the Contractor within a reasonable time (no more than 20 days) after the Work has been accepted by the County. 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/Engineer. Standard County forms shall be utilized.
- 5.2 The Owner shall provide the lands upon which the Work under this contract 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.
- 5.3 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.

ARTICLE 6 - CHANGES IN THE WORK

- 6.1 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 change order, or a work directive change. 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).
- 6.2 Contractor shall not be entitled to an increase in the contract price or an extension of the contract time with respect to any Work performed that is not required by the contract documents as amended, modified and supplemented.
- 6.3 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.
- 6.4 At any time Engineer may request a quotation from Contractor for a proposed change in the Work and within twenty-one (21) calendar days after receipt, Contractor shall submit a written and detailed proposal for an increase or decrease in the contract price or contract time for the proposed change. Engineer shall have 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 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.

ARTICLE 7 - CHANGE OF CONTRACT PRICE

- 7.1 The contract price 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 his expense without change in the contract price.
- 7.2 The contract price may only be changed by change order or by a written amendment. Any claim for an increase or decrease in the contract price 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 ten (10) days from the beginning of such occurrence and shall be accompanied by claimant's written statement that the amount claimed covers all known amounts (direct, indirect and consequential) to which the claimant is entitled as a result of the occurrence of said event.

7.3 The value of any Work covered by a change order or of any claim for an increase or decrease in the contract price shall be determined in one of the following ways (at Owner's discretion):

- 7.3.1 Where the Work involved is covered by unit prices contained in the contract documents, cost will be determined by application of such unit prices to the quantities of the items involved.
- 7.3.2 By mutual acceptance of lump sum.
- 7.3.3 On the basis of the cost of the Work plus Contractor's fee of not to exceed 15% for overhead and profit. (Contractor shall submit an itemized cost breakdown together with supporting data.)

7.4 Either Owner or Contractor may make a claim for an adjustment in the contract price. The unit price of an item of unit price Work shall be subject to re-evaluation and adjustment under the following conditions:

- 7.4.1 If the total cost of a particular item of unit price Work amounts to 5% or more of the contract price 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
- 7.4.2 If there is no corresponding adjustment with respect to any other item of Work; and
- 7.4.3 If a Contractor believes that it has incurred additional expense as a result thereof; or
- 7.4.4 If Owner believes that the quantity variation entitles it to an adjustment in the unit price; or
- 7.4.5 If the parties are unable to agree as to the effect of any such variations in the quantity of unit price Work performed.

ARTICLE 8 - CHANGE OF CONTRACT TIME

8.1 Contract time may only be changed by a change order or a written amendment. 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 as a result of the occurrence of said event.

- 8.2 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.
- 8.3 All time limits stated in the contract documents are of the essence.

ARTICLE 9 - WARRANTY, TEST/INSPECTION, CORRECTION

- 9.1 Contractor warrants (for a minimum period of three years or as otherwise stated herein) and guarantees to Owner that all work will be in accordance with the contract documents and will not be defective; that Owner, representatives of Owner, governmental agencies with jurisdictional interests will have access to the work at reasonable time for their observation, inspecting and testing (Contractor shall give 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).
- 9.2 If any work (including work of others) that is to be inspected, tested, or approved is covered without written concurrence of Engineer, it must, if requested by Engineer, be uncovered for observation. Such uncovering shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice. Neither observations by 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.
- 9.3 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 engineers, architects, 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 schedule and shall not be entitled to an extension of the contract time and the recovery of delay damages due to correcting or removing defective work.
 - 9.3.1 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, indirect and consequential costs of Owner in exercising such rights and remedies will be charged against Contractor in an amount approved as to reasonableness by Engineer and a change order will be issued incorporating the necessary revisions.

9.3.2 If within one year after the date of completion 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.

ARTICLE 10 - SUSPENSION/TERMINATION OF WORK

10.1 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 price or an extension of the contract time, or both, directly attributable to any suspension if Contractor makes an approved claim therefore.

10.2 Owner may terminate the contract if Contractor commences a voluntary case under any chapter of the Bankruptcy Code or any similar action by filing a petition under any other federal or state law relating to the bankruptcy or insolvency; if a petition is filed against the Contractor under any chapter of the Bankruptcy Code or similar relief under any other federal or state law; if Contractor persistently fails to perform the work in accordance with the contract documents; if Contractor disregards laws or regulations of any public body having jurisdiction or the Engineer; or otherwise violates in any substantial way any provisions of the contract.

10.2.1 Owner may, after giving Contractor (and the surety, if there is one) seven (7) days written notice and to the extent permitted by laws and regulations, terminate the services of Contractor; exclude Contractor from the site and take possession of the work and of all Contractor's tools, construction equipment and machinery at the 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 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 price, Contractor shall pay the difference to Owner. Such costs incurred by Owner shall be verified by Owner and incorporated in a change order; but in finishing the work, Owner shall not be required to obtain the lowest figure for the work performed. Contractor's obligations to pay the difference between such costs and such unpaid balance shall survive termination of the Agreement.

10.3 If, through no act or fault of Contractor, the work is suspended for a period of more than ninety (90) days by Owner or under an order of court or other public authority, or Engineer fails to act on any application or fails to pay Contractor any sum finally determined to be due; then Contractor may, upon seven (7) 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 Engineer has failed to act on any application of payment or Owner has failed to make any payment as aforesaid, Contractor may upon seven (7) days written notice to Owner stop the work until payment of all amounts then due.

ARTICLE 11 - CONTRACT CLAIMS

11.1 The rendering of a decision by Engineer 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 exercised 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. No action, either at law or at equity, shall be brought in connection with any such claim, dispute or other matter later than thirty (30) days after the date on which Owner/Engineer has rendered such written decision in respect thereof. Failure to bring an action within said thirty (30) day period shall result in Engineer's decision being final and binding on the Contractor. In no event may any such action be brought after the time at which instituting such proceedings would be otherwise barred by the applicable statute of limitations.

11.2 Before bringing any action in court pertaining to any claim, dispute or other matter in question(s) arising out of or relating to the contract documents or the breach thereof, or Engineer's final decision, except for claims which have been waived by the making and acceptance of final payment, the Contractor shall first submit written notice(s) of contract claims to the Purchasing Official for a decision within the earlier of sixty (60) days after the last date on which the contractor provided any goods or services required by the contract or after the date on which the contractor knew or should have known such a claim existed. The Manatee County Code of Law section 2-26-63 Contract Claims details the requirements and process for such a claim.

ARTICLE 12 - RESIDENT PROJECT REPRESENTATIVE - DUTIES, RESPONSIBILITIES

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

12.2 Resident Project Representative will:

- 12.2.1 Review the progress schedule, schedule of shop drawing submissions and schedule of values prepared by Contractor and consult with Owner/Engineer concerning their acceptability.
- 12.2.2 Attend preconstruction conferences. Arrange a schedule of progress meetings and other job conferences as required in consultation with Owner/Engineer and notify those expected to attend in advance. Attend meetings and maintain and circulate copies of minutes thereof.
- 12.2.3 Serve as Owner/Engineer's liaison with Contractor, working principally through Contractor's superintendent and assist him in understanding the intent of the contract documents. As requested by Owner/Engineer, assist in obtaining additional details or information when required at the job site for proper execution of the Work.
- 12.2.4 Receive and record date of receipt of shop drawings and samples, receive samples which are furnished at the site by Contractor and notify Owner/Engineer of their availability for examination.
- 12.2.5 Advise Owner/Engineer and Contractor or his superintendent immediately of the commencement of any work requiring a shop drawing or sample submission if the submission has not been approved by the Owner/Engineer.
- 12.2.6 Conduct on-site observations of the work in progress to assist Owner/Engineer in determining if the work is proceeding in accordance with the contract documents and that completed work will conform to the contract documents.
- 12.2.7 Report to Owner/Engineer whenever he believes that any work is unsatisfactory, faulty or defective or does not conform to the contract documents, or does not meet the requirements of any inspections, tests or approvals required or if work has been damaged prior to final payment; and advise Owner/Engineer when he believes work should be corrected or rejected or should be uncovered for observation or requires special testing, inspection or approval.

- 12.2.8 Verify that tests, equipment and system start-ups and operating and maintenance instructions are conducted as required by the contract documents and in the presence of the required personnel, and that Contractor maintains adequate records thereof; observe, record and report to Engineer appropriate details relative to the test procedures and start-ups.
- 12.2.9 Accompany visiting inspectors representing public or other agencies having jurisdiction over the project, record the outcome of these inspections and report to Owner/Engineer.
- 12.2.10 Transmit to Contractor, Owner/Engineer's clarifications and interpretations of the contract documents.
- 12.2.11 Consider and evaluate Contractor's suggestions or modifications in drawings or technical specifications and report them with recommendations to Owner/Engineer.
- 12.2.12 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 subsequent to the execution of the contract, Owner/Engineer's clarifications and interpretations of the contract documents, progress reports and other project related documents.
- 12.2.13 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. Send copies to Owner/Engineer.
- 12.2.14 Record names, addresses and telephone numbers of all Contractors, subcontractors and major suppliers of materials and equipment.
- 12.2.15 Furnish Owner/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.
- 12.2.16 Consult with Owner/Engineer in advance of scheduling major tests, inspections or start of important phases of the work.
- 12.2.17 Report immediately the occurrence of any accident.
- 12.2.18 Review applications for payment with Contractor for compliance with the established procedure for their submission and forward them with recommendations to Owner/Engineer, noting particularly their relation to

the schedule of values, work completed and materials and equipment delivered at the site but not incorporated in the work.

- 12.2.19 During the course of the work, verify that certificates, maintenance and operations manuals and other data required to be assembled and furnished by Contractor are applicable to the items actually installed, and deliver this material to Owner/Engineer for his review prior to final acceptance of the work.
- 12.2.20 Before Owner/Engineer issues a Certificate of Substantial Completion, submit to Contractor a list of observed items requiring completion or correction.
- 12.2.21 Conduct final inspection in the company of Owner/Engineer and Contractor and prepare a final list of items to be completed or corrected.
- 12.2.22 Verify that all items on final list have been completed or corrected and make recommendations to Owner/Engineer concerning acceptance.

12.3 Except upon written instructions of Owner/Engineer, Resident Project Representative:

- 12.3.1 Shall not authorize any deviation from the contract documents or approve any substitute materials or equipment;
- 12.3.2 Shall not exceed limitations on Owner/Engineer's authority as set forth in the contract documents;
- 12.3.3 Shall not undertake any of the responsibilities of Contractor, Subcontractors or Contractor's Superintendent, or expedite the work;
- 12.3.4 Shall not 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;
- 12.3.5 Shall not advise on or issue directions as to safety precautions and programs in connection with the work;
- 12.3.6 Shall not authorize Owner to occupy the project in whole or in part; and
- 12.3.7 Shall not participate in specialized field or laboratory tests.

NOTE: The form of all submittals, notices, change orders and other documents permitted or required to be used or transmitted under the Contract shall be determined by the County.

END OF SECTION

**MANATEE COUNTY
SOUTHWEST WATER RECLAMATION FACILITY
CLARIFIER 1 AND 2 REHABILITATION
MANATEE COUNTY PROJECT # 6078980**

Technical Specifications

Prepared For:



**MANATEE COUNTY
PUBLIC WORKS DEPARTMENT**

July 2011

Prepared By:



**MANATEE COUNTY
SOUTHWEST WATER RECLAMATION FACILITY
CLARIFIER 1 AND 2 REHABILITATION
MANATEE COUNTY PROJECT # 6078980**

Technical Specifications

Prepared For:



**MANATEE COUNTY
PUBLIC WORKS DEPARTMENT**

July 2011

GENERAL; CIVIL; MECHANICAL (PROCESS)

STATE OF
FLORIDA
PROFESSIONAL ENGINEER
Date



**MANATEE COUNTY
SOUTHWEST WATER RECLAMATION FACILITY
CLARIFIER 1 AND 2 REHABILITATION
MANATEE COUNTY PROJECT # 6078980**

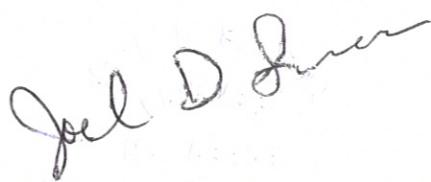
Technical Specifications

Prepared For:



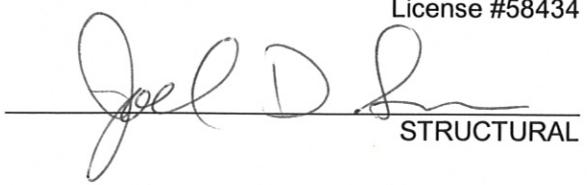
**MANATEE COUNTY
PUBLIC WORKS DEPARTMENT**

July 2011



7-14-11

Joel Smason, P.E.
License #58434



Joel D. Smason
STRUCTURAL

7-14-11

Date

**MANATEE COUNTY
SOUTHWEST WATER RECLAMATION FACILITY
CLARIFIER 1 AND 2 REHABILITATION
MANATEE COUNTY PROJECT # 6078980**

Technical Specifications

Prepared For:



**MANATEE COUNTY
PUBLIC WORKS DEPARTMENT**

July 2011

Mario Gamboa, P.E.
License #44675

A handwritten signature in black ink, appearing to read "Mario A. Gamboa".

ELECTRICAL; INSTRUMENTATION

7-13-11

Date

**MANATEE COUNTY
SOUTHWEST WATER RECLAMATION FACILITY
CLARIFIER 1 AND 2 REHABILITATION
MANATEE COUNTY PROJECT # 6078980
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SECTION 01005

GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE AND INTENT

- A. Description
 - 1. 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
 - 1. 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 FDEP permits. 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 Engineer, 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 costs incidental thereto. He shall repair or restore all structures and property that may be damaged or disturbed during performance of the work.
 - 2. 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 therefore.
 - 3. The Contractor shall provide and maintain such modern plant, tools, and equipment as may be necessary, in the opinion of the Engineer, to perform in a satisfactory and acceptable manner all the work required by this Contract. Only equipment of established reputation and proven efficiency shall be used. The Contractor shall be solely responsible for the adequacy of his workmanship, materials and equipment, prior approval of the Engineer notwithstanding.
- C. Public Utility Installations and Structures
 - 1. 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 whether owned or controlled by the Owner, other governmental bodies or privately owned by individuals, firms or corporations, used to serve the public with transportation, traffic control, gas, electricity, telephone, sewage, drainage, water or other public or private property which may be affected by the work shall be deemed included hereunder.
 - 2. The Contractor shall protect all public utility 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 Engineer. The Contractor shall so arrange his operations as to avoid any damage to these facilities. 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 Engineer. No separate payment shall be made for such protection or repairs to public utility installations or structures.

3. Public utility installations or structures owned or controlled by the Owner 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 therefore.
4. Where public utility installations or structures owned or controlled by the Owner 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 Engineer, 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 Engineer, 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.
5. The Contractor shall give written notice to Owner 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).
6. 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 Engineer.

1.02 PLANS AND SPECIFICATIONS

- A. Plans
 1. 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
 1. 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
 1. When, in the opinion of the Engineer, 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 Engineer and five paper prints thereof will be given to the Contractor.

D. Contractor to Check Plans and Data

1. The Contractor shall verify all dimensions, quantities and details shown on the Plans, Supplementary Drawings, Schedules, Specifications or other data received from the Engineer, 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 there from 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 Engineer, should such errors or omissions be discovered. All schedules are given for the convenience of the Engineer 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

1. 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

1. 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.
2. 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.
3. 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

1. The names of proposed manufacturers, material men, suppliers and dealers who are to furnish materials, fixtures, equipment, appliances or other fittings shall be submitted to the Engineer for approval. Such approval must be obtained before shop drawings will be checked. No manufacturer will be approved for any materials to be furnished under this Contract unless he shall be of good reputation and have a plant of ample capacity. He shall, upon the request of the Engineer, be required to submit evidence that he has manufactured a similar product to the one specified and that it has been previously used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.

2. All transactions with the manufacturers or subcontractors shall be through the Contractor, unless the Contractor shall request, in writing to the Engineer, that the manufacturer or subcontractor deal directly with the Engineer. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.
3. 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

1. 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

1. 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.
2. Spare parts shall be furnished as specified.
3. 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.

1. 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.
2. 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 Engineer 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.
3. 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 Engineer and made of ample size and strength for the purpose intended. Substantial templates and working drawings for installation shall be furnished.
4. The Contractor shall, at his own expense, 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.
5. 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.

E. Service of Manufacturer's Engineer

1. 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 Owner, such engineer or superintendent shall make all adjustments and tests required by the Engineer to prove that such equipment is in proper and satisfactory operating condition, and shall instruct such personnel as may be designated by the Owner in the proper operation and maintenance of such equipment.

1.04 INSPECTION AND TESTING

A. General

1. Inspection and testing of materials will be performed by the Owner unless otherwise specified.
2. 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 Engineer as a prerequisite for the acceptance of any material or equipment.
3. If, in the making of any test of any material or equipment, it is ascertained by the Engineer 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 Owner.
4. 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.
5. 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 Owner formally takes over the operation thereof.

B. Costs

1. All inspection and testing of materials furnished under this Contract will be performed by the Owner or duly authorized inspection engineers or inspections bureaus without cost to the Contractor, unless otherwise expressly specified.
2. 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.
3. Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the Owner for compliance. The Contractor shall reimburse the Owner for the expenditures incurred in making such tests on materials and equipment which are rejected for non-compliance.

C. Inspections of Materials

1. The Contractor shall give notice in writing to the Engineer, 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 Engineer 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

1. When inspection is waived or when the Engineer 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

1. 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 Engineer notifies the Contractor, in writing, that the results of such tests are acceptable.
2. Five copies of the manufacturer's actual test data and interpreted results thereof, accompanied by a certificate of authenticity sworn to by a responsible official of the manufacturing company, shall be forwarded to the Engineer for approval.
3. 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

1. 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

1. 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.
2. 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 Owner. The Supplier shall assist in the final field tests as applicable.

H. Failure of Tests

1. 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 Engineer 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 Owner, 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.
2. In case the Owner 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 Owner 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

1. 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 Engineer 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

1. 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 Engineer, provide a suitable temporary fence which shall be maintained until the permanent fence is replaced. The Engineer 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

1. 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

1. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Plans, or as given by the Owner/Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

B. Safeguarding Marks

1. 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 to removing without authorization such established points, stakes and marks.
2. 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

1. All elevations indicated or specified refer to the Mean Sea Level Datum of the NGVD 1929 Datum and/or NAVD 1988.

1.08 ADJACENT STRUCTURES AND LANDSCAPING

A. Responsibility

1. 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 Engineer, additional work is deemed necessary to avoid interference with the work, payment therefore will be made as provided for in the General Conditions.
2. 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.
3. 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 Owner and to the satisfaction of the Engineer. This does not preclude conforming to the requirements of the insurance underwriters. Copies of surveys, photographs, reports, etc., shall be given to the Engineer.
4. Prior to the beginning of any excavations, the Contractor shall advise the Engineer 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 Owner may order the Contractor, for the convenience of the Owner, to remove trees along the line or trench excavation. If so ordered, the Owner 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

1. 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 in the manner described in the Workmanship and Materials Paragraph in Section 02485, Seeding & Sodding.

D. Restoration of Fences

1. 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 Engineer. 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

1. 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

1. A strict compliance with ordinances regulating the production and emission of smoke will be required. No open fires will be permitted.

C. Noise

1. 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.
2. Except in the event of an emergency, no work shall be done between the hours of 7:00 P.M. and 7:00 A.M., or on weekends. If the proper and efficient prosecution of the work requires operations during the night or weekends, the

written permission of the Owner shall be obtained before starting such items of the work.

D. Access to Public Services

1. 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

1. 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

- A. 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 Engineer 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

1. 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 Engineer, such material, debris, or rubbish constitutes a nuisance or is objectionable.
2. The Contractor shall remove from the site all of his surplus materials and temporary structures when no further need therefore develops.

B. Final Cleaning

1. 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.
2. 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 Engineer which results from his construction operations.

B. Protection of Wetland Areas

1. 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

1. 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

1. 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. The work included in this contract consists of the following:
 - 1. Demolition of existing clarifier mechanisms and effluent launders in Clarifiers 1 & 2.
 - 2. Construction of new mechanisms and concrete effluent launders for Clarifiers 1 & 2.
 - 3. New metal canopy addition to the existing RAS/WAS pump station.
 - 4. New electrical service to Clarifiers 1 & 2 and the existing scum pump station.
 - 5. New VFD for existing RAS Pump 2.
- 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 Owner.
- 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

- A. Construct all the Work under a single contract.

1.03 WORK SEQUENCE

- A. Clarifier Shutdown:
 - 1. Only one clarifier can be out of service for rehabilitation at a time.
 - 2. Contractor shall complete all work on one clarifier before beginning construction on the second clarifier. All work on the first clarifier, including replacement of the perimeter walkway, startup and testing, shall be completed prior to beginning work on the second clarifier.
 - 3. Coordinate with plant staff on sequence of clarifier shutdown requirements.
- B. 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.
- C. The Contractor shall, if necessary and feasible, construct the work in stages to accommodate the Owner's use of the premises during the construction period;

coordinate the construction schedule and operations with the Owner's Representative.

- D. 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. Owner's Use.
 3. Public Use.
- B. Coordinate use of work site under direction of Engineer or Owner'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 Owner or separate contractor.
- E. Obtain and pay for the use of additional storage of work areas needed for Contractor operations.

1.05 OWNER 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 Owner, 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 Owner 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 Owner has the option of not accepting the entire work as a whole until it is completed, tested and approved by the Engineer and Owner.

1.06 PARTIAL OWNER OCCUPANCY

- A. The Contractor shall schedule his operations for completion of portions of the Work, as designated, for the Owner's occupancy prior to substantial completion of the entire work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01015

CONTROL OF WORK

PART 1 GENERAL

1.01 WORK PROGRESS

- A. 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 Engineer 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 Engineer 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

- A. The Contractor shall not enter or occupy private land outside of easements, except by permission of the affected property owner.

1.03 WORK LOCATIONS

- A. Work shall be located substantially as indicated on the drawings, but the Engineer 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 Engineer 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 Engineer 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 Engineer 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 Engineer, permanent relocation of a utility owned by the Owner is required, he 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 Owner will notify the utility to perform the work as expeditiously as possible. The Contractor shall fully cooperate with the Owner 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

- A. 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 Engineer.
- 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 Engineer 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 Engineer. 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 Engineer.
- 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 Engineer and Owner.
- C. Detours around construction areas will be subject to the approval of the Owner and the Engineer. Where detours are permitted, the contractor shall provide all necessary barricades and signs as required to divert the flow of traffic. While traffic

is detoured, the Contractor shall expedite construction operations and periods when traffic is being detoured, will be strictly controlled by the Owner.

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

- A. 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 Engineer and Owner well in advance of the interruption of any flow.

1.12 CLEANUP

- A. 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 Engineer.

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 Engineer. 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 Engineer. 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 Owner.

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

- A. Upon notice of award, the Contractor shall immediately apply for all applicable permits not previously obtained by the Owner 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 Engineer. The costs for obtaining all permits shall be borne by the Contractor.

1.02 CONNECTIONS TO EXISTING SYSTEM

- A. The Contractor shall perform all work necessary to locate, excavate and prepare for connections to the terminus of the existing systems all as shown on the Drawings or where directed by the Owner/Engineer. The cost for this work and for the actual connection to the existing systems shall be included in the price bid for the project and shall not result in any additional cost to the Owner. The termination point for each contract shall be as shown on the Contract Drawings.

1.03 RELOCATIONS

- A. 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 Engineer.

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 water, sewer, gas, telephone, electrical, or other 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. Cost for relocation of all existing lines shall be included in the price bid for the project. Should damage occur to an existing line, the Contractor shall bear the cost of all repairs.
- 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 of any such excavation by the Contractor.
- 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 Engineer of the location of the pipeline or utility and shall reroute or relocate the pipeline or utility as directed. Cost for relocation of existing pipelines or utilities shall be included in the price bid for the project.
- 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 Engineer and/or the owner of the utility.
- 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 Engineer 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

- A. 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 Engineer and Owner a Hurricane Preparedness Plan. The plan should outline the necessary measures which the Contractor proposes to perform at no additional cost to the Owner in case of a hurricane warning.
- B. In the event of inclement weather, or whenever Engineer 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 Engineer, 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

- A. Electricity as may be required for construction and permanent power supply shall be secured and purchased by the Contractor.

1.08 SALVAGE

- A. 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 Engineer or Owner and if so

shall be protected for a reasonable time until picked up by the Owner. Any equipment or material not worthy of salvaging, as directed by the Engineer, 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 Engineer, in writing, at least (ten) 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 Owner'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 Engineer.

1.11 CONSTRUCTION CONDITIONS

- A. 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 Engineer or County for excessive noise shall not relieve the Contractor of the other portions of this specification including, but not limited to contract time and contract price.
- 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 Owner 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 Owner.
- 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 (3) year warranty commencing at the time of Owner 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 (4) year warranty shall not relieve the Contractor of the three (3) year warranty starting at the time of Owner 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 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

- A. 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 Engineer. Do not proceed with work until Engineer 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. All survey work required in execution of Project.
 - 2. All costs of construction layout shall be included in the unit and lump sum prices contained in the respective divisions of the Contract Bid Form.
 - 3. Civil, structural or other professional engineering services specified or required to execute Contractor's construction methods.

1.02 QUALIFICATION OF SURVEYOR AND ENGINEER

- A. All construction staking shall be conducted by or under the supervision of a Florida Registered Professional Surveyor and Mapper approved by the Owner. The Contractor shall be responsible for the layout of all such lines and grades, which will be subject to verification by the Engineer.

1.03 SURVEY REFERENCE POINTS

- A. 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.
- B. Make no changes or relocations without prior written notice to Engineer.
- C. Report to Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- D. Require surveyor to replace project control points which may be lost or destroyed.
- E. Establish replacements based on original survey control.

1.04 PROJECT SURVEY REQUIREMENTS

- A. The Contractor shall establish temporary bench marks as needed, referenced to data established by survey control points.

1.05 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.

- 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 per Section 01720.

1.06 SUBMITTALS

- A. Submit name and address of Professional Surveyor and Mapper to Engineer for Owner's approval.
- B. Submit certificate signed by the Professional Surveyor and Mapper certifying that elevations and locations of improvements are in conformance, or nonconformance, with Contract Documents.

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 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 General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) Washington Navy Yard, Bldg. 197 Washington, DC 20407
MCUOD	Manatee County Utility Operations Department 4410 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
NEMA	National 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 24th 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

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

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SECTION 01150

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SCOPE

- A. The scope of this section of the Contract Documents is to further define the items included in each Bid Item in the Bid Form section of the Contract Documents. Payment will be made based on the specified items included in the description in this section for each bid item.
- B. 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 Owner/Engineer 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 MEASUREMENT STANDARDS

- A. Unless otherwise specified for the particular items involved, all measurements of distance shall be taken horizontally or vertically.

1.05 AREA MEASUREMENTS

- A. In the measurement of items to be paid for based on area of finished work, the lengths, and/or widths to be used in the calculations shall be the final dimensions measured along the surface of the completed work within the neat lines shown or designated.

1.06 LUMP SUM ITEMS

- 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 breakdown of the lump sum totals.

1.07 UNIT PRICE ITEM

- A. Separate payment will be made for the items of work described herein and listed on the Bid Form. Any related work not specifically listed, but required for satisfactory completion of the work shall be considered to be included in the scope of the appropriate listed work items.
- B. 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 Owner until as-built (record) drawings have been submitted and approved by the Engineer.
 - 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.

BID ITEM NO. 1- MOBILIZATION/DEMOBILIZATION

Measurement and payment for this Bid Item shall include full compensation for the required 100 percent (100%) Performance Bond, 100 Percent (100%) Payment Bond, all required insurance for the project and the Contractor's mobilization and demobilization costs as shown in the Bid Form.

Payment for mobilization shall not exceed 10 percent (10%) of the total Contract cost unless the Contractor can prove to the Owner that his actual mobilization cost exceeds 10 percent (10%).

BID ITEM NO 2 - MISCELLANEOUS WORK AND CLEANUP

Payment for all work included under this Bid Item shall be made at the Contract lump sum price bid listed in the Bid Form and shall represent full compensation for all labor, materials and equipment required to perform all the work as shown on the Contract Drawings and specified herein and any other miscellaneous work not specifically included for payment under other Bid Items obviously necessary to complete the Contract. Partial payments will be based on the breakdown of the Bid Item in accordance with the Schedule of Values submitted by the

Contractor and approved by the Engineer. Payment shall also include full compensation for project photographs, as-builts record drawings, project signs, traffic control, rubbish and spoil removal, repair, replacement or relocation of all related items and any and all other items required to complete the project in accordance with Contract Documents.

BID ITEM NO 3 - CLARIFIERS

Payment for all work included under this Bid Item shall represent full compensation in accordance with the lump sum price bid for the removal and replacement of existing walkway around clarifiers perimeter; demolition and replacement of the clarifier mechanisms; applying coating to clarifier tanks; construction of new concrete launders; installation of new clarifier mechanisms; installation of new baffles and weirs; and installation of miscellaneous piping and valves and all other materials and equipment necessary for a complete and fully operable system, including testing and start-up, all as shown on the Contract Drawings and/or called for in the Contract Specifications, ready for approval by the Engineer and acceptance by the Owner.

Measurement for periodic payments of this lump sum bid item will be in accordance with the approved Schedule of Values, to be supplied by the Contractor in accordance with the Contract Documents.

BID ITEM NO 4 – ELECTRICAL AND INSTRUMENTATION

Payment for all work included under this Bid Item shall represent full compensation in accordance with the lump sum price bid for the Electrical and Instrumentation work including new conduit and wiring; panels; variable frequency drive; and lighting and all other materials and equipment necessary for a complete and fully operable system, including testing and start-up, all as shown on the Contract Drawings and/or called for in the Contract Specifications, ready for approval by the Engineer and acceptance by the Owner.

Measurement for periodic payments of this lump sum bid item will be in accordance with the approved Schedule of Values, to be supplied by the Contractor in accordance with the Contract Documents.

BID ITEM NO. 5 – GROUT FOR CLARIFIER FLOOR REPAIR

Payment for all work under this Bid Item shall be made at the applicable Contract unit price bid per square foot of grout as shown on the Bid Form for furnishing, placing and installing the miscellaneous grout, measured in place. Any grout installed for replacing defective work or damaged caused by the Contractor shall be at the expense of the Contractor. Grout specifically included under any other Bid Item will not be measured or paid for under this Bid Item.

Measurement for grout shall be per actual square foot of grout furnished, placed, and installed as shown on the Contract Drawings or as ordered by the Engineer in writing. For payment purposes, depth of grout shall be assumed to be a uniform 2-inch over the measured square foot of grout furnished. Payment shall represent full compensation for all labor, materials, and equipment for mixing, placing, forming, and curing of the grout and all incidentals necessary to complete the grout work, ready for approval and acceptance by the Engineer/Owner. Measurement shall be based on the smallest rectangular area that encompasses the damaged region.

BID ITEM NO. 6 – CLARIFIER CONCRETE REPAIR

Payment for all work under this Bid Item shall be made at the applicable Contract unit price bid per square foot of concrete as shown on the Bid Form for furnishing, placing and installing the miscellaneous concrete or repair material, measured in place. Any concrete or repair material

installed for replacing defective work or damaged caused by the Contractor shall be at the expense of the Contractor. Concrete specifically included under any other Bid Item will not be measured or paid for under this Bid Item.

Measurement for miscellaneous concrete shall be per actual square foot of concrete or repair material installed to an average depth of 3 inches, as shown on the Contract Drawings or as ordered by the Engineer in writing. Payment shall represent full compensation for all labor, materials, and equipment for mixing, placing, forming, and curing of the concrete and all incidentals necessary to complete the concrete work, ready for approval and acceptance by the Engineer/Owner.

BID ITEM NO. 7 – EPOXY INJECTION FOR CONCRETE CRACK REPAIR

Payment for all work under this Bid Item shall be made at the applicable Contract unit price bid per linear foot of concrete crack repair as shown on the Bid Form for furnishing and injection of the installing the miscellaneous concrete, measured in place. Any crack repair necessary for replacing defective work or damaged caused by the Contractor shall be at the expense of the Contractor. Epoxy injection specifically included under any other Bid Item will not be measured or paid for under this Bid Item.

Measurement for the epoxy injection shall be per actual linear foot of crack repaired as shown on the Contract Drawings or as ordered by the Engineer in writing. For payment purposes, depth of crack shall be assumed to be a uniform 2-inch over the measured linear foot of crack repaired. Payment shall represent full compensation for all labor, materials, and equipment for mixing and injection of the epoxy, and all incidentals necessary to complete the concrete work, ready for approval and acceptance by the Engineer/Owner.

BID ITEM NO. 8 - DISCRETIONARY WORK

Payment for all work under this Bid Item and listed in the Bid Form shall be made only at the Owner's discretion in order to satisfactorily complete the project in accordance with the Plans and Specifications.

PART 2 PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01152

REQUESTS FOR PAYMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. 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 Owner and Contractor.

1.02 FORMAT AND DATA REQUIRED

- A. Submit payment requests in the form provided by the Owner 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 Owner or the Engineer 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

- A. 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: Major change in contract scope or time that must be approved by the Board.
- 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 Change: Change to contract quantity that does not require a change of scope or time extension.

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 Engineer 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.
- C. The Board of County Commissioners executes all Change Orders.

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 DIRECTIVE CHANGE

- A. In lieu of a Change Order, the Project Manager may issue a Field Directive change for the Contractor to proceed with additional work within the original intent of the Project.
- B. Field Directive change 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 Directive change 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 Engineer/Owner 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, plus additional information.
 1. Name of the Owner's authorized agent who ordered the work and date of the order.
 2. Date and time the 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 Owner, 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 Owner for approval. The Owner 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. Owner's definition of the scope of the required changes.
 2. Contractor's Proposal for a change, as approved by the Owner.
 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 Owner and Contractor.

1.09 TIME AND MATERIAL/FORCE ACCOUNT CHANGE ORDER/CONSTRUCTION CHANGE AUTHORIZATION

- A. At completion of the change, Contractor shall submit itemized accounting and supporting data as provided in the Article "Documentation of Proposals and Claims" of this Section.
- B. Engineer will determine the allowable cost of such work, as provided in General Conditions and Supplementary Conditions.
- C. Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time.
- D. Owner and Contractor will sign and date the Change Order to indicate their agreement therewith.

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 Owner or Engineer 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. Owner's Engineer.
 - 2. Owner'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. Owner'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 01310

CONSTRUCTION SCHEDULE & PROJECT RESTRAINTS

PART 1 GENERAL

1.01 GENERAL

- A. Construction under this contract must be coordinated with the Owner 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 Owner. 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 Owner. Such permission, however, may be revoked at any time by the Owner 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 insure 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.

1.03 PROGRESS OF THE WORK

- A. The work shall be executed with such progress as may be required to prevent any delay to the general completion of the work. The work shall be executed at such times and in or on such parts of the project and with such forces, materials and equipment to assure completion of the work in the time established by the Contract and in the manner set forth in the Contract.

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 Engineer to review Contractor's planning, scheduling, management and execution of the work; to assist Engineer 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 Owner 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 Engineer to review all submittals as set forth in the Contract Documents; items of work required of Owner 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 Owner.
- 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 Engineer, 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 Engineer. 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 Engineer 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 three copies of 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 Owner, 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 monthly progress schedules with each month's application for payment.
- G. Contractor shall submit three monthly status reports which will be retained by the Owner and Engineer.

2.06 MONTHLY STATUS REPORTS

- A. Contractor shall submit three copies of 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 Engineer and Contractor at a monthly schedule meeting and Contractor will address Engineer'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 Engineer 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. Engineer shall have 10 calendar days after receipt of the submittal to respond. Upon receipt of Engineer's comments, Contractor shall make the necessary revisions and submit the revised schedule within 10 calendar days. The resubmittal, if concurred with by Owner, 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 by Engineer and concurrence by Owner. 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 Engineer.

PART 3 EXECUTION (NOT USED)

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SECTION 01340

SHOP DRAWINGS, PROJECT DATA AND SAMPLES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. The Contractor shall submit to the Engineer 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. Within thirty (30) calendar days after the effective date of the Agreement, the Contractor shall submit to the Engineer, a complete list of preliminary data on items for which Shop Drawings are to be submitted. Included in this list shall be the names of all proposed manufacturers furnishing specified items and the date on which each Shop Drawing shall be submitted. Review of this list by the Engineer shall in no way relieve the Contractor from submitting complete Shop Drawings and providing materials, equipment, etc., fully in accordance with the Specifications. This procedure is required in order to expedite final review of Shop Drawings.
- C. The Contractor is to maintain an accurate updated submittal log and will bring this log to each scheduled progress meeting with the Owner and the Engineer. This log should include the following items:
 1. Submittal description and number assigned.
 2. Date to Engineer.
 3. Date returned to Contractor (from Engineer).
 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.

1.02 CONTRACTOR'S RESPONSIBILITY

- A. It is the duty of the Contractor to check all drawings, data and samples prepared by or for him before submitting them to the Engineer 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 Engineer 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.

- B. 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.
- C. The Contractor shall furnish the Engineer 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.
- D. 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 Engineer, with No Exceptions Taken or Approved As Noted.
- E. The Contractor shall submit to the Engineer 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 Engineer receives them.
- F. The Contractor shall submit five (5) copies of descriptive or product data submittals to complement shop drawings for the Engineer plus the additional copies if the Contractor requires more than 1 being returned. The Engineer shall retain four (4) sets.
- G. 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 Engineer of the necessary Shop Drawings.

1.03 ENGINEER'S REVIEW OF SHOP DRAWINGS AND WORKING DRAWINGS

- A. The Engineer'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 Engineer, 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 Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting any exception.

- D. When reviewed by the Engineer, 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 Engineer on previous submissions. The Contractor shall make any corrections required by the Engineer.
- 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 Engineer.
- G. The Engineer shall review a submittal/resubmittal a maximum of two (2) times after which cost of review shall be borne by the Contractor. The cost of engineering shall be equal to the Engineer's actual payroll cost.
- H. When the Shop and Working Drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.
- I. No partial submittals shall be reviewed. Incomplete submittals shall be returned to the Contractor and shall be considered not approved until resubmitted.

1.04 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 Engineer 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 Engineer 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 Engineer will utilize the color "red" in marking shop drawing submittals.

1.05 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 Engineer where required by the Contract Documents or requested by the Engineer and shall be submitted at least thirty (30) days (unless otherwise specified by the Engineer) 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 Engineer, 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 Owner and Engineer shall not have responsibility therefore.

1.06 SAMPLES

- A. The Contractor shall furnish, for the review of the Engineer, samples required by the Contract Documents or requested by the Engineer. Samples shall be delivered to the Engineer 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 Engineer.
- 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 Engineer. 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 Engineer 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)

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SECTION 01370

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. The Contractor shall submit to the Engineer 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 Engineer, 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 Engineer 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 pipelines.
- 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)

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SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.01 REQUIREMENTS 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 so as to be easily understood.

1.03 PROJECT PHOTOGRAPHS

- A. Provide two prints 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 Owner and Engineer 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 Engineer 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 Engineer on DVD for the permanent and exclusive use of the Engineer 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 Engineer. In addition, no progress payments shall be made until the preconstruction video recordings are accepted by the Engineer.

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. Owner 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. Owner 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 Engineer may require the Contractor to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor and no extra charge to the Owner shall be allowed on account of such testing and certification.
- E. Furnish incidental labor and facilities:
 - 1. To provide access to work to be tested.
 - 2. To obtain and handle samples at the project site or at the source of the product to be tested.
 - 3. To facilitate inspections and tests.

4. For storage and curing of test samples.

F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.

1. When tests or inspections cannot be performed due to insufficient notice, Contractor shall reimburse Owner 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 Engineer.

H. If the test results indicate the material or equipment complies with the Contract Documents, the Owner 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 (NEC).
- 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 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. One painted sign, of not less than 32 square feet (3 square meters) area, with painted graphic content to include:
 1. Title of Project.
 2. Name of Owner.
 3. Names and titles of authorities as directed by Owner.
 4. Prime Contractor.
- B. Graphic design, style of lettering and colors: As approved by the Engineer and subject to approval of the Owner.
- C. Erect on the site at a lighted location of high public visibility, adjacent to main entrance to site, as approved by the Engineer and the Owner

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: Manatee County Project Management shall generate and the General Contractor shall 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 utility improvements and the reconstruction of ??? Boulevard from U.S. ??? to ??? Street West. The project is expected to begin in August, 200X and be completed in July 200X.

Location Map

WE HOPE TO KEEP ANY INCONVENIENCE TO A MINIMUM. HOWEVER, IF YOU HAVE ANY PROBLEMS, PLEASE CONTACT THE FOLLOWING:

A. Contractor	C. 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 (1) coat of primer and one (1) coat of exterior paint.
- B. Paint graphics in styles, size and colors selected.

3.02 MAINTENANCE

- A. The Contractor shall maintain signs and supports in a neat, clean condition; repair damages to structures, framing or sign.

3.03 REMOVAL

- A. The Contractor shall remove signs, framing, supports and foundations at completion of project.

END OF SECTION

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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 Engineer.
 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 (2) 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 (2) copies to Engineer. Maintain one (1) 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 Engineer 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

- A. 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 01614

WIND DESIGN CRITERIA GENERAL SUMMARY

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Wind design criteria.

1.02 SYSTEM DESCRIPTION

- A. Design requirements:

1. Building code criteria: Design for wind in accordance with 2007 Florida Building Code, local amendments, and errata.
2. Basic wind speed: 130 miles per hour.
3. Exposure category: C.
4. Topographic factor, K_{tz} : 1.0.
5. Wind importance factor, I_w : 1.15.
 - a. Use anchor bolts, bolts, or welded studs for anchors for resisting wind forces. Anchor bolts used to resist wind forces shall have a standard hex bolt head. Do not use anchor bolts fabricated from rod stock with an L or J shape:
 - 1) Do not use concrete anchors, sleeve anchors, flush shells, chemical anchors, powder actuated fasteners, or other types of anchor unless indicated on the Drawings or accepted in writing by the Engineer.
 - 2) Wind forces must be resisted by direct bearing on the anchors used to resist wind forces. Do not use connections which use friction to resist wind forces.

1.03 SUBMITTALS

- A. Shop drawings and calculations: Complete shop drawings and wind design calculations where required by Specifications.
- B. Calculations shall be signed and stamped by a Civil or Structural Engineer licensed in the state where the work will be installed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01620

STORAGE AND PROTECTION

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. 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 accordance 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 a 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 continuous basis.
 - 3. Surfaces of products exposed to elements are not adversely affected. Any weathering of products, coatings and finishes is not acceptable under the requirements of these Contract Documents.
- B. Mechanical and electrical equipment which require 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 Engineer. 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 (1) month prior to installation without written authorization from the Engineer.
 - 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 Engineer 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 insure 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 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. 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 Engineer and Owner 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 Engineer determines that the Work is not substantially complete:
 1. The Engineer 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 Engineer.
 3. The Engineer shall reinspect the Work.
- E. When the Engineer finds that the Work is substantially complete:
 1. He shall prepare and deliver to the Owner 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 Owner as provided in Conditions of the Contract. When the Engineer considers the Work substantially complete, he will execute and deliver to the Owner and the Contractor 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 Owner's representative and are operational.

5. The Work is completed and ready for final inspection.
- B. The Engineer shall make an inspection to verify the status of completion after receipt of such certification.
- C. If the Engineer determines that the Work is incomplete or defective:
 1. The Engineer 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 Engineer that the Work is complete.
 3. The Engineer shall reinspect the Work.
- D. Upon finding the Work to be acceptable under the Contract Documents, the Engineer 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 Owner for the Engineer's fees.

1.04 CONTRACTOR'S CLOSEOUT SUBMITTALS TO ENGINEER

- 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 Engineer.
- 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

- A. 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

- A. Execute cleaning during progress of the Work and at completion of the Work, as required by the General Conditions.

1.02 DISPOSAL REQUIREMENTS

- A. 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 Owner 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 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Contractor shall maintain at the site for the Owner one (1) record copy of:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Engineer's field orders or written instructions.
 - 6. Approved shop drawings, working drawings and samples.
 - 7. Field test records.
 - 8. Construction photographs.

1.02 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 Engineer.

1.03 MARKING DEVICES

- A. Provide felt tip marking pens for recording information in the color code designated by the Engineer.

1.04 RECORDING

- A. Label each document "PROJECT RECORD" in neat large printed letters.
- B. Record information concurrently with construction progress.
- C. Do not conceal any work until required information is recorded.
- D. 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 televiewing 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 (2) 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 Owner/Engineer.

E. Specifications and Addenda; Legibly mark each Section to record:

1. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed.
2. Changes made by field order or by change order.

F. Shop Drawings (after final review and approval):

1. Five (5) sets of record drawings for each process equipment, piping, electrical system and instrumentation system.

1.05 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 Engineer. 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 dated mylar drawings together with a recordable compact disk (CD-R).
- C. The CD-R shall contain media in AutoCad Version 12 or later, or in any other CAD program compatible with AutoCad in DWG or DXF form. All fonts, line types, shape files 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 2 STANDARDS

2.01 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 Engineer.
- B. Drawings shall meet the criteria of paragraph 1.04 D above.

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01730

OPERATING AND MAINTENANCE DATA

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under Contract.
- B. Prepare operating and maintenance data as specified in this and as referenced in other pertinent sections of Specifications.
- C. Instruct Owner's personnel in maintenance of products and equipment and systems.
- D. 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 Owner'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 (3) 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 manufacturer'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 Owner's personnel.
- D. Prepare and include additional data when the need for such data becomes apparent during instruction on Owner's personnel.
- E. Additional requirements for operating and maintenance data: Respective sections of Specifications.

1.04 SUBMITTAL SCHEDULE

- A. Submit one (1) copy of completed data in final form fifteen (15) days prior to substantial completion.
 1. Copy will be returned after substantial completion, with comments (if any).
- B. Submit two (2) 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 OWNER'S PERSONNEL

- A. Prior to final inspection or acceptance, fully instruct Owner'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

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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 Engineer for review and transmittal to Owner.

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 (2) 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 Owner'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 (10) 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 (10) 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 Owner 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 02064

MODIFICATIONS TO EXISTING STRUCTURES, PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. 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 (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall cut, repair, reuse, excavate, demolish or otherwise remove parts of the existing structures or appurtenances, as indicated on the Contract Drawings, herein specified, or necessary to permit completion of the Work under this Contract. The Contractor shall 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. The Contractor shall dismantle and remove all existing equipment, piping, and other appurtenances required for the completion of the Work. Where called for or required, the contractor shall cut existing pipelines for the purpose of making connections thereto. Anchor bolts for equipment and structural steel removed shall be cut off one inch below the concrete surface. Surface shall be finished as specified in the Contract Documents.
- C. 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 anchorage, if required, is part of the installation shall also be installed as directed by the Engineer.
- D. No existing structure, equipment, or appurtenance shall be shifted, cut, removed, or otherwise altered except with the express approval of and to the extent approved by the Engineer.
- E. When removing materials or portions of existing utility pipelines and/or structures or when making openings in walls and partitions, the Contractor shall 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 permitted, line drilling will be required in cutting existing concrete.

- F. Materials and equipment removed in the course of making alterations and additions shall remain the property of the Owner, except that items not salvageable, as determined by the Engineer and the Owner, shall become the property of the Contractor to be disposed of by him off the Work site at his own place of disposal. Operating equipment shall be thoroughly cleaned, lubricated, and greased for protection during prolonged storage.
- G. 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. So far as possible 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 delay.
- H. All workmanship and new materials involved in constructing the alterations shall conform to the General Specifications for the classes of Work insofar as such specifications are applicable.
- 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 Specifications covering the new Work. When not covered, the Work shall be carried on in the manner and to the extent directed by the Resident Project Representative.
- J. Surfaces of seals visible in the completed Work shall be made to match as nearly as possible the adjacent surfaces.
- K. Non-shrink grout shall be used for setting wall castings, sleeves, leveling pump bases, doweling anchors into existing concrete and elsewhere as shown.
- L. Where necessary or required for the purpose of making connections, the Contractor shall cut existing pipelines in a manner to provide an approved joint. Where required, he shall use flanges, or provide Dresser Couplings, all as required.
- M. The Contractor shall provide flumes, hoses, piping 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 under this Contract.
- N. Care shall be taken not to damage any part of existing buildings or foundations or outside structures.

3.02 CONNECTING TO EXISTING PIPING AND EQUIPMENT

- A. 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 Manatee County representative must be present for all tie-ins for a visual inspection.

3.03 REMOVAL AND ABANDONMENT OF ASBESTOS CEMENT PIPE AND APPURTEANCES

- A. All Work associated with the removal or abandonment of existing asbestos cement pipe and appurtenances shall be performed by a licensed asbestos abatement contractor or subcontractor registered in the State of Florida.

- B. The asbestos abatement contractor or subcontractor 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 Contractor shall be responsible for all fees associated with permits, licenses and notices to the governing regulatory agencies.
- 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 17-251, "Asbestos".
 - 2. National Emission Standards Hazardous Air Pollution (NESHAP), 40 CFR, Part 61, Subpart M, latest revision.
 - 3. Occupational Safety and Health Act, 29 CFR
 - 4. The Environmental Protection Agency (EPA) Asbestos Abatement Worker Protection Rule.
 - 5. Florida Statute 455.300.

3.04 ASBESTOS CEMENT PIPE REMOVAL

- A. All asbestos cement pipe sections shown on the Drawings to be removed, and all related valves, fittings and appurtenances shall be removed in their entirety and disposed of by the Contractor in accordance with this Section. After removal of the facilities, all trenches shall be backfilled in accordance with the Contract Documents. The cost of disposing of the removed materials shall be borne by the Contractor.
- B. The Contractor shall make necessary provisions for the Engineer's representative to monitor all removal operations.
- C. The cutting of existing asbestos-cement (A/C, aka "Transite") pipe shall be by hand saw only activities by a licensed asbestos abatement contractor. No machine cutting shall be allowed. Removal of all portions 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 and every 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 (Phone #748-5543) is required.

3.05 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 sand/cement grout as specified herein. When such pipes are constructed with asbestos cement materials, the abandonment activities shall be performed by a licensed asbestos abatement contractor as specified in these Specifications.
- B. Grout shall be injected within the pipe sections indicated on the Drawings. The ends of these sections shall be capped and/or plugged. The grouting program shall consist of pumping sand-cement grout with suitable chemical additives at pressures necessary to fill the pipe sections shown on the Drawings to prevent the potential for future collapse.
- 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 Engineer. 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.

- D. The Contractor shall provide standpipes and/or additional means of visual inspection as required by the Engineer to determine if adequate grout material has filled the entire pipe section(s). The Contractor shall make necessary provisions for the Engineer's representative to monitor all grouting operations.
- E. All pipe to be abandoned shall be capped or plugged with a fitting or material that will prevent soil or other material from entering the pipe. All caps and plugs shall be subject to approval by the Engineer.

END OF SECTION

SECTION 02276

TEMPORARY EROSION AND SEDIMENTATION CONTROL WORK

PART 1 GENERAL

1.01 DESCRIPTION

- A. The Work specified in this Section consists of the design, provision, maintenance and removal of temporary erosion and sedimentation controls as necessary.
- B. Temporary erosion controls include, but are not limited to: grassing, mulching, netting, watering, and the reseeding of on-site surfaces and spoil and borrow area surfaces, interceptor ditches at ends of berms and other such work at those locations which will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by the Owner/Engineer.
- C. Temporary sedimentation controls include, but are not limited to: silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces which shall ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the Owner/Engineer.
- D. The Contractor is responsible for providing effective temporary erosion and sediment control measures during construction or until final controls become effective.

1.02 REFERENCE DOCUMENTS

- A. Florida Building Code.
- B. FDEP/COE Dredge and Fill Regulations and/or Permit as applicable.
- C. SWFWMD Permit Regulations and/or Permit as applicable.
- D. Florida Stormwater, Erosion and Sedimentation Control Inspector's Manual.

PART 2 PRODUCTS

2.01 EROSION CONTROL

- A. Netting - fabricated of material acceptable to the Owner.
- B. Seed and sod.

2.02 SEDIMENTATION CONTROL

- A. Bales - clean, seed free cereal hay type.
- B. Netting - fabricated of material acceptable to the Owner.

- C. Filter stone - crushed stone conforming to Florida Dept of Transportation specifications.
- D. Concrete block - hollow, non-load-bearing type.
- E. Concrete - exterior grade not less than one inch thick.

PART 3 EXECUTION

3.01 EROSION CONTROL

- A. Minimum procedures for grassing shall be:
 - 1. Scarify slopes to a depth of not less than 6 inches and remove large clods, rock, stumps, roots larger than 1/2 inch in diameter and debris.
 - 2. Sow seed within twenty-four (24) hours after the ground is scarified with either mechanical seed drills or rotary hand seeders.
 - 3. Apply mulch loosely and to a thickness of between 3/4-inch and 1-1/2 inches.
 - 4. Apply netting over mulched areas on sloped surfaces.
 - 5. Roll and water seeded areas in a manner which will encourage sprouting of seeds and growing of grass. Reseed areas which exhibit unsatisfactory growth. Backfill and seed eroded areas.

3.02 SEDIMENTATION CONTROL

- A. The Contractor shall install and maintain silt dams, traps, barriers, and appurtenances as shown on the approved descriptions and working drawings. Deteriorated hay bales and dislodged filter stone shall be replaced by the Contractor at his expense.

3.03 PERFORMANCE

- A. The Contractor, at his own expense, shall immediately take whatever steps are necessary to correct any deficiencies of the temporary erosion and sediment control measures employed if they fail to produce results or do not comply with the requirements of the State of Florida or any other federal, governmental or regulatory agency.

END OF SECTION

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 Engineer/Owner.

1.02 RELATED WORK NOT INCLUDED

- A. 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 Owner 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 eight (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 Engineer.

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 Engineer 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 Owner. 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 Engineer.
- 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 Engineer shall approve the finish grade of all areas to be seeded or sodded prior to seed or sod application.
- C. 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 Owner shall be repaired by the Contractor as directed by the Engineer.

3.02 CLEANUP

- A. 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 Engineer.
- B. Maintain landscape work for a period of 90 days immediately following complete installation of work or until Owner 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 Owner.

3.04 REPAIRS TO LAWN AREAS DISTURBED BY CONTRACTOR'S OPERATORS

- A. 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.

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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 Engineer, within ten (10) 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 ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51. Thickness of pipe shall be Class 50 or pressure Class 350. All pipe not buried shall be Class 53. All ductile iron pipe shall be clearly marked on the outside of the barrel to readily identify it from cast iron.
- B. Unrestrained joint pipe shall be supplied in lengths not to exceed 21 feet. Unless otherwise called for in the Contract Documents, unrestrained joint pipe shall be either the rubber-ring 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 approved equal.
- C. All fittings shall be pressure rated for 350 psi and meet the requirement of AWWA C110 or AWWA C153. Rubber gaskets shall conform to ANSI A21.11 for mechanical and push-on type joints for diameters up to 14-inch diameter. Gaskets

for 16-inch diameter and larger pipe shall be EPDM (Ethylene-Propylene Dine Monomer) such as the "Fastite Gasket" of American Ductile Iron Pipe Co., or approved equal.

- D. Water Mains: All ductile iron pipe and fittings shall have a standard thickness cement lining on the inside in accordance with AWWA/ANSI C104/A21.4 and a coal tar enamel coating on the outside. The coal tar enamel shall be in accordance with ANSI A21.4. All interior linings shall be EPA/NSF approved.
- E. Force Main Fittings: All ductile iron fittings shall have a factory applied fusion bonded epoxy or epoxy and polyethylene lining on the inside in accordance with manufacturer's specifications and a coal tar enamel coating on the outside. The coal tar enamel shall be in accordance with ANSI A21.4. The interior lining is to be based on manufacturer's recommendation for long-term exposure to raw sewage. It shall have a minimum ten (10) year warranty covering failure of the lining and bond failure between liner and pipe.
- F. Restrained joints shall be provided at all horizontal and vertical bends and fittings, at casings under roads and railroads and at other locations shown on the Contract Drawings. Restrained joint pipe fittings shall be designed and rated for the following pressures: 350 psi for pipe sizes up to and including 24 inch diameter; 250 psi for pipe sizes 30 inch diameter and above.

2.02 IDENTIFICATION

- A. Each length of pipe and each fitting shall be marked with the name of the manufacturer, size and class 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. Pipe shall be poly wrapped blue for potable water mains, purple for reclaimed water mains and green for sewage force mains. All potable water pipe shall be NSF certified and copies of lab certification shall be submitted to the Engineer.

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 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 one manufacturer.
- C. All valves and appurtenances shall have the name of the manufacturer and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.
- D. All valves shall have a factory applied, fusion bonded epoxy coating on interior and exterior unless noted otherwise in the plans or this specification.
- E. The equipment shall include, but not be limited to, the following:
 - 1. Ball Valves for PVC Pipe
 - 2. Plug Valves
 - 3. Valve Actuators
 - 4. Flange Adapter Couplings
 - 5. Flexible Couplings
 - 6. Hose Bibs

1.02 DESCRIPTION OF SYSTEMS

- A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of potable water, reclaim water, wastewater, etc., depending upon the applications.

1.03 QUALIFICATIONS

- A. 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 Specifications as applicable. Valves shall be as covered under mechanical devices in Section 8 of ANSI/NSF Standard 61.

1.04 SUBMITTALS

- A. Submit to the Engineer 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 Engineer for approval in accordance with the Specifications.

1.05 TOOLS

A. Special tools, if required for normal operation and maintenance shall be supplied with the equipment.

PART 2 PRODUCTS

2.01 BALL VALVES FOR PVC PIPE

A. Ball valves for PVC pipe shall be of PVC Type 1 with union, socket, threaded or flanged ends as required. Ball valves shall be full port, full flow, all plastic construction, 150 psi rated with teflon seat seals and T-handles. PVC ball valves shall be as manufactured by Celanese Piping Systems, Inc., Wallace and Tiernan, Inc., Plastiline, Inc., or approved equal.

B. All valves shall be mounted in such a position that valve position indicators are plainly visible when standing on the floor.

2.02 VALVE ACTUATORS

A. General

1. All valve actuators shall conform to Section 3.8 of the AWWA Standard Specification and shall be either manual or motor operated.
2. 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.
3. Butterfly valve actuators shall conform to the requirements of Section 3.8 of the AWWA Standard Specifications for Rubber Seated Butterfly Valves, Designated C504, insofar as applicable and as herein specified.

B. Manual Actuators

1. 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 and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Actuators shall be fully enclosed and designed to produce the specified torque with a maximum pull of 80 pounds on the handwheel or chainwheel. Actuator components shall withstand an input of 450 foot pounds for 30" and smaller and 300 foot pounds for larger than 30" size valves at extreme actuator positions without damage. 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. Valve actuators shall conform to AWWA C504, latest revision.

2.03 FLANGE ADAPTER COUPLINGS

A. Flange adapter couplings shall be of the size and pressure rating required for each installation and shall be suitable for use on either cast iron or ductile iron pipe. They shall be similar or approved equal to Dresser Company, Style 128. All couplings shall have a sufficient number of factory installed anchor studs to meet or exceed a minimum test pressure rating of 230 psi minimum.

2.04 FLEXIBLE COUPLINGS

A. Flexible couplings shall be either the split type or the sleeve type as shown on the Drawings.

1. Split type coupling shall be used with all interior and exterior piping noted on the Drawings. The couplings shall be mechanical type for radius groove piping. The couplings shall mechanically engage and lock grooved pipe ends in a positive couple and allow for angular deflection and contracting and expansion.
2. Couplings shall consist of malleable iron, ASTM Specification A47, Grade 32510 housing clamps in two or more parts, a single chlorinated butyl composition sealing gasket with a "C" shaped cross-section and internal sealing lips projecting diagonally inward, and two or more oval track head type bolts with hexagonal heavy nuts conforming to ASTM Specification A183 and A194 to assemble the housing clamps. Bolts and nuts shall be hot dipped galvanized after fabrication.
3. Victaulic type couplings and fittings may be used in lieu of flanged joints. Pipes shall be radius grooved as specified for use with the Victaulic couplings. Flanged adapter connections at fittings, valves, and equipment shall be Victaulic Vic Flange Style 741, equal by Gustin-Bacon Group, Division of Certain-Teed Products or approved equal.
4. Sleeve type couplings shall be used with all buried piping. The couplings shall be of steel and shall be Dresser Style 38 or 40, as shown on the Drawings, or equal. The coupling shall be provided with hot dipped galvanized steel bolts and nuts unless indicated otherwise.
5. All couplings shall be furnished with the pipe stop removed.
6. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.
7. If the Contractor decides to use victaulic couplings in lieu of flanged joints, he shall be responsible for supplying supports for the joints.

2.05 HOSE BIBS

A. Valves for hose bibs shall be 1" angle valves with threaded ends rated for a pressure of 200 pounds per square inch. Valve disc shall be renewable and made of Teflon or Buna-N. Valves shall be one of the following or equal:

1. Crane, No. 17TF
2. Stockham, Figure No. B222T

2.06 RESTRAINING CLAMPS

A. Restraining clamp assemblies as detailed in the Drawings for use at hydrant connections to water mains, or at fittings where shown on the Drawings, shall be as manufactured by American Cast Iron Pipe, Star Pipe Products, U.S. Pipe; or approved equal.

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 Engineer.
- 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 Engineer.
- C. Pipe for use with flexible couplings shall have plain ends as specified in the respective pipe sections.
- D. Flanged joints shall be made with high strength, low alloy Corten bolts, nuts and washers. Mechanical joints shall be made with mild corrosion resistant alloy steel bolts and nuts. All exposed bolts shall be painted the same color as the pipe. All buried bolts and nuts shall be heavily coated with two (2) coats of bituminous paint comparable to Inertol No. 66 Special Heavy.
- E. 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 inches from the end.

3.02 SHOP PAINTING

- A. 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.

3.03 FIELD PAINTING

- A. All metal valves and appurtenances specified herein and exposed to view shall be painted.

3.04 INSPECTION AND TESTING

- A. Completed pipe shall be subjected to hydrostatic pressure test for two (2) hours at 180 psi. All leaks shall be repaired and lines retested as approved by the Engineer. Prior to testing, the pipelines shall be supported in an approved manner to prevent movement during tests.

END OF SECTION

SECTION 02999
MISCELLANEOUS WORK AND CLEANUP

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes items and operations which are not specified in detail as separate items, but may be sufficiently described as to the kind and extent of work involved. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to complete all work under this Section.
- B. The Work of this Section may include, but is not limited to the following:
 - 1. Restoration of roads, sidewalks, driveways, curbing and gutters, fences, guardrails, lawns, shrubbery and any other existing items damaged or destroyed.
 - 2. Clean up.
 - 3. Incidental work (project photographs, testing, shop drawings, traffic control, record drawings, etc.).
 - 4. Stormwater and erosion control devices.

1.02 SUBMITTAL OF LUMP SUM BREAKDOWN

- A. Contractor shall submit to the Owner/Engineer, a breakdown of the lump sum bid for Miscellaneous Work and Cleanup Item in the Proposal within ten (10) days after date of Notice to Proceed.

1.03 WORK SPECIFIED UNDER OTHER SECTIONS

- A. All Work shall be completed in a workmanlike manner by competent workmen in full compliance with all applicable sections of the Contract Documents.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials required for this Section shall equal or exceed materials that are to be restored. The Contractor may remove and replace or reuse existing materials with the exception of paving.

PART 3 EXECUTION

3.01 RESTORING OF SIDEWALKS, ROADS, CURBING, FENCES AND GUARDRAILS

- A. The Contractor shall protect existing sidewalks & curbing. If necessary, sidewalks & curbing shall be removed from joint to joint and replaced after backfilling. Curbing damaged during construction because of the Contractor's negligence or

convenience, shall be replaced with sidewalks & curbing of equal quality and dimension at no cost to the Owner.

- B. At the locations necessary for the Contractor to remove, store and replace existing fences and guardrails during construction, the sections removed shall be only at the direction of the Engineer. If any section of fence is damaged due to the Contractor's negligence, it shall be replaced at no cost to the Owner with fencing equal to or better than that damaged and the work shall be satisfactory to the Engineer.
- C. Guardrails in the vicinity of the work shall be protected from damage by the Contractor. Damaged guardrails shall be replaced in a condition equal to those existing

3.02 STORMWATER AND EROSION CONTROL DEVICES

- A. The Contractor shall be responsible for, provide, and install all stormwater and erosion control devices necessary to insure satisfactory compliance with the Florida Department of Environmental Protection Stormwater, Erosion, and Sedimentation Control Inspector's Manual.

END OF SECTION

SECTION 03055

EPOXY BONDING REINFORCING BARS AND ALL THREAD RODS IN CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Bonding reinforcing bars and all thread rods in concrete using epoxy adhesive.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.
- B. American Society for Testing and Materials (ASTM):
 - 1. C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- C. ICC Evaluation Service, Inc.:
 - 1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
- D. SSPC - Society for Protective Coatings - Steel Structures Painting Council:
 - 1. SP-10 Near-White Blast Cleaning.

1.03 SUBMITTALS

- A. Product Data: Furnish technical data for epoxy adhesives, including installation instructions, independent laboratory test results, and handling and storage instructions.
- B. Quality Control Submittals:
 - 1. Epoxy manufacturer's past project experience data on at least 3 similar projects supplied with proposed products within the last 3 years.
 - 2. Special Inspection: Provide detailed step-by-step instructions for the special inspection procedure as required by Building Code as specified in Section 01410.
 - 3. ICC Evaluation Service, Inc., Evaluation Report meeting AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
 - 4. DELIVERY, STORAGE, AND HANDLING
- C. Storage of Epoxy Components:
 - 1. Store epoxy components on pallets or shelving in a covered-storage area.
 - 2. Control temperature above 60 degrees Fahrenheit and dispose of product if shelf life has expired.
 - 3. If stored at temperatures below 60 degrees Fahrenheit, test components prior to use to determine if they still meet specified requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. Like Items of Materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

2.02 EPOXY ADHESIVE FOR SELF-CONTAINED CARTRIDGE SYSTEM

- A. Epoxy adhesive shall have a current ICC Evaluation Service report documenting acceptance under AC308 for use with cracked concrete and for the seismic design categories specified.
- B. Meet ASTM C 881, Type IV, Grade 3, Class B or C depending on site conditions.
- C. Two-component, 100 percent solids, insensitive to moisture, and gray in color.
- D. Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.
- E. Packaging.
 - 1. Furnished in side-by-side cartridges with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle. Nozzle designed to thoroughly blend the components for injection from the nozzle directly into prepared hole.
 - 2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.
- F. .
- G. Manufacturers: One of the following or equal:
 - 1. Hilti, Tulsa, OK, RE 500 SDHigh Strength Epoxy Doweling System.
 - 2. Simpson Strong-Tie Company, Inc., Pleasanton, CA, SET-XP Epoxy-tie Anchoring System.

2.03 ALL THREAD RODS

- A. Materials: A307 or equal.

2.04 REINFORCING BARS

- A. Materials: As specified in Section 03200.

PART 3 EXECUTION

3.01 GENERAL

- A. Dispense epoxy components through specially designed static mixing nozzle that thoroughly mixes epoxy components and places mixed epoxy at base of predrilled hole.
- B. Mixing Nozzles: Disposable and manufactured in several sizes to accommodate different size and depth of holes.
- C. Provide Epoxy Adhesive Packaged as Follows:
 - 1. Disposable, self-contained cartridge system capable of dispensing both epoxy components in the proper mixing ratio, and fit into a manually or pneumatically operated caulking gun.
 - 2. Dispense components through a mixing nozzle that thoroughly mixes components.

3.02 HOLE SIZING AND INSTALLATION

- A. Drilling Holes:
 - 1. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by ENGINEER.
 - 2. The location of reinforcing bars or other obstructions shall be determined with a non-destructive indicator device.
- B. Hole Drilling Equipment:
 - 1. Electric or pneumatic rotary impact type with medium or light impact.
 - 2. Drill Bits: Carbide-tipped in accordance with ANSI B212-15 . unless otherwise recommended by the manufacturer or required as a "condition of use" in the ICC Evaluation Report submitted.
 - 3. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.
 - 4. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.
- C. Hole Diameter: Reinforcing bar diameter or all thread rod diameter plus 1/8 inch.
- D. Obstructions in Drill Path:
 - 1. If an existing reinforcing bar or other obstruction is hit while drilling hole, stop drilling hole and fill the hole with drypack mortar. Relocate the hole to miss the obstruction and drill another hole. Repeat the above until the hole has been drilled to the required depth.
 - 2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the structural member and endanger the stability of the structure. Drypack holes which hit obstructions and allow drypack to reach strength equal to the existing concrete before drilling adjacent holes. Epoxy grout may be substituted for drypack when acceptable to ENGINEER.
 - 3. When existing reinforcing steel is encountered during drilling and when acceptable to ENGINEER, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter.

4. Bent Bar Reinforcing bars: Where edge distances are critical, and striking reinforcing steel is likely, and if acceptable to ENGINEER, drill hole at 10 degree angle or less from axis of reinforcing bar or all thread rod being installed.
- E. Install reinforcing bars and all thread rods to depth, spacings, and locations as indicated on the Drawings.
- F. Cleaning Holes:
 1. Insert long air nozzle into hole and blow out loose dust. Use air that is free of oil, water, or other contaminants that will reduce bond.
 2. Use a stiff bristle brush to vigorously brush hole to dislodge compacted drilling dust.
 3. Repeat step 1.
 4. Repeat above steps as required to remove drilling dust or other material that will reduce bond. The hole shall be clean and dry.
- G. Cleaning Reinforcing Bars and All Thread Rods:
 1. Solvent clean reinforcing bar and all thread rods over the embedment length in accordance with SSPC SP-1 Solvent Cleaning. Provide an oil and grease free surface to promote bonding of adhesive to steel.
 2. Clean reinforcing bars and all thread rods over embedment length to bare metal. The reinforcing bars and all thread rods shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
- H. Filling Hole with Epoxy:
 1. Fill hole with epoxy before inserting the reinforcing bar or all thread rod. Fill hole with epoxy starting from bottom of hole. Fill hole without creating air voids.
 2. Fill hole with sufficient epoxy so that excess epoxy is extruded out of the hole when the reinforcing bar or all thread rod is inserted into the hole.
 3. Do not install epoxy prior to receiving epoxy manufacturer's onsite training.

3.03 MANUFACTURERS' SERVICES

- A. Furnish manufacturer's representative to conduct jobsite training for proper installation, handling, and storage of epoxy, for personnel who will perform actual installation. ENGINEER may attend training sessions.

END OF SECTION

SECTION 03071

EPOXIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Epoxy.
 - 2. Epoxy gel.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. D 638 - Standard Test Method for Tensile Properties of Plastics.
 - 2. D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
 - 3. D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Provide epoxy materials that are new and use them within shelf life limitations set forth by manufacturer.
 - 2. Perform and conduct work of this Section in neat orderly manner.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's data completely describing epoxy materials.
- B. Quality Control Submittals:
 - 1. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Epoxy: Water-insensitive two-part type low viscosity epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified: Manufacturers: One of the following or equal:
 - 1. BASF, MBT, Concresive Standard LVI.
 - 2. Sika Chemical Corp., Sikadur 35 Hi-Mod LV.

Physical Characteristic	Test Method	Required Results
Tensile Strength	ASTM D 638	8,000 pounds per square inch minimum at 14 days and 77 degrees Fahrenheit cure.
Flexure Strength	ASTM D 790	11,000 pounds per square inch minimum at 14 days and 77 degrees Fahrenheit cure.
Compressive Strength	ASTM D 695	16,000 pounds per square inch minimum at 24 hours and 77 degrees Fahrenheit cure.
Bond Strength	--	Concrete shall fail before failure of epoxy.
Gel Time for 5 Mil Film	--	Four hours maximum at 77 degrees Fahrenheit.
Elongation	ASTM D 638	1 percent minimum at 14 days and 77 degrees Fahrenheit.

B. Epoxy Gel: Manufacturers: One of the following or equal:

1. Sika Chemical Corp., Sikadur 31, Hi-Mod Gel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.
- B. Epoxy:
 1. Apply in accordance with manufacturer's installation instructions.
- C. Epoxy Gel:
 1. Apply in accordance with manufacturer's installation instructions.
 2. Use for vertical or overhead work, or where high viscosity epoxy is required.
 3. Epoxy gel used for vertical or overhead work may be used for horizontal work.

END OF SECTION

SECTION 03102

CONCRETE FORMWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Concrete formwork.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:

- 1. Design of concrete forms, falsework, and shoring in accordance with local, state, and federal regulations.
 - 2. Design forms and ties to withstand concrete pressures without bulging, spreading, or lifting of forms.

- B. Performance Requirements:

- 1. Construct forms so that finished concrete conforms to shapes, lines, grades, and dimensions indicated on the Drawings.
 - 2. It is intended that surface of concrete after stripping presents smooth, hard, and dense finish that requires minimum amount of finishing.
 - 3. Provide sufficient number of forms so that the work may be performed rapidly and present uniform appearance in form patterns and finish.
 - 4. Use forms that are clean and free from dirt, debris, concrete, and similar type items. Coat with acceptable form release agent if required, prior to use or reuse.

1.04 SUBMITTALS

- A. Information on the CONTRACTOR's Proposed Forming System: Submit in such detail as the ENGINEER may require to assure himself that proposed system complies with the intent of the Specifications.
- B. Form Release Agent. Manufacturer's product data and Material Safety Data Sheet (MSDS).

1.05 QUALITY ASSURANCE

- A. Qualifications of manufactured formwork systems. Manufactured forming systems shall have a minimum 5-year history of successful use for structures such as those

included in the Work. Submit experience record demonstrating at least 5 projects for review when requested by the ENGINEER. Provide details, photos, references, and other data requested by ENGINEER.

B. Regulatory Requirements: Install work of this Section in accordance with local, state, and federal regulations.

1.06 PROJECT CONDITIONS

A. Requirements Due to Weather Condition:

1. Removal of Formwork: Do not remove forms from concrete which has been placed when outside ambient air temperature is below 50 degrees Fahrenheit until concrete has attained specified strength as determined by test cylinders stored in field under conditions equivalent to those experience by the concrete structure.

PART 2 PRODUCTS

2.01 MATERIALS

A. Form Ties:

1. General:
 - a. Provide form ties compatible with forming system selected and produced by recognized manufacturer of concrete forming equipment.
 - b. Do not use wire ties or wood spreaders of any form.
 - c. Provide ties of type that accurately tie, lock, and spread forms.
 - d. Provide form ties of such design that, when forms are removed, no metal or other material remains within 1-1/2 inches of the surface of the concrete.
 - e. Do not allow holes in forms for ties to allow leakage during placement of concrete.
2. Cone-snap or Flat Bar Form Ties:
 - a. Cone-snap ties shall form a cone shaped depression in the concrete with a minimum diameter of 1 inch at the surface of the concrete and 1-1/2 inches deep.
 - b. Provide neoprene water seal washer located near the center of the concrete.
3. Taper Ties:
 - a. Neoprene Plugs for Taper Tie Holes: Size so that after they are driven, plugs are located in center third of wall thickeners.
 - b. Drypack Mortar for Filling Taper Tie Holes:
 - 1) Consist of mix of 1 part of Portland cement to 1 part of plaster sand.
 - 2) Amount of water to be added to cement-sand mix is to be such that mortar can be driven into holes and be properly compacted.
 - 3) Admixtures or Additives: Are not to be used in dry-pack mortar.

B. Built-up Plywood Forms:

1. Built-up plywood forms may be substituted for prefabricated forming system subject to following minimum requirements:

- a. Size and Material:
 - 1) Full size 4 by 8 feet plywood sheets, except where smaller pieces are able to cover entire area.
 - 2) Sheet Construction: 5-ply plywood sheets, 3/4 inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.
- b. Wales: Minimum 2 by 4 inch lumber.
- c. Studding and Wales: Contain no loose knots and be free of warps, cups, and bows.

C. Steel or Steel Framed Plywood Forms:

- 1. Steel Forms: Provide forms that are:
 - a. Rigidly constructed and capable of being braced for minimum deflection of finish surface.
 - b. Capable of providing finish surfaces that are flat without bows, cups, or dents.
- 2. Steel Framed Plywood Forms:
 - a. Provide forms that are rigidly constructed to provide minimum deflection of finished surfaces, and capable of being braced.
 - b. Plywood Paneling: 5-ply, 5/8 inch nominal or 3/4 inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.

D. Incidentals:

- 1. External Angles (corners at formed edges):
 - a. Where not otherwise indicated on the Drawings or specified, provide with 3/4 inch bevel, formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, slabs, walls, beams, columns, and openings.
 - b. Provide 1/4 inch bevel formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, walls, and slabs at expansion, contraction, and construction joints.
- 2. Keyways: Steel, plastic, or lumber treated with form coating, applied according to label directions.

E. Form Release Agent:

- 1. Effective, non-staining, non-residual, water-based, bond-breaking form coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:

- 1. Do not place any concrete until all forms have been thoroughly checked for alignment, level, strength, and to assure accurate location of all mechanical and electrical inserts or other embedded items.

3.02 INSTALLATION

A. Forms and Accessories:

1. Vertical Forms:
 - a. Remain in place minimum of 24 hours after concrete is placed.
 - b. If, after 24 hours, concrete has sufficient strength and hardness to resist surface or other damage, forms may be removed.
2. Other Forms Supporting Concrete and Shoring: Remain in place as follows:
 - a. Sides Of Footings: 24 hours minimum.
 - b. Vertical Sides of Beams, Girders, and Similar Members: 48 hours minimum.
 - c. Slabs, Beams, and Girders: Until concrete strength reaches specified strength or until shoring is installed.
 - d. Shoring for Slabs, Beams, and Girders: Shore until concrete strength reaches specified strength.
 - e. Wall Bracing: Until concrete strength of beams and slabs laterally supporting wall reaches specified strength.
3. Green Concrete:
 - a. No heavy loading on green concrete will be permitted.
 - b. Green concrete is defined as concrete with less than 100 percent of specified strength.
4. Immediately after forms are removed, carefully examine concrete surfaces, and repair any irregularities in surfaces and finishes as specified in Section 03300.

B. Form Ties:

1. Cone-Snap Rod and Bar Ties: Tie forms together at not more than 2 foot centers vertically and horizontally. After forms are removed from wall, fill tie holes as follows:
 - a. Remove form ties from surfaces.
 - b. Roughen cone shaped tie holes by heavy sandblasting before repair.
 - c. Dry pack cone shaped tie holes with drypack mortar as specified in Section 03600.
2. Taper Ties:
 - a. Neoprene Plug in Taper Tie Holes: After forms and taper ties are removed from wall, plug tie holes with neoprene plug as follows:
 - 1) Heavy sandblast and then clean tie holes.
 - 2) After cleaning, drive neoprene plug into each of taper tie holes with steel rod. Final location of neoprene plug shall be in center third of wall thickness. Bond neoprene plug to concrete with epoxy.
 - 3) During driving, locate steel rod in cylindrical recess made in plug.
 - a) At no time are plugs to be driven on flat area outside cylindrical recess.
 - b. Dry Pack Of Taper Tie Holes: After Installing Plugs in Tie Holes:
 - 1) Coat tie hole surface with epoxy bonding agent and fill with drypack mortar as specified in Section 03600.
 - a) Drypack Mortar: Place in holes in layers with thickness not exceeding tie hole diameter and heavily compact each layer.

- b) Dry pack the outside of the hole no sooner than 7 days after the inside of the hole has been dry packed.
- c) Wall surfaces in area of drypacked tie holes: On the water side of water containing structures and the outside of below grade walls:
 - (1) Cover with minimum of 10 mils of epoxy gel.
 - (2) Extend epoxy gel coating on wall surfaces minimum of 2 inches past drypack mortar filled tie holes.
 - (3) Provide finish surfaces that are free from sand streaks or voids.

C. Built-up Plywood Forms:

1. Form face supports:
 - a. Spaced maximum 24 inches on center. Closer spacing may be required. Provide form supports and wales required to prevent bulging of concrete surfaces and to maintain formed lines and surfaces within tolerances specified.
 - b. Install studs perpendicular to grain of exterior plys of plywood sheets.
2. Wales: Form wales of double lumber material minimum size as specified in this Section.
3. Form Reuses: Forms may be reused provided surface coating or overlay, faces, edges and corners are capable of producing flat, smooth, hard, dense, uniform finish on concrete when stripped.

D. Steel or Steel Framed Forms:

1. Steel Forms:
 - a. Adequately brace forms and form faces for minimum deflection of finish surface.
2. Steel Framed Plywood Forms:
 - a. Rigidly construct and brace with joints fitting closely and smoothly.
 - b. Form Reuse: Forms may be reused provided surface coating or overlay, faces, edges and corners are capable of producing flat, smooth, hard, dense, uniform finish on concrete when stripped.
3. Built-up plywood forms as specified in this Section may be used in conjunction with steel forms or steel framed plywood forms for special forming conditions such as corbels and forming around items which will project through forms.

E. Bracing and Alignment of Forms:

1. Line and Grade: Limit deviations to tolerances which will permit proper installation of structural embedded items or mechanical and electrical equipment and piping.
2. Formwork:
 - a. Securely brace, support, tie down, or otherwise hold in place to prevent any movement.
 - b. Make adequate provisions to resist uplift pressure, lateral pressure, and deflection of forms.
3. When Second Lift is Placed on Hardened Concrete: Take special precautions in form work at top of old lift and bottom of new lift to prevent:
 - a. Spreading and vertical or horizontal displacement of forms.

- b. Grout "bleeding" on finish concrete surfaces.
- 4. Pipe Stubs, Anchor Bolts, and Other Embedded Items: Set in forms where required.
- 5. Cracks, Openings, or Offsets at Joints in Formwork: Close those that are 1/16 inch or larger by tightening forms or by filling with acceptable crack filler.

F. Incidentals:

- 1. Keyways: Construct keyways as indicated on the Drawings.
- 2. Reentrant Angles: May be left square.
- 3. Level Strips: Install level strips at top of wall concrete placements to maintain true line at horizontal construction joints.
- 4. Inserts:
 - a. Encase pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Drawings or as required, in concrete.
 - b. Use dovetail anchors or ties in conjunction with slots or inserts for various materials as specified under other sections of these Specifications and as may be necessary for required work.

G. Pipe and Conduit:

- 1. Install pipe and conduit in structures as indicated on the Drawings.

H. Tolerances:

- 1. Finish concrete shall conform to shapes, lines, grades, and dimensions indicated on the Drawings.
- 2. At time of acceptance of project, the maximum deviation from true line and grade shall not exceed tolerances listed below.
- 3. General: Comply with ACI 117, except as modified in following paragraphs:
 - a. Slabs:
 - 1) Slope: Uniformly sloped to drain when slope is indicated on the Drawings. Provide slabs without depressions that puddle water.
 - 2) Slabs Indicated to Be Level: Have maximum deviation of 1/8 inch in 10 feet without any apparent changes in grade.
 - b. Circular Tank Walls: The CONTRACTOR may deviate from finish line indicated on the Drawings by use of forms with chord lengths not to exceed 2 feet provided the angle of departure at joints between adjacent chords is less than or equal to 3 degrees.
 - c. Inserts: Set inserts to tolerances required for proper installation and operation of equipment or systems to which insert pertains.
 - d. Maximum Tolerances: As follows:

Item	Inches
Sleeves and Inserts	Plus 1/8 Minus 1/8
Projected Ends of Anchor Bolts	Plus 1/4 Minus 0.0
Anchor Bolt Setting	Plus 1/16 Minus 1/16

END OF SECTION

SECTION 03150

CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Waterstops.
 - 2. Preformed synthetic sponge rubber expansion joint material.
 - 3. Miscellaneous joint materials.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. C 203 - Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
 - 2. D 412 - Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers – Tension.
 - 3. D 570 - Test Method for Water Absorption of Plastics.
 - 4. D 624 - Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 5. D 638 - Test Method for Tensile Properties of Plastics.
 - 6. D 746 – Test Method for Brittleness Temperature of Plastics and Elastomers by Imp-ct.
 - 7. D 747 - Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
 - 8. D 792 - Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
 - 9. D1751 - Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
 - 10. D 1752 - Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - 11. D 2240 - Test Method for Rubber Property - Durometer Hardness.
- B. U.S. Army Corps of Engineers (USACE):
 - 1. CRD-C-572, Specification for Polyvinylchloride Waterstop.

1.03 SUBMITTALS

- A. Product Data:
 - 1.
 - 2. Preformed Expansion Joint Material: Submit sufficient information on each type of material for review to determine conformance of material to requirements specified.

3. Bond Breakers: Manufacturer's product data and Material Safety Data Sheet (MSDS).
 - a. Where surfaces to which bond breaker will be applied will be exposed to contact with potable water, provide data indicating that product is suitable for such use.
- B. Samples: Submit minimum 6-inch long samples of the following when requested by the ENGINEER.
 1. Preformed expansion joint material. (1 set each type used)
- C. Test Reports: Submit reports indicating that average properties of material and finish conform to requirements specified in this Section.
 1. Preformed joint fillers.
- D. Certificates.
 1. Manufacturer's Instructions: Submit instructions for installation of each material used.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in unopened containers bearing the manufacturer's original label.
- B. Store and handle materials as recommended by the manufacturer.
 1. Spilled, spoiled, or open unused chemicals shall be disposed of in accordance with all local, state, and/or federal regulations.
- C. Protect concrete accessories from weather and direct exposure to sunlight before installation.

1.05 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 PREFORMED EXPANSION JOINT MATERIAL

- A. General: Use material type and thickness as indicated on the Drawings.
- B. Sponge Rubber Type:
 1. Manufacturers: One of the following or equal:
 - a. Tammstech, Inc., Cementone.
 - b. Burke Concrete Accessories Inc., Neoprene Sponge Rubber Expansion Joint.
- C. Bituminous Fiber Type:
 1. Asphalt-impregnated fiber board conforming to ASTM D 1751.
 2. Manufacturers: One of the following or equal:
 - a. Tammstech, Inc., Hornboard/fiber.
 - b. Burke Concrete Accessories Inc., Fiber Expansion Joint.

D. Self-Expanding Cork Type:

1. Cork sheet conforming to ASTM D 1752, Type III, protected to prevent expansion under normal atmospheric conditions before product is installed in the structures.
2. Manufacturers: One of the following, or equal:
 - a. W.R. Meadows, Inc., Self-Expanding Cork
 - b. APS Supply Co., Self-Expanding Cork

2.02 MISCELLANEOUS JOINT MATERIALS

A. Expanded Polystyrene Joint Filler:

1. Type: Commercially available polystyrene board, having following minimum characteristics:
 - a. Flexural Strength, Minimum: 35 pounds per square inch in accordance with ASTM C 203.
 - b. Compressive Yield Strength: Between 16 and 40 pounds per square inch, at 5 percent compression.

B. Bond Breaker: Bond breakers between concrete surfaces shall be non-staining, non-residual type preventing bond. Where placed on surfaces exposed to contact with potable water, bond breaker shall be suitable for such use, shall be non-toxic, and shall not impart taste or odor to the water.

PART 3 EXECUTION

3.01 INSTALLATION

A. General

1. Prepare and construct concrete joints as indicated on the Drawings and as specified in Section 03300.

B. Joints:

1. Construct expansion, contraction, and construction joints as indicated on the Drawings.
2. Preformed Expansion Joint Material: Fasten expansion joint strips to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.
3. Expanded Polystyrene Joint Filler:
 - a. When filler is indicated on the Drawings or specified, place filler in correct position before concrete is placed against filler.
 - b. Fill holes and joints in filler with caulking to prevent entry of mortar into joint or passage of mortar or concrete from one side of joint to other.
4. Sealants:
 - a. Install sealants and caulking as shown on the Drawings.

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SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Concrete reinforcement.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 315 - Detailing Manual: Details and Detailing of Concrete Reinforcement.
 - 2. 318 - Building Code Requirements for Structural Concrete.
- B. American Society for Testing and Materials (ASTM):
 - 1. A 185 - Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - 2. A 615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- C. Concrete Reinforcing Steel Institute (CRSI)
 - 1. Manual of Standard Practice.

1.03 SYSTEM DESCRIPTION

- A. The Drawings contain general notes concerning amount of reinforcement and placing, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Precast Concrete Bar Supports: Manufacturer's product data indicating compression strength of concrete supports.
- B. Shop Drawings:
 - 1. Reinforcing Steel:
 - a. Submit drawings showing bending and placement of reinforcement in accordance with the Contract Documents.
 - 1) Submit one copy shall be in reproducible form acceptable to the ENGINEER.
 - 2) Drawings shall conform to the recommendations of ACI 315.
 - 3) Drawings may not be annotated copies of the Contract Drawings, but shall be new scale drawings including plans, sections, and elevations required to clearly indicate the reinforcement to be furnished and installed.

- 4) Clearly indicate portions of structure covered by each submittal.
- 5) Placement drawings:
 - a) Clearly show placement, shapes, and dimensions of each bar listed in the bill of materials, including additional reinforcement at corners and openings required by details in the Contract Documents.
 - b) Show splice locations. Splice locations and associated bar lengths shall reflect CONTRACTOR's intended placement sequence.
 - c) Clearly identify locations of reinforcement with special coatings or special yield strength.
- 6) Bending details:
 - a) Reference bars to same identification marks shown on placement drawings.
 - b) If bend types or nomenclature differs from that recommended in the CRSI Manual of Standard Practice, provide details showing bend types and dimensional designations.
 - c) Clearly identify reinforcement with special coatings or special yield strength.
- b. Drawings that, in ENGINEER's opinion, are not sufficiently clear or complete will be rejected and a re-submittal will be required. Such determination shall be solely at the discretion of the ENGINEER, and rejection may occur with or without detailed review.

2. Changes to Contract Drawing requirements for reinforcement:

- a. Indicate in a separate letter or on shop drawings any changes to requirements indicated on the Contract Drawings.
- b. Changes will not be acceptable unless ENGINEER has accepted such changes in writing.

3. Review of shop drawings by ENGINEER will be limited to general compliance with the Contract Documents. Approval of shop drawing shall not relieve CONTRACTOR of responsibility for supplying all material required by CONTRACT DOCUMENTS, nor of responsibility for proper quantity, size and fit of reinforcement.

C. Samples:

- 1. Wire Reinforcement Supports: Submit samples of each type of chair and bolster proposed for use along with letter stating where each will be used.
- 2. Precast Concrete Bar Supports: Submit samples of each type of precast support proposed for use along with letter stating where each will be used.

D. Test Reports:

- 1. Certified copy of mill test for each steel proposed for use. Show physical properties and chemical analysis.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:

- 1. Deliver bars bundled and tagged with identifying tags.

B. Acceptance at Site:

1. Reinforcing Bars: Deliver reinforcing bars lacking grade identification marks accompanied by manufacturer's guarantee of grade.

1.06 SEQUENCING AND SCHEDULING

A. Bar Supports: Do not place concrete until product data and samples for bar supports have been accepted by the ENGINEER.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcement:

1. General: Provide reinforcing steel that is new material, of quality specified, free from excessive rust or scale or any defects affecting its usefulness.

B. Reinforcing Bars:

1. Reinforcing Bars to Be Embedded in Concrete or Masonry: Grade 60 deformed bars conforming to ASTM A 615.

C. Bar Supports:

1. Wire reinforcement supports
 - a. Stainless Steel.
 - 1) Stainless steel supports conforming to CRSI Class 2, Type B.
2. Precast Concrete Bar Supports (for slabs on grade only);
 - a. Precast concrete blocks with cast-in annealed steel tie wires, 16 gage or heavier. Compression strength of concrete blocks shall be equal to or greater than compression strength of surrounding concrete. Block height to provide required concrete cover. Block footprint dimensions 3-inches x 3-inches unless otherwise accepted by ENGINEER.

D. Tie Wires: Annealed steel.

E. Welded Wire Fabric Reinforcement:

1. Welded Wire Fabric: ASTM A 185.
2. Fabric may be used in place of reinforcing bars if accepted by the ENGINEER.
3. Provide fabric in flat sheet form.
4. Provide fabric having cross-sectional area per linear foot of not less than cross-sectional area per linear foot of reinforcing bars indicated on the Drawings.

2.02 FABRICATION

A. Shop Assembly:

1. Cut and bend bars in accordance with provisions of ACI 315 and ACI 318.
2. Bend bars cold.
3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Reinforcing Bars:
 - a. Verify that bars are new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings which adversely affect bonding capacity when placed in the work.

3.02 PREPARATION

- A. Surface Preparation:
 - 1. Reinforcing Bars: Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean any bars having rust scale, loose mill scale, or thick rust coat.
 - 2. Cleaning of Reinforcement Materials: Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placement.

3.03 INSTALLATION

- A. Reinforcing Bars:
 - 1. No field bending of bars will be allowed.
 - 2. Welding: No welding of bars will be allowed.
- B. Placing Reinforcing Bars:
 - 1. Accurately place bars and adequately secure them in position.
 - 2. Overlap bars at splices as specified or indicated on the Drawings.
 - 3. Unless specifically otherwise indicated on the Drawings, install bars at lap splices in contact with each other and fasten bars together with tie wire.
 - 4. If lap splice length for bars in concrete is not specified or indicated on the Drawings, bars shall be lap spliced in accordance with ACI 318.
 - 5. Bar Supports:
 - a. Provide in sufficient number to prevent sagging and to support loads during construction, but in no case less than quantities and at locations as indicated in ACI 315.
 - b. Do not use brick, broken concrete masonry units, spalls, rocks, or similar material for supporting reinforcing steel.
 - c. Support reinforcing for concrete placed on ground using precast bar supports as specified herein.
 - d. Support reinforcing for concrete placed over or between forms using wire bar supports as specified herein. Provide bar supports at formed vertical faces if required to maintain clear concrete cover indicated on the Drawings.
 - 6. Provide clear concrete cover indicated in the Typical Details unless otherwise noted on the Drawings.
- C. Tying of Bar Reinforcement:

1. Fasten bars securely in place with wire ties.
2. Tie bars sufficiently often to prevent shifting.
3. There shall be at least 3 ties in each bar length (does not apply to dowel lap splices or to bars shorter than 4 feet, unless necessary for rigidity).
4. Tie slab bars at every intersection around perimeter of slab.
5. Tie wall bars and slab bar intersections other than around periphery at not less than every fourth intersection, but at not greater than following maximum spacings:

Bar Size	Slab Bars Spacing (Inches)	Wall Bars Spacing (Inches)
Bars Number 5 and Smaller	60	48
Bars Number 6 through Number 9	96	60
Bars Number 10 and Number 11	120	96

6. After tying wire ties, bend ends of wire ties in towards the center of the concrete section. Wire ties shall conform to the cover requirements of the reinforcing bars.

D. Lap Splices of Reinforcing Bars:

1. Where bars are to be lap-spliced at joints in concrete, ensure bars project from concrete first placed, minimum length equal to lap splice length indicated on the Drawings.
2. Where lap splice length is not indicated on the Drawings, then provide lap splice length as specified in ACI 318 and this Division.

E. Welded Wire Fabric Reinforcement:

1. Install necessary wiring, spacing chairs, or supports to keep welded wire fabric in place while concrete is being placed.
2. Bend fabric as indicated on the Drawings or required to fit work.
3. Unroll or otherwise straighten fabric to make perfectly flat sheet before placing in the Work.
4. Lap splice welded wire fabric as indicated on the Drawings.
5. If lap splice length is not indicated on the Drawings, splice fabric in accordance with ACI 318.

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SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Cast-in-place concrete.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 318 - Building Code Requirements for Structural Concrete.
 - 2. ACI Manual of Concrete Practice.
- B. American Society for Testing and Materials (ASTM):
 - 1. C 31 - Practice for Making and Curing Concrete Test Specimens in the Field.
 - 2. C 33 - Specification for Concrete Aggregates.
 - 3. C 39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. C 40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - 5. C 42 - Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 6. C 88 - Test Method of Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - 7. C 94 - Specification for Ready-Mixed Concrete.
 - 8. C 114 - Test Methods for Chemical Analysis of Hydraulic Cement.
 - 9. C 117 - Test Method for Material Finer than 75- μm (No. 200) Sieve in Mineral Aggregates by Washing.
 - 10. C 123 - Test Method for Lightweight Particles in Aggregate.
 - 11. C 131 - Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 12. C 136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 13. C 138 - Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
 - 14. C 142 - Test Method for Clay Lumps and Friable Particles in Aggregate.
 - 15. C 143 - Test Method for Slump of Hydraulic Cement Concrete.
 - 16. C 150 - Specification for Portland Cement.
 - 17. C 156 - Test Method for Water Retention by Concrete Curing Materials.
 - 18. C 157 - Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
 - 19. C 171 - Specification for Sheet Materials for Curing Concrete.
 - 20. C 172 - Practice for Sampling Freshly Mixed Concrete.

- 21. C 231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- 22. C 260 - Specification for Air-Entraining Admixtures for Concrete.
- 23. C 289 - Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
- 24. C 295 - Guide for Petrographic Examination of Aggregates for Concrete.
- 25. C 309 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- 26. C 311 - Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete.
- 27. C 494 - Specification for Chemical Admixtures for Concrete.
- 28. C 595 - Specification for Blended Hydraulic Cements.
- 29. C 618 - Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland-Cement Concrete.
- 30. C 1064 - Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
- 31. C 1017 - Specification for Chemical Admixtures for use in Producing Flowing Concrete.
- 32. D 75 - Practices for Sampling Aggregates.

C. NSF International (NSF)

- 1. NSF Standard 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

- A. Alkali: Is defined to mean sum of sodium oxide and potassium oxide calculated as sodium oxide.
- B. Hairline Crack: Crack with a crack width of less than 4 thousandths of an inch (0.004 inches).

1.04 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. General:
 - a. Except as otherwise specified, provide concrete composed of portland cement, fine aggregate, coarse aggregate, and water so proportioned and mixed as to produce plastic, workable mixture in accordance with requirements as specified in this Section and suitable to specific conditions of placement.
 - b. Proportion materials in a manner that will secure lowest water-cement ratio which is consistent with good workability, plastic, cohesive mixture, and one which is within specified slump range.
 - c. Proportion fine and coarse aggregate in manner such as not to produce harshness in placing nor honeycombing in structures.
 - 2. Watertightness of Concrete Work: It is intent of this Section to secure for every part of the Work concrete and grout of homogeneous structure that, when hardened will have required strength, watertightness, and durability.

- a. It is recognized that some surface hairline cracks and crazing will develop in the concrete surfaces.
- b. Construction, control and expansion joints have been positioned in structures as indicated on the Drawings, and curing methods have been specified, to reduce number and size of these expected cracks, due to normal expansion and contraction expected from specified concrete mixes.
- c. Class A and Class B Concrete: Watertight: Repair cracks which develop in walls or slabs and repair cracks which show any signs of leakage until all leakage is stopped.
- d. Pressure inject visible cracks, other than hairline cracks and crazing, in following areas with epoxy as specified in Section 03931.
 - 1) Floors and walls of water bearing structures.
 - 2) Walls and overhead slabs of passageways or occupied spaces, outsides of which are exposed to weather or may be washed down and are not specified to receive separate waterproof membrane.
 - 3) Other Items Not Specified to Receive Separate Waterproof Membrane: Slabs over water channels, wet wells, reservoirs, and other similar surfaces.
- e. Walls or slabs, as specified above, that leak or sweat because of porosity or cracks too small for successful pressure grouting: Seal on water or weather side by coatings of surface sealant system, as specified in this Section.
- f. Grouting and Sealing: Continue as specified above until structure is watertight and remains watertight for not less than one year after final acceptance or date of final repair, whichever occurs later in time.

3. Workmanship and Methods: Provide concrete work, including detailing of reinforcing, conforming with best standard practices and as set forth in ACI 318 and ACI Manual of Concrete Practice.

1.05 SUBMITTALS

- A. Product Data: Submit data completely describing products.
- B. Information on Heating Equipment to Be Used for Cold Weather Concreting: Submit information on type of equipment to be used for heating materials and/or new concrete in process of curing during cold weather.
- C. For conditions that promote rapid drying of freshly placed concrete such as low Humidity, high temperature, and wind: Submit corrective measures proposed for use prior to placing concrete.
- D. Copies of Tests of Concrete Aggregates: Submit certified copies of commercial laboratory tests not more than 90 days old for samples of each aggregate proposed for use in concrete aggregates.
 - 1. Fine Aggregate:
 - a. Clay lumps.
 - b. Reactivity.
 - c. Shale and chert.

- d. Soundness.
 - e. Color.
 - f. Decantation.
- 2. Coarse Aggregate:
 - a. Clay lumps and friable particles.
 - b. Reactivity.
 - c. Shale and chert.
 - d. Soundness.
 - e. Abrasion loss.
 - f. Coal and lignite.
 - g. Materials finer than 200 sieve.
- E. Sieve Analysis: Submit sieve analyses of fine and coarse aggregates being used at least every 3 weeks and at any time there is significant change in grading of materials.
- F. Concrete Mixes: Submit full details, including mix design calculations for concrete mixes proposed for use for each class of concrete.
 - 1. Include information on correction of batching for varying moisture contents of fine aggregate.
 - 2. Submit source quality test records with mix design submittal.
 - a. Include calculations for required average compression strength of concrete (f'_c) based on source quality test records.
- G. If There is Change in Aggregate Source, or Aggregate Quality from Same Source: Submit new set of design mixes covering each class of concrete.
- H. Test Batch Test Data:
 - 1. Submit data for each test cylinder.
 - 2. Submit data that identifies mix and slump for each test cylinder.
- I. Sequence of Concrete Placing: Submit proposed sequence of placing concrete showing proposed beginning and ending of individual placements.
- J. Curing Compound: Submit complete data on proposed compound.
- K. Repair of Defective Concrete: Submit mix design for grout.
- L. Acceptance of Method of Concrete Repair: Make no repair until the ENGINEER has accepted method of preparing surfaces and proposed method of repair.
- M. If Either Fine or Coarse Aggregate Is Batched from More than One Bin: Submit analyses for each bin, and composite analysis made up from these, using proportions of materials to be used in mix.
- N. Cement Mill Tests: Include alkali content, representative of each shipment of cement for verification of compliance with specified requirements.
- O. Pozzolan Certificate of Compliance: Identify source of Pozzolan and certify compliance with requirements of ASTM C 618.

- P. Admixtures: Manufacturer's catalog cuts and product data indicating compliance with standards specified.
 - 1. If air entraining admixture requires test method other than ASTM C 231 to accurately determine air content, make special note of requirements in submittal.
- Q. Information on mixing equipment.
- R. CONTRACTOR's report of field quality control testing for slump, temperature, unit weight, and air entrainment. Include designation numbers for associated compressive strength test cylinders with report.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping:
 - 1. Deliver, store, and handle concrete materials in manner as to prevent damage and inclusion of foreign substances.
 - 2. Deliver and store packaged materials in original containers until ready for use.
 - 3. Deliver aggregate to mixing site and handle in such manner that variations in moisture content will not interfere with steady production of concrete of specified degree of uniformity and slump.
- B. Acceptance at Site: Reject material containers or materials showing evidence of water or other damage.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Hot Weather Concreting:
 - a. When Ambient Air Temperature Is above 90 Degrees Fahrenheit: Prior to placing concrete, cool forms and reinforcing steel to by water cooling to below 90 degrees Fahrenheit.
 - b. Temperature of Concrete Mix at Time of Placement: Keep temperature below 90 degrees Fahrenheit by methods that do not impair quality of concrete.
 - 2. Cold Weather Concreting:
 - a. Concrete placed below ambient air temperature of 45 degrees Fahrenheit and falling or below 40 degrees Fahrenheit: Make provision for heating water.
 - b. If materials have been exposed to freezing temperatures to degree that any material is below 35 degrees Fahrenheit: Heat such materials.
 - c. Heating Water, Cement, or Aggregate Materials:
 - 1) Do not heat in excess of 160 degrees Fahrenheit.
 - d. Protection of Concrete in Forms:
 - 1) Protect by means of covering with tarpaulins, or other acceptable covering.
 - 2) Provide means for circulating warm moist air around forms in manner to maintain temperature of 50 degrees Fahrenheit for at least 5 days.

3. For conditions that promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind: Take corrective measures to minimize rapid water loss from concrete.
4. Furnish and use sufficient number of maximum and minimum self-recording thermometers to adequately measure temperature around concrete.

1.08 SEQUENCING AND SCHEDULING

- A. Schedule placing of concrete in such manner as to complete any single placing operation to construction, contraction, or expansion joint.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate:

1. General:
 - a. Provide concrete aggregates that are sound, graded as specified, and free of deleterious material in excess of allowable amounts specified.
 - b. Test for aggregate gradation in accordance with ASTM D 75 and C 136.
 - c. Provide unit weight of fine and coarse aggregate to produce in place concrete with weight of:
 - 1) Not less than 140 pounds per cubic foot for normal weight concrete.
 - 2) Not more than 115 pounds per cubic foot for lightweight concrete.
2. Aggregate for Normal Weight Concrete
 - a. Fine Aggregate:
 - 1) Provide fine aggregate conforming to ASTM C 33, except as modified in the following paragraphs.
 - 2) Deleterious Substances: Not in excess of following percentages by weight.

Item	Test Method	Percent
Shale or Chert	ASTM C 295	1
Clay Lumps	ASTM C 142	1

- b. Coarse Aggregate:
 - 1) General: Provide coarse aggregate conforming to the requirements of ASTM C 33, except as modified in the following paragraphs.
 - 2) Weight: Not exceeding 15 percent, for thin or elongated pieces having length greater than 5 times average thickness.
 - 3) Deleterious Substances: Not in excess of following percentages by weight, and in no case having total of all deleterious substances exceeding 2 percent.

Item	Test Method	Percent
Shale or chert	ASTM C 295	1
Coal and lignite	ASTM C 123	1/4

Clay lumps and friable particles	ASTM C 142	1/4
Materials finer than Number 200 sieve	ASTM C 117	1/2*
* Except when material finer than Number 200 sieve consists of crusher dust, maximum amount shall be 1 percent.		

4) Grading:

- a) As specified in ASTM C 33, Size Number 57, unless otherwise specified or authorized in writing by the ENGINEER.
- b) Aggregate for Class CE Concrete for Encasement of Electrical Conduits: Graded as specified in ASTM C 33, Size Number 8.

3. Aggregate for Lightweight Concrete

a. Fine Aggregate:

- 1) Provide fine aggregate conforming to ASTM C330.

b. Coarse Aggregate:

- 1) General: Provide coarse aggregate conforming to the requirements of ASTM C330.
- 2) Grading: As specified in ASTM C330 for 3/4 inch to No. 4, unless otherwise specified or authorized in writing by the ENGINEER.

B. Portland Cement:

- 1. General: Conform to specifications and tests for ASTM C 150, Types II or III, Low Alkali, except as specified otherwise.
- 2. Low Alkali Portland: Have total alkali containing not more than 0.60 percent.
- 3. Exposed Concrete in Any Individual Structure: Use only one brand of portland cement.
- 4. Cement for Finishes: Provide cement from same source and of same type as concrete to be finished.

C. Admixtures:

1. General:

- a. Do not use admixtures of any type, except as specified, unless written authorization has been obtained from the ENGINEER.
- b. Admixtures shall be compatible with concrete constituents and with other admixtures. All admixtures in a given mix shall be products of the same manufacturer to ensure compatibility.
- c. Admixtures for concrete that will be in contact with potable water shall be non-toxic and shall not impart taste or odor to the water. Admixtures shall be listed under NSF 61 or carry other approval, that is acceptable to the ENGINEER, for use in contact with potable water
- d. Do not use admixtures containing chlorides calculated as chloride ion in excess of 0.5 percent by weight.
- e. Use in accordance with manufacturer's recommendations and add each admixture to concrete mix separately.

2. Air Entraining Admixture:

- a. Provide entrained air of evenly dispersed air bubbles at time of placement.
- b. Conform to ASTM C 260.

3. Fly Ash Pozzolan Admixture:
 - a. Pozzolan:
 - 1) Conforming to requirements of ASTM C 618, Class F.
 - 2) Pozzolan may replace portland cement at ratio of 1.0 pound fly ash for each pound of portland cement replaced.
 - 3) Maximum of 20 percent by weight of minimum quantity of portland cement listed in Table A under paragraph 2.03D may be replaced with pozzolan.
 - 4) Do not use pozzolan as an admixture in concrete made with portland-pozzolan cement.
 - b. Loss on Ignition for Pozzolan: Not exceed four percent.
4. Water Reducing Admixture:
 - a. May be used at the CONTRACTOR's option.
 - b. Conform to ASTM C 494, Type A.
 - c. Not contain air entraining agents.
 - d. Liquid form before adding to the concrete mix.
 - e. No decrease in cement is permitted as result of use of water reducing admixture.
5. High-Range Water Reducer / Superplasticizer:
 - a. Conform to ASTM C 494, Type F or ASTM C 1017, Type I. Use shall produce non-segregating plasticized concrete with little bleeding and the physical properties of low water/cement ratio concrete. Admixture shall maintain treated concrete in a plasticized state for not less than 2 hours.

D. Water:

1. Water for Concrete, Washing Aggregate, and Curing Concrete: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.
2. Chlorides and Sulfate Ions:
 - a. Water for Conventional Reinforced Concrete: Use water not containing more than 1,000 (mg/L) of chlorides calculated as chloride ion, nor more than 1,000 (mg/L) of sulfates calculated as sulfate ion.

E. Non-slip Abrasive:

1. Type: Aluminum oxide abrasive of size 8/16, having structure of hard aggregate, homogenous, non-glazing, rustproof, and unaffected by freezing, moisture, or cleaning compounds.
2. Manufacturers: One of the following or equal:
 - a. Exolon Company, Tonawanda, New York.
 - b. Abrasive Materials, Incorporated, Hillsdale, Michigan.

F. Conduit Encasement Coloring Agent:

1. Color: Red color concrete used for encasement of electrical ducts, conduits, similar type items.
2. Manufacturers: One of the following or equal.
 - a. Frank D. Davis Company, Red Oxide Number 1117.
 - b. I. Reiss Company, Inc., equivalent product.
3. Conduit Encasement Concrete: Mix into each cubic yard of concrete 10 pounds of coloring agent.

G. Curing and Finishing Materials

1. General:
 - a. Materials shall be compatible with concrete and with other materials.
 - b. Curing and finishing materials for concrete that will be in contact with potable water shall be non-toxic and shall not impart taste or odor to the water. Materials shall be listed under NSF 61 or carry other approval that is acceptable to ENGINEER for use in contact with potable water.
2. Sprayed Membrane Curing Compound: Clear type with fugitive dye conforming to ASTM C 309, Type 1D.
3. Evaporation Retardant:
 - a. Manufacturers: One of the following or equal:
 - 1) Master Builders Technologies, Cleveland, Ohio, Confilm.
 - 2) Euclid Chemical Company, Cleveland, Ohio, Eucobar.
4. Plastic Membrane Curing: Use polyethylene film conforming to ASTM C 171 unless otherwise noted.
 - a. Color: White
 - b. Thickness: Minimum 6 mils.
 - c. Loss of Moisture: Not exceed 0.055 grams per square centimeter of surface when tested in accordance with ASTM C 156.

2.02 EQUIPMENT

A. Mixing Concrete:

1. Mixers may be of stationary plant, paver, or truck mixer type.
2. Provide adequate equipment and facilities for accurate measurement and control of materials and for readily changing proportions of material.
3. Mixing Equipment:
 - a. Capable of combining aggregates, cement, and water within specified time into thoroughly mixed and uniform mass and of discharging mixture without segregation.
 - b. Maintain concrete mixing plant and equipment in good working order and operated at loads, speeds, and timing recommended by manufacturer or as specified.
 - c. Proportion cement and aggregate by weight.

B. Machine Mixing:

1. Batch plant shall be capable of controlling delivery of all material to mixer within 1 percent by weight of individual material.
2. If bulk cement is used, weigh it on separate visible scale which will accurately register scale load at any stage of weighing operation from zero to full capacity.
3. Prevent cement from coming into contact with aggregate or with water until materials are in mixer ready for complete mixing with all mixing water.
4. Procedure of mixing cement with sand or with sand and coarse aggregate for delivery to project site, for final mixing and addition of mixing water will not be permitted.
5. Retempering of concrete (re-mixing of concrete that has started to take its initial set) will not be permitted.
6. Discharge entire batch before recharging.

7. Volume of Mixed Material Per Batch: Not exceed manufacturer's rated capacity of mixer.
8. Mixers:
 - a. Perform mixing in batch mixers of acceptable type.
 - b. Equip each mixer with device for accurately measuring and indicating quantity of water entering concrete, and operating mechanism such that leakage will not occur when valves are closed.
 - c. Equip each mixer with device for automatically measuring, indicating, and controlling time required for mixing.
 - 1) Interlock device to prevent discharge of concrete from mixer before expiration of mixing period.

C. Transit-mixed Concrete:

1. Mix and deliver in accordance with ASTM C 94.
2. Total Elapsed Time Between Addition of Water at Batch Plant and Discharging Completed Mix: Not to exceed 90 minutes nor 300 revolutions of the mixing drum. Under conditions contributing to quick setting, total elapsed time permitted may be reduced by the ENGINEER.
3. Temperature - Minimum and Maximum Allowable During Mixing and Transporting:
 - a. Minimum: 55°F
 - b. Maximum: 90°F
4. Equip each truck mixer with device interlocked so as to prevent discharge of concrete from drum before required number of turns and furnish such device that is capable of counting number of revolutions of drum.
5. Continuously revolve drum after it is once started until it has completely discharged its batch.
 - a. Do not admit water until drum has started revolving.
 - b. Right is reserved to increase required minimum number of revolutions or to decrease designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing. The CONTRACTOR will not be entitled to additional compensation because of such increase or decrease.

D. Other Types of Mixers: In case of other types of mixers, mixing shall be as follows:

1. Mix concrete until there is uniform distribution of materials, and discharge mixer completely before recharging.
2. Neither speed nor volume loading of mixer shall exceed manufacturer's recommendations.
3. Continue mixing for minimum of 1-1/2 minutes after all materials are in drum, and for batches larger than one cubic yard increase minimum mixing time 15 seconds for each additional cubic yard or fraction thereof.

2.03 MIXES

A. Measurements of Materials:

1. Measure materials by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the ENGINEER.
2. Furnish apparatus for weighing aggregates and cement that is suitably designed and constructed for this purpose.

3. Accuracy of Weighing Devices: Furnish devices that have capability of providing successive quantities of individual material that can be measured to within one percent of desired amount of that material.
4. Measuring or Weighing Devices: Subject to review by the ENGINEER, and bear valid seal of the Sealer of Weights and Measures having jurisdiction.
5. Weighing Cement:
 - a. Weigh cement separately.
 - b. Cement in Unbroken Standard Packages (Sacks): Need not be weighed.
 - c. Bulk Cement and Fractional Packages: Weigh such cement.
6. Mixing Water: Measured by volume or by weight.

B. Concrete Proportions and Consistency:

1. Concrete Consistency and Composition:
 - a. Provide concrete that can be worked readily into corners and angles of forms and around reinforcement without excessive vibration and without permitting materials to segregate or free water to collect on surface.
 - b. Prevent unnecessary or haphazard changes in consistency of concrete.
2. Ratio of Coarse Aggregate to Fine Aggregate: Not less than 1.0 nor more than 2.0 for all concrete Classes, with exception of Class CE.
3. Aggregate:
 - a. Obtain aggregate from source that is capable of providing uniform quality, moisture content, and grading during any single day's operation.
4. Concrete Mix Water to Cement Ratio, Minimum Cement Content, and Slump Range: Conform to values specified in Table A in this Section.
5. Concrete Batch Weights: Control and adjust so as to secure maximum yield, and at all times maintain proportions of concrete mix within specified limits.
6. Mixture Modification: If required, by the ENGINEER, modify mixture within limits set forth in this Section.
7. Admixtures: Provide admixtures as specified in this Section.
 - a. Air Entraining Admixture
 - 1) Add agent to batch in portion of mixing water.

2. Class A Concrete: Normal weight concrete with minimum weight of 140 pounds per cubic foot. Use Class A concrete at all locations except those where Classes B, C and CE are specified or indicated on the Drawings.
3. Class B Concrete: Normal weight concrete with minimum weight of 140 pounds per cubic foot. Class B concrete may be substituted for Class A concrete, when high-early strength concrete is needed in areas specifically accepted by the ENGINEER and that do not require sulfate resistant concrete.
4. Class C Concrete: Normal weight concrete with minimum weight of 140 pounds per cubic foot. Class C concrete may be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and where indicated on the Drawings.
5. Class CE Concrete: Normal weight concrete with minimum unit weight of 140 pounds per cubic foot. Use Class CE for electrical conduit encasements.
6. Class D Concrete: Lightweight concrete with maximum unit weight of 115 pounds per cubic foot. Use Class D for lightweight precast prestressed concrete roof framing including tees, inverted tee beams, rectangular roof beams.

"TABLE A" CONCRETE WITH AIR ENTRAINMENT						
Class	Specified Compressive Strength f'_c at 28 Days (pounds per square inch)	Aggregate Type	Ratio of Maximum Net Water to Cementitious Materials	Minimum Cementitious Materials per Cubic Yard of Concrete (by weight - pounds)	Slump Range (Inches)	Entrained Air (Percent)
A (Type II cement)	4,500	Normal weight	0.42	564	2 to 4*	6±1.5
B (Type III cement)	4,500	Normal weight	0.42	564	2 to 4*	6±1.5
C	2,500	Normal weight	0.62	423	3 to 6	5±1
CE	2,500	Normal weight	0.62	564	3 to 6	5±1
D	5,000	Light weight	0.45	658	2 to 4	5±1

* NOTE: Slump for slabs, decks, walks, and beams shall be not more than 3-1/2 inches. Slump for drilled piers shall be 5 inches ±1 inch.

7. Pumped Concrete: Provide pumped concrete that complies with all requirements of this Section.
8. Do not place concrete with slump outside limits indicated in Table A.
9. Classes:
 - a. Classes A, C, and CE Concrete: Make with Type II low alkali cement.
 - b. Class B Concrete: Make with Type III low alkali cement.

c. Class D Concrete: Make with Type II or Type III low alkali cement.

E. Admixtures:

1. Air Entraining Admixture:
 - a. Add agent to batch in portion of mixing water.
 - b. Batch solution by means of mechanical batcher capable of accurate measurement.

2.04 SOURCE QUALITY CONTROL

A. Tests:

1. Concrete Mixes:
 - a. Trial Batches
 - 1) After concrete mixes have been accepted by ENGINEER, have trial batches of the accepted Class A, Class B, and Class D concrete mix designs prepared by testing laboratory acceptable to the ENGINEER.
 - 2) Prepare trial batches for each class and slump range required within that class. Use cement and aggregates proposed to be used for the Work.
 - 3) Trial Batches: Provide batches of sufficient quantity to determine slump, workability, consistency, and finishing characteristics, and to provide sufficient test cylinders.
 - 4) Perform test batches and tests required to establish trial batches and acceptability of materials without change in Contract Price.
 - 5) If trial batch tests do not meet specified requirements for slump, strength, workability, consistency, drying shrinkage, and finishing, change concrete mix design proportions and, if necessary, source of aggregate. Make additional trial batches and tests until an acceptable trial batch is produced that meets requirements of this Section.
 - 6) Do not place concrete until the concrete mix design and trial batch have been accepted by ENGINEER.
 - b. Test Cylinders: Provide cylinders having six-inch diameter by 12-inch length and that are prepared in accordance with ASTM C 31 for tests specified in this Section.
 - 1) Test 8 cylinders from each trial batch for compressive strength in accordance with ASTM C 39.
 - a) Test 4 cylinders at 7 days and 4 at 28 days.
 - b) Establish ratio between 7 day and 28 day strength for mix. Seven-day strength may be taken as satisfactory indication of 28-day strength provided effects on concrete of temperature and humidity between 7 day and 28 day are taken into account.
 - 2) Average Compressive Strength of 4 Test Cylinders Tested At 28 Days shall be equal to or greater than required average compressive strength f'_{cr} on which concrete mix design is based.
 - c. Required Average Compressive Strength:
 - 1) Determine required average compressive strength (f'_{cr}) for selection of concrete proportions for mix design, for each class of concrete, using calculated standard deviation and its corresponding specified

compressive strength f'_c , in accordance with ACI 318, Part 3, Chapter 5.

- 2) When test records of at least 30 consecutive tests that span period of not less than 45 calendar days are available, establish standard deviation as described in ACI 318, Part 3, Chapter 5 and modified herein.
- 3) Provide test records from which to calculate standard deviation that represent materials, quality control procedures, and conditions similar to materials, quality control procedures, and conditions expected to apply to concrete for the Work.
- 4) Provide changes in materials and proportions within test records that are more restricted than those for the Work.
- 5) Specified Compressive Strength (f'_c) of Concrete Used in Test Records: Within 1,000 pounds per square inch of that specified for the Work.
- 6) When lacking adequate test records for calculation of standard deviation meeting requirements, determine required average compressive strength $f'_c r$ from following Table B.

TABLE B

Specified Compressive Strength f'_c (pounds per square inch)	Required Average Compressive Strength $f'_c r$ (pounds per square inch)
Less than 3,000	$f'_c + 1,000$
3,000 to 5,000	$f'_c + 1,200$

2. Pozzolan:
 - a. Sampling and Testing:
 - 1) Sample and test pozzolan in accordance with ASTM C 311.
 - 2) In Computing Water to Cement Ratio And Cement Content Per Cubic Yard Of Concrete: Consider cement weight to be weight of portland cement plus 100 percent of weight of fly ash.
3. Aggregate:
 - a. Testing of concrete aggregate is at CONTRACTOR's expense.
 - b. Sieves:
 - 1) Use sieves with square openings for testing grading of aggregates.
 - 2) Sieve Analyses: If sieve analyses indicate significant change in materials, the ENGINEER may require that new mix design be submitted and accepted before further placing of concrete.
 - c. Sample aggregate in accordance with ASTM D 75 and C 136.
 - d. Fine Aggregate:
 - 1) Provide fine aggregate not containing strong alkali nor organic matter which gives color darker than standard color when tested in accordance with ASTM C 40.
 - 2) Provide aggregate having soundness complying with requirements of ASTM C 33 when tested in accordance with ASTM C 88.
 - 3) Provide aggregate complying with reactivity requirements of ASTM C 33 when tested in accordance with ASTM C 289.
 - e. Coarse Aggregate:

- 1) Soundness when tested in accordance with ASTM C 88: Have loss not greater than 10 percent when tested with sodium sulfate.
- 2) Abrasion Loss: Not exceed 45 percent after 500 revolutions when tested in accordance with ASTM C 131.
- 3) Reactivity: Not exceed limits specified in Appendix of ASTM C 33 when tested in accordance with ASTM C 289.
- f. Portland Cement:
 - 1) Determination Alkali Content: Determine by method set forth in ASTM C 114.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Under conditions that result in rapid evaporation of moisture from the surface of the concrete, immediately after the concrete has been screeded, coat the surface of the concrete with a liquid evaporation retardant. Apply the evaporation retardant again after each work operation as necessary to prevent drying shrinkage cracks. Conditions which result in rapid evaporation of moisture may include one or more of the following:
 1. Low humidity.
 2. Windy conditions.
 3. High temperature.
- B. Joints and Bonding:
 1. As far as practicable construct concrete work as monolith.
 2. Locations of contraction, construction, expansion, and other joints are indicated on the Drawings or as specified in this Section.
 3. Construction Joints:
 - a. Where construction joints are not indicated on the Drawings, provide slabs and walls with construction joints at intervals not greater than 30 feet.
 - b. In order to preserve strength and watertightness of structures, make no other joints, except as authorized the ENGINEER.
 - c. At construction joints, thoroughly clean concrete of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter by means of heavy sandblasting, and wash surfaces just prior to succeeding concrete placement.
 - d. At Horizontal Joints: Immediately prior to resuming concrete placing operations, thoroughly spread bed of grout not less than 1/2 inch in thickness nor more than 1 inch in thickness over horizontal joint surfaces.
 4. Keyways in Joints:
 - a. Provide keyways in joints as indicated on the Drawings.
 - b. Treat lumber keyway material with form release coating, applied in accordance with manufacturer's instructions.
 5. Take special care to ensure that concrete is well consolidated around, below, and against waterstops and that waterstops are secured in proper position.
 6. Cleaning of Construction Joints:

- a. Wash construction joints free of sawdust, chips, and other debris after forms are built and immediately before concrete or grout placement.
 - b. Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, use vacuum cleaner for their removal, after which flush cleaned surfaces with water.
 - c. Provide cleanout hole at base of each wall and column for inspection and cleaning.
- 7. Expansion and Construction Joints
 - a. Constructed where and as indicated on the Drawings.
 - b. Waterstops, Expansion Joint Material, Synthetic Rubber Sealing Compound, and Other Similar Materials: As specified in Section 03150.
- 8. Repair of Concrete: Where it is necessary to repair concrete by bonding mortar or new concrete to concrete which has reached its initial set, first coat surface of set concrete with epoxy bonding agent.

C. Conveying and Placing Concrete:

- 1. Convey concrete from mixer to place of final deposit by methods that prevent separation or loss of materials.
- 2. Use chutes and equipment for pumping, and conveying concrete of such size and design as to ensure practically continuous flow of concrete at delivery end without separation of materials.
- 3. Design and use chutes and devices for conveying and depositing concrete that direct concrete vertically downward when discharged from chute or conveying device.
- 4. Keep equipment for conveying concrete thoroughly clean by washing and scraping upon completion of any day's placement.

D. Placing Concrete:

- 1. Place no concrete without prior authorization of the ENGINEER.
- 2. Do Not Place Concrete Until:
 - a. Reinforcement is securely and properly fastened in its correct position and loose form ties at construction joints have been retightened.
 - b. Dowels, bucks, sleeves, hangers, pipes, conduits, bolts, and any other fixtures required to be embedded in concrete have been placed and adequately anchored.
 - c. Forms have been cleaned and oiled as specified.
- 3. Placement of concrete in which initial set has occurred, or of retempered concrete, will not be permitted.
- 4. Place no concrete during rainstorms or high velocity winds.
- 5. Protect concrete placed immediately before rain to prevent water from coming in contact with such concrete or winds causing excessive drying.
- 6. Keep sufficient protective covering on hand at all times for protection of concrete.
- 7. After acceptance, adhere to proposed sequence of placing concrete, except when specific changes are requested and accepted by the ENGINEER.
- 8. Notify the ENGINEER in writing of readiness, not just intention, to place concrete in any portion of the work.

- a. Provide this notification in such time in advance of operations as the ENGINEER deems necessary to make final inspection of preparations at location of proposed concrete placing.
- b. Place forms, steel, screeds, anchors, ties, and inserts in place before notification of readiness is given to the ENGINEER.
- c. Depositing Concrete:
 - 1) Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing.
 - 2) Do not deposit concrete in large quantities in one place and work along forms with vibrator or by other methods.
 - 3) Do not drop concrete freely into place from height greater than 5 feet.
 - 4) Use tremies for placing concrete where drop is over 5 feet.
 - 5) Commence placement of concrete on slopes, at bottom of slope.
- 9. Place concrete in approximately horizontal layers not to exceed 24 inches in depth and bring up evenly in all parts of forms.
- 10. Continue concrete placement without avoidable interruption, in continuous operation, until end of placement is reached.
- 11. After placement begins, continue without significant interruption. Take precautions to prevent any delay from exceeding 20 minutes.
- 12. If concrete is to be placed over previously placed concrete and more than 20 minutes have elapsed, then spread layer of grout not less than 1/2 inch in thickness nor more than 1 inch in thickness over surface before placing additional concrete.
- 13. Placement of Concrete for Slabs, Beams, or Walkways:
 - a. If cast monolithically with walls or columns, do not commence until concrete in walls or columns has been allowed to set and shrink.
 - b. Allow set time of not less than one hour for shrinkage.

E. Consolidating Concrete:

- 1. Place concrete with aid of acceptable mechanical vibrators.
- 2. Thoroughly consolidate concrete around reinforcement, pipes, or other shapes built into the work.
- 3. Provide sufficiently intense vibration to cause concrete to flow and settle readily into place and to visibly affect concrete over radius of at least 18 inches.
- 4. Vibrators:
 - a. Keep sufficient vibrators on hand at all times to vibrate concrete as placed.
 - b. In addition to vibrators in actual use while concrete is being placed, have on hand minimum 1 spare vibrator in serviceable condition.
 - c. Place no concrete until it has been ascertained that all vibrating equipment, including spares, are in serviceable condition.
- 5. Take special care to place concrete solidly against forms so as to leave no voids.
- 6. Take every precaution to make concrete solid, compact, and smooth, and if for any reason surfaces or interiors have voids or are in any way defective, repair such concrete in manner acceptable to the ENGINEER.

F. Footings and Slabs on Grade:

1. Do not place concrete on ground or compacted fill until subgrade is in moist condition acceptable to the ENGINEER.
2. If necessary, sprinkle subgrade with water not less than 6 nor more than 20 hours in advance of placing concrete.
3. If it becomes dry prior to actual placing of concrete, sprinkle again, without forming pools of water.
4. Place no concrete if subgrade is muddy or soft.

G. Loading Concrete:

1. **Green Concrete:**
 - a. No heavy loading of green concrete will be permitted.
 - b. Green concrete is defined as concrete with less than 100 percent of the specified strength.
2. No backfill shall be placed against concrete walls until the concrete has reached the specified strength and the connecting slabs and beams have been cast and have reached the specified strength.
3. Use construction methods, sequencing, and allow time for concrete to reach adequate strength to prevent overstress of the concrete structure during construction.

H. Curing Concrete:

1. **General:**
 - a. Cure concrete by methods specified in this Section.
 - b. Cure concrete minimum of 7 days at average daily temperature not less than 50°F. In no case shall temperature of curing concrete drop below 40°F.
 - 1) Average daily temperature is calculated by summing hourly measurements of air temperature in the shade at the face of the concrete, and dividing the sum by 24. In calculating sum of the temperatures recorded, any measurement less than 50°F shall be recorded as 0°F and included in the sum.
 - c. Cure concrete to be painted or cast against adjacent concrete (including construction joints) with water or plastic membrane.
 - d. Do not use curing compound on concrete surfaces that are to receive paint or upon which any material is to be bonded.
 - e. Water cure or plastic membrane cure concrete slabs that are specified to be sealed by concrete sealer or to receive grout topping.
 - f. Cure other concrete by water curing or sprayed curing membrane at the CONTRACTOR's option.
 - g. Floor slabs may be cured using plastic membrane curing.
2. **Water Curing:**
 - a. Keep surfaces of concrete being water cured (including tops of walls) constantly and visibly moist day and night for period of not less than 7 days.
 - b. Each day forms remain in place may count as 1 day of water curing.
 - c. No further curing credit will be allowed for forms in place after contact has once been broken between concrete surface and forms.
 - d. Do not loosen form ties during period when concrete is being cured by leaving forms in place.

- e. When steel forms are used, leave forms in place minimum 48 hours. Application of water for curing shall commence only after, but within 1 hour of, the time forms are removed.
3. Sprayed Membrane Curing:
 - a. Apply curing compound to concrete surface after repairing and patching, and within 1 hour after forms are removed.
 - b. If more than 1 hour elapses after removal of forms, do not use membrane curing compound, but apply water curing for full curing period.
 - c. If surface requires repairing or painting, water cure such concrete surfaces.
 - d. Curing Compound:
 - 1) Do not remove curing compound from concrete in less than 7 days.
 - 2) Curing compound may be removed only upon written request by the CONTRACTOR and acceptance by the ENGINEER, stating what measures are to be performed to adequately cure structures.
 - 3) Remove curing compound placed within construction joint silhouette by heavy sandblasting prior to placing any new concrete.
 - 4) Apply curing compound by mechanical, power operated sprayer and mechanical agitator that will uniformly mix all pigment and compound.
 - 5) Apply compound in at least 2 coats.
 - 6) Apply each coat in direction 90 degrees to preceding coat.
 - 7) Apply compound in sufficient quantity so that concrete has uniform appearance and that natural color is effectively and completely concealed at time of spraying.
 - 8) Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
 - 9) Thickness and Coverage of Compound: Provide compound having film thickness that can be scraped from surfaces at any and all points after drying for at least 24 hours.
 - 10) The CONTRACTOR is cautioned that method of applying curing compound specified herein may require more compound than normally suggested by manufacturer of compound and also more than is customary in the trade.
 - 11) Apply amounts specified herein, regardless of manufacturer's recommendations or customary practice, if curing compound is used in place of water curing.
 - 12) If the CONTRACTOR desires to use curing compound other than specified compound, coat sample areas of concrete wall with proposed compound and also similar adjacent area with specified compound in specified manner for comparison.
 - a) If proposed sample is not equal or better, in opinion of the ENGINEER, in all features, proposed substitution will not be allowed.
 - 13) Prior to final acceptance of the work, remove, by sandblasting or other acceptable method, any curing compound on surfaces exposed to view, so that only natural color of finished concrete is visible uniformly over entire surface.
 4. Plastic Membrane Curing:

- a. Polyethylene film may be used to cure slabs. Seal joints and edges with small sand berm.
- b. Install plastic membrane as soon as concrete is finished and can be walked on without damage.
- c. Keep concrete moist under plastic membrane.

3.02 CONCRETE FINISHING

- A. Edges of Joints:
 1. Provide joints having edges as indicated on the Drawings.
 2. Protect wall and slab surfaces at edges against concrete spatter and thoroughly clean upon completion of each placement.

3.03 FIELD QUALITY CONTROL

- A. Testing Laboratory:
 1. OWNER will designate a testing laboratory for compression testing of field-cast concrete cylinders in accordance with ASTM C 39. Laboratory testing expenses will be paid by OWNER.
- B. Testing
 1. During progress of construction, sample concrete in accordance with ASTM C 172 and make tests to determine whether concrete produced complies with project specifications.
 2. CONTRACTOR's personnel to prepare test report including date and location of placement, name(s) of personnel performing tests, concrete batch delivery ticket number, concrete temperature, slump, unit weight, and air content.
 3. CONTRACTOR shall make, protect, and cure cylinders for compression strength testing in accordance with ASTM C 31.
 - a. Label cylinders to indicate location of pour and cylinder numbers.
 - b. Required number of cylinders for test set: Not less than 4 cylinder specimens, each 6 inches in diameter by 12 inches long. Two cylinders to be tested at 7 days, and two cylinders to be tested at 28 days.
 - c. Required number of test sets:
 - 1) Provide at least one test set for each class of concrete placed each day.
 - 2) Provide at least one test set for each half-day's placement of each class of concrete.
 - 3) Provide at least one test set for each 150 cubic yards of each class placed.
 4. Additional testing performed by CONTRACTOR's ACI-certified personnel:
 - a. Slump test in accordance with ASTM C 143.
 - 1) Test slump at the beginning of each placement, as often as necessary to keep slump within the specified range, and when requested to do so by the ENGINEER.
 - b. Temperature test in accordance with ASTM C 1064.
 - c. Test for unit weight in accordance with ASTM C 138.
 - d. Test for air content in accordance with ASTM C 231.

- 1) If air entraining admixture used requires testing methods other than ASTM C 231 to accurately determine air content, report testing requirements to ENGINEER well in advance of concrete placement.
- 2) Test percentage of entrained air at beginning of each placement, when requested by ENGINEER, and as often as necessary to maintain entrained air within specified range.

C. Enforcement of Specification Requirements

1. Compressive Strength.
 - a. Concrete is expected to reach higher compressive strength than that which is indicated in Table A as specified compressive strength f'_c .
 - b. Strength Level of Concrete: Will be considered acceptable if following conditions are satisfied.
 - 1) Average of all sets of 3 consecutive strength test results is greater or equal to specified compressive strength f'_c .
 - 2) No individual strength test (average of 2 cylinders) falls below specified compressive strength f'_c by more than 500 pounds per square inch.
 - 3) Whenever one, or both, of 2 conditions stated above is not satisfied, provide additional curing of affected portion followed by cores taken in accordance with ASTM C 42 and ACI 318 and comply with the following requirements:
 - a) If additional curing does not bring average of 3 cores taken in affected area to at least specified compressive strength f'_c , designate such concrete in affected area as defective.
 - b) The ENGINEER may require the CONTRACTOR to strengthen defective concrete by means of additional concrete, additional reinforcing steel, or replacement of defective concrete, all of the CONTRACTOR's expense.
2. Slump, Temperature, and Air Entrainment.
 - a. Do not use concrete that does not meet specification requirements in regards to slump, temperature, or air entrainment, but remove such concrete from project site.

3.04 ADJUSTING

A. Repair of Defective Concrete:

1. Remove and replace or repair defective work.
2. Correct defective work as specified in this Article.
3. Do not patch, repair, or cover defective work without inspection by the ENGINEER.
4. Provide repairs having strength equal to or greater than specified concrete for areas involved.
 - a. Chip out and key imperfections in the work and make them ready for repair.
5. Dry Pack Method:
 - a. Dry Pack Method: Use for holes having depth nearly equal to or greater than least surface dimension of hole, for cone-bolt, and narrow slots cut for repair.

- b. Smooth Holes: Clean and roughen by heavy sandblasting before repair.
- 6. Mortar Method of Replacement: Use for following:
 - a. Holes too wide to dry pack and too shallow for concrete replacement.
 - b. Comparatively shallow depressions, large or small, which extend no deeper than reinforcement nearest surface.
- 7. Concrete Replacement:
 - a. Use: When holes extend entirely through concrete section or when holes are more than 1 square foot in area and extend halfway or more through the section.
 - b. Method of Repair for Surfaces of Set Concrete to Be Repaired: First coat with epoxy bonding agent.
- 8. Acceptable Method of Concrete Repair:
 - a. Make no repair until the ENGINEER has accepted method of preparing surfaces and proposed method of repair.

END OF SECTION

SECTION 03366

TOOLED CONCRETE FINISHES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Tooled concrete finishes.

1.02 SUBMITTALS

- A. Description of coating manufacturer's recommended concrete surface finishes for new concrete scheduled to receive coatings under Section 09960.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping:
 - 1. Deliver and store packaged materials in original containers until ready for use.

PART 2 PRODUCTS

2.01 MIXES

- A. Mortar Mix for F4 Finish: Consist of 1 part cement and 1-1/2 parts of fine sand passing Number 100 screen, mixed with enough water and emulsified bonding agent to have consistency of thick cream.
- B. Mortar Mix for F5 Finish: Consist of 1 part cement to 1-1/2 parts of sand which passes Number 16 screen.

2.02 NON-SLIP ABRASIVE

- A. See Section 03300 for non-slip abrasive.

PART 3 EXECUTION

3.01 CONCRETE FINISHES

- A. General:
 - 1. Addition of white cement may be required to produce finish which matches color of concrete to be finished.
 - 2. During finishing of concrete flatwork, addition of water to mixes in place or concrete surfaces is not allowed. A concrete finishing agent/evaporation retardant may be used for surfaces other than those requiring water curing if approved in advance by the ENGINEER. Use of finishing agents shall not

relieve CONTRACTOR of responsibility to provide curing and protection specified.

3. Where concrete surfaces are scheduled to receive paints or coatings under Division 9, confirm surface finish and preparation recommended by paint or coating manufacturer, report any discrepancies between those requirements and this Section to ENGINEER, and confirm concrete finishes to be provided.

B. Vertical Concrete Surfaces: Use following finishes for vertical concrete surfaces.

1. F1 Finish: No special treatment other than repair defective work and fill depressions 1 inch or deeper and tie holes with mortar after removal of curing membrane.
2. F2 Finish: No special treatment other than repair defective work, remove fins, fill depressions 1/2 inch or deeper and tie holes with mortar after removal of curing membrane.
3. F3 Finish: Repair defective work, remove fins, offsets, and curing membrane, and grind projections smooth. Fill depressions 1/4 inch or larger in depth or width and tie holes with mortar after removal of curing membrane.
4. F4 Finish:
 - a. Same as specified for F3 Finish, and, in addition fill depressions and holes 1/16 inch or larger in width with mortar.
 - b. "Brush-Off" sandblast surfaces prior to filling holes to expose all holes near surface of the concrete.
 - c. Thoroughly wet surfaces and commence filling of pits, holes, and depressions while surfaces are still damp.
 - d. Perform filling by rubbing mortar over entire area with clean burlap, sponge rubber floats, or trowels.
 - e. Do not let any material remain on surfaces, except that within pits and depressions.
 - f. Wipe surfaces clean and moist cure.
5. F5 Finish: Receive same finish specified for F3 Finish, and, in addition, receive special stoned finish, in accordance with following requirements:
 - a. Remove forms and perform required repairs, patching, and pointing as specified in this Section.
 - b. Wet surfaces thoroughly with brush and rub with hard wood float dipped in water containing 2 pounds of portland cement per gallon.
 - c. Rub surfaces until form marks and projections have been removed.
 - d. Spread grindings from rubbing operations uniformly over surface with brush in such manner as to fill pits and small voids.
 - e. Moist cure brushed surfaces and allow to harden for 3 days.
 - 1) After curing, obtain final finish by rubbing with carborundum stone of approximately Number 50 grit until entire surfaces have smooth texture and are uniform in color.
 - 2) Continue curing for remainder of specified time.
 - f. If any concrete surface is allowed to become too hard to finish in above specified manner, sandblast and wash related surfaces exposed to view, whether finished or not.
 - 1) While still damp, rub over surface, plastic mortar, as specified for brushed surfaces and handstoned with Number 60 grit carborundum

stone, using additional mortar for brushed surfaces until surface is evenly filled without an excess of mortar.

- 2) Continue stoning until surface is hard.
- 3) After moist curing for 3 days, make surface smooth in texture and uniform in color by use of Number 50 or Number 60 grit carborundum stone.
- 4) After stoning, continue curing until 7 day curing period is completed.

C. Horizontal Concrete: Use following finishes for horizontal concrete surfaces:

1. S1 Finish: Screeding to grade and leave without special finish.
2. S2 Finish: Smooth steel trowel finish.
3. S3 Finish: Steel trowel finish free from trowel marks. Provide smooth finish free of all irregularities.
4. S4 Finish: Steel trowel finish, without local depressions or high points, followed by light hairbroom finish. Do not use stiff bristle brooms or brushes. Perform brooming parallel to slab-drainage. Provide resulting finish that is rough enough to provide nonskid finish. Finish shall be subject to review and acceptance by the ENGINEER.
5. S5 Finish: Nonslip abrasive: After concrete has been screeded level and hardened enough to support man standing on a board, sprinkle abrasive from shake screen into surface at uniform rate of 25 pounds for each 100 square feet of surface area, wood float into finish, then trowel abrasive into surface with steel trowel properly exposing abrasive in surface as required to provide nonslip surface.

D. Concrete Floor Surfaces to Which Surfacing Material Is Applied: Finish smooth with tolerance within 1/8 inch in 10 feet in any direction from lines indicated on the Drawings.

3.02 LOCATIONS FOR CONCRETE FINISHES

A. Finish concrete surfaces as indicated on the Drawings. Where not specified or indicated on the Drawings, finish surfaces as follows:

1. F4 Finish for Following Vertical Surfaces:
 - a. Concrete surfaces specified or indicated to be painted.
 - b. Concrete surfaces, interior or exterior, exposed to view. Includes surfaces in channels, basins, and similar structures to a point 12 inches below the normal operating water level.
2. F3 Finish for Following Vertical Surfaces:
 - a. Surfaces in channels, basins, and similar structures that are located more than 12 inches below the normal operating water level.
3. F2 Finish for Following Vertical Surfaces:
 - a. Concrete surfaces not exposed to view in the finished work.
4. S5 Finish for Following Surfaces:
 - a. Exterior ramps.
5. S4 Finish for Following Surfaces:
 - a. Exterior walkways.
 - b. Tops of exterior walls or beams which are to serve as walkways.
 - c. Tops of exterior walls or beams which are to support gratings.

6. S3 Finish for Following Surfaces:
 - a. Building and Machine Room Floors Which Are Not Covered with Surfacing Material.
7. S2 Finish for Following Surfaces:
 - a. Tops of corbels.
 - b. Tops of walls and beams not designated for S4 finish.
 - c. Tops of slabs not designated for S4.
 - d. All other horizontal surfaces not specified to be finished otherwise.
8. S1 Finish for Following Surfaces:
 - a. Basin bottoms to which layer of grout is to be applied.
 - b. Projecting footings which are to be covered with dirt.
 - c. Slab surfaces which are to be covered with concrete fill.

END OF SECTION

SECTION 03600

GROUTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete mortar.
 - 2. Drypack mortar.
 - 3. Epoxy grout.
 - 4. Grout.
 - 5. Non-shrink grout.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch or 50-millimeter cube specimens).
 - 1. C 230 - Standard Specification For Flow Table For Use In Tests Of Hydraulic Cement
 - 2. C 531 - Standard Test Method for Liner Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
 - 3. C 579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.
 - 4. C 939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
 - 5. C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - 6. C 1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

1.03 SUBMITTALS

- A. Non-Shrink Grout: Submit manufacturer's literature and certified test data prior to installation.
- B. Non-Shrink Epoxy Grout: Submit manufacturer's literature and certified test data prior to installation.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be delivered to the jobsite in their original, unopened packages or containers, clearly labeled with the manufacturer's product identification and printed instructions.
- B. All materials shall be stored in a cool dry place and in accordance with the manufacturer's recommendations.

C. All materials shall be handled in accordance with the manufacturer's instructions.

1.05 PROJECT/SITE CONDITIONS

A. Refer to manufacturer's literature or contact the manufacturer for any special physical or environmental limitations that may be required for use of products.

1.06 WARRANTIES

- A. Non-Shrink Grout: The manufacturer shall warranty that the non-shrink grout will never go below its initial placement volume when tested in accordance with ASTM C 1107.
- B. Non-Shrink Epoxy Grout: The manufacturer shall warranty that non-shrink epoxy grout will show negligible shrinkage or expansion when tested in accordance with ASTM C 531.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete Mortar:
 - 1. General: Consist of concrete mixture with coarse aggregate removed and water quantity adjusted as required.
 - 2. At Exposed Concrete Surfaces Not to Be Painted or Submerged in Water: White cement.
- B. Dry-Pack Mortar:
 - 1. Consist of mixture of portland cement and sand.
- C. Epoxy Grout:
 - 1. Consist of mixture of epoxy and sand.
 - 2. Sand: Clean, bagged, graded, and kiln dried silica sand.
- D. Grout:
 - 1. Consist of mixture of portland cement and sand.
- E. Non-Shrink Grout:
 - 1. Manufacturers: One of the following or equal:
 - a. Five Star Products, Inc., Fairfield, CT, Five Star Grout.
 - b. BASF, MBT, Cleveland, OH, Masterflow 928.
 - 2. Preportioned and prepackaged cement-based mixture. It shall contain no metallic particles such as aluminum powder and no metallic aggregate such as iron filings. It shall require only the addition of potable water.
 - 3. Potable Water for Pre-Soaking, Mixing, and Curing: Clean and free of oils, acids, alkalies, organics, and any other deleterious matter.
 - 4. Bleeding: Free from the emergence of mixing water from within or the presence of water on its surface.
 - 5. In accordance with ASTM C 1107.
 - 6. Consistency: Remain at a minimum flowable consistency for at least 45 minutes after mixing at 45 degrees Fahrenheit to 90 degrees Fahrenheit

when tested in accordance with ASTM C 230. If at a fluid consistency, it shall be verified in accordance with ASTM C 939.

7. Dimensional Stability (height change): In accordance with ASTM C 1107, volume-adjusting Grade B or C at 45 degrees to 90 degrees. It shall show 90 percent or greater bearing area under bases or baseplates.
8. Compressive Strength: Non-shrink grout shall show minimum compressive strengths at 45 degrees Fahrenheit to 90 degrees Fahrenheit in accordance with ASTM C 1107 for various periods from the time of placement, including 5,000 pounds per square inch at 28 days when tested in accordance with ASTM C 109 as modified by ASTM C 1107.

2.02 MIXES

- A. Concrete Mortar Mix:
 1. Use water-to-cementitious materials ratio that is no more than that specified for concrete being repaired.
 2. At Exposed Concrete Surfaces Not to Be Painted or Submerged in Water: Use sufficient white cement to make color of finished patch match that of surrounding concrete.
- B. Dry-Pack Mortar Mix: Use only enough water so that resulting mortar will crumble to touch after being formed into ball by hand.
- C. Epoxy Grout:
 1. Mix in accordance with manufacturer's installation instructions.
 2. Proportioning:
 - a. For Horizontal Work: Consist of mixture of 1 part epoxy as specified in Section 03071 with not more than 2 parts sand.
 - b. For Vertical or Overhead Work: Consist of 1 part epoxy gel as specified in Section 03071 with not more than 2 parts sand.
- D. Grout Mix:
 1. For Concrete Repair: Mix in same proportions used for concrete being repaired, with only sufficient water to give required consistency for spreading.
 2. For Spreading over the Surfaces of Construction or Cold Joints: Mix with no more water used than allowed by water-to-Cementitious materials ratio specified for concrete.
 3. For Other Applications: Mix in proportions by weight of 1 part cement to 4 parts of concrete sand.
- E. Non-Shrink Grout: Mix in accordance with manufacturer's installation instructions such that resulting mix has flowable consistency and is suitable for placing by pouring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect concrete surfaces to receive grout or mortar and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations, and all loose material or foreign matter likely to affect the bond or performance of grout or mortar.

- B. Inspect baseplate and anchor systems for rust, oil, and other deleterious substances that may affect the bond or performance of grout.
- C. Confirm that newly placed concrete has been cured sufficiently to attain its design strength and limit further shrinkage.
- D. Verify that temperature of cementitious or epoxy grout does not exceed manufacturer's recommendations.

3.02 PREPARATION

- A. Surface Preparation:
 - 1. Roughen all concrete surfaces by heavy sandblasting, chipping, or other mechanical means to assure bond. Loose or broken concrete shall be removed.
 - 2. All grease, oil, dirt, curing compounds, laitance, and other deleterious materials that may affect bond that were identified in the inspection process shall be completely removed from concrete and bottoms of baseplates. All metal surfaces should have a 2 to 3 mil peak-to-valley profile for epoxy grouts.
 - 3. For cementitious mortars and grouts, concrete shall be saturated surface damp. Any standing water shall be removed prior to placing grouts.
 - 4. For epoxy grouts, do not wet concrete surfaces with water. Instead, where required, wet surfaces with epoxy for horizontal work or epoxy gel for vertical or overhead work prior to placing epoxy grouts.
- B. Forms and Headboxes for Cementitious or Epoxy Grouts:
 - 1. Forms for grouts shall be built of material with adequate strength to withstand the placement of grouts.
 - 2. Forms must be rigid and liquid tight. All cracks and joints shall be caulked with an elastomeric sealant. All forms shall be lined with polyethylene for easy grout release. Forms carefully waxed with two coats of heavy-duty paste wax shall also be acceptable.
 - 3. Forms shall be 4 to 6 inches higher than the baseplate on one side of the baseplate configuration when using head pressure for placement.
 - 4. A sufficient number of headboxes shall be built to facilitate placement of grouts.
 - 5. Air relief holes a minimum 1/8 inch in diameter shall be provided when required by a baseplate configuration to avoid entrapping air underneath.

3.03 APPLICATION

- A. Cement Mortar and Grout:
 - 1. For Defective Concrete Repair:
 - a. Filling: Filling of voids around items through the concrete.
 - b. Grout Spreading: Spread over construction joints, cold joints, and similar type items.
 - 2. Concrete Surfaces:
 - a. Apply epoxy-bonding agent to clean, roughened, and dry surfaces before placing mortar or grout.
 - 3. Placing:
 - a. Exercise particular care in placing Portland cement mortar or grout since they are required to furnish structural strength, or impermeable water seal, or both.

- b. Do not use cement mortar or grout that has not been placed within 30 minutes after mixing.
- B. Epoxy Grout:
 - 1. Apply in accordance with manufacturer's installation instructions.
 - 2. Use where specified herein or where indicated on the Drawings.

3.04 PLACEMENT

- A. Grout shall only be installed after the final equipment alignment is correct and accepted by the ENGINEER.
 - 1. Grouts shall be mixed in accordance with the manufacturer's recommendations.
 - 2. Use mortar mixer with moving paddles for mixing grouts. For cementitious grouts, pre-wet the mixer and empty out excess water before beginning mixing.
 - 3. Cementitious Grouts:
 - a. Add non-shrink cementitious grout to a premeasured amount of water that does not exceed the manufacturer's maximum recommended water content.
 - b. Mix cementitious grouts per manufacturer's instructions for uniform consistency.
 - c. Grouts may be drypacked, flowed, or pumped into place. All baseplate grouting shall take place from one side of a baseplate to the other to avoid trapping air. Do not overwork grouts.
 - d. Do not retemper grout by adding more water after stiffening.
 - e. Hydrostatic head pressure shall be maintained by keeping the level of the grout in the headbox above the bottom of the baseplate. The headbox should be filled to the maximum level and the grout worked down to top of baseplate.
 - 4. Epoxy Grouts:
 - a. Epoxy grouts shall be mixed in complete units. Do not vary the ratio of components or add solvent to change the consistency of the mix.
 - b. Pour the hardener into the resin and mix for at least 1 minute and until each mixture is uniform in color. Pour the chemical components into the mortar mixer wheelbarrow and add the aggregate. Mix until aggregate is uniformly wetted. Over mixing will cause air entrapment in the mix.
 - c. All epoxy grout shall be flowed into place using a headbox. All grouting shall take place from one side of a baseplate to the other in a continuous flow to avoid trapping air.
 - d. Hydrostatic head pressure shall be maintained by keeping the level of grout in headboxes above the bottom of baseplates. Headboxes shall be filled to the maximum level and grout worked down to the bottom of baseplates.
 - e. Epoxy grouts shall not be cut back after setting. The final level of grout will be as installed with all chamfer edges built into the formwork.

3.05 CURING

- A. Cementitious Grouts:
 - 1. Grouts must be cut back to the lower edge of baseplates after reaching initial set. Provide a 45 degree angle cut back.

2. Clean equipment and tools as recommended by the grout manufacturer.
3. Cure grouts in accordance with manufacturer's specifications and recommendations. Keep grout moist for a minimum of 3 days. The method needed to protect grouts will depend on temperature, humidity, and wind. Wet burlap, a soaker hose, sun shading, ponding, and, in extreme conditions, a combination of methods shall be employed.
4. Grouts shall be maintained above 40 degrees Fahrenheit until they have attained a compressive strength of 3,000 pounds per square inch, or above 70 degrees Fahrenheit for a minimum of 24 hours to avoid damage from subsequent freezing.

B. Epoxy Grouts:

1. Cure grouts in accordance with manufacturers' specifications and recommendations. Do not wet cure epoxy grouts.
2. Consult the manufacturer for appropriate cure schedule. In no case should any surface in contact with epoxy grout be allowed to fall below 50 degrees Fahrenheit for a minimum of 48 hours after placement.

3.06 FIELD QUALITY CONTROL

- A. Non-shrink cementitious grouts shall be tested for 24 hour compressive strength in accordance with ASTM C 109.
- B. Non-shrink grouts shall be tested for 24 hour compressive strength in accordance with ASTM C 579, Method B.

END OF SECTION

SECTION 03700

MODIFICATIONS AND REPAIR TO EXISTING CONCRETE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor, materials, equipment and incidentals required to cut, repair, demolish, excavate or otherwise modify parts of existing structures or appurtenances as shown on the Drawings and as specified herein, including connecting new concrete to existing concrete, as necessary to complete the work under this Contract.

1.02 QUALITY ASSURANCE

- A. Do not cut, remove, or otherwise alter existing structures or concrete until authorization is given by the ENGINEER.
- B. When removing materials or portions of existing structures, and when making openings in existing structures, 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, nor to damage the structures or contents by falling or flying debris. Unless otherwise permitted, line drilling will be required in cutting existing concrete.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Epoxy Bonding Compound: Two component, moisture insensitive, heavy viscosity, high strength, rigid epoxy system that will bond under dry, damp or wet conditions, and is equal to BurkEpoxy MV or BurkEpoxy Mortar as manufactured by The Burke Company, Sikadur Hi-Mod as manufactured by Sika Chemical Corp., or Euco 615 Epoxy as manufactured by Euclid Chemical Company.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Take field measurements in the required structures to determine the amount of concrete to be removed and/or repaired and the amount of patching to be done.

3.02 CONSTRUCTION METHODS

- A. Where new concrete is to be made integral with existing concrete, use the methods shown in the Drawings.
- B. Mix and apply all bonding and patching materials in accordance with the manufacturer's instructions and recommendations.

3.03 MODIFYING OR REPAIRING EXISTING CONCRETE

- A. Remove concrete to the depths shown or required. Roughen contact surface by chipping, sandblasting, scarifying or other approved methods. Thoroughly clean the surface, removing loose particles and dust.
- B. Cut off projecting reinforcement when required to provide at least 1-inch cover. Where shown, bend reinforcement across cut face and cover with new concrete.
- C. Thoroughly wash the roughened concrete surfaces and keep the surfaces saturated for at least 6 hours before placing new concrete. Remove all free water prior to placing the concrete. An epoxy bonding compound, as specified, may be used in lieu of saturating surface for 6 hours.
- D. Place cement mortar, where required, to a thickness slightly in excess of the finished surface, and steel-trowel-finish, flush with the adjacent surface.
- E. When the finish surface of new concrete in exposed surfaces is not specified to be coated, match the color of the existing adjoining concrete as closely as possible.
- F. Mix cement mortar in the proportions of one part portland cement to two parts of sand by volume. Do not use accelerating admixtures in surface treatment. Where shown on the Drawings, use a non-shrink grout for patching and filling.

3.04 CONNECTIONS, NEW CONCRETE TO EXISTING CONCRETE

- A. Make connections to existing concrete as shown on the Drawings.
- B. Where it is necessary to expose existing reinforcement, clean the reinforcing rods or wire mesh by wire brushing and hook new reinforcement into existing reinforcement and lap or weld as directed. Provide at least 3/4-inch clearance around each bar.
- C. Mix and apply the epoxy in strict accordance with the printed instructions of the approved manufacturer.
- D. Preparation of Concrete Surfaces:
 1. Surfaces must be clean and sound. Surfaces may be dry, damp, or wet, but free of standing water. Remove dust, laitance, grease, curing compounds, impregnations, waxes, foreign particles, and disintegrated materials by

- mechanical abrasion methods such as sandblasting. Sandblast steel to appropriate finish.
- 2. If the concrete surfaces are sound and it is only necessary to remove laitance, grease or dust, the Contractor may, with the prior written approval of the Engineer, forego sandblasting and wash the concrete with a degreasing and etching chemical applied in accordance with the manufacturer's written instructions and as stipulated in these Specifications hereinafter.
- 3. Degreasing and Etching Chemical: ProSoCo, Inc., Sure-Klean Degreaser & Etch, or equal.
- 4. Application of Degrease and Etching Compound: As per manufacturer recommendations.

E. Application of Bonding Compound:

- 1. Cover the area to be overlayed with one coat of the epoxy compound applied with long-nap paint rollers, brushes, brooms, or by spray as per manufacturer's instructions.
- 2. Place the concrete while the epoxy compound is still tacky. If the bonding compound should harden before the concrete is placed, apply a fresh coat over the hardened coat and proceed.

F. Application of Grouting: To prepare a grout for anchor bolts or to level base plates, mix the compound as recommended by the manufacturer.

G. Weather Limitations: Place the epoxy compound only when both the concrete surface temperature and the ambient temperature are as recommended by the manufacturer.

3.05 OPENINGS IN CONCRETE

- A. Where openings are required for pipes, thimbles for gates, gate stems or other installations in existing concrete structures, cut the existing concrete within the limits required, as shown on Drawings or specified, expose the existing reinforcing steel and perform the work in such a manner as to prevent damage to the existing adjacent structures or equipment.
- B. Unless otherwise permitted, line drilling will be required.
- C. Where concrete is cut to provide openings for gate stems, accurately install pipe sleeves and grout in place in an approved manner.
 - 1. Clean the exposed reinforcement by wire brushing, then cut and bend to permit the installation and finally bend around the new pipe or thimble. Provide additional reinforcement as shown on the Drawings for typical reinforcing details of openings in walls and slabs, otherwise shown, specified or required.
 - 2. After installation of pipelines and thimbles, etc., prepare the existing concrete as specified above and fill the void between the outside of the pipe or thimble and the existing concrete with non-shrink non-metallic grout.

END OF SECTION

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SECTION 03926
CONCRETE REPAIR AND REHABILITATION

PART 1 GENERAL

1.01 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment and incidentals as shown, specified and required to repair or rehabilitate all existing concrete members, grout overlays and surfaces identified in the Contract Documents.
 - 2. Repair all damage to new concrete construction as specified herein, except that where such repairs are specified in Section 03300, Cast-in-Place Concrete.

- B. Coordination:
 - 1. Review installation procedures in the following Section and coordinate the installation of items that must be included with the repair and rehabilitation of concrete.

1.02 QUALITY CONTROL

- A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. ASTM C 109, Test Method for Compressive Strength of Hydraulic Cement Mortars.
 - 2. ASTM C 157, Test Method for Length Change of Hardened Cement Mortar and Concrete.
 - 3. ASTM C 882, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete.
 - 4. ASTM D 412, Test Methods for Vulcanized and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
 - 5. ASTM D 624, Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 6. ASTM D 903, Test Method for Peel or Stripping Strength of Adhesive Bonds.
 - 7. ASTM G 109, Test Method for Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments.

- B. Construction Tolerances: Construction tolerances shall be as specified in Section 03300, Cast-in-Place Concrete, except as specified herein and elsewhere in the Contract Documents.

1.03 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Submit manufacturer's product information and recommended placement procedures for all repair materials.

2. Submit Shop Drawings, when requested by ENGINEER, to show all methods for supporting existing structures, pipes, etc., during demolition and repair activities. Comply with the requirements of Section 01 33 00.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials:
 1. Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information.
 - a. Name or title of material.
 - b. Manufacturer's stock number and date of manufacture.
 - c. Manufacturer's name.
- B. Storage of Materials:
 1. Storage only acceptable project materials on project site.
 2. Store in a suitable location approved by ENGINEER. Keep area clean and accessible.
 3. Restrict storage to repair materials and related equipment.
 4. Comply with health and fire regulations including the Occupational Safety and Health Act of 1970.
- C. Handling of Materials:
 1. Handle materials carefully to prevent inclusion of foreign materials.
 2. Do not open containers or mix components until necessary preparatory Work has been completed and application Work will start immediately.

PART 2 PRODUCTS

2.01 REPAIR MORTAR

- A. Repair mortar shall be a prepackaged cement based product specifically formulated for the repair of concrete surface defects. The repair mortar shall be a one-component, portland cement, fast setting, trowel-grade mortar. The repair mortar shall be enhanced with a penetrating corrosion inhibitor and shall have the following properties:

Physical Property	Value	ASTM Standard
Compressive Strength (minimum)		
at 1 day	2000 psi	C 109
at 28 days	6000 psi	C 109
Bond Strength (minimum)		
at 28 days	1800 psi	C 882*
* Modified for use with repair mortars.		

- B. Where the least dimension of the placement in width or thickness, exceeds 1-inch, the repair mortar shall be extended by addition of aggregate as recommended by the manufacturer.

- C. Product and Manufacturer: Provide one of the following:
 - 1. SikaRepair 222 or SikaRepair 223 , as manufactured by Sika Corporation.
 - 2. Or equal.

2.02 BONDING AGENT

- A. Bonding agent shall be a three component epoxy modified cementitious product with an anti-corrosion ingredient.
- B. Product and Manufacturer: Provide one of the following:
 - 1. Sika Armatec 110 EpoCem, as manufactured by Sika Corporation.
 - 2. Or equal.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which repair Work is to be installed, and notify ENGINEER, in writing, of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.02 GENERAL

- A. Surface Preparation:
 - 1. The entire area to be repaired shall have all laitance, foreign material, and unsound concrete removed by chipping, abrasive blasting or hydroblasting. Size and effort of equipment shall be limited such that sound concrete is not removed or damaged. The surface shall be further roughened as specified herein. Where non-shrink grout or repair mortar is used, any additional surface preparation steps recommended by the manufacturer shall be performed.
 - 2. Where repair concrete, shotcrete, or cement grout is used, and a bonding agent is not required, or where the repair mortar or non-shrink grout manufacturer recommends a wet or saturated surface, water shall be delivered to the surface continuously for a minimum of four hours. Where large surface areas are to be repaired, fog spray nozzles mounted on stands shall be provided in sufficient numbers such that the entire surface to be repaired is in contact with the fog spray cloud. The concrete shall be prevented from drying until after the repair operation is completed or seven days, whichever is more. Unrepaired surfaces shall be rewetted by water spray on at least a daily basis. Should more than four days elapse without rewetting the unrepaired surfaces, the original saturating procedure shall be repeated. All standing water in areas to be repaired shall be removed prior to placement of repair material. Means to remove excess water from the structure shall be provided.
 - 3. Where the repair material manufacturer recommends the use of an epoxy-bonding agent, the recommendations of both the repair material and bonding agent manufacturers shall be followed.
- B. Care shall be taken to fully consolidate the repair material, completely filling all portions of the area to be filled.

- C. The repair surface shall be brought into alignment with the adjacent existing surfaces to provide a uniform, even surface. The repair surface shall match adjacent existing surfaces in texture and shall receive any coatings or surface treatments which had been provided for the existing surface.
- D. Curing:
 - 1. Curing of repair mortar shall be according to the manufacturer's recommendations except that the minimum cure period shall be seven days.
 - 2. Curing of other materials shall be according to Section 03300, Cast-in-Place Concrete.

3.03 TREATMENT OF SURFACE AND GROUT DEFECTS

- A. Surface defects are depressions in a concrete or grout surface which do not extend all the way through the member. The depressions can result from the removal of an embedded item, the removal of an intersecting concrete member, physical damage, unrepaired rock pockets created during original placement, or spalls from corroded reinforcing steel or other embeds.
- B. Preparation:
 - 1. Test for delaminated grout by striking with a wood 2 x 4 or a hammer. Where a hollow sound is encountered, remove poorly adhered grout.
 - 2. All loose, damaged concrete and grout shall be removed by chipping to sound material.
 - 3. Where existing reinforcing bars are exposed, concrete shall be removed to a minimum of 1-inch all around the bars. If the existing bars are cut through, cracked, or the cross sectional area is reduced by more than 25 percent, the ENGINEER shall be notified immediately.
 - 4. The perimeter of the damaged area shall be score cut at a right angle to the concrete surface to a minimum depth of 0.5-inch and a maximum depth to not cut any existing reinforcing steel. Existing concrete shall be chipped up to the score line so that the minimum thickness of repair mortar is 0.5-inch. "Feather Edges" will not be permitted.
- C. Repair Material:
 - 1. Repair of surface defects in members, which are normally in contact with water or soil, or in the interior surfaces of enclosed chambers that contain water shall be made only with repair mortar.
 - 2. Repair of other surface defects may be by the application of repair mortar, repair concrete, shotcrete, or cement grout, as appropriate.

3.04 PATCHING OF HOLES IN CONCRETE

- A. For holes larger than 48-inches, refer to the Drawings for reinforcement details.

3.05 REPAIR OF DETERIORATED CONCRETE

- A. This Section pertains to concrete which has been damaged due to corrosion of reinforcing steel, physical damage due to abrasion, and wear due to age.
- B. Surface Preparation:
 - 1. All loose, broken, softened, and acid contaminated concrete shall be removed by abrasive blasting and chipping down to sound, uncontaminated concrete.

2. When the removal of deteriorated concrete is completed, CONTRACTOR to notify the ENGINEER, in writing. Two weeks shall be scheduled for the ENGINEER to inspect the surface, perform testing for acid contamination, determine if additional concrete must be removed, and to develop any special repair details that may be required. Should it be determined that additional concrete must be removed to reach sound, uncontaminated material, another two week period shall be scheduled for further evaluation after the end of the additional removal.
3. Additional surface preparation shall follow the recommendations of the repair mortar manufacturer.
4. Isolated areas of exposed reinforcing bars shall be treated as required for repair of surface defects. If extensive areas of reinforcement are uncovered after removal of deteriorated concrete, repair methods shall be as determined by the ENGINEER.

C. Repair Mortar Placement:

1. The procedures recommended by the manufacturer for the mixing and placement of the repair mortar shall be followed.
2. After the initial mixing of the repair mortar, additional water shall not be added to change the consistency should the mix begin to stiffen.
3. Apply bonding agent per manufacturer's recommendations. Do not exceed open time before applying repair mortar. If temperature in area is greater than 95°F, contact manufacturer.
4. Repair mortar shall be placed to a minimum thickness as recommended by the manufacturer, but not less than 0.50-inch. Where removal of deteriorated concrete results in a repair thickness of less than 0.5-inch to return to original concrete surface location in isolated areas totaling less than ten percent of the total repair area, additional concrete shall be removed to obtain the 0.5-inch thickness. Where the area with repair thickness of less than 0.5-inch exceeds ten percent of the total repair area, notify the ENGINEER. In any case, repair mortar shall be added so that the minimum cover over existing reinforcing steel is 2-inches. Do not place repair mortar so as to create locally raised areas. Where there is a transition with wall surfaces which are not in need of repair, the repair mortar shall not be feathered at the transition. A score line shall be sawcut to not less than the minimum repair mortar depth and concrete chipped out to it to form the transition. Care shall be taken to not cut or otherwise damage any reinforcing steel.
5. The repair mortar shall be placed to an even, uniform plane to restore the member to its original surface. Tolerance for being out of plane shall be such that the gap between a 12-inch straight edge and the repair mortar surface does not exceed 0.125-inch and the gap between a 48-inch straight edge and the repair mortar surface does not exceed 0.25-inch. This shall apply to straight edges placed in any orientation at any location.

D. Finishing:

1. The repair mortar shall receive a smooth, steel trowel finish of similar texture as the existing.

E. Curing:

1. Curing shall be performed as recommended by the repair mortar manufacturer, except that the cure period shall be at least 24 hours and shall be by means of a continuous fog spray. If the manufacturer recommends the use of a curing compound, no material shall be used that would interfere with

the bond of the protective coating system or adhesive used for placing PVC lining, where required.

3.06 EXPOSED REBAR REPAIR

- A. The entire area to be repaired shall have all corrosion, foreign materials, and unsound concrete by means of abrasive blasting or hydroblasting.
- B. Surface shall be visually dry before application of the corrosion inhibitor. The corrosion inhibitor shall be placed liberally to achieve 100 sq ft/gal coverage in two or more coats by allowing it to soak into the substrate. The re-coat time between coats shall be a minimum of one hour. Apply by use of rollers, brushes, or hand-pressure spray equipment.
- C. After the last coat of the corrosion inhibitor is applied, a minimum curing time of 24 hours is required.
- D. For mortar coating, refer to Paragraph 3.05.C, Repair Mortar Placement, Paragraph 3.05.D, Finishing, and Paragraph 3.05.E, Curing.

3.07 FIELD QUALITY CONTROL

- A. CONTRACTOR shall employ a testing laboratory to perform field quality control testing.
- B. ENGINEER will direct the CONTRACTOR on the number of standard compression tests and specimens required as specified below, under the direct inspection by ENGINEER.
- C. CONTRACTOR shall furnish all necessary assistance required by ENGINEER. Provide all labor, material and equipment required including rods, molds, thermometer, curing in a heated storage box, and all other incidentals required. Above will be subject to approval by ENGINEER. Furnish all necessary storage, curing, and transportation required by the testing.
- D. Repair Concrete: Repair concrete shall be tested as required in Section 03300, Cast-in-Place Concrete.

END OF SECTION

SECTION 03931

EPOXY INJECTION SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Epoxy injection system.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. D 638 - Standard Test Method for Tensile Properties of Plastics.
 - 2. D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
 - 3. D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.03 SUBMITTALS

- A. Product data: Submit manufacturer's data completely describing epoxy injection system materials.
- B. Quality control submittals:
 - 1. Certificates of Compliance.
 - 2. Manufacturer's Instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manufacturers: One of the following or equal:
 - 1. BASF, MBT, Concresive Standard LVI.
 - 2. Sika Chemical Corp., Sikadur 35, Hi-Mod LV.
- B. Epoxy:
 - 1. Provide epoxy materials that are new and use them within shelf-life limitations set forth by manufacturer.
 - 2. Water-insensitive 2-part type low viscosity epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified:

Physical Characteristic	Test Method	Required Results
Tensile Strength	ASTM D 638	8,000 pounds per square inch at 14 days.
Flexure Strength	ASTM D 790	11,000 pounds per square inch at 14 days.
Compressive Strength	ASTM D 695	11,000 pounds per square inch at 24 hours.

Physical Characteristic	Test Method	Required Results
Bond Strength	--	Concrete shall fail before failure of epoxy.
Gel Time for 5 Mil Film	--	4 hours maximum.
Elongation	ASTM D 638	1 percent minimum at 14 days.

2.02 EQUIPMENT

- A. Pump unit:
 - 1. Furnish unit to be used for injection that is positive displacement type with interlock to provide in-line mixing and metering system for 2 component epoxy.
 - 2. Furnish pressure hoses and injection nozzle of such design as to allow proper mixing of 2 components of epoxy.
 - 3. Presence of standby injection unit may be required.

2.03 MIXES

- A. Epoxy injection system materials:
 - 1. Mix epoxy in accordance with manufacturer's installation instructions.
 - 2. Do not use solvents to thin epoxy system materials introduced into cracks or joints.

PART 3 EXECUTION

3.01 PREPARATION

- A. Surface preparation:
 - 1. Epoxy injection system:
 - a. General: Before processing, sweep or clean area in vicinity of crack location to receive epoxy and leave in generally clean condition.
 - b. Joints to receive epoxy: Clean in manner such that joints are free from dirt, laitance, and other loose matter.

3.02 INSTALLATION

- A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.
- B. Perform and conduct work of this Section in neat, orderly manner.
- C. Epoxy injection system:
 - 1. Apply adequate surface seal to crack or joint to prevent escape of epoxy.
 - 2. Establish entry points at distance along seal not less than thickness of cracked member.
 - 3. Force epoxy into crack at first port with sufficient pressure to advance epoxy to adjacent port.
 - 4. Seal original port and shift entry to port at which epoxy appears.

5. Continue this manner of port-to-port injection until each joint has been injected for its entire length.
6. For small amounts, or where excessive grout pressure developed by pump unit might further damage structure, premixed material and hand caulking gun may be used if acceptable to the ENGINEER.
7. Seal ports, including adjacent locations where epoxy seepage occurs, as necessary to prevent drips or run out.
8. After epoxy injection is complete, remove surface seal material and refinish concrete in area where epoxy was injected to match existing concrete.

END OF SECTION

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SECTION 06611

FIBERGLASS REINFORCED PLASTIC FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Fiberglass reinforced plastic fabrications including:
 - 1. Weirs.
 - 2. Baffles.

PART 2 PRODUCTS

2.01 WEIRS AND BAFFLES

- A. Manufacturers: One of the following or equal:
 - 1. MFG Water Treatment Products Company, Union City, PA
 - 2. F. B. Leopold Company.
 - 3. Warminster Fiberglass Company.
 - 4. Chemical Proof Corporation, Arlington, WA.
 - 5. LaValley Construction, Biloxi, MS.
 - 6. Norcore Plastics, Inc., Tacoma, WA.
 - 7. Fibrex Corporation, Burlington, WA.
 - 8. Specialty Plastics, Inc., Baton Rouge, LA.
 - 9. Xerxes Corporation, Anaheim, CA.
 - 10. Paramount Plastics, Rancho Cucamonga, CA.
 - 11. Ershigs, Inc., Bellingham, WA.
 - 12. Corrosion Controllers, Inc., Washougal, WA.
 - 13. Fibercast, Sand Springs, OK.
- B. Materials:
 - 1. Hand lay-up construction.
 - 2. Minimum Corrosion Liner:
 - a. One "C" or Nexus veil as specified for the service environment.
 - b. Remainder 1-1/2 ounce per square foot mat to total minimum thickness of 0.096 inches on surface exposed to the service environment.
 - 3. Ultraviolet Stabilizer: Added to the exterior surface coat of fabrications intended for outside service, in the type and amount recommended by the resin manufacturer.
 - 4. Resin: Premium grade vinyl ester, manufactured by one of the following or equal as recommended by the resin manufacturer for the specific operating environment:
 - a. Ashland Chemical Company, Derakane 411-350.
 - b. Ashland Chemical Company, Hetron 922.
 - c. Reichhold Inc., Reichhold Dion VER 9100.
 - d. Interplastic Corporation, Interplastic VE 8300.
 - 5. Color: Natural, unless otherwise specified.

C. Fabrication:

1. Baffles: Hand lay-up components to specified shape and dimensions.
2. Weirs:
 - a. Match die molded.
 - b. Weir Plates:
 - 1) Of shape and dimensions specified.
 - 2) Provide 2-1/2 inch diameter holes for adjustment.
 - 3) Resin coat cut edges, and drilled and countersunk holes in fiberglass reinforced plastic fabrications.
 - c. Furnish fiberglass reinforced plastic butt plates for joints.
 - d. Washers:
 - 1) Of same material as weirs, with surfaces smooth, free of voids, and without dry spots and crazes.

D. Design Criteria and Chemical Exposure: As specified for the application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for installation of products as specified.

3.02 ERECTION AND INSTALLATION, GENERAL

A. Install products where indicated on the Drawings in accordance with manufacturer's printed instructions.

3.03 WEIR PLATES

- A. Fasten to concrete with stainless steel anchor bolts or concrete anchors.
- B. Seal edge between concrete and weir with synthetic rubber.
- C. Use stainless steel washers under nuts.

END OF SECTION

SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Acrylic-Latex sealant.
 - 2. Precast concrete joint sealant.
 - 3. Silicone sealant.
 - 4. Synthetic rubber sealing compound.
 - 5. Synthetic sponge rubber filler.
 - 6. Related materials.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. M 198 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
- B. ASTM International (ASTM):
 - 1. C 920 - Standard Specification for Elastomeric Joint Sealants.
 - 2. D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - 3. D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
- C. Federal Specification (FS):
 - 1. FS TT-S-00227e - Sealing Compound, Elastomeric Type, Multi-Component.

1.03 SUBMITTALS

- A. Product data.
- B. Samples, include color selections.
- C. Manufacturer's Installation Instructions.
- D. Warranty.

1.04 QUALITY ASSURANCE

- A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.
- B. Installer qualifications: Manufacturer approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.

1.05 PROJECT/SITE CONDITIONS

- A. Environmental requirements: Do not apply sealant on wet or frosty surfaces or when surface temperature is higher than 100 degrees Fahrenheit or lower than recommended by the manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products in accordance with manufacturer's recommendations.
- B. Code date packages. Do not use material older than manufacturer's published shelf life. Store materials at temperatures lower than 80 degrees Fahrenheit. Condition materials in accordance with manufacturer's instructions prior to installation.

1.07 SEQUENCING AND SCHEDULING

- A. Caulk joints prior to painting.

1.08 WARRANTY

- A. Warrant to correct defective products for minimum 5 years in accordance with manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 ACRYLIC-LATEX SEALANT

- A. Permanently flexible, nonstaining, and nonbleeding latex modified acrylic sealant compound, colors as selected by ENGINEER from manufacturer's standard options. Manufacturers: One of the following or equal:
 1. Tremco, Tremflex 834.
 2. Pecora Corp., Number AC-20.
 3. Sonneborn, Sonolac.

2.02 PRECAST CONCRETE JOINT SEALANT

- A. Preformed, cold-applied, ready-to-use, flexible joint sealant in accordance with ASTM C990 and AASHTO M 198. Manufacturers: One of the following or equal.
 1. Henry Corporation, Ram-Nek.
 2. Concrete Sealants Division, ConSeal.

2.03 SILICONE SEALANT

- A. ASTM C 920, Type S, Grade NS, Class 25, single component silicone sealant. Manufacturers: One of the following or equal:
 1. Tremco, Proglaze.
 2. Pecora Corp., Number 864.
 3. Dow Corning, Number 795.
 4. General Electric, Number 1200 Series.

2.04 SYNTHETIC RUBBER SEALING COMPOUND

- A. Manufacturer: One of the following or equal:
 - 1. Sika Corporation, Lyndhurst, NJ, Sikaflex 2c NS or SL
 - 2. Polymeric Systems, Inc., PSI 275.
 - 3. Pacific Polymers, Garden Grove, CA, Elastothane 227R.
- B. Material: In accordance with ASTM C 920 Type M, Grade P (pourable), Class 25 and Type M, Grade NS (non-sag), Class 25; multi-part polyurethane; able to cure at room temperature to firm, highly resilient rubber; able to perform satisfactory when continuously submerged in water or sewage and exposed to direct sunlight in dry condition; with the following properties determined at 75 degrees Fahrenheit and 50 percent relative humidity:
 - 1. Base: Polyurethane rubber.
 - 2. Solids: Minimum 97 percent.
 - 3. Application time: Minimum 2 hours.
 - 4. Cure time: Maximum 3 days.
 - 5. Tack free time: 24 hours.
 - 6. Ultimate hardness: Non-sag 25, Pourable/SL 40, within 5 Shore A.
 - 7. Tensile strength: Non-sag 120 pounds per square inch minimum and Self-leveling minimum 170 pounds per square inch when tested in accordance with ASTM D 412.
 - 8. Ultimate elongation: Minimum 490 percent when tested in accordance with ASTM D 412.
 - 9. Tear resistance: Non-sag 45 pounds per inch minimum and Self-leveling minimum 85 pounds per inch when tested in accordance with ASTM D 624, Die C.
 - 10. Service temperature range: Minus 25 degrees to 158 degrees Fahrenheit.
- C. Color: Gray to match concrete, unless indicated on the Drawings.

2.05 SYNTHETIC SPONGE RUBBER FILLER

- A. Closed-cell expanded sponge rubber manufactured from synthetic polymer neoprene base, or resilient polyethylene foam backer rod. Manufacturers: One of the following or equal:
 - 1. Presstite, Number 750.3 Ropax Rod Stock.
 - 2. Rubatex Corp., Rubatex-Cord.
- B. Characteristics:
 - 1. Suitable for application intended.
 - 2. Strength: As necessary for supporting sealing compound during application.
 - 3. Resiliency: Sufficient resiliency to prevent significant load transfer across joint.
 - 4. Resistance to environmental conditions of installation.
 - 5. Bonding: No bonding to the sealing compound.
 - 6. Structure: Cellular, prevents wicking or absorption of water.
 - 7. Compatibility with other materials in joint and acceptance by manufacturer of sealing compound.
 - 8. Size: Minimum 25 percent greater than nominal joint width.

2.06 RELATED MATERIALS

- A. Primer: Nonstaining type, recommended by sealant manufacturer to suit application.

- B. Joint cleaner: Noncorrosive, nonstaining, compatible with joint forming materials and as recommended by sealant manufacturer.
- C. Bond breaker tape: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify acceptability of joint dimensions, physical, and environmental conditions.
- B. Verify that surfaces are dry, clean, and free of dirt, grease, curing compound, and other residue which might interfere with adhesion of sealants.

3.02 PREPARATION

- A. Allow concrete to cure thoroughly before caulking.
- B. Synthetic sponge rubber filler:
 - 1. Prepare surfaces designated to receive filler in accordance with manufacturer's installation instructions.
 - 2. Do not stretch filler beyond its normal length during installation.
- C. Caulking:
 - 1. Verify that surfaces are dry, clean, and free of dirt, grease, curing compounds, and other residue that might interfere with adhesion of caulking compound.
 - 2. Concrete, masonry, wood, and steel surfaces: Clean and prime in accordance with manufacturer's instructions prior to caulking.
- D. Synthetic rubber sealing compound:
 - 1. Ensure surfaces to which synthetic rubber must bond are dry and free of dust, dirt, and other foreign residue.
 - 2. Heavy sandblasted caulking groove to sound surface, and prime with manufacturer's recommended primer for particular surface.
- E. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but neither more than 5/8 inches deep nor less than 3/8 inches deep.
- F. For normal moving building joints sealed with elastomeric sealants not subject to traffic, fill joints to depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
- G. For joints sealed with acrylic-latex sealants, fill joints to depth in range of 75 percent to 125 percent of joint width.
- H. Use joint filler to achieve required joint depths, to allow sealants to perform properly.
- I. Prepare surfaces and install synthetic sponge rubber filler in accordance with manufacturer's recommendations.

- J. Do not stretch filler beyond normal length during installation.
- K. Apply bond breaker when recommended by joint sealer manufacturer.

3.03 INSTALLATION

- A. Synthetic sponge rubber filler: Install filler in accordance with manufacturer's installation instructions.
- B. Caulking, joints, and sealing:
 - 1. Construct expansion, contraction, and construction joints as indicated on the Drawings.
 - 2. Install pipe and conduit in structures as indicated on the Drawings.
 - 3. Caulk doors, windows, louvers, and other items installed in or over concrete openings inside and out.
 - 4. Use synthetic rubber sealing compound for caulking where indicated on the Drawings or as specified, except for masonry construction and where specified otherwise.
 - 5. Complete caulking prior to painting.
 - 6. Verify that concrete is thoroughly cured prior to caulking.
 - 7. When filler compressible material is used, use untreated type.
 - 8. Apply caulking with pneumatic caulking gun.
 - 9. Use nozzles of proper shape and size for application intended.
 - 10. Maintain continuous bond between caulking and sides of joint to eliminate gaps, bubbles, or voids and fill joint in continuous operation without layering of compound.
 - 11. Employ experienced applicators to caulk joints and seams in neat workmanlike manner.
 - 12. To hasten curing of compound when used on wide joints subject to movement, apply heat with infrared lamps or other convenient means.
 - 13. Apply synthetic rubber sealing compound with pneumatic caulking tool or other acceptable method.

3.04 CLEANING

- A. Clean surfaces adjacent to sealant as work progresses.
- B. Remove excess uncured sealant by soaking and scrubbing with sealant cleaning solvent.
- C. Remove excess cured sealant by sanding with Number 80 grit sandpaper.
- D. Leave finished work in neat, clean condition.

3.05 SCHEDULE

- A. Synthetic rubber sealing compound, non-sag Type II:
 - 1. Use where indicated on the Drawings.
 - 2. Water-bearing and earth-bearing concrete structures.
 - 3. Joints in masonry, concrete vertical surfaces, and metal-faced panels in vertical surfaces.
 - 4. Joints between sheet metal flashing and trim.
 - 5. Joints between sheet metal flashing and trim, and vertical wall surfaces.

6. Small voids between materials requiring filling for weathertight performance in vertical surfaces.
7. Perimeters of frames of doors, windows, louvers, and other openings where bonding is critical to airtight performance.
8. Expansion and control joints in masonry vertical surfaces.

B. Synthetic rubber sealing compound, self-leveling Type I:

1. Use where indicated on the Drawings.
2. Expansion and control joints in masonry, concrete horizontal surfaces, and metal panels in horizontal surfaces.
3. Small voids between materials requiring filling for weathertight performance in horizontal surfaces.
4. Pavement joints.
5. Perimeters of frames of doors, windows, louvers, and other openings in horizontal surfaces where bonding is critical to airtight performance.

C. Silicone:

1. Use where indicated on the Drawings.
2. Joints and recesses formed where window, door, louver and vent frames, and sill adjoin masonry, concrete, stucco, or metal surfaces.
3. Door threshold bedding.
4. Moist or wet locations, including joints around plumbing fixtures.
5. Stainless steel doors and frames, including joints between applied stops and frames, and around anchor bolts.
6. Plenum joints.

D. Acrylic latex:

1. Use where indicated on the Drawings.
2. Interior joints with movement less than 7.5 percent and not subject to wet conditions.

END OF SECTION

SECTION 09960

COATINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Field applied coatings.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. D 4262-83 - Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
 - 2. D 4263-83 - Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - 3. D4285-83 - Test Method for Indicating Oil or Water in Compressed Air.
 - 4. D4541-93 - Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers.
- B. NACE International, The Corrosion Society (NACE):
 - 1. RPO188-99 - Discontinuity (Holiday) Testing of Protective Coatings.
- C. National Association of Pipe Fabricators (NAPF):
 - 1. NAPF 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
- D. NSF International (NSF):
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
- E. SSPC – Society for Protective Coatings:
 - 1. SSPC SP1 - Solvent Cleaning.
 - 2. SSPC SP2 - Hand Tool Cleaning.
 - 3. SSPC SP3 - Power Tool Cleaning.
 - 4. SSPC SP5 - White Metal Blast Cleaning.
 - 5. SSPC SP6 - Commercial Blast Cleaning.
 - 6. SSPC SP7 - Brush-Off Blast Cleaning.
 - 7. SSPC SP10 - Near-White Blast Cleaning.
 - 8. SSPC SP 11 - Power Tool Cleaning to Bare Metal.
 - 9. SSPC-SP 12 - High- and Ultrahigh-Pressure Water Jetting.
- F. Underwriters' Laboratory (UL):
 - 1. UL 3P83 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

- A. Submerged Metal: Steel or iron surfaces below tops of channel or structure walls which will contain water even when above expected water level.
- B. Submerged Concrete and Masonry Surfaces: Surfaces which are or will be:

1. Underwater.
2. In structures which normally contain water.
3. Below tops of walls of water containing structures.

C. Exposed Surface: Any metal or concrete surface, indoors or outdoors that is exposed to view.

D. Dry Film Thickness (DFT): Thickness of fully cured coating, measured in mils.

E. Volatile Organic Compound (VOC): Content of air polluting hydrocarbons in uncured coating product measured in units of grams per liter or pounds per gallon, as determined by EPA Method 24.

F. Ferrous: Cast iron, ductile iron, wrought iron, and all steel alloys except stainless steel.

G. Where SSPC surface preparation standards are specified or implied for ductile iron pipe or fittings, the equivalent NAPF surface preparation standard shall be substituted for the SSPC standard.

1.04 PERFORMANCE REQUIREMENTS

- A. Coating materials for concrete and metal surfaces shall be especially adapted for use in wastewater treatment plants.
- B. Coating for final coats shall be fume resistant, compounded with pigment suitable for exposure to sewage gases, especially to hydrogen sulfide and to carbon dioxide.
- C. Pigments shall be materials that do not darken, discolor, or fade due to action of sewage gases.

1.05 SUBMITTALS

- A. Shop Drawings: Include schedule of where and for what use coating materials are proposed in accordance with requirements for Product Data.
- B. Product Data: Include description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips.
 1. Regulatory Requirements: Submit data concerning the following:
 - a. Volatile organic compound limitations.
 - b. Coatings containing lead compounds and PCBs.
 - c. Abrasives and abrasive blast cleaning techniques, and disposal.
- C. Samples: Include 8-inch square drawdowns or brush-outs of topcoat finish when requested. Identify each sample as to finish, formula, color name and number and sheen name and gloss units.
- D. Certificates: Submit in accordance with requirements for Product Data.
- E. Manufacturer's Instructions: Include the following:
 1. Special requirements for transportation and storage.
 2. Mixing instructions.

3. Shelf life.
4. Pot life of material.
5. Precautions for applications free of defects.
6. Surface preparation.
7. Method of application.
8. Recommended number of coats.
9. Recommended dry film thickness (DFT) of each coat.
10. Recommended total dry film thickness (DFT).
11. Drying time of each coat, including prime coat.
12. Required prime coat.
13. Compatible and non-compatible prime coats.
14. Recommended thinners, when recommended.
15. Limits of ambient conditions during and after application.
16. Time allowed between coats (minimum and maximum).
17. Required protection from sun, wind and other conditions.
18. Touch-up requirements and limitations.

F. Manufacturer's Representative's Field Reports.

G. Operations and Maintenance Data:

1. Reports on visits to project site to view and approve surface preparation of structures to be coated.
2. Reports on visits to project site to observe and approve coating application procedures.
3. Reports on visits to coating plants to observe and approve surface preparation and coating application on items that are "shop coated."

H. Quality Assurance Submittals:

1. Quality Assurance plan.
2. Qualifications of coating applicator including List of Similar Projects.

I. Warranty

1. Warrant free of defects in material and workmanship for 3 years from the date of acceptance or date of first beneficial use by the OWNER.

1.06 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Minimum of 5 years experience applying specified type or types of coatings under conditions similar to those of the Work.
 - a. Provide qualifications of applicator and references listing five similar projects completed in the past two years.
2. Manufacturer approved applicator when manufacturer has approved applicator program.
3. Approved and licensed by polymorphic polyester resin manufacturer to apply polymorphic polyester resin coating system.
4. Approved and licensed by elastomeric polyurethane (100 percent solids) manufacturer to apply 100 percent solids elastomeric polyurethane system.
5. Applicator of off-site application of coal tar epoxy shall have successfully applied coal tar epoxy on similar surfaces in material, size, and complexity as on the Project.

- B. Regulatory Requirements: Comply with governing agencies regulations by using coatings that do not exceed permissible volatile organic compound limits and do not contain lead.
- C. Certification: Certify that applicable pigments are resistant to discoloration or deterioration when exposed to hydrogen sulfide and other sewage gases and product data fails to designate coating as "fume resistant."
- D. Field Samples: Prepare and coat an area between corners or limits such as control or construction joints of each system. Approved field sample may be part of Work.
- E. Compatibility of Coatings: Use products by same manufacturer for prime coats, intermediate coats, and finish coats on same surface, unless specified otherwise.
- F. Services of Coating Manufacturers Representative: Make periodic visits to the project site to provide consultation and inspection services during surface preparation and application of coatings, and to make visits to coating plants to observe and approve surface preparation procedures and coating application of items to be "shop primed and coated".

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products in accordance with manufacturers recommendations.
- B. Remove unspecified and unapproved paints from Project site immediately.
- C. Deliver containers with labels identifying the manufacturer's name, brand name, product type, batch number, date of manufacturer, expiration date or shelf life, color, and mixing and reducing instructions.
- D. Store coatings in well-ventilated facility that provides protection from the sun weather, and fire hazards. Maintain ambient storage temperature between 45 and 90 degrees Fahrenheit, unless otherwise recommended by the manufacturer.
- E. Take precautions to prevent fire and spontaneous combustion.

1.08 PROJECT CONDITIONS

- A. Surface Moisture Contents: Do not coat surfaces that exceed manufacturer specified moisture contents, or when not specified by the manufacturer, the following moisture contents:
 1. Masonry, Concrete and Concrete Block: 12 percent.
- B. Do Not Apply Coatings:
 1. Under dusty conditions, unless tenting, covers, or other such protection is provided for structures to be coated.
 2. When light on surfaces measures less than 15 foot-candles.
 3. When ambient or surface temperature is less than 50 degrees Fahrenheit unless manufacturer allows a lower temperature.
 4. When relative humidity is higher than 85 percent.
 5. When surface temperature is less than 5 degrees Fahrenheit above dew point.
 6. When surface temperature exceeds the manufacturer's recommendation.

7. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
8. Apply clear finishes at minimum 65 degrees Fahrenheit.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Special Coatings: One of the following or equal:
 1. Ameron: Ameron International, Brea, CA.
 2. CarboLine: CarboLine, St. Louis, MO.
 3. Devoe: Devoe Coatings, Louisville, KY.
 4. Dudick: Dudick, Inc., Streetsboro, OH.
 5. Sanchem: Sanchem, Chicago, IL.
 6. S-W: Sherwin-Williams Co., Cleveland, OH.
 7. Tnemec: Tnemec Co., Kansas City, MO.
- B. Paints, Exterior Exposure: One of the following or equal:
 1. Modified Waterborne Acrylate: One of following or equal:
 - a. Tnemec: Enviro-Crete.

2.02 PREPARATION AND PRETREATMENT MATERIALS

- A. Metal Pretreatment: As manufactured by one of the following or equal:
 1. Ameron: Galvaprep.
 2. International: Galvaprep 5 or Alumiprep 33.
 3. S-W: P60G2, Wash Primer.
 4. Tnemec: Series N69 Hi-Build Epoxoline II
- B. Surface Cleaner and Degreaser: As manufactured by one of the following or equal:
 1. CarboLine Surface Cleaner No.3.
 2. Devoe: Devprep 88.
 3. S-W: Clean and Etch.

2.03 COATING MATERIALS

- A. Alkali Resistant Bitumastic: As manufactured by one of the following or equal:
 1. CarboLine: Bitumastic Super Service Black.
 2. S-W: Corothane I Coal Tar, B65B11.
 3. Tnemec: 46-465.
- B. Wax Coating: As manufactured by one of the following or equal:
 1. Sanchem: No-Ox-Id A special.
- C. High Solids Epoxy Primer Not less than 80 Percent Solids by Volume: As manufactured by one of the following or equal:
 1. Ameron: Amerlock 400.
 2. CarboLine: Super Hi-Gard 891.
 3. Devoe: Bar Rust 233H.
 4. S-W: Macropoxy HS.
 5. Tnemec:
 - a. Series 135 Chembuild (non-immersion service).

- b. Series 104 HS (immersion service).
- D. High Solids Epoxy Not less than 80 Percent Solids by Volume: As manufactured by one of the following or equal:
 - 1. Ameron: Amerlock 400.
 - 2. CarboLine: Super Hi-Gard 891.
 - 3. Devoe: Bar Rust 233H.
 - 4. S-W: Macropoxy HS.
 - 5. Tnemec:
 - a. Series 135 Chembuild (non-immersion service).
 - b. Series 104 HS (immersion service).
- E. Aliphatic or Aliphatic-Acrylic Polyurethane: As manufactured by one of the following or equal:
 - 1. Ameron: Amercoat 450HS.
 - 2. CarboLine: Carbothane 134HG.
 - 3. Devoe: Devthane 379.
 - 4. S-W: High Solids Polyurethane.
 - 5. Tnemec: Series 73 Endura-Shield II.
- F. Asphalt Varnish: AWWA C 500.
- G. Protective Coal Tar: As manufactured by one of the following or equal:
 - 1. CarboLine: Bitumastic No. 50.
 - 2. S-W: Cooper Black, No. 750.
 - 3. Tapecoat Co.: T.C. Mastic.
- H. Coal Tar Epoxy: As manufactured by one of the following or equal:
 - 1. Ameron: 78HB.
 - 2. CarboLine: 300-M, Bitumastic.
 - 3. Devoe: Devtar 247.
 - 4. S-W: B69B60 Tar Guard.
 - 5. Tnemec: Series 46H-413.
- I. Painting Pretreatment and Primers
 - 1. Concrete, Smooth, Filler/primer: One of following or equal:
 - a. S/W: B61W2, Epoxy Ester Masonry Filler/Sealer.
 - b. Tnemec: W55 WB, Tneme-Crete.

2.04 MIXES

- A. Mix epoxy parts in accordance with manufacturer's instructions.
- B. Mix coal tar epoxy in containers furnished by manufacturer for mixing purposes. Mix unit quantities only. Use power mixer for minimum time recommended by manufacturer. Do not include time during pouring or stirring in mixing time.

PART 3 EXECUTION

3.01 GENERAL PROTECTION

- A. Protect adjacent surfaces from coatings and damage. Repair damage resulting from inadequate or unsuitable protection:
- B. Protect adjacent surfaces not to be coated from spatter and droppings with drop cloths and other coverings.
 - 1. Mask off surfaces of items not to be coated or remove items from area.
- C. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being coated and in particular, surfaces within storage and preparation area.
- D. Place cotton waste, cloths and material which may constitute fire hazard in closed metal containers and remove daily from site.
- E. Remove electrical plates, surface hardware, fittings and fastenings, prior to application of coating operations. Carefully store, clean and replace on completion of coating in each area. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finish.

3.02 GENERAL PREPARATION

- A. Prepare surfaces in accordance with coating manufacturer's instructions, unless more stringent requirements are specified in this Specification.
- B. Protect following surfaces from abrasive blasting by masking, or other means:
 - 1. Threaded portions of valve and gate stems.
 - 2. Machined surfaces for sliding contact.
 - 3. Surfaces to be assembled against gaskets.
 - 4. Surfaces of shafting on which sprockets are to fit.
 - 5. Surfaces of shafting on which bearings are to fit.
 - 6. Machined surfaces of bronze trim, including those slide gates.
 - 7. Cadmium-plated items except cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment requiring abrasive blasting.
 - 8. Galvanized items, unless scheduled to be coated.
- C. Protect installed equipment, mechanical drives, and adjacent coated equipment from abrasive blasting to prevent damage caused by entering sand or dust.
- D. Concrete:
 - 1. Allow new concrete to cure for minimum of 28 days before coating.
 - 2. Clean concrete surfaces of dust, mortar, fins, loose concrete particles, form release materials, oil, and grease. Fill voids so that surface is smooth. Etch or brush off-blast clean in accordance with SSPC SP-7 to provide surface profile similar to 60 grit sandpaper, or as recommended by coating manufacturer.
- E. Ferrous Metal Surfaces:
 - 1. Remove grease and oil in accordance with SSPC SP-1.
 - 2. Remove rust, scale, and welding slag and spatter, and prepare surfaces in accordance with appropriate SSPC standard as specified herein.

3. Abrasive blast surfaces prior to coating.
4. When abrasive blasted surfaces rust or discolor before coating, abrasive blast surfaces again to remove rust and discoloration.
5. When metal surfaces are exposed because of coating damage, abrasive blast surfaces before touching-up.

F. Ferrous Metal Surfaces Not to be Submerged: Abrasive blast in accordance with SSPC SP-10, unless blasting may damage adjacent surfaces, prohibited or specified otherwise. Where not possible to abrasive blast, power tool clean surfaces in accordance with SSPC SP-3.

G. Ferrous Metal Surfaces to be Submerged: Unless specified otherwise, abrasive blast in accordance with SSPC SP-5 to clean and provide roughened surface profile of not less than 2 mils and not more than 4 mils in depth when measured with Elcometer 123, or as recommended by the coating manufacturer.

H. Ductile Iron Pipe and Fittings to be Lined or Coated: Abrasive blast clean in accordance with NAPF 500-03.

I. Sherardized, Aluminum, Copper, and Bronze Surfaces: Prepare in accordance with coating manufacturer's instructions.

J. Galvanized Surface:

1. Degrease or solvent clean to remove oily residue.
2. Power tool or hand tool clean or whip abrasive blast.
3. Apply metal pretreatment within 24 hours before coating galvanized surfaces that cannot be thoroughly abraded physically, such as bolts, nuts, or preformed channels.

K. Shop Primed Metal:

1. Certify that primers applied to metal surfaces in the shop are compatible with coatings to be applied over such primers in the field.
2. Remove shop primer from metal to be submerged by abrasive blasting in accordance with SSPC SP-10, unless greater degree of surface preparation is required by coating manufacturer's representative.
3. Correct abraded, scratched or otherwise damaged areas of shop prime coat by sanding or abrasive blasting in accordance with SSPC SP-6.
4. When entire shop priming fails or has weathered excessively, or when recommended by coating manufacturer's representative, abrasive blast shop prime coat to remove entire coat and prepare surface in accordance with SSPC SP-10.
5. When incorrect prime coat is applied, remove incorrect prime coat by abrasive blasting in accordance with SSPC SP-10.
6. When prime coat not authorized by ENGINEER is applied, remove unauthorized prime coat by abrasive blasting in accordance with SSPC SP-10.
7. Shop Applied Bituminous Paint or Asphalt Varnish: Abrasive blast clean shop applied bituminous paint or asphalt varnish from surfaces scheduled to receive non-bituminous coatings.

L. Abrasive blast cadmium-plated, zinc-plated, or sherardized fasteners in same manner as unprotected metal when used in assembly of equipment designated for abrasive blasting .

- M. Abrasive blast components to be attached to surfaces which cannot be abrasive blasted before components are attached.
- N. Grind sharp edges to approximately 1/16 inch radius before abrasive blast cleaning.
- O. Remove and grind smooth all excessive weld material and weld spatter before blast cleaning.
- P. FRP Surfaces:
 - 1. Prepare surfaces to be coated by light sanding and wipe-down with clean cloths, or by solvent cleaning in strict accordance with coating manufacturer's instructions.
- Q. Cleaning of Previously Coated Surfaces:
 - 1. Utilize cleaning agent to remove soluble salts such as chlorides and sulfates from concrete and metal surfaces.
 - a. Cleaning Agent: Biodegradable non-flammable and containing no volatile organic compounds.
 - b. Manufacturer: Chlor-Rid International, Inc., or accepted equal.
 - 2. Cleaning of surfaces utilizing the decontamination cleaning agent may be accomplished in conjunction with abrasive blast cleaning, high pressure, washing, or hand washing as approved by the coating manufacturer's representative and the ENGINEER.
 - 3. Test cleaned surfaces in accordance with the cleaning agent manufacturer's instructions to ensure all soluble salts have been removed. Additional cleaning shall be carried out as necessary.
 - 4. Final surface preparation prior to application of new coating system shall be made in strict accordance with coating manufacturer's printed instructions

3.03 MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Remove grilles, covers and access panels for mechanical and electrical system from location and coat separately.
- B. Finish coat primed equipment with color selected by the ENGINEER.
- C. Prime and coat insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars and supports, except where items are plated or covered with prefinished coating.
- D. Replace identification markings on mechanical or electrical equipment when coated over or spattered.
- E. Coat interior surfaces of air ducts, convector and baseboard heating cabinets that are visible through grilles and louvers with 1 coat of flat black paint, to limit of sight line.
- F. Coat exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.
- G. Coat both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them

- H. Color code equipment, piping, conduit and exposed ductwork and apply color banding and identification, such as flow arrows, naming and numbering, in accordance with DIVISIONS 15 and 16.

3.04 GENERAL APPLICATION REQUIREMENTS

- A. Apply coatings in accordance with manufacturer's instructions.
- B. Coat metal unless specified otherwise.
 - 1. Aboveground piping to be coated shall be empty of contents during application of coatings.
- C. Verify metal surface preparation immediately before applying coating in accordance with SSPC Pictorial Surface Preparation Standard.
- D. Allow surfaces to dry, except where coating manufacturer requires surface wetting before coating.
- E. Wash coat and prime sherardized, aluminum, copper, and bronze surfaces, or prime with manufacturer's recommended special primer.
- F. Prime shop primed metal surfaces. Spot prime exposed metal of shop primed surfaces before applying primer over entire surface.
- G. Apply minimum number of specified coats.
- H. Apply coats to thicknesses specified, especially at edges and corners.
- I. Apply additional coats when necessary to achieve specified thicknesses.
- J. Coat surfaces without drops, ridges, waves, holidays, laps, or brush marks.
- K. Remove spatter and droppings after completion of coating.
- L. When multiple coats of same material are specified, tint prime coat and intermediate coats with suitable pigment to distinguish each coat.
- M. Dust coatings between coats. Lightly sand and dust surfaces to receive high gloss finishes, unless instructed otherwise by coating manufacturer.
- N. Apply coating by brush, roller, trowel, or spray, unless particular method of application is required by coating manufacturer's instructions or these Specifications.
- O. Spray Application:
 - 1. Stripe coat edges by brush before beginning spray application, as necessary, to ensure specified coating thickness along edges.
 - 2. When using spray application, apply coating to thickness not greater than that recommended in coating manufacturer's instructions for brush coat application.
 - 3. Use airless spray method, unless air spray method is required by coating manufacturer's instruction or these Specifications.
 - 4. Conduct spray coating under controlled conditions. Protect adjacent construction and property from coating mist or spray.

P. Drying and Recoating:

1. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.
2. Limit drying time to that required by these Specifications or coating manufacturer's instructions.
3. Do not allow excessive drying time or exposure which may impair bond between coats.
4. Recoat epoxies within time limits recommended by coating manufacturer.
5. When time limits are exceeded, abrasive blast clean prior to applying another coat.
6. When limitation on time between abrasive blasting and coating cannot be met before attachment of components to surfaces which cannot be abrasive blasted, coat components before attachment.
7. Ensure primer and intermediate coats of coating are unscarred and completely integral at time of application of each succeeding coat.
8. Touch up suction spots between coats and apply additional coats where required to produce finished surface of solid, even color, free of defects.
9. Leave no holidays.
10. Sand and recoat scratched, contaminated, or otherwise damaged coating surfaces so damages are invisible to naked eye.

Q. Concrete:

1. Apply first coat (primer) only when surface temperature of concrete is decreasing in order to eliminate effects of off-gassing on coating.

3.05 ALKALI RESISTANT BITUMASTIC

A. Preparation:

1. Prepare surfaces in accordance with general preparation requirements.

B. Application:

1. Apply in accordance with general application requirements and as follows:
 - a. Apply at least 2 coats, 8 to 14 mils dry film thickness each.

3.06 WAX COATING

A. Preparation:

1. Prepare surfaces in accordance with general preparation requirements.

B. Application:

1. Apply in accordance with general application requirements and as follows:
 - a. Apply at least 1/32-inch thick coat with 2 inch or shorter bristle brush.
 - b. Thoroughly rub coating into metal surface with canvas covered wood block or canvas glove.

3.07 HIGH SOLIDS EPOXY SYSTEM

A. Preparation:

1. Prepare surfaces in accordance with general preparation requirements and as follows:

- a. Abrasive blast ferrous metal surfaces to be submerged at jobsite in accordance with SSPC SP-5 prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP-10.
- b. Abrasive blast non-submerged ferrous metal surfaces at jobsite in accordance with SSPC SP-10, prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP-6.
- c. Abrasive blast clean ductile iron surfaces in accordance with SSPC SP-7.

B. Application:

- 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply minimum 2-coat system with minimum total dry film thickness (DFT) of 12 mils.
 - b. Recoat or apply succeeding epoxy coats within time limits recommended by manufacturer. Prepare surfaces for recoating in accordance with manufacturer's instructions.
 - c. Coat metal to be submerged before installation when necessary, to obtain acceptable finish and to prevent damage to other surfaces.
 - d. Coat entire surface of support brackets, stem guides, pipe clips, fasteners, and other metal devices bolted to concrete.
 - e. Coat surface of items to be exposed and adjacent 1 inch to be concealed when embedded in concrete or masonry.

3.08 HIGH SOLIDS EPOXY AND POLYURETHANE COATING SYSTEM

A. Preparation:

- 1. Prepare surfaces in accordance with general preparation requirements and as follows:
 - a. Prepare concrete surfaces in accordance with general preparation requirements.
 - b. Touch up shop primed steel and miscellaneous iron.
 - c. Abrasive blast ferrous metal surfaces at jobsite in accordance with SSPC SP-6, Commercial Blast Cleaning, prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP-6.
 - d. Degrease or solvent clean, whip abrasive blast, power tool, or hand tool clean galvanized metal surfaces.
 - e. Lightly sand fiberglass pipe to be coated and wipe clean with dry cloths, or solvent clean in accordance with coating manufacturer's instructions.
 - f. Abrasive blast clean ductile iron surfaces.

B. Application:

- 1. Apply coatings in accordance with general application requirements and as follows:
- 2. Apply 3 coat system consisting of:
 - a. Primer: 4 to 5 mils dry film thickness high solids epoxy primer,
 - b. Intermediate Coat: 4 to 5 mils dry film thickness high solids epoxy intermediate coat, and
 - c. Top Coat: 2.5 to 3.5 mils dry film thickness aliphatic or aliphatic-acrylic polyurethane topcoat.

3. Recoat or apply succeeding epoxy coats within 30 days or within time limits recommended by manufacturer, whichever is shorter. Prepare surfaces for recoating in accordance with manufacturer's instructions.
4. For fiberglass pipe, apply one coat high solids epoxy (4 to 5 mils DFT) and two coats aliphatic or aliphatic-acrylic polyurethane.

3.09 ASPHALT VARNISH

- A. Preparation:
 1. Prepare surfaces in accordance with general preparation requirements.
- B. Application:
 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply minimum 2 coats.

3.10 PROTECTIVE COAL TAR

- A. Preparation:
 1. Prepare surfaces in accordance with general preparation coal tar requirements.
- B. Application:
 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply minimum 20 mils dry film thickness coating.

3.11 COAL TAR EPOXY

- A. Preparation:
 1. Prepare surfaces in accordance with general preparation requirements and as follows:
 - a. Abrasive blast iron or steel surfaces to be coated as submerged metal in accordance with SSPC SP-5. Prepare other metal surfaces to be coated with coal tar epoxy in accordance with epoxy manufacturer's instructions.
- B. Application:
 1. Apply coatings in accordance with general application requirements and as follows:
 - a. Apply two coats of 8 mils each for a total 16 mils dry film thickness.
 - b. Apply coal tar epoxy on blasted steel on same day that steel is blasted.

3.12 FIELD QUALITY CONTROL

- A. Each coat will be inspected. Strip and remove defective coats, prepare surfaces and recoat. When approved, apply next coat.
- B. Control and check dry film thicknesses and integrity of coatings.
- C. Measure dry film thickness with calibrated thickness gauge.
- D. Dry film thicknesses on ferrous-based substrates may be checked with Elcometer Type 1 Magnetic Pull-off gage or Positector 6000.

- E. Verify coat integrity with low-voltage holiday detector. Allow ENGINEER to use detector for additional checking.
- F. Check wet film thickness before coal tar epoxy coating cures on concrete or non-ferrous metal substrates.
- G. Arrange for services of coating manufacturer's field representative to provide periodic field consultation and inspection services to ensure proper surface preparation of facilities and items to be coated, and to ensure proper application and curing.
 - 1. Notify ENGINEER 24 hours in advance of each visit by coating manufacturer's representative.
 - 2. Provide ENGINEER with a written report by coating manufacturer's representative within 48 hours following each visit.

3.13 SCHEDULE OF ITEMS NOT REQUIRING COATING

- A. General: Unless specified otherwise, the following items do not require coating.
 - 1. Items that have received final coat at factory and not listed to receive coating in field.
 - 2. Aluminum (except where in contact with concrete), brass, bronze, copper, plastic, rubber, stainless steel, chrome, everdur, or lead.
 - 3. Buried or encased piping or conduit.
 - 4. Exterior Concrete.
 - 5. Galvanized roof decking, electrical conduits, pipe trays, cable trays, and other items.
 - a. Areas on galvanized items or parts where galvanizing has been damaged during handling or construction shall be repaired as follows:
 - 1) Clean damaged areas by SSPC SP-1, SP-2, SP-3, or SP-7 as required.
 - 2) Apply two coats of a cold galvanizing zinc compound such as ZRC World Wide Inovatie Zinc Technologies of Mansfield, MA or accepted equal, in strict accordance with manufacturer's instructions.
 - 6. Grease fittings.
 - 7. Steel to be encased in concrete or masonry.

3.14 SCHEDULE OF SURFACES TO BE COATED IN THE FIELD

- A. In general, apply coatings to steel, iron, galvanized surfaces, and wood surfaces unless specified or otherwise indicated on the Drawings. Coat concrete surfaces and anodized aluminum only when specified or indicated on the Drawings.
- B. Following schedule is incomplete. Coat unlisted surfaces with same coating system as similar listed surfaces. Verify questionable surfaces.
- C. Concrete:
 - 1. High Solids Epoxy:
 - a. Safety markings.
- D. Metals:
 - 1. Alkali Resistant Bitumastic:
 - a. Aluminum surfaces to be placed in contact with wood, concrete, or masonry.

2. Wax Coating:
 - a. Sliding faces of sluice and slide gates and threaded portions of gate stems.
3. High Solids Epoxy and Polyurethane System: exterior non-immersed ferrous metal surfaces including:
 - a. Non immersed portions of the clarifier mechanisms.
 - b. Pipe, valves, pipe hangers, supports and saddles, conduit, cable tray hangers, and supports.
 - c. Motors and motor accessory equipment.
 - d. Drive gear, drive housing, coupling housings, and miscellaneous gear drive equipment.
 - e. Valve and gate operators and stands.
 - f. Structural steel including galvanized structural steel.
 - g. Mechanical equipment supports, drive units, and accessories.
 - h. Pumps not submerged.
2. High Solids Epoxy System:
 - a. Submerged portions of the clarifier mechanisms.
 - b. Field priming of ferrous metal surfaces with defective shop prime coat where no other prime coat is specified; for non-immersion service.
 - c. Exterior of submerged piping and valves other than stainless steel or PVC piping.
 - d. Submerged pipe supports and hangers.
 - e. Stem guides.
 - f. Other submerged iron and steel metal unless specified otherwise.
 - g. Submerged piping.
3. Asphalt Varnish:
 - a. Underground valves and valve boxes.
4. Protective Coal Tar:
 - a. Underground pipe flanges, excluding pipe, corrugated metal pipe couplings, flexible pipe couplings and miscellaneous underground metals not otherwise specified to receive another protective coating.

E. Painting Concrete, Smooth: 2 coats of following finish paints over specified sealer:

1. Modified Waterborne Acrylate:
 - a. Exterior of existing concrete clarifier tanks. Match existing color.

END OF SECTION

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SECTION 11353

CIRCULAR SECONDARY CLARIFIER EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Specification of equipment for installation in circular secondary clarifiers of center feed, peripheral overflow design.
 - 2. Clarifier Accessories:

- B. Related Sections
 - 1. Section 01614 Wind Design Criteria
 - 2. Section 16135 Cabinets and Enclosures
 - 3. Section 16144 Disconnect Switches
 - 4. Section 16222 Motors
 - 5. Section 16412 Low Voltage Circuit Breakers
 - 6. Section 16416 Transient Voltage Surge Suppressors
 - 7. Section 16422 Motor Control
 - 8. Section 16951 Electrical Functional Testing
 - 9. Section 17411 Control Strategies
 - 10. Section 17427 Panel Instruments

1.02 REFERENCES

- A. American Gear Manufacturers Association (AGMA):
 - 1. 201.02 - Tooth Proportions for Coarse-Pitch Involute Spur Gears.
 - 2. 390.03a - Handbook - Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears.
 - 3. 908 - Information Sheet - Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical and Herringbone Gear Teeth.
 - 4. 2000 - Gear Classification and Inspection Handbook - Tolerances and Measuring Methods for Unassembled Spur and Helical Gears (Including Metric Equivalents).
 - 5. 2001 - Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
 - 6. 2004 - Gear Materials and Heat Treatment Manual.
 - 7. 6019 - Standard for Gearmotors Using Spur, Helical, Herringbone, Straight Bevel or Spiral Bevel Gears.
 - 8. 6022 - Design Manual for Cylindrical Wormgearing
 - 9. 6034 - Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
 - 10. 9005 - Industrial Gear Lubrication.

- B. American Institute of Steel Construction (AISC):

1. Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design.
2. Code of Standard Practice for Steel Bridges and Buildings.

C. American National Standards Institute (ANSI):

1. ANSI/ASME B29.1M - Precision Power Transmission Roller Chains, Attachments And Sprockets.

D. American Society for Testing and Materials (ASTM):

1. A 36/A 36M - Specifications for Structural Steel.
2. A 48 - Specification for Gray Iron Castings.
3. A 148/A 148M - Specification for Steel Castings, High Strength, for Structural Purposes.
4. A 325 - Specification for High-Strength Bolts for Structural Steel Joints.
5. A 536 - Specification for Ductile Iron Castings.

E. American Welding Society (AWS):

1. D 1.1 - Structural Welding Code for Steel.

F. American Bearing Manufacturers Association (ABMA):

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

G. Florida Building Code (FBC)

H. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment (1,000 volts maximum).

I. Underwriter Laboratories, Inc (UL)

1. UL 508 – Industrial Control Equipment

1.03 DEFINITIONS

- A. Continuous Operation: 24 hour-per-day operation for design life of not less than 20 years, which equals 175,200 hours.
- B. Intermittent Operation: Periodic operation, including starts and stops, and prolonged periods of resting.
- C. Subassemblies: Includes, but may not be limited to, complete center column, drive cage, drive assembly, truss arms, and scum skimming system.
- D. Set: Equipment necessary to completely furnish 2 clarifiers.
- E. Continuous Running Torque: The 100 percent AGMA torque, assumed to be continuously applied, 24 hours a day, to the drive system. Bearing life, gear strength, gear durability, gear rating, mechanism structural design, and alarm and shutdown setpoints are specified as a percentage of the continuous running torque.

F. Momentary Peak Torque: The maximum torque for rating yield strength or ultimate strength of center drive mechanism components. The numerical value for momentary peak torque shall be 2.0 x continuous running torque.

1.04 SYSTEM DESCRIPTION

A. Nominal Clarifier Dimensions:

1. Diameter: 105 feet.
2. Side Water Depth: 12.5 feet.
3. Bottom Slope: As indicated on the Drawings.

B. Sludge Collector Mechanism:

1. Supply as a complete and operational system by a single manufacturer.
2. Equipment to include, but not be limited to, the following components:
 - a. Walkways and access bridges with guardrail and grating.
 - 1) Tank wall to center column for Clarifiers No. 1 and 2.
 - b. Center column.
 - c. Influent well.
 - d. Flocculating well.
 - e. Center drive cage.
 - f. Sludge collector truss arms.
 - g. Sludge collection draw-off pipes.
 - h. Scum skimming system.
 - i. Center drive mechanism.
 - j. Drive motor.
 - k. Electrical control panel
 - l. Overload devices and alarms.
 - m. Other components necessary to provide a complete system.
3. Process Description:
 - a. Mixed liquor enters the clarifier through a center column and is discharged into the influent well through openings in the center column.
 - b. The influent well dissipates the kinetic energy of the influent mixed liquor flow. Peripheral outlet ports in the influent well create a controlled tangential discharge of the mixed liquor into the flocculating well to enhance flow distribution and flocculation.
 - c. The flocculating well promotes flocculation of the mixed liquor suspended solids and allows for a gradual redirection of the flow velocity into the clarifier.
 - d. Clarifier Nos. 1 & 2:
 - 1) A central drive mechanism mounted on a center column supports and rotates a center cage with two truss arm assemblies, each supporting a scraper blade and a surface skimming arm.
 - 2) The sludge collection draw-off pipes withdraw the sludge accumulated on the clarifier bottom and conveys it to a sludge collection center manifold for continuous removal.
 - e. The scum skimming system consists of a skimming arm that collects secondary scum from the surface of the clarifier and deposits it into the scum collection trough.

C. Design Requirements:

1. Operating Parameters:

- a. Maximum Allowable Headloss through the Center Column, the Influent Well, and the Flocculating Well at Peak Flow = 3 inches.
- b. Mixed Liquor Suspended Solids Concentration Range = 1,000 mg/L to 4,000 mg/L.
- 2. Mechanical Design:
 - a. Design for a continuous running torque of 32,000 foot pounds.
 - b. Design collector mechanism to operate at a tip speed, measured at the ends of the rake arms, of approximately 8 feet per minute.
 - c. Use no chains, sprockets, bearings, or gears below the water surface for the sludge collector mechanism.
- 3. Structural Design:
 - a. Design the sludge collector mechanism in accordance with the Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design, except:
 - 1) Provide a 1/4 inch minimum thickness for all members, except where specifically modified in PART 2 under EQUIPMENT COMPONENTS.
 - 2) Include stresses in members caused by bending and twisting due to eccentricities of members at joints.
 - b. Slenderness Ratio (KI/r) using K Value of 1.0 shall not exceed the values specified below:
 - 1) Tension Members: Not greater than 240.
 - 2) Compression Members: Not greater than 200.
 - c. Corrosion Allowance:
 - 1) For all structural members and center column, add 1/8 inch to the thickness used for the final design calculations to check member stresses and buckling. This corrosion allowance is to be applied to the design thickness and not to the minimum member thickness specified earlier. The final member thickness shall be the greater of the specified minimum thickness or the sum of the design thickness and the corrosion allowance.
 - d. Base member weights used for design on final full member thickness.
 - e. Full member thicknesses may be used for performing deflection calculations.
 - f. Design the center cage and the truss arms as an integral structure. Design the center cage and the connections to the truss arms for the reactions from the truss arms.
 - g. Do not include live load where its inclusion results in lower stresses in a member under investigation.
 - h. Load Combinations: Design each structural member of the sludge collector mechanism for the most critical load combination resulting from the following load combinations:
 - 1) Dead load + live load + continuous running torque.
 - 2) Dead load + live load + torque due to cut-out torque test.
 - 3) Other load combinations selected by the manufacturer.
 - 4) Truss Arm Load Cases: Use the following load cases on the truss arms for load combinations:
 - a) Equal uniform horizontal load along the full length of both truss arms which results in a combined torque equal to the continuous running torque.

- b) Uniform horizontal loads along the full length of both truss arms which results in 70 percent of the torque from one truss arm and 30 percent of the torque from the other truss arm for a combined torque equal to the continuous running torque.
- c) Load on truss arm(s) due to cut-out torque load test.

- i. Deflections:
 - 1) The horizontal deflection of the truss arm, due to truss arm deflection plus rotational deflection of the center cage for load cases which contain continuous running torque, shall not exceed a deflection equal to the radius of the clarifier divided by 400 (L/400). Not more than 60 percent of the total horizontal deflection shall be due to center cage rotation. Horizontal deflection of the truss arm shall be measured at the end of the truss arm furthest from the center column.
 - 2) The vertical deflection of the truss arm due to equipment dead load shall not exceed the length of the truss arm divided by 800 (L/800).

1.05 SUBMITTALS

- A. Submit product data and shop drawings, operation and maintenance manuals, and test reports as detailed herein.
- B. Product Data and Shop Drawings:
 - 1. Shop drawings shall consist of a cover sheet indicating the drawing number and specification page and number to which referenced, intended use and data summary, outline drawings, cut-away drawings, parts lists, material specification lists, and all information required to substantiate that the proposed equipment meets the specifications. Shop drawing submittals will not be considered complete if cut-away or assembly drawings with part and material specification lists are not included.
 - 2. General arrangement drawings showing the complete assembly, part numbers, and materials list.
 - 3. Detailed Drawings:
 - a. Sludge collector mechanism indicating dimensions, member sizes and thicknesses, welding, and connection details.
 - b. Drive mechanism showing sizes, dimensions, and arrangement of each drive component.
 - c. For gears, except those contained in the gearmotor speed reducer, detailed drawings with the following minimum data for each gear:
 - 1) Number of teeth.
 - 2) Net face width.
 - 3) Outside diameter of external gears.
 - 4) Inside diameter of internal gears.
 - 5) Normal diametral pitch or axial pitch for worms.
 - 6) Normal generating pressure angle.
 - 7) Lead angle (for worms).
 - 8) Operating center distance.
 - 9) Addendum modification coefficient.
 - 10) Tooth thickness or pin or span measurements.
 - 11) Quality numbers in accordance with AGMA 390.03a and AGMA 2000.
 - 12) Material alloy.

- 13) Type of heat treatment.
- 14) Tooth surface hardness.
- 15) Tooth core hardness.
- 16) For case hardened gears, effective case depth to Rc 50.
- 17) Lubricant type (mineral/synthetic/EP).
- 18) Lubricant viscosity.
4. Certified motor data sheets.
5. Shop primer and coating data.
6. Electrical Control Panel System data, including:
 - a. Control Panel front view and dimensions
 - b. Control, schematics, and wiring diagrams
 - c. Data for control devices, including power disconnect switch, motor starter, control push buttons, indicating lights, alarm horn/strobe light and any required pertinent instrument.
7. Spare parts list.
8. Qualifications and resume of installation engineer.
9. Training course outlines.
10. Manufacturer's experience and reference list as specified in Article Quality Assurance.

C. Manufacturer's Installation Instructions.

D. Calculations: Include, without necessarily being limited to:

1. Structural Calculations: Calculations shall be prepared and signed by a registered structural engineer in the state of Florida demonstrating compliance with structural criteria specified in this Section. Submit design calculations with complete shop drawings.
2. Mechanical and Hydraulic Calculations: Performed by a registered professional engineer. Calculations are intended to:
 - a. Substantiate continuous running torque loading and overload torque rating of each component of drive mechanism. Calculations shall clearly specify all design parameters used in developing the ratings. All ratings shall be in strict conformance with the latest revisions of AGMA 6034 and AGMA 2001.
 - b. Demonstrate that each bearing in drive mechanism complies with bearing life requirements of this Section.

E. Reference List: Include the following information as a minimum:

1. Name and location of installation.
2. Name and telephone number of the person in direct responsible charge of the equipment.
3. Month and year the equipment was placed in operation.
4. Size of equipment.
5. Number of units installed.
6. Service.

F. Test Reports:

1. Method of conducting cut-out torque test and verification that method of testing will not impose stresses in any member which exceeds maximum allowable stresses specified in this Section.

2. Results of field torque tests on sludge collector mechanism.

G. Operation and Maintenance Manuals.

H. Certificates: Manufacturer's certification that equipment was installed in accordance with the manufacturer's instructions, inspected by the manufacturer, serviced with the proper initial lubricants, and equipped with applicable safety equipment and controls.

I. Technician's Qualifications Resume: Submit resume of technician to perform Manufacturers Field Service.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Experience: Demonstrate minimum 10 years experience in manufacture of clarifiers which have been successfully utilized in domestic wastewater applications.
2. References: Provide a reference list of at least 5 different installations in domestic wastewater treatment plants of not less than 5 million gallons per day in the continental United States, where the manufacturer has supplied equipment substantially similar in design and characteristics to that proposed here. The installations listed must:
 - a. Have been designed and fabricated by the manufacturer.
 - b. Be at least 100 feet in diameter.
 - c. Have been in operation for last 5 years.
 - d. Include in the list the name, address, and telephone number of the OWNER, the design flow of plant, the sludge collector dimensions, and the time in operation.

B. Welding and Welder Qualifications:

1. Perform welding and qualify and certify welders in accordance with AWS D1.1.
2. Welds:
 - a. Use shielded arc welding.
 - b. Conform to requirements of design loads.
 - c. Conform to information indicated on the Drawings.
 - d. Use continuous watertight seal welds.
 - e. Use a minimum weld size of 1/4 inch.
 - f. Field welding is permitted only for bridge splice (if required).

C. Equipment Subassemblies: Mark parts with erection match marks for ease of field erection. Lubricate moving parts before shipment. When necessary to disassemble parts for shipping, coat uncoated exposed machine surfaces with suitable, easily removable, rust-preventive compound before shipping.

1.07 PROJECT CONDITIONS

A. Environmental Project Conditions:

1. Installation in a wastewater treatment plant.
2. Moderate quantities of commercial and industrial waste.
3. Exposure to industrial solvents and petroleum products.
4. Operation at approximately 15 to 20 feet above mean sea level.
5. Ambient Air Temperature:

- a. Maximum 110 degrees Fahrenheit.
 - b. Minimum 20 degrees Fahrenheit.
6. Wastewater temperature:
 - a. Maximum 90 degrees Fahrenheit.
 - b. Minimum 50 degrees Fahrenheit.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Shipment:
 1. All materials shall be suitably packaged and braced to protect against damage during transit, handling, and unloading.
 2. Manufacturer shall package equipment, be responsible for, and make good, any and all damage until the equipment is delivered to the job site.
 3. Accessories shall be packaged separately in containers clearly marked "ACCESSORIES ONLY".
 4. A packing list, listing the contents of each container, shall be placed in a moistureproof envelope and securely fastened to the outside of the container.
 5. Provide written storage procedures for all equipment.
- B. Delivery to Job Site:
 1. Manufacturer shall fabricate and deliver materials to the job site in conformance with the CONTRACTOR's construction schedule to minimize handling and on-site storage of equipment.
- C. Storage and Protection: Protect the system components at the site and during installation prior to project completion. As a minimum, provide cover, ventilation, and proper stacking to prevent warping of any equipment stored on-site. Prevent rotating equipment from prolonged idle periods of no more than 15 days to prevent bearing damage.

1.09 MAINTENANCE

- A. Spare Parts: Furnish the following spare parts suitably packaged and marked. Include a price list and name, address, and telephone number of local supplier:
 1. 2 sets of scum skimmer blade wear strips.
 2. 4 sets of shear pins.
 3. 1 set of scum skimmer wipers.
 4. 1 set each of oil seals for the worm shaft and pinion shaft.
- B. Special Tools: Provide the following special tools:
 1. Tools required to assemble, disassemble, repair, and maintain equipment, and that have been specifically made for use on the equipment.
 2. Necessary eyebolts, hooks, and rods for handling equipment parts.
 3. List of tools with the maintenance and operation data describing the uses of the tools.

1.10 WARRANTY

- A. As specified in Section 01030.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sludge Collector Mechanism: All equipment components of the sludge collector mechanism including the walkways and access bridges, center column, influent well, flocculating well, center drive cage, sludge collector truss arms, scum skimming system, sludge draw-off pipes, center drive mechanism, drive motor, electrical controls, and overload devices and alarms, shall be furnished by the same manufacturer. Some equipment may require modification from the manufacturer's standard. Exercise care to assure that the electrical, mechanical, structural, and miscellaneous systems comply with the requirements specified herein or in other referenced sections.
 - 1. Manufacturers: One of the following or equal:
 - a. Ovivo.
- B. Density Current Baffle:
 - 1. Manufacturers: One of the following or equal:
 - a. MFG Water Treatment Products Company
 - b. Nefco, Inc.

2.02 MATERIALS

- A. For all components unless specified otherwise, use the materials of construction specified below.
- B. Structural Steel:
 - 1. ASTM A 36.
 - 2. Grind all edges of steel members to approximately 1/16 inch minimum radius using standard workmanship and a grinder.
- C. Anchor Bolts: Type 316 stainless steel.
- D. Weir Plate: Fiberglass reinforced plastic as specified in Section 06611.
- E. Scum Baffles: Fiberglass reinforced plastic as specified in Section 06611.
- F. Fasteners and Washers: Type 304 stainless steel, except for bolts which will be removed during installation and any high-strength bolts.
- G. High strength bolts: Use ASTM A 325 hot-dip galvanized high strength bolts in attaching truss arms to cage, and cage to center drive gear casting.
- H. Do not use cadmium plated parts and fasteners.
- I. Dissimilar Metals: All aluminum components shall be isolated from steel components to prevent electrolysis.

2.03 SLUDGE COLLECTOR MECHANISM

- A. Walkways and Access Bridges:
 - 1. Materials:
 - a. Welded steel truss construction.

2. Design:
 - a. Tank wall to center column for Clarifiers No. 1 and 2.
 - b. Composed of 2 main members laterally braced together.
 - c. Minimum live load of 100 pounds per square foot.
 - d. Maximum deflection not to exceed span length divided by 360 (L/360) for dead plus live loads.
 - e. Support light standards and fixtures as indicated on the Drawings.
 - f. Supported Using:
 - 1) For Clarifiers No. 1 and 2, center column at one end and the outer concrete clarifier wall at the other.
 - 2) Make allowance at outer concrete wall for expansion and contraction of walkway due to temperature changes.
 - a) Use self-lubricating bearings.
 - b) Do not use non-lubricated metal-to-metal slide plates or direct metal-to-concrete bearing.
 - c) Prevent lateral movement of bridge at outer wall.
 - g. Provide additional structural supports as required to support scum spray and other piping on the bridge.
3. Platform at the Center Turntable: Provide a minimum clearance of 2 feet 6 inches around all sides of drive mechanism and allow uninhibited access to all parts of the drive unit.
4. Guardrail with Kickplate:
 - a. On both sides of walkway and all around center turntable platform.
 - b. Truss may be as the walkway guardrail if it meets FBC and OSHA requirements. Provide guard as specified in 05500 around center column access platform.
5. Walking Surface:
 - a. Materials: Aluminum treadplate.
 - b. Location: Over entire bridge and center turntable platform.

B. Center Column:

1. Materials:
 - a. Vertically mounted, cylindrical steel column.
 - 1) Inside Diameter: As designed by the manufacturer.
 - 2) Wall Thickness: 1/4-inch minimum.
2. Design:
 - a. Support the entire sludge collector mechanism including inboard end of bridge.
 - b. Size and anchor the center column to be capable of resisting design loads when the tank is empty or full.
3. Center Column Anchorage:
 - a. Mount the center column over the influent port at the center of the clarifier floor. Connect the base flange of the center column to the concrete foundation using the existing anchor bolts.
 - b. If existing anchor bolts are unusable, as determined by the Engineer, or replacement is required:
 - 1) Cut existing anchor bolts flush with existing concrete floor.
 - 2) Drill and epoxy anchor new anchor bolts. Use a rigid steel template to accurately locate anchor bolts for the center column.

- 3) Supplier shall coordinate with the CONTRACTOR to ensure proper anchor bolt location.
- 4) Center column base anchor bolts:
 - a) Not less than 8 in number.
 - b) Not less than 15 bolt diameters of embedment length.
 - c) Not less than 3/4 inches in diameter.
 - d) Use a minimum edge distance for anchor bolts of the larger of 6 inches or 6 anchor bolt diameters, and as required to clear reinforcing bars located around opening.
- 4. Outlet Ports: Provide outlet ports in the upper end of the center column to disperse influent flow into the influent well. Provide the following:
 - a. A total of 4 ports.
 - b. Appropriately reinforced port openings.
 - c. Port Dimensions: Not less than 264 square inches.
- 5. Flange and stiffen the top of the center column for supporting the sludge collector mechanism, the drive mechanism, and the access bridge. Attach the center column to the drive assembly using bolts.
- 6. Drain Holes: Provide two 2 inch holes at bottom to allow column to drain into the tank.

C. Influent Well:

- 1. Materials:
 - a. Structural steel plate and members.
 - b. Reinforced with steel stiffening angles where necessary.
- 2. Design:
 - a. Closed-bottom tub concentric with the center column.
 - b. Supported around the outside of the center drive cage.
 - c. Diffuse influent flow into the clarifier tangentially, evenly, and efficiently without excessive disturbances.
 - d. Outlet Gates:
 - 1) Shall direct and control tangential flow into the clarifier.
 - 2) Dimensions: As designed by the manufacturer.
 - e. Dimensions: 12 foot inside diameter.
 - f. Provide two 2-inch orifices in the bottom to allow the well to drain as the clarifier is emptying.

D. Flocculating Well:

- 1. Materials:
 - a. Structural steel plate and members.
 - b. Reinforced with steel stiffening angles where necessary.
- 2. Design:
 - a. Dimensions: 24 foot inside diameter.
 - b. Equip with a minimum of 4 baffled slots to allow for removal of floating material in the well.
 - c. Support from center cage using rigid connection. Other methods of connection such as swinging supports or breakaway supports are not permitted.

E. Center Drive Cage:

- 1. Materials:
 - a. Structural steel members.
- 2. Design:

- a. Box truss design.
- b. Design to carry load from the truss arms plus its own dead load.
- c. Fasten center drive cage to spur gear assembly using bolted connection.
- d. Design to support and rotate the truss arm assemblies with the surface skimming arm and sludge draw-off pipes.

F. Sludge Collector Truss Arms:

- 1. Materials:
 - a. Structural steel.
- 2. Design:
 - a. Truss design. Tie rods not permitted.
 - b. Maintain width of the truss arm the same as the width of center drive cage to ensure alignment and proper connection.
 - c. Rigidly connect truss arm to the center drive cage.
 - d. Conform truss arm to slope of tank floor.
 - e. Use the truss arm to support the scum skimmer arm and sludge draw-off pipes.
 - f. Provide five (5) 8-inch diameter draw-off pipes on each truss arm for a total of 10 draw-off pipes.

G. Scum Skimming System: Consisting of two full radius scum skimmer assemblies on each clarifier that pushes floating scum to a full radius scum trough for removal. Basic components of skimmer assembly include scum deflector blades and skimmer device.

- 1. Scum Deflector Blades:
 - a. Material: Structural steel plate.
 - b. Designed to collect and push floating scum radially outward toward the circumferential scum baffle.
 - c. Extends from the flocculating well to the scum skimmer device.
 - d. Attached to the rotating collector mechanism at the flocculating well, supported with skimmer assembly supports from the sludge collector truss arms.
 - e. Attach inner end of deflector blade tangentially to the flocculating well where practicable. Otherwise, provide maximum angle of approach of scum deflector blade to the scum in order to drift the scum to circumferential baffle.
- 2. Scum Skimmer Device:
 - a. Materials: Structural steel plate and members.
 - b. Attach to outer end of the scum deflector blade to trap scum for discharge into scum trough.
 - c. Size: Full length of the scum trough.
 - d. Design:
 - 1) Maintain continuous contact and proper alignment with scum baffle and inclined scum ramp to positively rake scum to the scum trough.
 - 2) Use a hinged blade to move entrapped scum up the scum beach to the scum trough.
 - 3) Provide a replaceable wear block on the outer edge of each scum skimmer device.
 - e. Hinged blade:

- 1) Adjustable vertically to control the dewatering of scum as it travels up the inclined ramp to the scum trough.
- 2) Adjustable vertically over the length to ensure contact with the scum trough even though the trough may not be level.
- 3) Capable of being raised and locked out above the water level or held horizontally against the circumferential scum baffle when skimming is not required.
- 4) Equipped with replaceable scum skimmer wipers on the bottom inner and outer edges to seal the entrapped scum and water when moving up the inclined approach ramp to the scum trough.
- f. Scum Skimmer Wipers: Oil resistant neoprene.
- g. Wear Block:
 - 1) Material: Polyvinyl chloride.
 - 2) Wear block constantly forced against circumferential scum baffle to keep baffle clean using a coiled spring arrangement.
 - 3) Force between baffle and wear block adjustable between 1 to 5 pounds.
- h. Wear Block Coiled Springs:
 - 1) Material: 18-8 stainless steel.
 - 2) Enclosed to protect them from the weather.
 - 3) Spring Enclosures:
 - a) Material: Welded steel or cast iron housing.
 - b) Bronze bushed and grease lubricated for easy movement of hinged blades.
- 3. Scum Trough:
 - a. Fabricated from 1/4 inch minimum thickness steel plate.
 - b. Supported from clarifier wall by structural steel members.
 - c. Scum Trough:
 - 1) No internal stiffeners or structural members which obstruct scum flow.
 - 2) Standard pipe flanged connection for scum discharge pipe. Size as indicated on the Drawings.
- 4. Skimmer Assembly Supports:
 - a. Material: Structural steel members.
 - b. Attached to the sludge collector truss arms. Do not support scum skimmer assembly from the scum baffle.
 - c. Space supports, brought up from the truss arm, at not greater than 10 feet apart.
- 5. Equipment manufacturer shall size and locate counterweights to be installed by the CONTRACTOR.
- 6. Threaded Fasteners: 18-8 stainless steel.
- 7. The manufacturer shall provide a position switch and solenoid valve to control spray water into the scum trough. SUPPLIER shall determine location of the position switch and coordinate with the CONTRACTOR for mounting. Upon tripping the position switch, the solenoid shall open for an operator adjustable time. Solenoid valves shall be Automatic Switch Company (Series 8210), Skinner Electric Valve Division (Series C), or equal.

H. Center Drive Mechanism: Provide a center drive mechanism consisting of a primary speed reducer driven by electric motor, through a roller chain using an intermediate gearset consisting of a cylindrical-worm and helical-wormgear, and a low speed gearset consisting of a spur pinion and internal spur gear.

1. Gear Motor Speed Reducer:
 - a. Type: Cylindrical-worm or helical-wormgear motor. Planetary gear units will not be acceptable.
 - b. Speed reducer conforming to AGMA 6034 and 6010.
 - c. Service Factors: Minimum speed reducer service factor of 2.0 minimum based on continuous running torque.
 - d. Connect speed reducer output shaft to drive sprocket of chain drive.
 - e. Speed Reducer Overhung Load Rating:
 - 1) Exceed the chain pull (based on continuous running torque) by 1.50 minimum.
 - f. Oil Bath Lubrication:
 - 1) Lubricant per AGMA 9005.
 - 2) Provide oil fill, drain, and oil level indicator devices.
 - 3) Oil Bath Protection Seal: Felt.
 - g. All gears supported by anti-friction bearings.
 - h. Lubricant: per AGMA 9005.
2. Intermediate Gearset:
 - a. Type: Cylindrical-worm and wormgear.
 - b. Materials:
 - 1) Worm: Alloy steel, hardened, ground, and polished.
 - 2) Wormgear: Centrifugally cast bronze.
 - 3) Washers: Hardened steel to prevent embedding of bolt head or nut.
 - 4) Bushings: Bronze.
 - 5) Housing: Cast iron in accordance with ASTM A 48, Class 30 minimum.
 - c. Load Capacity: Rated according to AGMA 6034.
 - d. Service Factor: Minimum of 1.25 based on continuous running torque.
 - e. Wormgear Shaft:
 - 1) Drives pinion of low-speed gearset.
 - 2) Support shaft by anti-friction bearings or combination of anti-friction bearings and bushing.
 - f. Wormgear: Conforming to AGMA 6022.
 - g. Worm Shaft: Support by anti-friction bearings. If the wormgear is bolted to a drive hub, it shall be piloted for concentricity.
 - h. Worm and Wormgear Shaft: Anti-friction bearings shall have ABMA L-10 life of 180,000 hours minimum based upon continuous running torque.
 - i. Provide oil bath lubrication. Lubricant per AGMA 9005. Provide oil fill, drain, and oil level indicator devices.
3. Low-speed Gearset:
 - a. Provide low-speed gearset using spur pinion and internal spur gear.
 - b. Spur Pinion shall be:
 - 1) Integral with its shaft or keyed to a shaft. If keys are used, the pinion shall be secured to the shaft with a shrink fit. Set screws will not be acceptable.
 - 2) Welded spur pinion and shafts will not be acceptable.
 - 3) Keyed spur pinions shall have a wall thickness above the keyway equal to 1 tooth whole depth minimum. Keyway and keyseat shall have 0.02-inch minimum inside radii. Keys shall have 0.04 inch minimum chamfer on all edges.

- 4) Manufactured to have a minimum AGMA Quality Class 8 per AGMA 2000.
- c. Provide full depth teeth conforming to AGMA 201.02.
 - 1) Stub pitch gear teeth will not be accepted.
 - 2) Undercut gear teeth will not be accepted.
- d. Load capacity rated according to AGMA 2001.
- e. Power Rating Based on Continuous Service and the Lower of The:
 - 1) Pitting resistance for the pinion and gear.
 - 2) Bending strength for the pinion and gear.
- f. Minimum service factor of 1.25 based on continuous running torque.
- g. Overload torque capacity (based on yielding of the pinion or gear teeth) exceeding the momentary peak torque by 1.8 minimum.
- h. Internal Spur Gear:
 - 1) Material: Ductile (nodular) iron in accordance with ASTM A 536 or cast steel in accordance with ASTM A 148, or heat treated alloy steel.
 - 2) Minimum AGMA Quality Class 6 per AGMA 2000.
 - 3) Internal spur gear bolted to the center drive cage.
- i. Turntable Base:
 - 1) Material: Ductile (nodular) iron in accordance with ASTM A 536 or cast iron in accordance with ASTM A 48, Class 40 minimum. Fabricated steel bases will not be accepted.
 - 2) Bolted to the center column to provide support for the internal spur gear, entire rotating collector mechanism, and one end of the access bridge.
- j. Raceways, Ball Bearings, and Oil Bath:
 - 1) Raceways and Ball Bearings:
 - a) Raceways: Heat treated alloy steel.
 - b) Ball Bearings: Heat treated alloy steel.
 - 2) Provide replaceable annular raceways to support vertical and horizontal forces transmitted by ball bearings on turntable base and internal spur gear.
 - a) Raceway 40 inches minimum in diameter.
 - b) Size the raceways using the following equation:

$$q = 59,466 \left(\frac{P}{N * D^2} \right)^{1/3}$$

Where:

q = Contact stress, psi (maximum = 300,000 psi)

P = Total rotating (hung) load, lb., including truss arms, center cage, internal spur gear, influent well, flocculating well, skimmers, tapered spiral scraper blades, counterweights, and any other rotating weight.

N = No. of balls.

D = Ball diameter, in.

- c) Replacement accomplished without removing or backing up the access bridge.
- 3) Design raceway and ball bearings for ABMA L-10 life of 200,000 hours minimum.
- 4) Provide oil bath for turntable base and internal spur gear.
 - a) Include felt seal and dust shield protection.

- b) Provide oil fill, oil drain, and oil level indicator devices in readily accessible locations.
 - c) Lubricant per AGMA 9005.
- 4. Chain Drive:
 - a. Material:
 - 1) Sprockets: Steel.
 - b. Type: Standard roller chain conforming to ANSI/ASME B 29.1M connecting drive sprocket of the gear motor speed reducer to the driven sprocket.
 - c. Drive Sprocket: Minimum of 12 teeth.
 - d. Chain and Sprockets Enclosure: Enclose roller chain and sprockets in weather proof fabricated steel guard with service openings.
 - e. Chain:
 - 1) Minimum tensile strength greater than 4 times chain pull based on momentary peak torque.
 - 2) Power rating exceeding the transmitted power (based on continuous running torque) by 1.50 minimum.
- 5. Drive Motor:
 - a. Type: Drive motor shall be a squirrel-cage induction type.
 - b. Comply with general requirements specified in Section 16222.
 - c. Motor Characteristics:
 - 1) Minimum continuous horsepower not less than 3/4.
 - 2) Voltage: 480 volts.
 - 3) Phase: 3, Premium Efficiency
 - 4) Frequency: 60 hertz.
 - 5) Insulation: Class B, moisture resistant.
 - 6) Service Factor: 1.15.
 - 7) Maximum Ambient Temperature: 40 degrees centigrade.
 - 8) Enclosure: TEFC, Heavy Duty for Marine Corrosive Environment
 - 9) Synchronous Speed: 1,800 revolutions per minute.
 - 10) Overtemperature Switch Detection.
 - d. Nameplate Information: Include all information listed under subparagraph "Motor Characteristics" above.

I. Electrical Controls:

1. Local Control Panel:
 - a. Enclosure: Weatherproof NEMA 4X, made with 316 stainless steel, according to requirements specified in section 16135
 - b. Provide enclosure with sunshields on top, back and two sides.
 - c. Provide moisture drain fitting at the bottom.
 - d. Safety Disconnect Switch with lockout means per requirements specified in section 16144
 - e. Full Voltage Non-reversing Motor Starter, per requirements specified in section 16422.
 - f. Low voltage circuit breakers per requirements specified in section 16412
 - g. Transient Voltage Surge Protectors on the 3 phase, 480 volts circuit and the 120 volt control circuit, per requirements specified in section 16416
 - h. Provide control relays, Terminal Blocks, Alarm Horns, and Nameplates per requirements specified in section 16050.

- i. Provide selector switches, indicating lights and miscellaneous control devices per requirements specified in section 17427.
- j. Provide all necessary controls and devices for compliance with control description specified in section 17411.
- k. Manufacture the control panel according to the requirements of UL-508 for Industrial Control Panels and provide the panel with the UL-508 label.
- l. Mount local control panel near drive mechanism on self supporting heavy duty aluminum pedestal with back-mounting plate as indicated on the Drawings. Do not mount the control panel on safety guardrails.
- 2. Electrical wiring conforming to requirements specified in Division 16.
- 3. Drive Overload Device and Alarms:
 - a. Torque Overload Device: Incorporate into drive assembly.
 - 1) Mechanical overload device shall be actuated by torque from the rotation of the wormgear.
 - 2) Torque Indicator:
 - a) Provide a visual torque indicator oriented so that it may be read from the walkway at all times during operation.
 - b) Calibrate torque indicator from 0 to 160 percent of the continuous running torque.
 - 3) Include with the overload device, 2 independently adjustable switches as follows:
 - a) Alarm Switch: An alarm switch that shall be adjusted to activate an alarm when load reaches 80 percent of the continuous running torque.
 - b) Cut-out Switch: A cut-out switch that shall be adjusted to shut off the motor when load reaches 100 percent of the continuous running torque.
 - c) Alarm circuit to sound an alarm horn and illuminate a red lamp, both mounted at the local control panel.
 - d) Alarm contacts of the maintained type rated at 10 amps continuous pilot duty.
 - e) Overload Device Indicating Meter Enclosure: Weatherproof steel, NEMA 4X.
 - 4) Provide electrical supply to overload device as indicated on the Drawings. Include:
 - a) Electrical components of overload device compatible with alarm devices.
 - b) Other electrical requirements as indicated on the Drawings.
 - b. Additional Protection:
 - 1) Provide shear pins in the drive assembly for additional protection above the shut-off torque rating.
 - a) This additional protection device shall function at approximately 125 percent of continuous running torque.
 - b) Shear Pins: Corrosion resistant material.
 - 2) Provide limit switch that indicates breakage of the shear pin due to any circumstance. Shear pin limit switch shall be interlocked with motor controls to prevent mechanism from operating with a broken shear pin.
 - a) Materials: Corrosion Resistant
 - b) Electrical Enclosure: NEMA 4X.
 - c. Alarm Lamp:
 - 1) Provide vapor-tight red alarm lamp suitable for outdoor installation.

- d. Equipment Identification Plates: Provide 16 gauge stainless steel identification plate, securely mounted on equipment in readily visible location, bearing equipment identification tag number.

2.04 CLARIFIER ACCESSORIES

- A. Spray Systems:
 - 1. The clarifier manufacturer shall provide a spray ring with nozzles to control foam/scum buildup in the flocculating well as shown on the drawings. The spray ring shall run continuously.
 - 2. The clarifier manufacturer shall provide a spray system with nozzles to control spray water into the scum trough. The spray system shall be controlled as specified in 2.03, G, 7.
 - 3. Nozzles as specified in Section 15120.
 - 4. Pipe and fittings shall be SCH 80 PVC as specified in Section 15265.
- B. Density Current Baffle:
 - 1. The baffle system shall consist of a series of baffle panels which are attached to the inboard launder and form an inclined, shelf-like surface around the entire inner periphery of the tank as indicated on the Drawings.
 - 2. Construct panels of corrosion-resistant, UV-treated fiberglass-reinforced plastic. For the resin, use an isophthalic polyester with corrosion-resistant properties, 33-402 resin or equivalent, which is typically used in submerged wastewater treatment applications. Do not use any fillers in the resin except as required for viscosity control, for which, up to 5 percent by weight of a thixotropic agent may be added. Treat the resin to provide ultraviolet suppression.
 - 3. Glass reinforcement to consist of chemically bonded surfacing mat and copped strand roving, with the glass contents of the finished laminate to be not less than 30 percent by weight.
 - 4. The nominal thickness of each baffle panel shall be 3/16 inches minimum.
 - 5. Attach the panels to the inboard launder at an integrally molded top edge mounting flange with pre-drilled holes to accommodate anchors for mounting.
 - 6. Design the baffle to withstand a buoyant force load equal to the weight of the water displaced from the volume beneath the baffle. In addition, design the baffle to withstand common wind loads where applicable. Provide sufficient pitch and width of the angle's working surface of the baffle to divert the flow and create a self-cleaning action of the baffle.
 - 7. Manufacturer shall furnish certified test reports of the physical and mechanical properties of the product. Each panel shall have the following minimum physical properties:

Tensile Strength	12,000 psi per ASTM D 638
Flexural Strength	19,000 psi per ASTM D 790
Hardness	Barcol 35 per ASTM D 2583
 - 8. Manufacturer shall also furnish certified design calculations and drawings showing details of installation.
 - 9. Install the baffle as indicated on the Drawings and in accordance with the manufacturer's recommendations. Use Type 316 stainless steel for all the installation fasteners.

2.05 FINISHES

- A. Shop Finishing:
 - 1. Sludge Collector Drive Mechanisms: Prime and finish paint before shipping to project site.

- B. Field Finishing:
 - 1. Sludge Collector Mechanisms: Perform surface preparation and coating as specified in Section 09960.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install sludge collector mechanism and clarifier accessories as indicated on the Drawings and in accordance with the manufacturer's installation instructions and recommendations.

- B. Field Welding:
 - 1. Field welding is permitted only for the bridge splice.
 - 2. Use shielded arc welding and conform to requirements of design loads.

- C. Guardrail with Kickplate: Install on both sides of walkway and around center turntable.

- D. Scum Skimming System: Install counterweights designed and located by the manufacturer.

- E. Center Column: Mount center column vertically over influent port at center of basin floor.

3.02 FIELD QUALITY CONTROL

- A. Testing, Training, and Startup: As specified in the requirements below.

- B. Tests:
 - 1. General: Conduct tests in presence of the ENGINEER.
 - 2. Working under Direction of Manufacturer's Engineer, Perform Field Tests on Each Mechanism as Follows:
 - a. Cut-out Torque Test:
 - 1) Perform cut-out torque test prior to placement of grout topping on concrete slab.
 - 2) The manufacturer shall propose a method of conducting this test and shall verify that the method of testing will not impose stresses in members that exceed allowable stresses.
 - b. Adjustments and Settings to Overload Device:
 - 1) Adjustments and Settings: Perform necessary adjustments and settings to overload device to ensure that sludge collector mechanism will sound an alarm and switch off the drive motor when specified overload conditions occur in tank.

- 2) Test Run: Perform test run following completion of adjustments and settings of overload device to confirm effectiveness of overload device.
- c. Dry Test Run of Equipment:
 - 1) Special Attention: Give attention during dry test run of equipment to operation of scum skimming device.
 - 2) Settings of Skimmer Boom to Scum Box Lip and Rubber Wiping and Sealing Strips: Set as required to ensure that adequate volume of scum is discharged under normal operating conditions.
- d. Electrical Functional Test:
 - 1) Provide functional testing of the clarifier drive together with the control panel per requirements specified in section 16951.

C. Required Results:

1. Sludge Collector Mechanism:
 - a. In event mechanism fails to meet field quality control test requirements of this Section, make necessary changes and retest mechanism.
 - b. If mechanism remains unable to meet test requirements to satisfaction of the ENGINEER, remove and replace such mechanism with satisfactory mechanism at no additional cost.

D. Manufacturer's Field Service:

1. CONTRACTOR to coordinate field service work with the manufacturer's service representative, OWNER, and ENGINEER prior to initiating such work.
2. Manufacturer's Service Representative:
 - a. Manufacturer is to furnish services of representative experienced in erection and operation of the sludge collector mechanism.
 - b. Period of Services: The manufacturer shall include in his bid a minimum of four 8 hour days and 2 trips. The specified durations are the minimum required time on the job site and do not include travel time.
 - c. Services are to include the following:
 - 1) Installation consultation and advice.
 - 2) Checking and supervision of the collector installation.
 - 3) Inspection and certification that unit is ready to sweep in grout prior to grouting operation.
 - 4) Final inspection and adjustments prior to testing.
 - 5) Supervision of testing.
 - 6) Instruction of personnel on operation and maintenance of equipment.

END OF SECTION

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Basic design and performance requirements for mechanical equipment.

1.02 REFERENCES

- A. American Gear Manufacturer's Association (AGMA) Standards:
 1. AGMA 2001-B88 - Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
 2. AGMA 6000-A88 - Specification for Measurement of Linear Vibration on Gear Units.
 3. AGMA 6010-E88 - Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives.
 4. AGMA 6019-E89 - Standard for Gear motors using Spur, Helical, Herringbone, Straight Bevel or Spiral Bevel Gears.
 5. AGMA 6025-C90 - Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives.
- B. American Society of Mechanical Engineers (ASME):
 1. ASME PTC 8.2 - Performance Test Code for Centrifugal Pumps.
 2. ASME PTC 10 - Performance Test Code - Compressors and Exhausters.
 3. ASME PTC 17 - Performance Test Code - Reciprocating Internal-Combustion Engines.
 4. ASME PTC 11 - Performance Test Code - Measurement of Shaft Horsepower - Instruments and Apparatus.
- C. American Bearing Manufacturers Association (ABMA) Standards:
 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- D. American Society for Testing and Materials (ASTM):
 1. A 36 - Standard Specification for Structural Steel.
 2. A 48 - Standard Specification for Gray Iron Castings.
 3. A 526 - Standard Specification for Steel Sheet, Zinc Coated by the Hot Dip Process, Commercial Quality.
 4. B 61 - Standard Specification for Steam or Valve Bronze Castings.
 5. B 62 - Standard specification for Composition Bronze or Ounce Metal Castings.
 6. E 527 - Standard Practice for Numbering Alloys and Metals (UNS).
- E. Hydraulic Institute Standards (HI):
 1. HI 1.1-1.5 - Centrifugal Pumps - Nomenclature, Definitions, Application, and Operation.

2. HI 1.6 - Centrifugal Pump Tests.
3. HI 2.1-2.5 - Vertical Pumps - Nomenclature, Definitions, Application, and Operation.
4. HI 2.6 - Vertical Pump Tests.
5. HI 3.1-1.5 - Rotary Pumps - Nomenclature, Definitions, Application, and Operation.
6. HI 3.6 - Rotary Pump Tests.
7. HI 4.1-4.6 - Sealless Rotary Pumps - Nomenclature, Definitions, Application, and Test.
8. HI 5.1-1.6 - Sealless Centrifugal Pumps - Nomenclature, Definitions, Application, Operation, and Test.
9. HI 6.1-6.5 - Reciprocating Power Pumps - Nomenclature, Definitions, Application, and Operation.
10. HI 7.1-7.5 - Controlled Volume Pumps - Nomenclature, Definitions, Application, and Operation.
11. HI 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application, and Sound Measurement.

F. American Petroleum Institute (API):

1. ANSI/API 682 - Shaft Sealing Systems for Centrifugal and Rotary Pumps.

1.03 DEFINITIONS

- A. Special Tools: Tools that have been specifically made for use on unit of equipment for assembly, disassembly, repair, or maintenance.
- B. Resonant Frequency: That frequency at which a small driving force produces an ever-larger vibration if no dampening exists.
- C. Rotational Frequency: The revolutions per unit of time usually expressed as revolutions per minute.
- D. Critical Frequency: Same as resonant frequency for the rotating elements or the installed machine and base.
- E. Peak Vibration Velocity: The root mean square average of the peak velocity of the vibrational movement times the square root of 2 in inches per second.
- F. Rotational Speed: Same as rotational frequency.
- G. Maximum Excitation Frequency: The excitation frequency with the highest vibration velocity of several excitation frequencies that are a function of the design of a particular machine.
- H. Critical Speed: Same as critical frequency.
- I. Free Field Noise Level: Noise measured without any reflective surfaces (an idealized situation); sound pressure levels at 3 feet from the source unless specified otherwise.
- J. Operating Weight: The weight of unit plus weight of fluids or solids normally contained in unit during operation.

1.04 SYSTEM DESCRIPTION

A. General:

1. Provisions specified under each technical equipment specification prevail over and supersede conflicting provisions as specified in this Section.
2. Provide equipment and parts that are suitable for stresses, which may occur during fabrication, transportation, erection, and operation.
3. Provide equipment that has not been in service prior to delivery, except as required by tests.
4. Like parts of duplicate units are to be interchangeable.
5. When 2 or more units of equipment for the same purpose are required, provide products of same manufacturer.
6. Equipment manufacturer's responsibility extends to selection and mounting of gear drive units, motors or other prime movers, accessories, and auxiliaries required for proper operation.
7. When necessary, modify manufacturer's standard product to conform to specified requirements or requirements indicated on the Drawings and contained in Laws and Regulations.

B. Material Requirements:

1. Materials: Suitable for superior corrosion resistance and for services under conditions normally encountered in similar installations.
2. Dissimilar Metals: Separate contacting surfaces with dielectric material.

C. Power Transmission Systems:

1. Power Transmission Equipment: V-belts, sheaves, shaft couplings, chains, sprockets, mechanical variable-speed drives, variable frequency drives, gear reducers, open and enclosed gearing, clutches, brakes, intermediate shafting, intermediate bearings, and U-joints are to be rated for 24 hour-a-day continuous service or frequent stops-and-starts intermittent service, whichever is most severe, and sized with a minimum service factor of 1.5.
 - a. Apply 1.5 service factor to nameplate horsepower and torque of prime source of power and not to actual equipment loading.
 - b. Apply service factors higher than 1.5 when recommended for continuous 24 hour-per-day operation and shock loadings specified in AGMA 6010-E88, other applicable AGMA standards, or other applicable referenced standards.
 - c. When manufacturer recommends service factor greater than 1.5, manufacturer's recommendation takes precedence.

D. Vibration:

1. Resonant Frequency: Ensure there are no natural resonant torsional, radial, or axial frequencies within 25 percent above or below the operating rotational frequencies or multiples of the operating rotational frequencies that may be excited by the equipment design.
2. Design, balance and align equipment to meet the vibration criteria specified in Section 15958.

E. Equipment Mounting and Anchoring:

1. Mount equipment on cast iron or welded steel bases with structural steel support frames. Utilize continuous welds to seal seams and contact edges between steel members. Grind welds smooth.
2. Provide bases and supports with machined support pads, dowels for alignment of mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits.
3. Provide jacking screws in bases and supports for equipment weighing over 1,000 pounds.
4. Anchorage of Equipment to Concrete: Perform calculations and determine number, size, type, strength, and location of anchor bolts or other connections.
5. Provide bolt sleeves for anchor bolts for heavy equipment. Adjust bolts to final location and fill sleeve with non-shrink grout.
6. Anchorage of Equipment to Metal Supports: Perform calculations and determine number, size, type, strength, and location of bolts used to connect equipment to metal supports.
7. Design equipment anchorage, supports, and connections for dead load, running loads, loads during start-up, seismic load, and other loads as required for proper operation of equipment.

F. Equipment Units Weighing 50 Pounds or More: Provide with lifting lugs or eyes to allow removal with hoist or other lifting device.

1.05 SUBMITTALS

A. Product Data:

1. For Each Item of Equipment:
 - a. Design features.
 - b. Load capacities.
 - c. Efficiency ratings.
 - d. Material designations by UNS alloy number or ASTM Specification and Grade.
 - e. Data needed to verify compliance with the Specifications.
 - f. Catalog data.
 - g. Name plate data.
 - h. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.
2. Gear Reduction Units:
 - a. Engineering information per applicable AGMA standards.
 - b. Gear mesh frequencies.

B. Shop Drawings:

1. Drawings for Equipment:
 - a. Drawings that include outline drawings, cut-away drawings, parts lists, material specification lists, and other information required to substantiate that proposed equipment complies with specified requirements.
2. Outline drawings showing equipment, driver, driven equipment, pumps, seal, motor(s) or other specified drivers, variable frequency drive, shafting, U-joints, couplings, drive arrangement, gears, baseplate or support dimensions, anchor bolt sizes and locations, bearings, and other furnished components.
3. Installation and checkout instructions including leveling and alignment tolerances, grouting, lubrication requirements, and initial start-up procedures.

4. Wiring, control schematics, control logic diagrams and ladder logic or similar for computer based controls.
5. Recommended or normal operating parameters such as temperatures and pressures.
6. Alarm and shutdown set points for all controls furnished.

C. Calculations:

1. Calculations and other information to substantiate equipment base plates, supports, bolts, anchor bolts, and other connections meet minimum design strength requirements.
2. Bearing L_{10} life calculations in accordance with ABMA 9 or ABMA 11 calculation methods for drivers, pumps, gears, shafts, motors, and other drive line components with bearings.
3. Calculations and other information to substantiate that operating rotational frequencies meet the requirements of this Section.
4. Torsional Analysis of Power Transmission Systems: When torsional analysis specified in the equipment Sections, provide:
 - a. Sketch of system components identifying physical characteristics including mass, diameter, thickness, and stiffness.
 - b. Results of analysis including first and second critical frequencies of system components and complete system.
5. Calculations shall be signed and stamped by a civil or structural engineer registered to practice in the state where the Project is located.

D. Quality Control Submittals:

1. Source quality control reports and certified test data as specified in Section 15958.
2. Submit factory test reports before shipment.
3. Certified static and dynamic balancing reports for rotating equipment.
4. Field quality control reports and test data as specified in Section 15958.
5. Start-Up Plan: Proposed plan for field-testing equipment.
6. Certificate of Proper Installation.
7. Submit material test reports a specified in the equipment sections.

E. Operation and Maintenance Manuals:

1. Submit prior to training of OWNER's personnel.
2. Make available at project site complete copy of manuals for use by field personnel and ENGINEER during start-up and testing of equipment.
3. Include manufacturer and model number of every bearing; include calculated ball pass frequencies of the installed equipment for both the inner and outer raceways.
4. Include motor rotor bar pass frequencies.

1.06 QUALITY ASSURANCE

A. Manufacturer's Field Service:

1. Furnish services of authorized representative specially trained in installation of equipment.
 - a. Visit project site and perform tasks necessary to certify installation.
 - b. Furnish Certificate of Proper Installation.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping:
 - 1. Equipment: Pack in boxes, crates, or otherwise protect from damage and moisture, dust, or dirt during shipment, handling, and storage.
 - 2. Bearings: Separately pack or otherwise suitably protect during transport.
 - 3. Spare Parts: Deliver in boxes labeled with contents, equipment to which spare parts belong, and name of CONTRACTOR.
- B. Storage:
 - 1. Equipment Having Bearings: Store in enclosed facilities. Rotate units at least once per month or more often as recommended by the manufacturer to protect rotating elements and bearings.
 - 2. Gear Boxes: Oil filled or sprayed with rust preventive protective coating.
- C. Protection:
 - 1. Equipment: Protect equipment from deleterious exposure.
 - 2. Painted Surfaces: Protect against impact, abrasion, discoloration, and other damage.

1.08 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Equipment for project include:
 - a. Installation in a wastewater treatment plant.
 - b. Moderate quantities of commercial and industrial waste.
 - c. Ambient Temperatures: 20 to 110 degrees Fahrenheit.
 - d. Relative Humidities: 50 to 100 percent.
 - e. Site Elevation: Approximately approximately 15-20 feet above mean sea level.

1.09 SEQUENCING AND SCHEDULING

- A. Equipment Anchoring: Obtain anchoring material and templates or setting drawings from equipment manufacturers in adequate time for anchors to be cast-in-place when concrete is placed.
- B. Coordinate details of equipment with other related parts of the Work, including verification that structures, piping, wiring, and equipment components are compatible.
- C. General Start-Up and Testing of Equipment:
 - 1. Perform general start-up and testing procedures after operation and maintenance manuals for equipment have been received.
 - 2. Conduct functional testing of mechanical or electrical systems when each system is substantially complete and after general start-up and testing procedures have been successfully completed.
 - 3. Functional testing requirements as specified in Section 15958 and 16950 and the equipment sections.

1.10 MAINTENANCE

- A. Special Tools:
 - 1. When specified, provide special tools required for operation and maintenance.
 - 2. Mark or tag and list such tools in maintenance and operations instructions. Describe use of each tool.
- B. Spare Belts:
 - 1. When spare belts are specified, furnish 1 spare belt for every different type and size of belt-driven unit.
 - a. Where 2 or more belts are involved, furnish matched sets.
 - b. Identify as to equipment, design, horsepower, speed, length, sheave size, and use.
 - c. Package in boxes labeled with identification of contents.
- C. Spare Parts:
 - 1. Assume responsibility until turned over to OWNER.
 - 2. Store in enclosed facilities.
 - 3. Furnish itemized list and match identification tag attached to every part.
 - 4. List parts by generic title and identification number.
 - 5. Furnish name, address, and telephone number of supplier and spare parts warehouse.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Ferrous Materials:
 - 1. Steel for Members used in Fabrication of Assemblies: ASTM A 36.
 - 2. Iron Castings: ASTM A 48, tough, close-grained gray iron, free from blowholes, flaws, and other imperfections.
 - 3. Galvanized Steel Sheet: ASTM A 526, minimum 0.0635 inch (16 gauge).
 - 4. Expanded Metal: ASTM A 36, 13 gauge, 1/2-inch flat pattern expanded metal.
- B. Nonferrous Materials:
 - 1. Stainless Steel: Type 304 or 316 as specified. Provide L grade where welding required.
 - 2. Bronze in Contact with Liquid: Composition of not more than 2 percent aluminum nor more than 6 percent zinc; UNS Alloy C83600, C92200 or C92700 in accordance with ASTM B 61, B 62, B 505, or B 584, when not specified otherwise.
- C. Dielectric Materials for Separation of Dissimilar Metals:
 - 1. Neoprene, bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other materials.
- D. Anchors Bolts: As specified.

2.02 SHAFT COUPLINGS

- A. General:

1. Type and Ratings: Provide nonlubricated type, designed for not less than 50,000 hours of operating life.
2. Sizes: Provide as recommended by manufacturer for specific application, considering horsepower, speed of rotation, and type of service.
3. Use: Use of couplings specified in this Section does not relieve CONTRACTOR of responsibility to provide precision alignment of driver-driven units as required by equipment manufacturer and alignment criteria specified elsewhere in this section.

B. Shaft Couplings - Close Coupled: Shaft couplings for close coupled electric motor driven equipment 1/2 horsepower or larger and subject to sudden torque reversals or shock loading:

1. Manufacturers: One of the following or equal:
 - a. T.B. Woods, Dura-Flex, L-Jaw C-Jaw or G-Jaw.
 - b. Lovejoy, S-Flex.
2. Provide flexible couplings designed to accommodate angular misalignment, parallel misalignment, and end float.
3. Manufacture flexible component of coupling from synthetic rubber, or urethane.
4. Provide service factor of 2.5 for electric motor drives and 3.5 for engine drives.
5. Do not allow metal-to-metal contact between driver and driven equipment.
6. Examples of loads where sudden torque reversals may be expected:
 - a. Reciprocating pumps, blowers, and compressors.
 - b. Conveyor belts.
 - c. Reversing equipment.

C. Shaft Couplings - Direct Connected: Shaft couplings for direct connected electric motor driven equipment 1/2 horsepower or larger and subject to normal torque, non-reversing applications:

1. Manufacturers: One of the following or equal:
 - a. Falk, WA Torus.
 - b. T.B. Woods, Dura-Flex, Sure-Flex or Form-Flex.
2. Provide flexible couplings designed to accommodate shock loading, vibration, and shaft misalignment or offset.
3. Provide flexible connecting element of rubber and reinforcement fibers.
4. Connect stub shafts through collars or round flanges, firmly keyed to their shafts with neoprene cylinders held to individual flanges by through pins.

D. Spacer Couplings: Where cartridge type mechanical seals or non-split seals are specified, provide a spacer type coupling of sufficient length to remove the seal without disturbing the driver or driven equipment unless noted otherwise in the individual equipment specifications.

E. Specialized Couplings: Where requirements of equipment dictate specialized features, supply coupling recommended for service by manufacturer.

2.03 GEAR REDUCTION UNITS

A. Type: Helical or herringbone, unless otherwise specified.

B. Design:

1. Made of alloys treated for hardness and for severe service.
2. AGMA Class II Service:

- a. Use more severe service condition when such is recommended by unit's manufacturer.
- 3. Cast iron housing with gears running in oil.
- 4. Anti-friction bearings.
- 5. Thermal horsepower rating based on maximum horsepower rating of prime mover not actual load.
- 6. Manufactured in accordance with applicable AGMA standards.

C. Planetary gear units are not to be used.

2.04 BEARINGS

- A. Type: Oil or grease lubricated, ball or roller antifriction type, of standard manufacture.
- B. Oil Lubricated Bearings: Provide either pressure lubricating system or separate oil reservoir splash type system.
 - 1. Size oil lubrication systems to safely absorb heat energy generated in bearings when equipment is operating under normal conditions and with the ambient temperature 15 degree Fahrenheit above the maximum ambient temperature specified elsewhere in this Section.
 - 2. Provide an external oil cooler when required to satisfy the specified operating conditions. Provide air cooled system if a water cooling source is not indicated on the Drawings. Equip oil cooler with a filler pipe and external level gauge.
- C. Grease Lubricated Bearings, Except Those Specified to Be Factory Sealed: Fit with easily accessible grease supply, flush, drain, and relief fittings.
 - 1. Lubrication Lines and Fittings:
 - a. Lines: Minimum 1/4-inch diameter stainless steel tubing.
 - b. Multiple Fitting Assemblies: Mount fittings together in easily accessible location.
 - c. Use standard hydraulic type grease supply fittings.
 - 1) Manufacturers: One of the following or equal:
 - a) Alenite.
 - b) Zurk.
- D. Ratings: Rated in accordance with ABMA 9 or ABMA 11 for L_{10} rating life of not less than 50,000 hours.
 - 1. Higher ratings, when specified in other Sections, supersede preceding requirement.

2.05 SAFETY GUARDS

- A. Drive Assemblies: Enclose sprockets, belts, drive chains, gearings, couplings, and other moving parts on drive assemblies in safety enclosures that are in compliance with applicable Laws and Regulations.
- B. Shafts: Provide guards that protect personnel from rotating shafts or components within 7.5 feet of floors or operating platforms.
- C. Guard Requirements:
 - 1. Allow visual inspection of moving parts without removal.
 - 2. Allow access to lubrication fittings.

3. Prevent entrance of rain or dripping water for outdoor locations.
4. Size belt and sheave guards to allow for installation of sheaves 15 percent larger and addition of one belt.

D. Materials:

1. Sheet Metal: Carbon steel, 12 gauge minimum thickness, hot-dip galvanized after fabrication.
2. Fasteners: Type 304 stainless steel.

2.06 SPRING VIBRATION ISOLATORS

A. Design Requirements:

1. Telescopic top and bottom housing with vertical stabilizers to resist lateral and vertical forces.
2. Use steel coil springs.

B. Performance Requirements: Minimum spring deflection of 1 inch under static load and capable of limiting transmissibility to 10 percent maximum at design operating load.

C. Manufacturers: One of the following or equal:

1. California Dynamics Corporation, Type RJSR.
2. Mason Industries, equivalent product.

D. Materials:

1. Fabricate isolators using welded steel or shatterproof ductile iron in accordance with ASTM A 536 Grade CS-45-12.
2. Spring Steel: ASTM A 125.

2.07 WARNING SIGNS

- A. Provide for equipment that starts automatically or remotely.
- B. Material and Size: Metal as specified.
- C. Colors: Black lettering on yellow background.
- D. Text: As specified.

2.08 FABRICATION

A. Nameplates:

1. Engraved or stamped on Type 304 stainless steel and fastened to equipment at factory in an accessible and visible location.
2. Indicate Following Information as Applicable:
 - a. Manufacturer's name.
 - b. Equipment model number and serial number.
 - c. Maximum and Normal rotating speed.
 - d. Horsepower.
 - e. Rated capacity.
 - f. Service class per applicable standards.
3. Nameplates for Pumps: Include:
 - a. Rated total dynamic head in feet of fluid.

- b. Rated flow in gallons per minute.
 - c. Impeller, gear, screw, diaphragm, or piston size.
- 4. Gear Reduction Units: Include:
 - a. AGMA Class of service.
 - b. Service factor.
 - c. Input and output speeds.
- B. Bolt Holes in Equipment Support Frames: Do not exceed bolt diameter by more than 25 percent, up to limiting maximum diameter oversize of 1/4 inch.
- C. Shop Finishing:
 1. Provide factory and field coating as specified in Section 09960. If not specified in Section 09960, provide coating as follows:
 - a. Bases and Support Frames in Contact with Concrete or Other Material: Coat contacting surfaces with minimum of 2 coats of zinc chromate primer before installation or grouting.
 - b. Shop Primer for Steel and Iron Surfaces, Unless Specified Otherwise:
 - 1) Manufacturers: One of the following or equal:
 - a) Ameron, Amercoat 185 Universal Primer.
 - b) Cook, 391-N-167 Barrier Coat.
 - c) Kop-Coat, Pug Primer.
 - d) Tnemec, 37-77 Chem-Prime.
 - e) Valspar, 13-R-28 Chromox Primer.
 - c. Coat machined, polished, and nonferrous surfaces which are not to be painted with rust-preventive compounds.
 - 1) Manufacturers: One of the following or equal:
 - a) Houghton, Rust Veto 344.
 - b) Rust-Oleum, R-9.
 - d. Coating for Ferrous Metal Surfaces, Except Stainless Steel: High solids polyamine epoxy.
 - e. Finish Painting of Motors: Shop finish paint with manufacturer's standard coating, unless otherwise specified in Section 09960.

2.09 SOURCE QUALITY CONTROL

- A. As specified in Section 15958 for testing requirements and the individual equipment sections of the Specifications.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect all components for shipping damage, conformance to specifications, and proper torques and tightness of fasteners.

3.02 PREPARATION

- A. Metal Work Embedded in Concrete:
 1. Accurately place and hold in correct position while concrete is being placed.
 2. Clean surface of metal in contact with concrete immediately before concrete is placed.

- B. Concrete Surfaces Designated to Receive Grout:
 - 1. Heavy sandblast concrete surface in contact with grout.
 - 2. Clean surfaces of sandblasting sand, grease, oil, dirt, and other foreign material that may reduce bonding of grout.
 - 3. Concrete Saturation: Saturate concrete with water. Concrete shall be saturated surface damp at time grout is placed.
- C. Field Measurements:
 - 1. Prior to fabrication of equipment, take measurements for installation of equipment and verify dimensions indicated on the Drawings. Ensure equipment and ancillary appurtenances fit within available space.

3.03 INSTALLATION

- A. Install equipment in accordance with manufacturer's installation instructions and recommendations.
- B. Lubrication Lines and Fittings:
 - 1. Lines from Fittings to Point of Use: Support and protect.
 - 2. Fittings:
 - a. Bring fittings to outside of equipment in manner such that they are readily accessible from outside without necessity of removing covers, plates, housings, or guards.
 - b. Mount fittings together wherever possible using factory-mounted multiple fitting assemblies securely mounted, parallel with equipment lines, and protected from damage.
 - c. Fittings for Underwater Bearings: Bring fittings above water surface and mount on edge of structure above.
- C. Alignment of Drivers and Equipment:
 - 1. Where drive motors or other drivers are connected to driven equipment by flexible coupling, disconnect coupling halves and align driver and equipment after complete unit has been leveled on its foundation.
 - 2. Comply with procedures of appropriate Hydraulic Institute Standards, AGMA Standards, alignment tolerances of equipment manufacturers and the following requirements to bring components into angular and parallel alignment:
 - a. Maximum Total Coupling Offset (not the per plane offset): Not to exceed 0.5 mils per inch of coupling length for spacer couplings based on coupling length (not dial separation).
 - b. Utilize jacking screws, wedges, or shims as recommended by the equipment manufacturer and as specified in the equipment sections.
 - 3. Use reverse-indicator arrangement dial type or laser type alignment indicators: Mount indicators on the driver/coupling flange and equipment/coupling flange. Alignment instrumentation accuracy shall be sufficient to read angular and radial misalignment at 10 percent or less of the manufacturer's recommended acceptable misalignment.
 - 4. Alignment and calculations shall include measurement and allowance for thermal growth, spacer coupling length, indicator separation and axial spacing tolerances of the coupling.
 - 5. When alignment satisfies most stringent tolerance of system components, grout between base and foundation. Allow minimum 48 hours for grout to

harden. After grout hardens, remove jacking screws, tighten anchor bolts and other connections, and recheck alignment. Correct alignment as required.

6. After operational testing is complete, dowel motor or drivers and driven equipment. Comply with manufacturer's instructions.

D. Special Techniques: Use applicable special tools and equipment, including precision machinist levels, dial indicators, and gauges as required in equipment installations.

E. Tolerances:

1. Completed Equipment Installations: Comply with requirements for intended use and specified vibration and noise tolerances.

F. Warning Signs: Mount securely with stainless fasteners at equipment that can be started automatically or from remote locations.

3.04 FIELD QUALITY CONTROL

A. Test equipment as specified in Section 15958 and the individual equipment Section of the Specifications.

3.05 MANUFACTURER'S REPRESENTATIVE

A. Field Checkout: Before field-testing and start-up, provide services of factory-trained field service representative to certify the equipment has been installed, aligned, and checked in accordance with the manufacturer's instructions and the Specifications.

B. Testing: Provide services of factory trained representative to observe and advise the CONTRACTOR during field quality control testing.

C. Training: When training is specified, provide services of factory-trained representative to perform training as specified.

END OF SECTION

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SECTION 15052
BASIC PIPING MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Basic piping materials and methods.

1.02 REFERENCES

- A. American Society of Testing and Materials (ASTM):
 - 1. F 37 - Standard Test Methods for Sealability of Gasket Materials.

1.03 DEFINITIONS

- A. Buried Pipe: Pipe that is buried in the soil, or cast in a concrete pipe encasement that is buried in the soil.
- B. Exposed Pipe: Pipe that is located above ground, or pipe that is located inside a structure, supported by a structure, or case into a concrete structure.
- C. Underground Piping: Piping actually buried in soil or cast in concrete.
- D. Underwater Piping: Piping below tops of walls in basins or tanks containing water.
- E. Wet Wall: Wall with water on at least 1 side.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Link -type seals.
 - 2. Gaskets.

PART 2 PRODUCTS

2.01 LINK TYPE SEALS

- A. Characteristics:
 - 1. Modular mechanical type, consisting of interlocking neoprene or synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening.
 - 2. Assemble links solely with stainless steel bolts and nuts to form a continuous rubber belt around the pipe.
 - 3. Provide a nylon polymer pressure plate with 316 Stainless Steel hardware. Isolate pressure plate from contact with wall sleeve.
- B. Manufacturers: One of the following or equal:
 - 1. Calpico, Incorporated.

2. Pipeline Seal and Insulator, Inc., Link-Seal.

2.02 GASKETS

- A. Gaskets for Non-Steam Cleaned Ductile Iron and Steel Piping:
 1. Suitable for pressures equal to and less than 150 pounds per square inch gauge, temperatures equal to or less than 250 degrees Fahrenheit, and raw sewage service.
 2. Gasket Material:
 - a. Neoprene elastomer with minimum Shore A hardness value of 70.
 - b. Reinforcement: Inserted 13-ounce nylon fabric cloth for pipes 20 inch or larger.
 - c. Thickness: Minimum 3/32-inch thick for less than 10-inch pipe; minimum 1/8 inch thick for 10-inch and larger pipe.
 3. Manufacturers: One of the following or equal:
 - a. Pipe less than 20 inches in diameter:
 - 1) Garlock, Style 7797.
 - 2) John Crane, similar product.
 - b. Pipe 20 inches in diameter and larger:
 - 1) Garlock, Style 8798.
 - 2) John Crane, similar product.
- B. Gaskets for Flanged Joints in Polyvinyl Chloride and Polyethylene Piping:
 1. Suitable for pressures equal to or less than 150-pounds per square inch gauge, with low flange bolt loadings, temperatures equal and less than 120 degrees Fahrenheit, and polymer, chlorine, caustic solutions, and other chemicals, except chemicals which liberate free fluorine including fluoroochemicals and gaseous fluorine.
 2. Material: 0.125-inch thick Viton rubber.
 3. Manufacturers: One of the following or equal:
 - a. Garlock.
 - b. John Crane, similar product.
- C. Gaskets for Flanged Joints in Ductile Iron or Steel Water Piping:
 1. Suitable for hot or cold water, pressures equal to or less than 150 pounds per square inch gauge, and temperatures equal to or less than 160 degrees Fahrenheit.
 2. Material:
 - a. Neoprene elastomer, compressed, with non-asbestos fiber reinforcement.
 3. Manufacturers: One of the following or equal:
 - a. Garlock, Bluegard 3300.
 - b. John Crane, similar product.
- D. Gaskets for any other fluids or any other pressure or temperature conditions shall be suitable for the specific fluids and pressure and temperature conditions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Existing Conditions:
 1. Locate and expose existing structures, piping, conduits, and other facilities and obstructions that may affect construction of underground piping before starting excavation for new underground piping and appurtenances.
 2. Verify sizes, elevations, locations, and other relevant features of existing facilities and obstructions. Determine conflicts for the construction of the new underground piping and appurtenances.
 3. Make piping location and grade adjustments to resolve conflicts between new piping and existing facilities and obstructions.

3.02 INSTALLATION

- A. General:
 1. Piping Drawings:
 - a. Except in details, piping is indicated diagrammatically. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings. Sizes and locations are indicated on the Drawings.
 - b. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed.
 - 1) Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Times.
 2. Piping Alternatives:
 - a. Provide piping as specified in this Section, unless indicated on the Drawings or specified otherwise.
 - b. Alternative Pipe Ratings: Piping with greater pressure rating than specified may be substituted in lieu of specified piping without changes to the Contract Price. Piping of different material may not be substituted in lieu of specified piping.
 - c. Valves in Piping Sections: Capable of withstanding specified test pressures for piping sections and fabricated with ends to fit piping.
 - d. For flanged joints, where one of the joining flanges is raised face type, provide a matching raised face type flange for the other joining flange.
- B. Wall and Slab Penetrations:
 1. Provide sleeves for piping penetrations through aboveground masonry and concrete walls, floors, ceilings, roofs, unless specified or otherwise indicated on the Drawings.
 2. For piping 1 inch in nominal diameter and larger, provide sleeves with minimum inside diameters of 1 inch plus outside diameter of piping. For piping smaller than 1 inch in nominal diameter, provide sleeve of minimum twice the outside diameter of piping.
 - a. Arrange sleeves and adjacent joints so piping can be pulled out of sleeves and replaced without disturbing the structure.
 - b. Cut ends of sleeves flush with surfaces of concrete, masonry, or plaster.

- c. Conceal ends of sleeves with escutcheons where piping runs through floors, walls, or ceilings of finished spaces within buildings.
- d. Seal spaces between pipes and sleeves with link-type seals when not otherwise specified or indicated on the Drawings.
- e. Seal openings around piping running through interior walls and floors of chlorine rooms and chlorine storage rooms gastight with synthetic rubber sealing compound.

C. Exposed Piping:

- 1. Install exposed piping in straight runs parallel to the axes of structures, unless otherwise indicated on the Drawings.
 - a. Install piping runs plumb and level, unless otherwise indicated on the Drawings. Slope plumbing drain piping with a minimum of 1/4 inch per foot downward in the direction of flow. Slope digester gas piping to drip traps or low-point drains at a minimum of 1/2 inch per foot where condensate flows against the gas, or at a minimum of 1/4 inch per foot where condensate flows with gas.
- 2. Install exposed piping after installing equipment and after piping and fitting locations have been determined.
- 3. Support Piping: As specified in Sections 15061.
 - a. Do not transfer pipe loads and strain to equipment.
- 4. In addition to the joints indicated on the Drawings, provide unions, flexible couplings, flanged joints, flanged coupling adapters, and other types of joints or means which are compatible with and suitable for the piping system, and necessary to allow ready assembly and disassembly of the piping.
- 5. Assemble piping without distortion or stresses caused by misalignment.
 - a. Match and properly orient flanges, unions, flexible couplings, and other connections.
 - b. Do not subject piping to bending or other undue stresses when fitting piping. Do not correct defective orientation or alignment by distorting flanged joints or subjecting flange bolts to bending or other undue stresses.
 - c. Flange bolts, union halves, flexible connectors, and other connection elements shall slip freely into place.
 - d. Alter piping assembly to fit, when proper fit is not obtained.
 - e. Install eccentric reducers or increasers with the top horizontal for pump suction piping.

D. Buried Piping:

- 1. Bury piping with minimum 2-foot cover without air traps, unless otherwise indicated on the Drawings.
- 2. Where 2 similar services run parallel to each other, piping for such services may be laid in the same trench. Lay piping with sufficient room for assembly and disassembly of joints, for thrust blocks, for other structures, and to meet separation requirements of public health authorities having jurisdiction.
- 3. Laying Piping:
 - a. Lay piping in finished trenches free from water or debris. Begin at the lowest point with bell ends up slope.
 - b. Place piping with top or bottom markings with markings in proper position.
 - c. Lay piping on an unyielding foundation with uniform bearing under the full length of barrels.

- d. Where joints require external grouting, banding, or pointing, provide space under and immediately in front of the bell end of each section laid with sufficient shape and size for grouting, banding, or pointing of joints.
- e. At the end of each day's construction, plug open ends of piping temporarily to prevent entrance of debris or animals.

E. Connections to Existing Piping:

- 1. Expose existing piping to which connections are to be made with sufficient time to permit, where necessary, field adjustments in line, grade, or fittings.
 - a. Protect domestic water/potable water supplies from contamination.
 - 1) Make connections between domestic water supply and other water systems in accordance with requirements of public health authorities.
 - 2) Provide devices approved by OWNER of domestic water supply system to prevent flow from other sources into the domestic supply system.
 - 2. Make connections to existing piping and valves after sections of new piping to be connected have been tested and found satisfactory.
 - 3. Provide sleeves, flanges, nipples, couplings, adapters, and other fittings needed to install or attach new fittings to existing piping and to make connections to existing piping.
 - 4. For flanged connections, provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

F. Connections to In-Service Piping:

- 1. Where operation and maintenance of existing facilities require that a shutdown be made during hours other than normal working hours, perform the related work in coordination with the hours of actual shutdown.

G. Connections Between Ferrous and Nonferrous Metals:

- 1. Connect ferrous and nonferrous metal piping, tubing, and fittings with dielectric couplings especially designed for the prevention of chemical reactions between dissimilar metals.
- 2. Nonferrous metals include aluminum, copper, and copper alloys.

H. Flanged Connections Between Dissimilar Metals Such as Ductile Iron Pipe and Steel Pipe:

- 1. Provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

3.03 CLEANING

A. Piping Cleaning:

- 1. Upon completion of installation, clean piping interior of foreign matter and debris. Perform special cleaning when required by the Contract Documents.

3.04 PIPING SCHEDULE

A. Abbreviations:

- 1. The following abbreviations used in the column of test method refer to the respective methods as specified in Section 15956.

AM	Air method
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GR	Gravity method
HH	High head method
LH	Low head method
SC	Special case
2.	Abbreviations to designate piping include the following:
CI	Cast iron
CL	Class, followed by the designation
DIP	Ductile iron piping
GA	Gauge, preceded by the designation
GE	Grooved end joint
NPS	Nominal pipe size, followed by the number in inches
psi	pounds per square inch
psig	pounds per square inch gauge
PVC	Polyvinyl Chloride
SCH	Schedule, followed by the designation
SST	Stainless steel

END OF SECTION

PIPING SCHEDULE							
Service	Nominal Diameter (inches)	Materials	Joints/ Fittings	Test Pressure/ Method	Lining	Coating	Comments
Scum	4-6	Ductile Iron Class 150	Flange, Restrained MJ	LH	Fusion Bonded Epoxy	Coal Tar Epoxy (Underground) High Solids Epoxy (Above Ground)	
Plant Service Water	1-3	Sch. 80 PVC	SW	HH	None	None	
Notes: 1. All exposed piping shall be painted and/or coated in accordance with Section 09960.							

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SECTION 15075

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Mechanical Identification including the following:
 - 1. Equipment nameplates.
 - 2. Pipe identification by color and legend.
 - 3. Underground Warning Tape
 - 4. Identification of equipment and components of systems with paint, brands, tags, and signboards.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

- A. Submit Following:
 - 1. Product data.
 - 2. Samples.
 - 3. Manufacturer's installation instructions.
 - 4. Submit following:
 - a. Operation and Maintenance Data.
 - b. Warranty.

PART 2 PRODUCTS

2.01 EQUIPMENT NAMEPLATES

- A. Material and Fabrication:
 - 1. Stainless steel sheet engraved or stamped with text, holes drilled, or punch for fasteners.
- B. Fasteners:
 - 1. Number 4 or larger oval head stainless steel screws or drive pins.
- C. Text:
 - 1. Manufacturers name, equipment model number and serial number, identification tag number, and when appropriate, drive speed, motor horsepower with rated capacity, pump rated total dynamic head and impeller size.

2.02 PIPE IDENTIFICATION

- A. Manufacturers:

1. One of the following or equal:
 - a. Seton, Opti Code Pipe Markers.
 - b. Lab Safety Supply.

B. Materials:

1. Pipe Markers: Self-adhesive vinyl, suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit; meet ANSI A13.1 requirements.
 - a. Lettering:

Nominal Pipe Diameter	Lettering Size
Less than 1.5	1/2 inch
1.5 inches to 2 inches	3/4 inch
2.5 inches to 6 inches	1-1/4 inches
8 inches to 10 inches	2-1/2 inches
Over 10 inches	3-1/2 inches

 - b. Marker Colors:

Service	Lettering	Background
Flammables, chemicals, toxics	Black	Yellow
Water, nontoxic solutions or low hazard liquids	White	Green
Nonflammable or nontoxic gases	White	Blue
Fire quenching fluids (foam, fire water, CO ₂ Halon)	White	Red
2. Coating: As specified in Section 09960.
3. Pipe Identification Tags: Aluminum or stainless steel with stamped-in 1/4 inch high identifying lettering.
4. Pipe Identification Tag Chains: Aluminum or stainless steel.
5. Snap-on Markers: Markers with 3/4 inch high letters for 3/4 to 4 inch pipe or covering, or 5 inch high letters for 5 inch or larger pipe or cover, as manufactured by one of following:
 - a. Brady Bradysnap-On B-915.
 - b. Seton Setmark.

2.03 UNDERGROUND WARNING TAPE

A. Manufacturer:

1. One of the following or equal:
 - a. Seton Name Plate Company, Branford, CT.

B. Material:

1. Metallic detection tape; minimum 4 mil thick by 6 inches wide polyethylene film with wording, "Caution" with name of service followed by words, "Line Buried Below" repeated continuously along tape length, with alternate metallic and color strips. Colors as follows:
 - a. Water: Blue.
 - b. Telephone: Orange.

- c. Sewer: Green.
- d. Gas and Other Services: Yellow.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify satisfactory conditions of substrate for applying identification.
- B. Verify that conditions are satisfactory for installation and application of products as specified.

3.02 PREPARATION

- A. Prepare and coat surfaces as specified in Section 09960.
- B. Prepare surface in accordance with product manufacturer's instructions.

3.03 PIPING IDENTIFICATION

- A. Identify exposed piping, valves, and accessories, and piping, in accessible chases with lettering or tags designating service of each piping system with flow directional arrows and color code.
- B. Color Code:
 - 1. Coat piping scheduled to be color coded completely with specified colors.
 - 2. Coat segments of pipe specified to be unpainted with specified coding color long enough to accommodate required lettering and arrows.
- C. Coat piping specified to be coated to match adjacent surfaces, unless otherwise directed.
- D. Lettering and Flow Direction Arrows:
 - 1. Stencil lettering on painted bands or use snap-on markers on pipe to identify pipe. When stenciling, stencil 3/4 inch high letters on 3/4 through 4-inch pipe or coverings, or 5-inch high letters on 5-inch and larger pipe or coverings.
 - 2. Provide lettering and flow direction arrows near equipment served, adjacent to valves, both sides of walls and floors where pipe passes through, at each branch or tee, and at intervals of not more than 50 feet in straight runs of pipe.
- E. Where scheduled, space 6-inch wide bands along stainless steel pipe at 10-foot intervals and other pipe at 5-foot intervals.
- F. Metal Tags:
 - 1. Where outside diameter of pipe or pipe covering is 5/8 inch or smaller, provide metal pipe identification tags instead of lettering.
 - 2. Fasten pipe identification tags to pipe with chain.
 - 3. Where tags are used, color code pipe as scheduled.
- G. Underground Warning Tape:
 - 1. Place warning tape in pipe trench, 12 inches above the pipe.

3.04 APPLICATION

- A. Identify piping with legend markers, directional arrow markers, and number markers; use self adhesive arrow roll tape to secure ends of piping markers and indicate flow direction.
- B. Provide legend markers, directional arrow markers and number markers where piping passes through walls or floors, at piping intersections and at maximum 15 foot spacing on piping runs.
- C. Provide piping marker letters and colors as scheduled.
- D. Place markers on piping so they are visible from operator's position in walkway or working platform near piping. Locate markers along horizontal centerline of pipe, unless better visibility is achieved elsewhere.

END OF SECTION

SECTION 15094

PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. 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.
- 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 Engineer for approval, as provided in the Contract Documents, shop drawings of all items to be furnished under this Section.
- B. Submit to the Engineer, 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 Engineer 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 ten (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.
- B. The following sizes are minimum requirements and are subject to the Engineer'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)	Minimum Rod Diameter (inches)
Less than 2 1/2	3/8
2 1/2 - 4	1/2
4	5/8
6	3/4
8 -12	7/8
14 - 18	1
20 - 30	1 1/4

- 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 Grinnel 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 insets 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., 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 and 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 Engineer. 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 Engineer, 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 Engineer, 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.
 - 1) 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, or Wej-it manufactured by Wej-it Expansion Products, Inc.
- 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.

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 Engineer.
- 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 Engineer.

- 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 (1) 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.
- 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 Engineer.
- 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 15120

PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Piping specialties including:
 1. Spray nozzles.

1.02 SUBMITTALS

- A. Product Data:
 1. Manufacturer's certificate attesting successful performance of specified tests.
 2. Manufacturer's published installation instructions.

PART 2 PRODUCTS

2.01 SPRAY NOZZLES

- A. Design:
 1. Operating pressure 10 pounds per square inch gauge, at which pressure each nozzle discharges not less than 3.5 gallons per minute, nor more than 5.0 gallons per minute.
 - a. Spray: Flat, heavy sheet, fan with uniform distribution.
 - b. Fan width at the water surface not less than 6.5 feet at 10 pounds per square inch gauge.
 - c. Spray deflection with a replaceable deflector insert free to rotate away from the orifice opening and mechanically locked in place and counterweighted.
 2. Spray nozzles structurally suitable for pressure up to 200 pounds per square inch gauge.
 3. Nozzles, easy flush type.
- B. Materials:
 1. Spray Nozzles: Leaded bronze.
 2. Nozzles provided with 1/4 inch national pipe thread, and the orifice diameter not less than 1/4 inch.
 3. Replaceable Spray Deflector: Neoprene rubber.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Spray Nozzles:
 1. Install spray nozzles so that elevation of the nozzles is 18 inches above the water surface.

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SECTION 15265

PLASTIC PIPING AND TUBING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Plastic pipe, tubing, and fittings.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. B 16.12 - Cast Iron Threaded Screwed Drainage Fittings.
- B. American Society for Testing and Materials (ASTM):
 - 1. D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load.
 - 2. D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
 - 3. D 1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 4. D 1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - 5. D 1869 - Standard Specification for Rubber Rings for Asbestos-Cement Pipe.
 - 6. D 2321 - Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 7. D 2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
 - 8. D 2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 9. D 2467 - Standard Specification for Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 10. D 2513 - Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
 - 11. D 2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 12. D 2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
 - 13. D 2657 - Heat Joining Polyolefin Pipe and Fittings.
 - 14. D 2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
 - 15. D 2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.
 - 16. D 2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
 - 17. D 2855 - Standard Practice for Making Solvent-cemented Joints with Poly (Vinyl Chloride)(PVC) Pipe and Fittings.
 - 18. D 3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

19. D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
20. D 3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
21. D 3350 - Standard Specification for Polyethylene Plastic Pipes and Fittings Materials.
22. D 4101 - Specification for Propylene Plastic Injection and Extrusion Materials.
23. F 439 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
24. F 441 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
25. F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
26. F 483 - Standard Test Method for Total Immersion Corrosion Test for Aircraft Maintenance Chemicals.
27. F 493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
28. F 645 - Guide for Selection, Design and Installation of Thermoplastic Water Pressure Piping Systems.
29. F 679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
30. F 714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

C. American Water Works Association (AWWA):

1. C900 - Polyvinyl/Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water Distribution.

D. Code of Federal Regulations:

1. Title 49 - Transportation.

E. Plastics Pipe Institute (PPI):

1. TR 31 - Underground Installation of Polyolefin Piping.

F. United States Department of Transportation:

1. Materials Transportation Bureau.

1.03 ABBREVIATIONS

- A. DR: Dimension Ratio.
- B. ID: Inside Diameter of piping or tubing.
- C. NPS: Nominal Pipe Size followed by the size designation.
- D. NS: Nominal Size of piping or tubing.
- E. PVC: Polyvinyl Chloride.
- F. SDR: Standard Dimension Ratio; the Outside Diameter divided by the pipe wall thickness.

1.04 SUBMITTALS

- A. Product Data: Describe materials, pipe, fittings, gaskets and solvent cement.
- B. Manufacturer's Published Installation Instructions.
- C. Certificates:
 1. Submit manufacturer's certificate attesting that plastic pipe, tubing, and fitting types meet specified requirements.
 2. Manufacturer's certification of date of manufacture of plastic pipe and tubing for each lot delivered.
 3. Copies of solvent cement manufacturer's report and certification in accordance with ASTM D 2564 for PVC piping, and ASTM F 493 for CPVC piping.

1.05 QUALITY ASSURANCE

- A. Mark plastic pipe with nominal size, type, class, schedule, or pressure rating, manufacturer and all markings required by applicable ASTM and AWWA standards.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping materials from sunlight, scoring and distortion.
- B. Do not allow surface temperatures on pipe and fittings to exceed 120 degrees Fahrenheit.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Extruding and Molding Material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.
- B. Fittings: Same material as the pipe and of equal or greater pressure rating, except that fittings used in drain, waste and vent piping systems need not be pressure rated.
- C. Unions 2-1/2 Inches and Smaller: Socket end screwed unions. Make unions 3 inches and larger of socket flanges with 1/8-inch full face soft neoprene gasket.

2.02 PVC PIPING, SCHEDULE TYPE

- A. Materials:
 1. PVC Schedule Type Piping: Designation PVC 1120 in accordance with ASTM D 1785 and appendices thereto.
 - a. Pipe and Fittings: Extruded from Type I, Grade 1, Class 12454-B material in accordance with ASTM D 1784.
 - b. PVC Schedule Type Piping: Schedule 80 unless otherwise indicated on the Drawings.
 2. Fittings:
 - a. Supplied by pipe manufacturer.
 - b. Pressure Fittings: In accordance with ASTM D 2466 or ASTM D 2467.

- c. DWV Fittings: In accordance with ASTM D 2665.
- 3. Solvent Cement: In accordance with ASTM D 2564.

2.03 PVC PIPING, CLASS TYPE

- A. PVC Pipe, Class Type: In accordance with ASTM D 2241.
 - 1. Thermoplastic Pipe Materials Designation Code: PVC 1120, 1220 or 2120.
 - 2. PVC Compound: Class 12454-B in accordance with ASTM D 1784.
 - 3. Standard Dimension Ratio: SDR not greater than 17.
- B. Fittings: Ductile iron with transition gasket sized to accommodate the outside pipe diameter.

2.04 SOURCE QUALITY CONTROL

- A. PVC Piping, Schedule Type:
 - 1. Mark pipe and fittings in accordance with ASTM D 1785.
- B. PVC Piping, Class Type:
 - 1. Test pipe to withstand, without failure, 600 pounds per square inch, gauge, hydrostatic pressure for a minimum of 5 seconds.
 - 2. Test integral bell with the pipe.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Where not otherwise specified, install piping in accordance with ASTM F 645, or manufacturer's published instructions for installation of piping, as applicable to the particular type of piping.
 - 2. Provide molded transition fittings for transitions from plastic to metal or IPS pipe. Do not thread plastic pipe.
 - 3. Locate unions where required for adequate access and assembly of the piping system.
 - 4. Provide serrated nipples for transition from plastic pipe to rubber hose.
- B. Installation of PVC Piping, Schedule Type:
 - 1. Solvent weld joints in accordance with ASTM D 2855.
 - 2. Install piping in accordance with manufacturer's published instructions.
- C. Installation of PVC Piping, Class Type:
 - 1. Install piping in accordance with the Appendix of AWWA C 900 complemented with manufacturer's published instructions.

3.02 FIELD QUALITY CONTROL

- A. Leakage Test for PVC Piping, Class Type:
 - 1. Polyvinyl-Chloride (PVC) Piping, Class Type: Subject to visible leaks test and to pressure test with maximum leakage allowance, as specified in Section 15956.

2. Pressure Test with Maximum Leakage Allowance: Perform test after backfilling.
 - a. Pressure: 125 pounds per square inch, gauge.
 - b. Maximum leakage allowance as follows, wherein the value for leakage is in gallons per 100 joints per hour:

NPS, Inches	1-1/2	2	2-1/2	3	4	6	8	10	12
Leakage	0.41	0.52	0.63	0.76	0.98	1.45	1.88	2.35	2.80

3. Test Procedure: Pull the mandrel through the line under test by one person, by hand, with reasonable effort, without the aid of mechanical equipment.
4. Failing Test: Where the mandrel test is not successful, remove and replace the section of piping with the obstruction, and test the piping again, including visible leaks test, pressure test with maximum leakage allowance, mandrel tests, and other specified tests:
 - a. Correction of excessive deflection or obstructions by methods other than removal of the affected piping and replacement of the removed piping with new piping will not be accepted.

END OF SECTION

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SECTION 15956

PIPING SYSTEMS TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Test requirements for piping systems.

1.02 REFERENCES

- A. Uniform Plumbing Code (UPC).
- B. Uniform Mechanical Code (UMC).

1.03 TESTING REQUIREMENTS

- A. General Requirements:
 1. Testing requirements are stipulated in Laws and Regulations; are included in the Piping Schedule in Section 15052; are specified in the specifications covering the various types of piping; and are specified herein.
 2. Requirements in Laws and Regulations supersede other requirements of Contract Documents, except where requirements of Contract Documents are more stringent, including higher test pressures, longer test times, and lower leakage allowances.
 3. Test plumbing piping in accordance with Laws and Regulations, the Uniform Plumbing Code, and UL requirements.
 4. When testing with water, the specified test pressure is considered to be the pressure at the highest point of the piping section under test. Lower test pressure as necessary to prevent testing the lowest point above a safe test pressure.
- B. Furnish necessary personnel, materials, and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges, and other means and facilities required to perform tests.
- C. Water for Testing, Cleaning, and Disinfecting:
 1. Water for testing, cleaning, and disinfecting will be provided by the OWNER.
- D. Pipes to be Tested: Test only those portions of pipes that have been installed as part of this Contract. Test new pipe sections prior to making final connections to existing piping. Furnish and install test plugs, bulkheads, and restraints required to isolate new pipe sections. Do not use existing valves as test plug or bulkhead.
- E. Unsuccessful Tests:
 1. Where tests are not successful, correct defects or remove defective piping and appurtenances and install piping and appurtenances that comply with the specified requirements.
 2. Repeat testing until tests are successful.
- F. Test Completion: Drain and leave piping clean after successful testing.

G. Test Water Disposal: Dispose of testing water in accordance with requirements of federal, state, county, and city regulations governing disposal of wastes in the location of the Project and disposal site.

1.04 SUBMITTALS

A. Schedule and Notification of Tests:

1. Submit a list of scheduled piping tests by noon of the working day preceding the date of the scheduled tests.
2. Notification of Readiness to Test: Immediately before testing, notify ENGINEER in writing of readiness, not just intention, to test piping. Have personnel, materials, and equipment specified in place before submitting notification of readiness.

1.05 SEQUENCE

- A. Clean piping before pressure or leak tests.
- B. Underground pressure piping may be tested before or after backfilling when not indicated or specified otherwise.
- C. Backfill and compact trench, or provide blocking that prevents pipe movement before testing underground piping with a maximum leakage allowance.
- D. Test underground piping before encasing piping in concrete or covering piping with slab, structure, or permanent improvement.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 TESTING HIGH-HEAD PRESSURE PIPING

A. Test piping for which the specified test pressure in the Piping Schedule is 20 pounds per square inch gauge or greater, by the high head pressure test method, indicated "HH" in the Piping schedule.

B. General:

1. Test connections, hydrants, valves, blowoffs, and closure pieces with the piping.
2. Do not use installed valves for shutoff when the specified test pressure exceeds the valve's maximum allowable seat differential pressure. Provide blinds or other means to isolate test sections.
3. Do not include valves, equipment or piping specialties in test sections if test pressure exceeds the valve, equipment or piping specialty safe test pressure allowed by the item's manufacturer.
4. During the performance of the tests, test pressure shall not vary more than plus or minus 5 pounds per square inch gauge with respect to the specified test pressure.
5. Select the limits of testing to sections of piping. Select sections that have the same piping material and test pressure.

6. When Test Results Indicate Failure of Selected Sections, Limit Tests to Piping:
 - a. Between valves.
 - b. Between a valve and the end of the piping.
 - c. Less than 500 feet long.
7. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.

C. Testing Procedures:

1. Fill piping section under test slowly with water while venting air. Use potable water for all potable waterlines and where noted on the Piping Schedule
2. Before pressurizing for the tests, retain water in piping under slight pressure for a water absorption period of minimum 24 hours.
3. Raise pressure to the specified test pressure and inspect piping visually for leaks. Consider visible leakage testing complete when no visible leaks are observed.

D. Pressure Test with Maximum Leakage Allowance:

1. Leakage allowance is zero for piping systems using flanged, National Pipe Thread threaded and welded joints.
2. Pressure test piping after completion of visible leaks test.
3. For piping systems using joint designs other than flanged threaded or welded joints, accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period.
 - a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage and no damage to piping and appurtenances has occurred.
 - b. Successful completion of the pressure test with maximum leakage allowance shall have been achieved when the observed leakage during the test period is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.
 - c. When leakage is allowed, calculate the allowable leakage by the following formula:

$$L = S \times D \times P^{1/2} \times 133,200^{-1}$$

wherein the terms shall mean:

L = Allowable leakage in gallons per hour.

S = Length of the test section in feet.

D = Nominal diameter of the piping in inches.

P = Average observed test pressure in pounds per square inches, gauge, at the lowest point of the test section, corrected for elevation of the pressure gauge.

x = The multiplication symbol.

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SECTION 16010

ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Electrical distribution system and utilization equipment.
 - 1. Electrical installation and connection of equipment furnished requires electric power and control.
 - 2. Provide concrete encased underground conduit systems, and concrete pullboxes indicated on the Drawings.
 - 3. Disconnect and remove, relocate, and reconnect electrical equipment as specified as necessary for complete function of process equipment.
 - 4. Provide new electrical panels, modify and add circuits and circuit breakers to existing electrical panels, and provide other electrical equipment as specified in other sections and as indicated on the Drawings.
 - 5. Demolish existing equipment and underground electrical conduits, and remove existing wiring for buildings or structures required to be remodel or upgraded.
- B. Electrical Constraints:
 - 1. Protect and prevent damage to existing underground piping utilities and electrical utilities associated with remaining process equipment, during construction of new underground utilities.
 - 2. Existing motor control center and panelboard modifications:
 - a. Maintain existing electrical panels in continuous operation during connection of new power feeders associated with secondary clarifiers.
 - b. Coordinate temporary shutdown of power to existing motor control centers and panelboards and provide continuous power for continuous plant operation.
 - 1) Constraints During Momentary Shutdown of power to existing process equipment:
 - a) Provide and verify proper functioning of temporary power
 - 2) Indicate shutdown of main electric power on Progress Schedule. Shutdowns will be permitted to the extent that existing operation of the plant will not be jeopardized and identified constraints are satisfied.
 - 3. Existing Electric Room in Headworks and Electrical System Modifications:
 - a. Coordinate with plant operators the demolition of existing electrical equipment shown on the Drawings. Demolition of existing electrical equipment shall not be done until temporary power or permanent power system is completely functional and tested.
 - 4. Existing Instrumentation System Modifications:
 - a. Coordinate with plant operators the additional PLC items interconnected with existing SCADA network, and avoid interruption of SCADA system.

1.02 SYSTEM DESCRIPTION

- A. Furnish and install a tested and working electrical system, as indicated on the Drawings and as specified. System includes all items not specifically mentioned in these Specifications or indicated on the Drawings or accepted Shop Drawings, but which are obviously necessary to make a complete working installation, and shall be deemed to be included herein.
- B. Notify ENGINEER of discrepancies within the Contract Documents and discrepancies between the Contract Documents and actual field conditions.
- C. The Specifications and Drawings indicate or specify minimum sizes of equipment, electric devices, and other components of electrical system, but the Specifications and Drawings do not indicate every offset and fitting, or every structural or mechanical difficulty that may be encountered during the execution of the Work.
- D. Install equipment at locations indicated on the Drawings as closely as field conditions permit. Obtain accepted equipment submittal dimensions prior to installing pads, and conduits.
- E. Make minor variations to alignment of equipment and/or installation of raceway systems to avoid conflict with other portions of the Work.
- F. Single Line Diagrams: Single line diagrams and block diagrams indicate circuit voltages for low voltage equipment, also indicate some wire and conduit sizes, circuit protection rating, and other pertinent data. Use single line diagrams to resolve conflicts.
 - 1. When not indicated on the Drawings, provide grounding in accordance with NEC Article 250 and as specified in Section 16062.
- G. Electrical Utility Services:
 - 1. The electrical utility service for the Southwest Water Reclamation Facility is existing and it shall remain as is and without interruption.
- H. Temporary Power:
 - 1. Provide and maintain temporary power, lighting, and telephone systems as needed for construction as required. Include weatherproof panel(s) for main breakers and electrical power distribution system.
 - 2. Install temporary wiring in accordance with NEC Article 305 with Type SO portable cable, watertight connections, and ground fault interrupting equipment.
 - 3. Provide temporary power and controls for the existing process equipment at the Headworks, due to possible impact to underground wiring system during excavation and construction of conduits associated with secondary clarifier structure.
 - 4. Provide temporary power and conduits for temporary telephone system at the Construction -office trailers.
 - 5. After construction is completed, remove temporary power and control systems.

1.03 PERFORMANCE REQUIREMENTS

- A. Operate electrical equipment successfully at full-rated load, without failure, at an ambient air temperature of 40 degrees Celsius, and rated for an altitude of 100 feet.

- B. Coordination of Electrical Equipment Rating: Verify actual equipment, motor full-load, and locked-rotor current ratings. When providing equipment with different motor full-load and locked-rotor current ratings than indicated on the Drawings, coordinate branch circuit conductor sizes, motor overload protection, motor controllers, control power transformers, and branch circuit overcurrent protection required for equipment provided.
- C. Branch Circuit Conductor Current Carrying Capacity: Minimum 125 percent of the full-load current rating of equipment.
- D. Branch Circuit Conductor Size: Adequate to prevent voltage drop greater than 2 percent from branch circuit protection device to equipment with equipment running at full-load and rated voltage. Include conductor derating in accordance with ambient temperature and conduit fill requirements.
- E. Motor Running Overload Protection Devices:
 - 1. Rated or selected to trip at no more than the following percent of motor nameplate full-load current rating:
 - a. 125 percent for motors with marked service factor not less than 1.15.
 - b. 125 percent for motors with marked temperature rise not over 40 degrees Celsius.
 - c. 115 percent for all other motors.
 - 2. Size and provide upon verification of actual motor or nameplate data.
 - 3. Where power factor correction capacitors are provided on load side of motor running overload protection device, selection or setting shall be based on the improved power factor of motor circuit and not the full-load nameplate current of motors.
- F. Overload Heaters Required for Motors with Temperature Rise of 50 Degrees Celsius: As selected from motor controller manufacturer's overload heater selection tables.
- G. Motor Controller Size: Coordinated with horsepower size of motor.
- H. Motor-Branch-Circuit Short Circuit and Ground Fault Protections Device: Capable of tripping open in 30 seconds or less on locked-rotor current of motor. This device shall also protect the motor-branch-circuit conductors and the motor control apparatus against overcurrent due to short-circuit or ground faults. Protect motor control circuits with device type specified or as indicated on the Drawings.

1.04 SUBMITTALS

- A. Shop Drawings and Product Data:
 - 1. Include data on and details of control devices, fixtures, wire, cables, raceways, and other electrical equipment specified or indicated on the Drawings.
 - 2. Include protective device coordination study, short circuit fault analysis, circuit breaker settings, and other calculations and studies as specified.
 - 3. Detailed schematic diagrams for control equipment. Schematic diagrams to show existing wiring.
 - 4. Point-to-point interconnection diagrams, for all devices.
 - 5. Calibration and testing forms.
 - 6. Loop diagrams.
 - 7. Conduit and raceway submittal drawings for lighting and receptacles, etc.

8. Factory testing procedures.
9. Functional testing plan.
10. Training plan for plant staff.

B. Project Record Documents:

1. Include drawings of wiring terminations at electrical equipment including, but not limited to:
 - a. Terminal/junction boxes.
 - b. Revised Shop Drawings reflecting modifications made during progress of the Work including testing, and revised Specifications and Drawings with conductors identified identically as on the Specifications and Drawings and accepted Shop Drawings. Updated Shop Drawings shall include all drafting work.

C. Acceptance Testing Information and Documents: Submit as specified in Section 16950.

D. Operating and Maintenance Data (Electrical Equipment):

1. Manuals shall include the following:
 - a. Comprehensive index.
 - b. Complete "as-built" set of approved shop drawings.
 - c. Internal and interconnecting CAD-generated wiring and control diagrams with data to explain detailed operation and control of the equipment. Diagrams shall contain tabulated "as left" settings for all timing relays and alarm and trip setpoints.
 - d. A control sequence describing startup, operation and shutdown for all equipment functional modes as applicable (i.e., LOCAL-MANUAL, LOCAL-AUTOMATIC, REMOTE-MANUAL, REMOTE AUTOMATIC, etc.).
 - e. Description of the function of each principal item of equipment.
 - f. Installation and maintenance instructions.
 - g. Safety precautions.
 - h. Diagrams and illustrations.
 - i. Testing methods.
 - j. Performance data.
 - k. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - l. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
 - m. Provide operations and maintenance (O&M) manuals in electronic format on CD, provide in Adobe Acrobat format or Microsoft Word Format. Documents not originally in digital form shall be scanned at 300 dpi, content being the same as the hard copy O&M manuals.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Perform electrical work, including connection to electrical equipment integral with mechanical equipment, in accordance with latest published requirements of the following codes and code/standard making organizations:

1. American National Standards Institute (ANSI).
2. American Society for Testing and Materials (ASTM).
3. Institute of Electrical and Electronics Engineers (IEEE).

- 4. Insulated Cable Engineers Association (ICEA).
- 5. National Electrical Code (NEC).
- 6. National Electrical Contractors Association (NECA).
- 7. National Electrical Safety Code (NESC).
- 8. National Electrical Manufacturers Association (NEMA).
- 9. National Fire Protection Association (NFPA).
- 10. National Fire Protection Association (NFPA); Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA-820).
- 11. State of Florida Building Code and local codes.

B. When applicable, materials and equipment used in performance of electrical work shall be listed or labeled by Underwriters' Laboratories or other equivalent, recognized, and independent testing laboratory, for the class of service intended.

C. Manufacturer Qualifications:

- 1. Low Voltage Equipment: Manufacturer of proposed product with components uniquely selected by engineering review.
 - a. Proprietary bussing and enclosure designs listed by UL in manufacturer's own file for minimum 15 years with satisfactory performance record.
 - b. Capable of providing warranty for assembly when built-up with components from various manufacturers.

D. Implementation of Protective Device Studies: Have qualified independent testing service implement recommended settings defined in accepted coordination study for protective devices such as relays, fuses, and circuit breakers as specified in Section 16950. The OWNER will withhold payment for the electrical equipment protected by the devices until the studies are accepted and the results are implemented.

E. Experience and Requirements for Electrical Subcontractor: The electrical work in Division 16 of the specifications shall be furnished and installed by a single electrical and controls specialty entity (or electrical subcontractor) with at least 10 years of prior experience in electrical construction project for the water and/or wastewater process industry.

- 1. The electrical contracting entity shall have a specialty active license in the State of Florida.
- 2. The firm shall have completed at least 5 projects in the last 5 years of similar or larger scope of work for wastewater related projects.
- 3. The supervising personnel shall have at least 10 years of prior field hands on electrical experience in projects of similar or larger electrical scope of construction work.
- 4. Upon request from the Construction Administrator, the CONTRACTOR shall submit the qualifications of the electrical specialty firm or electrical subcontractor, including at least five (5) previous electrical projects, with a reference, names, and telephone numbers of the OWNERS for the previous projects. Also, upon request submit the resumes of the key supervising and electrical personnel who will perform the electrical work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Ship electrical panels, switchboards, motor control centers, and other electrical distribution equipment in sealed dust and moisture-proof plastic sheet enclosures.

Equipment containing dirt, dust, water, grease, rust, or damaged parts or components may be rejected.

- B. Provide for delivery, unloading, transportation, and storage of equipment until installation. Protect electrical and instrumentation equipment and panels from physical and environmental damage. Store and maintain equipment in a weatherproof building until installed.
- C. Store electrical equipment, including switchboard, motor control center, instrumentation control panels, and other enclosures that house electronic equipment rated for a specified ambient or environmental temperature range, in air conditioned buildings to protect equipment from temperatures above 90 degrees Fahrenheit and heated buildings to protect equipment from temperatures below 40 degrees Fahrenheit. Assume liability for the storage facilities or equipment stored therein.
- D. Maintain storage facilities in neat condition with utilities. Maintain stored equipment in same condition as when received.
- E. Provide continuous access for inspection of stored equipment.

1.07 HAZARDOUS AREAS

- A. Headworks Structure:
 - 1. Comply with the requirements of the Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820).

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate work with ENGINEER to minimize downtime of existing operating equipment and electrical distribution system and to preclude unsafe operations. Notify OWNER 10 days prior to power interruptions. Coordinate downtime with OWNER.
- B. Prior to performing work on live or energized electrical equipment, or in underground pull boxes or manholes containing energized circuits, identify the circuits and coordinate with Owner prior to de-energize the circuits. Also, provide necessary safety protection in accordance with Electrical Life Safety Code and OSHA requirements if work needs to be momentarily performed with energized circuits.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 PREPARATION

- A. Cutting, Patching and Repairing: Where it becomes necessary to cut into existing work for the purpose of making electrical installations, use core drills for making

circular holes. Other demolition methods for cutting or removing shall be reviewed by the ENGINEER prior to starting the work.

3.02 INSTALLATION

- A. Corrosion Protection:
 - 1. Isolate dissimilar metals, except conduit and conduit fittings, that may come in contact, with neoprene washers, 9 mil polyethylene tape, or gaskets.
 - 2. Restore factory finishes which are damaged or rusted to their original new condition in accordance with manufacturer's instructions.
- B. Install electrical work prior to placing floors and walls. Provide all sleeves and openings through floors and walls required for passage of all conduits and other raceways. Sleeves shall be rigidly supported and suitably packed or sealed to prevent ingress of wet concrete or water.
- C. Provide all insets and hangers required to support raceways and other electrical equipment. If the inserts, hangers, sleeves, or openings, are improperly placed or installed, do all necessary work to rectify the errors.

3.03 CLEANING

- A. Clean each piece of electrical equipment, existing and new, both inside and outside, paint each equipment if necessary to match existing paint.

3.04 PROTECTION

- A. Protect products in outdoor locations or air heated areas and provide heat to eliminate condensation until acceptance by OWNER.

END OF SECTION

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SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Basic electrical materials and methods.

1.02 REFERENCES

- A. American Society for Testing Materials (ASTM):
 - 1. A 525 - Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized), by Hot-Dip Process.
- B. National Electrical Manufacturers' Association (NEMA).

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Connections of electrical equipment to supports shall be designed to resist the operating forces plus windload forces.

1.04 SUBMITTALS

- A. Structural calculations for electrical equipment anchorage.
- B. Shop drawings and product data.

1.05 WARRANTY

- A. Submit manufacturer's standard warranty.

1.06 EXTRA MATERIALS

- A. Furnish and install a minimum of 25 percent spare terminal blocks in each terminal/junction box.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Unless specified otherwise indicated on the Drawings, the fabricator of major electrical equipment, such as lighting and distribution panelboards, and motor control centers, shall also be the manufacturer of the major devices herein.

2.02 MATERIALS

A. Materials, equipment, and parts comprising any unit or part thereof specified or indicated on the Drawings shall be new and unused, of current manufacture, and of highest grade consistent with the industrial industry standards. Damaged materials, equipment, and parts are not considered to be new and unused and will not be accepted.

2.03 EQUIPMENT

A. Support Channels: Steel, hot-dip galvanized with G90 coating in accordance with ASTM A 525 for interior and exterior locations, or stainless steel for corrosive locations.

1. Manufacturers: One of the following or equal:
 - a. Unistrut.
 - b. Superstrut.
 - c. Globe Strut.

B. Support Channel Bolts, Nuts, and Washers: 316 Stainless steel.

C. Non-Fused Terminal Blocks: Sized as required for conductors.

1. Manufacturers: One of the following or equal:
 - a. Square D Company.
 - b. Buchanan.

D. Fused Terminal Blocks: Circuit isolation, fused switch type, sized as required for conductors. Fuse size shall be based upon actual load and conductors to be protected.

1. Manufacturers: One of the following or equal:
 - a. Square D Company.
 - b. Buchanan.

E. Control Relays:

1. Industrial 600 volt, 10 ampere type with contact arrangement and operating coils of proper voltage as required by control circuit sequence; with minimum of 4 reversible-pole contacts; coils sealed by pressure molding.
2. Non-industrial or plug-in type control relays shall be prohibited unless accepted in writing.
3. Manufacturers: One of the following or equal:
 - a. Square D Company.
 - b. Cutler-Hammer.

F. Intrinsically Safe Relays:

1. Factory Mutual approved to allow the use of every type of remote pilot device located in Class 1, Division 1 or 2, hazardous areas by providing a pilot circuit incapable of releasing sufficient electrical energy to ignite gases and vapors classified in Groups A, B, C, and D.
2. Output relay with double pole, double throw contacts continuous rating of 10 amperes at 120 volts alternating current, capable of operating on the voltage indicated.
3. Manufacturers: One of the following or equal:
 - a. B/W - Controls Series 53.
 - b. Cutler-Hammer - Powered Relay.

- G. Reset Timers and Repeat Cycle Timers:
 - 1. Industrial type; 120 volts alternating current, 60 hertz operating power; 6 amperes minimum at 120 volts alternating current output unless otherwise indicated on the Drawings or specified.
 - 2. In enclosure as indicated on the Drawings or specified; plug-in or non-industrial timers shall be prohibited unless accepted in writing.
 - 3. Manufacturers: One of the following or equal:
 - a. Eagle.
 - b. Paragon.
- H. Twenty-Four Hour Timers:
 - 1. Heavy-duty industrial, 120 volts, 60 hertz alternating current operating power, electronic type; 15 amperes at 120 volts alternating current output, single channel type; lithium battery-backed; single pole double throw.
 - 2. In enclosure; plug-in or non-industrial timers shall be prohibited unless accepted in writing.
 - 3. Manufacturers: One of the following or equal:
 - a. Paragon, EC Series
 - b. Tork, equivalent model.
- I. Timing Relays: Heavy-duty industrial, 600 volt, 10 amperes.
 - 1. Manufacturers: One of the following or equal:
 - a. Square D Company.
 - b. Cutler-Hammer.
- J. Area Lighting Control Timers:
 - 1. Electromechanical type; astronomic dial to automatically turn lights ON at dusk and OFF at dawn with day omitting device; with DPST contacts rated for 40 amperes per pole; 120 volts, 60 hertz alternating current operating power.
 - 2. Housed in a NEMA 1 enclosure. Plug-in or non-industrial timers shall be prohibited unless accepted in writing. The timers shall be Z series.
 - 3. Manufacturers: One of the following or equal:
 - a. Tork.
 - b. Paragon.
 - c. PCI Industries.
- K. Buzzers: Capable of producing an adjustable audible sound which shall be minimum 70 decibels at 10 feet from the buzzer.
 - 1. Manufacturers: One of the following or equal:
 - a. Edwards Signaling.
 - b. Federal Signal.
- L. Alarm Horns: Capable of producing an adjustable audible sound which shall be minimum 100 decibels at 10 feet from the horn, accepting up to 8 different plug-in tone modules, and having distinct tones so no 2 horns have the same tone; receiving 120 volt power from its respective control panel as specified or as indicated on the Drawings.
 - 1. Manufacturers: One of the following or equal:
 - a. Edwards Signaling.
 - b. Federal Signal.
- M. Siren (Horn) with Revolving Lights:

1. Weatherproof siren (horn) suitable for surface mounting, 120 V, adjustable volume, and minimum of 4 selectable tones.
2. Revolving lights, weatherproof, suitable for surface water.
3. Manufacturers: To match existing:
 - a. Siren (horn):
 - 1) Edwards Adaptatone Signal Multi-tone Four Tone Select No. 5823T22.
 - b. Revolving Light:
 - 2) Edwards Tri-Beam Revolving Light with Permanent Model No. 5846T53.

N. Thermostats: Unless otherwise specified elsewhere in the Contract Documents, the thermostats shall be:

1. Heavy-duty type with full load rating of 120 volts, 16 amps.
2. Provided with a clear plastic splash-proof protective thermostat cover to inhibit corrosion and moisture damage.
3. Manufacturers: One of the following or equal:
 - a. Honeywell, T6051 Series.
 - b. Rockwell, equivalent.

O. Warning Lights:

1. Warning rotating lights, 40 watt, suitable for indoor and outdoor use, corrosive environment.
2. Red color lens.
3. Shall direct light in a 360 degree pattern.
4. With all necessary accessories for wall-mounting or as specified otherwise elsewhere in these Contract Documents.
5. Voltage: To match the equipment requirements.
6. Manufacturers: One of the following or equal:
 - a. Federal Signal Model 121.
 - b. Edwards Signaling equivalent.

P. Nameplates:

1. Type: Black Iamicoid with white letters.
2. Fastener: Round head stainless steel screws.

Q. Automatic Equipment and High Voltage Warning Signs:

1. Type: Suitable for exterior use and meeting OSHA regulations.

R. Medium Voltage Circuit Raceway Labels: Vinyl plastic.

1. Manufacturers: One of the following or equal:
 - a. Brady.
 - b. Seton.

S. Underground Hazard Tape: 6 inches wide.

1. Manufacturers: One of the following or equal:
 - a. Panduit.

T. Cable Ties:

1. Tefzel Plenum-rated cable ties (or equal), sized appropriately to the conditions. Install at 4 foot maximum intervals, roughly centered between hangers, and at other appropriate locations to keep the wire groups neat.

PART 3 EXECUTION

3.01 GENERAL

- A. Verify dimensions indicated on the Drawings. Actual locations, distances, and levels will be governed by actual field conditions. The CONTRACTOR shall also review information indicated on the Drawings for architectural, structural, yard, mechanical, and other specialties, and the accepted electrical and mechanical shop drawings, and shall adjust his work to conform to all conditions indicated thereon.
- B. Coordinate for consistency lens colors of all pilot lights included in all equipment assemblies specified in Divisions 11 through 17 (subject to ENGINEER's acceptance).

3.02 EQUIPMENT INSTALLATION

- A. Anchor electrical equipment to building floors, electrical equipment foundations, or other supports by bolts and anchor bolts and studs.
- B. Anchor electrical equipment with concrete anchors or flush shells only when indicated on the Drawings.
- C. Anchor each piece of electrical equipment with minimum 1/2 inch diameter Type 316 stainless steel bolts, anchor bolts, or studs. Acceptable connectors shall be furnished in each corner of each section of electrical equipment, minimum.
- D. Where plates are embedded in concrete supporting electrical equipment, fasten electrical equipment to the embedded plates with minimum 1/2 inch diameter welded studs. Where required, the number of studs connecting the embedded plates to floors shall be increased as required based upon the calculations of seismic forces in order to resist the forces from the electrical equipment supplied. The additional studs shall be deemed as part of these Contract Documents.

3.03 TORQUING

- A. After installing and before energizing electrical equipment, torque each bolted bus and cable connection in accordance with manufacturer's recommendations with calibrated torque wrenches. Include each bolt at each connection, both factory and field installed, for motor control centers, variable frequency drives, bus ducts, switchgear, switchboards, and other equipment installed.

3.04 CONDUCTOR FASTENERS

- A. Use screw type conductor fasteners and other permanent, such as epoxy conductor adhesives, in junction or pull boxes, termination cabinets, panels, panelboards, switchboards, switchgear, motor control centers, variable frequency drives, or other enclosures containing electrical devices and/or conductors. Do not use glue-on type conductor fasteners.

3.05 SUPPORT CHANNELS

- A. Install channels, as required for support of raceways, cable trays, device enclosures, and other electrical equipment.

- B. Separate iron or steel supports from aluminum with 1/4 inch neoprene or other non-metallic gaskets.
- C. Paint field cuts and scratches of galvanized steel channels with a cold galvanizing spray paint.

3.06 TERMINAL BLOCKS

- A. Furnish and install terminal blocks in control panels, cabinets, terminal/junction boxes, variable frequency drives, motor control centers, switchgear and similar equipment and identify the terminal blocks by numbering and labeling in accordance with accepted shop drawings. The terminal blocks shall be circuit isolation fused-switch type where indicated on the Drawings and as required.

3.07 NAMEPLATES

- A. Furnish and install nameplates where indicated on the Drawings or specified.
- B. Each disconnect means for service, feeder, branch, or equipment conductors and push-button stations shall have nameplates indicating its purpose or identifying the load.

3.08 AUTOMATIC EQUIPMENT WARNING AND HIGH VOLTAGE SIGNS

- A. Mount permanent warning signs at mechanical equipment which may be started automatically or from remote locations. Fasten warning signs with round head stainless steel screws or bolts, located and mounted in a manner acceptable to ENGINEER.
- B. Mount permanent and conspicuous warning signs on (front and back) equipment, doorways to equipment rooms, pull boxes, manholes, where the voltage exceeds 600 volts.
- C. Place a warning ribbon or other effective means suitable for conditions above underground installations in accordance with NEC. Place warning signs on utilization equipment that has more than one source of power. Provide panel and circuit number of conductor tag of the power source disconnect.
- D. Place warning signs on utilization equipment that has 120 VAC control voltage source used for interlocking. Provide panel, circuit number, and conductor tag of control voltage source disconnect.

3.09 ADJUSTING

- A. Adjust, set timers and contacts for proper equipment operation.

3.10 DEMONSTRATION

- A. Demonstrate operation of equipment.

END OF SECTION

SECTION 16062

GROUNDING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Grounding electrode systems, consisting of concrete encased bare ground conductors and ground rods.

1.02 REFERENCES

- A. National Electrical Code (NEC), Article 250 - Grounding.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Driven Ground Rods:
 - 1. Copper-covered steel.
 - 2. 3/4 inch diameter.
 - 3. 10 feet long, minimum.
- B. Ground Conductor: Bare copper.
- C. Precast Ground Wells: Eight inch inside diameter, minimum, with cast iron cover.
 - 1. Manufacturers: one of the following or equal:
 - a. Oldcastle Precast
 - b. Christy, valve boxes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide concrete encased bare ground conductor in each duct bank. Run grounding electrode system conductors continuously in duct banks, through manholes, handholes, other raceway boxes, and cable tray exteriors. Connect conductors to structure ground ring or grounding system to provide a continuous grounding electrode system.
- B. Bond electrical enclosures, including metallic raceways, panels, switchboards and other similar metallic panels, cases and devices associated with power, instrumentation, and control systems to the grounding electrode system.

- C. Drive ground rods and install grounding conductors prior to construction of concrete slabs and duct banks.
 - 1. Extend grounding conductors through concrete to accessible points for grounding equipment and electrical enclosures.
 - 2. Install grounding system at each structure where switchgear, motor control centers, switchboards, panelboards, panels, or other electrical equipment are installed.
- D. Provide either exothermic welded or mechanical connections for grounding cable to rods or cable.
- E. When size is not indicated on the Drawings, size grounding conductors in accordance with NEC Table 250-66 and Table 250-122.
- F. Provide a green insulated equipment grounding conductor, or multi-conductor cable with integral green insulated grounding conductor, with each feeder and branch circuit from the power source grounding means to the load equipment or device.
- G. Provide ground bushings at both ends of rigid conduit runs. Do not use locknuts. Bond ground bushings to the grounding system.
- H. When not indicated on the Drawings, provide a minimum size of No. 2/0 or larger grounding electrode systems in compliance with NEC-250.

3.02 FIELD QUALITY CONTROL

- A. Test ground resistance, as specified in Section 16950, of entire system and at each building/structure where electrical equipment is installed.
- B. Invite ENGINEER to witness ground resistance testing.
- C. Where maximum allowable ground resistance of 5 ohms is exceeded, install additional grounding mats or ground rods until ground resistance is equal to or below maximum allowable ground resistance.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Identification of electrical conductors, raceways and equipment, and electrical equipment signs.

1.02 REFERENCES

- A. National Electrical Code (NEC):
 - 1. Article 110-22 - Disconnecting Means.
 - 2. Article 210-4 - Multiwire Branch Circuits.
 - 3. Article 200 - Use and Identification of Grounded Conductors.
 - 4. Article 384 - Switchboards and Panelboards.
 - 5. Article 300 - Wiring Methods.

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. General: Submit shop drawings for electrical equipment room layouts, drawn at a minimum at 3/8 inch = 1 foot, scale.
 - 2. Cross Reference: Diagram shall carry a uniform and coordinated set of wire numbers and terminal block numbers to permit cross-referencing between the contract document drawings, the drawings prepared by the CONTRACTOR, and equipment O&M Manual Drawings.
 - 3. Drawing number cross references and continuation references shall also be provided. Contractor-prepared drawings shall reference applicable Contractor drawings such as P&IDs, control and logic diagrams, interface wiring diagrams, panel drawings, etc. CONTRACTOR-prepared drawings shall be submitted in 11 inch by 17 inch or larger paper size and drawn with AutoCAD software and they shall also reference applicable drawings provided by equipment manufacturers.
 - 4. On any drawing prepared for this project, if a wire, circuit, enclosure, panel, or device is continued on another drawing, the continuation drawing shall be referenced (and vice-versa). Wherever wires are shown connected to terminals, the drawings which show the continuation of the circuits on those terminals must be referenced.
 - 5. Interconnection Diagrams: Cables shall not be installed into raceways until the wiring interconnection diagrams are reviewed by the design engineer.
 - 6. Sample schematics and diagrams are indicated on typical detail drawings for reference and understanding of minimum information required for submittal of shop drawings schematics and diagrams, and submittal of O&M schematics and diagrams.
 - 7. Include tagging system, labels, markers, hazard tape, nameplates, and signs.
- B. Product Data: Include tagging system, labels, markers, and hazard tape.

C. Project Record Documents:

1. Document wire, cable, and conductor tags, and bundle tags installed in accordance with the Contract Documents.
2. Document installed wire, cable, and conductor tags and bundle tags when not specifically indicated.
3. Indicate on Record Drawings deviations from accepted shop drawing conductor identification.

1.04 QUALITY ASSURANCE

A. Pre-Installation Conference:

1. Purpose: To clearly define requirements specified for circuit/cable/conductor identification, hold a meeting including representatives of CONTRACTOR, OWNER, and ENGINEER prior to significant cable or conductor purchase and installation/termination.

PART 2 PRODUCTS

2.01 LABELS

A. Manufacturers: One of the following or equal:

1. Brady.
2. Seton.

B. Type: Sleeve type.

2.02 CONDUCTOR AND CABLE MARKERS

A. Wire Markers

1. All conductors including field conductors and internal panel conductors shall be permanently marked with wire numbers at each end.
2. Markers shall consist of machine printed, black characters on white tubing.
 - a. General.
 - 1) Tubing shall be sized for the wire and insulation on which it is to be placed.
 - 2) Tubing shall be tight on the wire.
 - 3) Characters shall face the open panel, and shall read from left to right or top to bottom.
 - 4) Machine printed.
 - 5) Wire marker shall start within 1/32 inch of end of stripped insulation point.
 - b. Heat-shrinkable tubing.
 - 1) Tubing shall be shrunk using a heat gun which produces low temperature heated air.
 - 2) Manufactured by:
 - a) Raychem.
 - b) Brady.
 - c) Thomas & Betts.
 - d) Kroy.
 - c. Pre-printed slip on sleeve markers.
 - 1) Manufactured by:
 - a) Grafoplast.

- B. Markers used in tunnels or other wet locations and for all security system labels shall be on heat-shrinkable marking sleeves.
- C. Use self-laminating vinyl on white background for markers within electrical equipment such as panels, termination cabinets, motor control centers.

2.03 RACEWAYS IDENTIFICATION (TAGS)

- A. Conduit numbers shall be pressure stamped into a noncorrosive 2 inch long, 1/2 inch wide stainless steel tape, Dymo marking system or equal. A tag with number shall be fixed with No. 18 AWG or larger type 304 stainless steel wire, to each conduit segment and at the end of each conduit and within 3 feet of each pull box, panelboard and switchboard.

2.04 NAMEPLATES, LABELS AND SIGNS

- A. Nameplates:
 - 1. Type: Black lamicoid with white letters.
 - 2. Fastener: Round head stainless steel screws.
- B. Automatic Equipment and High Voltage Warning Signs:
 - 1. Type: Suitable for exterior use and meeting OSHA regulations.
- C. Security System Cable Circuit Raceway Labels: Vinyl plastic.
 - 1. Manufacturers: One of the following or equal:
 - a. Brady.
 - b. Seton.
- D. Underground Hazard Tape: 6 inches wide.
 - 1. Manufacturers: One of the following or equal:
 - a. Panduit.
 - b. Thomas and Betts.

PART 3 EXECUTION

3.01 CIRCUIT IDENTIFICATION

- A. Identify 3-phase system conductors and cables as Phases A, B, and C and identify 1-phase system conductors and cables at electrical equipment including, but not limited to, switchgear, switchboards, panelboards, motor control centers, and motors.
 - 1. Match OWNER's existing electrical system identification scheme or meet requirements of the authority responsible for the project.
 - 2. 3-phase 480 Volts AC System Conductors: Phase A, brown; Phase B, orange; Phase C, yellow.
 - 3. Three-Phase Conductors for 120/208 VAC Circuits: Phase A, black; Phase B, red; Phase C, blue.
 - 4. Neutral Conductor: White for 120 VAC and gray for 277 VAC.
 - 5. Insulated Equipment Grounding Conductor: Green.
 - 6. General Purpose AC Control Conductors: Purple.
 - 7. General Purpose DC Control Conductors: Purple with white stripes.

8. Single-Phase Conductors for 120/240 VAC Circuits: Phase A, Black; Phase B, red.
- B. Use color coding and phasing consistent throughout the site. Bus bars at panelboards and motor control centers to be connected Phase A-B-C, top to bottom, or left to right facing connecting lugs.
- C. Conductors Number 2 American Wire Gauge (AWG) and smaller to be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables to be coded by the use of colored tape.
- D. In addition to color coding, for all 1-phase and 3-phase systems, identify each cable (single or multi-conductor) and conductor at each end, in each manhole, pullbox, cable tray, or other component of the raceway system. This identification is applicable to all power, control, alarm, signal, and instrumentation cables, and conductors.
- E. Identify each cable (single or multi-conductor) and groups or bundles of individual single conductors in each manhole, pullbox, cable tray or other component of the raceway system with circuit identification markers. Implement a "from-to" cable/conductor bundle tagging system as part of this identification effort. Label cables/conductors in wireways at 30 foot intervals.
- F. Identify each individual conductor at each termination. This includes such locations as switchgear, switchboards, motor control centers, variable frequency drives, control panels, junction/terminal boxes, all field devices, security panels and junction boxes, and all other locations where conductors are terminated. Identify the termination of these conductors in accordance with the accepted shop drawings. Tag conductors with sleeve type labels.
- G. Where more than 1 nominal voltage system exists, identify each ungrounded system conductor by phase and system. Permanently post means of identification at each branch-circuit panelboard, switchboard, switchgear, motor control center, or other type of power distribution equipment.
- H. Include the following minimum information for wire and cable identification:
 1. Circuit number or load identification tag number.
 2. Origin (from source).
 3. Destination (to load).
- I. Wire Numbers:
 1. The CONTRACTOR shall coordinate the wire numbering system with all vendors of equipment so that each and every field wire has a unique wire number associated with it for the entire system.
 - a. Wire numbers shall correspond to the wire numbers on the control drawings, or panel and circuit numbers for receptacles and lighting.
 - b. Wire numbers shall correspond to the terminal block number to which they are attached in the control panel.
 - c. Internal panel wires on a common terminal shall have the same wire number assigned.
 - d. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath

free-standing equipment. All individual control conductors and instrumentation cable shall be identified at pull points as described above.

- 1) Armored multiconductor cable shall be labeled using the conduit number shown on the plans, following the requirements for conduit markers in Section 16075.
2. The following wiring numbering scheme shall be followed throughout the project and used for field wire numbers between PCMs, VCPs, MCCs, field starters, field instruments, etc.

(ORIGIN LOC.) – (ORIGIN TERM.) / (DEST. LOC.) – (DEST. TERM.)

OR

(ORIGIN LOC.) – (ORIGIN TERM.)
(DEST. LOC.) – (DEST. TERM.)

Where:

ORIGIN LOC. = Designation for originating panel or device.
ORIGIN TERM. = Terminal designation at originating panel or device.
DEST. LOC. = Designation for destination panel or device.
DEST. TERM. = Terminal designation at destination panel or device,
OR
DEST. TERM. = PLC I/O address at destination panel.

- a. Equipment and field instruments are always identified as the origin.
- b. PCMs are always identified as the destination.
- c. Location is the panel designation for VCP, LCP or PCM. For connections to MCCs, location is the specific starter tag and loop number. Location is the tag and loop number for motor starters, field instruments and equipment. Any hyphen in the panel designation or tag and loop number shall be omitted.
- d. Terminal designation is the actual number on the terminal block where the conductor terminates at field devices and vendor control panels. For multi-conductor cables, all terminal numbers shall be shown, separated by commas.
- e. Terminal designations at motor leads shall be the motor manufacturer's standard terminal designation (T1, T2, T3, etc.)
- f. Terminal designations at PCMs where the field conductor connects to a PLC input or output shall be the PLC address (Note: the following PLC I/O numbering scheme is typical for Allen Bradley, the numbering scheme should be modified to match that of the actual PLC manufacturer used for the project).
 - 1) W:X:Y/Z for a discrete point or W:X:Y.Z for an analog point.

W = I for input, O for Output.
X = PLC number (1,2,3...).
Y = Slot number (01, 02, 03...).
Z = Terminal number (00, 01, 02...) for a discrete point.
Z = Word Number (1,2,3...) for an analog point.
 - 2) Examples of discrete points: I:1:01/01, O:2:10/07
 - 3) Examples of analog points: I:1:01.2, O:2:02.3

- g. Terminal designations at PCMs where the conductor does not connect to a PLC I/O point shall be the terminal number with a "C" prefix (C0010). For common power after a fuse or neutrals after a switch the subsequent points will have an A, B, C, ... etc. suffix (C0010A).
- 3. Case 1: Vendor Control Panel (VCP) to Process Control Module (PCM):

Field wire number/label: A-B/C-D

- A = Vendor Control Panel number without hyphen (VCP111).
- B = Terminal number within VCP, MCC, or starter (manufacturer/vendor's standard will be acceptable).
- C = Process control module without a hyphen (PCM100).
- D = Either PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010).

Examples: VCP111-10/PCM100-I:1:01/01.
VCP111-10/PCM100-O:1:10/07.
VCP111-10/PCM100-C0100.

- 4. Case 2: Field instrument to PCM:

Field wire number/label: E-F/C-D

- C = Process control module without hyphen (PCM100).
- D = Either PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010).
- E = Field mounted instrument tag and loop numbers without hyphen (PITA300).
- F = Manufacturer's standard terminal number within instrument. Use both terminal numbers for analog points separated by a comma.

Examples: PITA300-2,3/PCM300-I:1:01.1.
TSHA101-1/PCM200-I:2:01/00.

- 5. Case 3: Motor Control Center (MCC) to PCM:

Field wire number/label: G-B/C-D

- B = Terminal number within VCP, MCC, or starter (manufacturer/vendor's standard will be acceptable).
- C = Process control module without hyphen (PCM100).
- D = Either PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010).
- G = MCC use actual starter designation in MCC i.e., MSA131 without hyphen located in MCC-120.

Examples: MSA131-10/PCM100-I:1:01/01.
MSA131-10/PCM100-O:1:10/07.
MSA131-10/PCM100-C0100.

6. Case 4: MCC to VCP:

Field wire number/label: G-B/A-B

- A = Vendor Control Panel number without hyphen (VCP111).
- B = Terminal number within VCP, MCC, or starter (manufacturer/vendor's standard will be acceptable).
- G = MCC use actual starter designation in MCC i.e., MSA131 without hyphen located in MCC-120.

Example: MSA131-X2/VCP111-10.

7. Case 5: Motor leads to MCC

Field wire number/label: H-I/G-B

- B = Terminal number within VCP, MCC, or starter (manufacturer/vendor's standard will be acceptable).
- G = MCC use actual starter designation in MCC i.e., MSA131 without hyphen located in MCC-120.
- H = Equipment tag and loop number without hyphen (RWP131).
- I = Motor manufacturer's standard motor lead identification (T1, T2, T3, etc.)

Example: RWP131-T1/MSA131-T1.

8. Case 6: Remote or separately mounted starters or VFDs to PCM

Field wire number/label: J-B/C-D

- B = Terminal number within VCP, MCC, or starter (manufacturer/vendor's standard will be acceptable).
- C = Process control module without hyphen (PCM100).
- D = Either PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010).
- J = Remote mounted starter or VFD tag and loop number without hyphen (MSA121)

Examples: MSA121-10/PCM100-I:1:01/01.
MSA121-10/PCM100-O:2:10/07.
MSA121-10/PCM100-C0010.

9. All spare conductors shall be terminated on terminal blocks and shall be identified as required for other field wires, with an "S" prefix.

Example: S MSA315-21/PCM200-C0125

3.02 NAMEPLATES

- A. Furnish and install nameplates for all electrical equipment indicated on the Drawings or specified. Also, use single line and panel schedule legends for nameplate data.

- B. Each disconnect means for service, feeder, branch, or equipment conductors and pushbutton stations shall have nameplates indicating its purpose or identifying the load.

3.03 AUTOMATIC EQUIPMENT WARNING AND HIGH VOLTAGE SIGNS

- A. Mount permanent warning signs at mechanical equipment which may be started automatically or from remote locations. Fasten warning signs with round head stainless steel screws or bolts, located and mounted in a manner acceptable to ENGINEER.
- B. Mount permanent and conspicuous warning signs on (front and back) equipment, doorways to equipment rooms, pull boxes, manholes, where the voltage exceeds 600 volts.
- C. Label exposed medium voltage circuit raceways at 50 foot intervals with 1 inch letters stating the voltage; example - 12,470 volts.
- D. Place a warning ribbon or other effective means suitable for conditions above ductbank underground installations.
- E. Place warning signs on utilization equipment that has more than one source of power. Provide panel and circuit number of conductor tag of the power source disconnect.
- F. Place warning signs on utilization equipment that has 120 VAC control voltage source used for interlocking. Provide panel, circuit number, and conductor tag of control voltage source disconnect.

END OF SECTION

SECTION 16100

LIGHTNING PROTECTION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for Lightning protection system for the Secondary Clarifier Structures.
 - 1. The lightning protection system shall be a conventional Faraday Multi-Point type System, and the related scope of work

1.02 REFERENCES

- A. Lightning Protection Institute (LPI):
 - 1. LPI-175 - Standard of Practice.
- B. National Electrical Code (NEC):
 - 1. Article 250 - Grounding.
- C. National Fire Protection Association (NFPA):
 - 1. ANSI/NFPA 780 - Lightning Protection Code.
- D. Underwriters Laboratories, Inc. (UL) for Faraday Multi-Point Type System:
 - 1. UL 96 - Lightning Protection Components.
 - 2. UL 96A - Installation Requirements for Lightning Protection Systems.

1.03 SYSTEM DESCRIPTION

- A. Lightning Protection System: ANSI/NFPA 780; Class I, UL 96A; Master Labeled system(s) protecting, consisting of air terminals on roof(s), bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Shop drawings showing layout of air terminals with the respective configuration of the zone of protection, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor types and sizes, conductors routing, connection, termination details, applicable air terminal and other calculations.
- B. Product Data: Include dimensions and materials of each component, and include indication of listing in accordance with UL 96 for the Faraday Multi-Point System; and listing data for ESE Protection System in accordance with Applied Research Laboratories, Inc
- C. Certificates:
 - 1. Submit 2 notarized photocopies of the completed Application for UL Master Label, for each lightning protection system.

2. Submit written confirmation of having obtained UL Master Label and LPI certification for each Faraday lightning protection system.
3. Written confirmation regarding the system manufacturer's and the system installer's membership in the Lightning Protection Institute.

D. Project Record Documents:

1. Accurately record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors.
2. Manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

- A. Manufacturers Qualifications: As indicated below. Company specializing in lightning protection equipment with minimum 5 years experience, and member of the Lightning Protection Institute.
- B. Installers Qualifications: Authorized installer of manufacturer with minimum 5 years documented experience.

1.06 SEQUENCING AND SCHEDULING

- A. Coordinate work with other trades to ensure neat, correct, and unobtrusive installation.
- B. Coordinate the work of this Section with roofing and exterior and interior finish installations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. One of the following or equal for the Faraday Multi-Point Lightning Protection:
 1. A-C Lightning Security, Inc.
 2. Lightning Master.
 3. Thompson Lightning Protection, Inc.

2.02 MATERIALS

- A. Components for the Faraday Multi-Point Lightning Protection System:
 1. Listed in accordance with UL 96.
 2. Air Terminals: Copper.
 3. Grounding Rods: 3/4 " x 10' Copper-clad steel.
 4. Ground Plate or Base: Copper with bolt pressure connectors and mounted with stainless steel hardware
 5. Conductors: Copper 29 strands, 17 gauge minimum.
 6. Connectors and Splicers: Bronze.
- B. Miscellaneous Materials: Copper, of type and size recommended by the manufacturer of the lightning protection system, except that bolts, screws, and other threaded fasteners shall be stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify that field measurements are as indicated on the shop drawings.
- C. Beginning of installation means installer accepts existing conditions.
- D. Protect elements surrounding work of this Section from damage or disfiguration.

3.02 INSTALLATION

- A. Install systems in accordance with manufacturer's instructions unless otherwise specified herein.
- B. Physically connect lightning protection equipment to structural members including metal deck.
- C. Install the systems in accordance with UL 96A, ANSI/NFPA 780, LPI-175, NEC and as specified herein. In the event that the above standards, codes and these Specifications address an issue differently, apply the most stringent requirement.
- D. Install equipment in a neat manner.
- E. Install the system(s) with complete network including air terminals, roof area system, connections, bonds with downleads routed down the structures and terminating into proper grounding.
- F. Clearances: Assure 6 foot minimum distance required by NEC:
 - 1. From lightning rod conductors to non-current-carrying metal parts of electrical equipment unless they are bonded to the rods.
 - 2. From lightning protection grounding electrodes to electrodes of other grounding systems.
- G. Do not use lightning protection rods and electrodes in lieu of the grounding electrodes for electrical equipment.
- H. Furnish and install lightning surge arrestors and protectors as required in coordination with other electrical equipment/work.
- I. Extend air terminals a minimum of 12 inches above object to be protected.
- J. Maintain horizontal or downward coursing of main conductor and insure that bends have at least an 8 inch radius and that no bend of a conductor forms an included angle of less than 90 degrees.
- K. Install ground electrodes not less than 1 foot below grade and not less than 2 feet from foundation walls.
- L. Bond isolated metallic body at or below the roof subject to inductance and within 6 feet of lightning protection system conductors.

- M. Assure sound common bonding and interconnections with other grounding systems.
- N. Use minimum 1 inch PVC conduits or PVC-coated rigid steel conduits to protect lightning system conductors from damage.
- O. Ensure that air terminals are installed to withstand calculated wind force due to 100 miles per hour winds with a 1.3 gust factor without structural damage and without damage to integrity of the lightning protection system.
- P. Assure bonding distances in accordance with paragraph 3.05B in this Section.

3.03 FIELD QUALITY CONTROL

- A. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and certification of the lightning protection system(s) under provisions of UL 96A.
- B. Obtain UL Master Label and attach to each building at location directed by OWNER.

3.04 PROTECTION

- A. Protect products until acceptance by OWNER.

END OF SECTION

SECTION 16123
600 VOLT OR LESS WIRES AND CABLES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. 600 volt class wire and cable.
 - 2. Instrumentation class wire and cable.
 - 3. Communication and Security System wire and cable.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. B 3 - Standard Specification for Soft or Annealed Copper Wire.
 - 2. B 8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- B. Insulated Cable Engineers Association (ICEA).
- C. National Electrical Code (NEC):
 - 1. Article 250 - Grounding.
 - 2. Article 310 - Conductors for General Wiring.
 - 3. Article 725 - Class 1, Class 2, and Class 3 Remote - Control, Signaling, and Power-Limited Circuits.
 - 4. Article 760 - Fire Alarm Systems.
 - 5. Article 800 - Communication Circuits.
- D. Underwriters' Laboratories, Inc., (UL):
 - 1. UL 1277 Subject - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.03 SUBMITTALS

- A. Shop Drawings: Show splice locations. Submit cable pulling calculations for all cable feeder larger than 2/0 AWG and pulling lengths longer than 200 feet. Submit cable pulling calculations for all conductor runs longer than 400 feet.
- B. Product Data: Include wires, cables, pulling compounds, and splicing materials.

1.04 QUALITY ASSURANCE

- A. Conform to ASTM and ICEA standards.
- B. Furnish mechanical conductor connector and heat-shrink type insulation by same manufacturer.

PART 2 PRODUCTS

2.01 WIRE AND CABLE MATERIALS

- A. Conductors: ASTM B 8, soft drawn copper, maximum 12 months old, minimum 97 percent conductivity. American Wire Gauge (AWG) sizes as indicated on the Drawings, Class B or C stranded.
- B. Insulation Thickness: Minimum specified by NEC Article 310.
- C. Conductor Sizes: As indicated on wiring schedules and Drawings.

2.02 600-VOLT CLASS CABLE

- A. Power Wire and Cable:
 - 1. Manufacturers: One of the following or equal:
 - a. Okonite Company.
 - b. General Cable.
 - c. Rockbestos Company.
 - d. Southwire Company
- B. Shielded Power Cable:
 - 1. Manufacturers: One of the following or equal:
 - a. Olflex.
- C. Control Wire and Cable:
 - 1. Manufacturers: One of the following or equal:
 - a. Okonite Company.
 - b. General Cable.
 - c. Rockbestos Company.
 - d. Southwire Company
- D. Insulation for Individual Wires or Multiple Conductor Cable for Power and Control Circuits:
 - 1. Type XHHW-2 insulation for use in dry and wet locations and underground ductbanks.
- E. Jackets for Multiple Conductor Cable for Power and Control Circuits: Type CPE.
- F. Tray Cable:
 - 1. Minimum size Number 1/0 AWG for single wires.
 - 2. Multi-conductor cable listed and identified on its surface as suitable for cable tray use, Type TC cable in accordance with NEC Article 318.
 - 3. Multi-Conductor Cables Requiring Connection to Neutral: Provided with integral white insulated conductor with ambient temperature adjustment in accordance with NEC Table 310-16.
- G. Multi-Conductor Cable Insulated Grounding Conductors:
 - 1. Color: Integral green.
 - 2. Sizes: In accordance with NEC 250-122.
- H. Solid-conductor wire, Number 12 AWG and smaller, may be used only for lighting and receptacle circuits.

2.03 INSTRUMENTATION CLASS CABLE

- A. Single Pair or Triad Applications:
 - 1. Manufacturers: One of the following or equal:
 - a. The Okonite Company, Okoseal-N Type P-OS.
 - b. Equivalent manufactured by Cooper Industries, Belden Wire and Cable Division.
- B. Multiple Pair or Triad Applications:
 - 1. Manufacturers: One of the following or equal:
 - a. The Okonite Company, Okoseal-N Type SP-OS.
 - b. Equivalent manufactured by Cooper Industries, Belden Wire and Cable Division.
- C. Approved for cable tray installation in accordance with the National Electrical Code.
- D. Number of Individually Shielded, Twisted Pairs and Triads: As indicated on the Drawings or as necessary for the application.
- E. Voltage Rating: 600 volts.
- F. Cable Type: TC.
- G. Temperature Rating: 90 degrees Celsius dry location, 75 degrees Celsius wet location.
- H. Conductors: Bare, soft annealed copper in accordance with ASTM B 3, Class B, 7-strand concentric in accordance with ASTM B 8.
- I. Conductor Insulation: Flame-retardant polyvinyl chloride, 15 mils nominal thickness, with nylon jacket 4 mils nominal thickness, 90 degrees Celsius temperature rating in accordance with Underwriter's Laboratory Subject 1277.
- J. Color Code: Provide conductor color code as specified in Section 16075.
- K. Single Pair or Triad Shielding:
 - 1. Group Shielding: Minimum 1.35 mil double-faced aluminum/synthetic polymer-backed tape overlapped to provide 100 percent coverage.
 - 2. Drain Wire: 7-strand tinned copper drain wire, 2 sizes smaller than conductor.
- L. Multiple Pair or Triad Shielding:
 - 1. Group Shield: 1.35 mil aluminum-polyester tape overlapped to provide 100 percent coverage and a 7-strand tinned copper drain wire, 2 sizes smaller than conductor. Completely isolate group shields from each other.
 - 2. Cable Shield: 2.35 mils double-faced aluminum and synthetic polymer backed tape overlapped to provide 100 percent coverage and a 7-strand tinned copper drain wire, same size as conductors.
- M. Jacket: Black, flame-retardant in accordance with Underwriters' Laboratory Subject 1277, 90 degrees Celsius temperature rating, rip cord laid longitudinally under jacket to facilitate removal.

- N. Conductor Size: Number 16 AWG minimum unless otherwise indicated on the Drawings.
- O. Numerically identify one conductor within each pair and triad.

2.04 COMMUNICATION CABLE

- A. Manufacturers: One of the following or equal:
 - 1. Cooper Industries, Belden Wire and Cable Division.
 - 2. American Telephone and Telegraph.
- B. Number of Twisted Pairs: As indicated on the Drawings.
- C. Voltage Rating: 300 volts.
- D. Insulation: Thermoplastic, color coded in accordance with telephone industry standards.
- E. Jacket: High molecular weight polyethylene, surface printed with year of manufacture and cable description at maximum 24 inch intervals.
- F. Shield: 8 mil aluminum or copper, overlapped to provide 100 percent coverage, covered totally on both sides with copolymer or equal coating able to provide an effective moisture barrier.
- G. Inner Jacket: High molecular weight polyethylene, able to provide strength and surge barrier.
- H. Conductors: ASTM B3, solid, soft, bare copper.
- I. Conductor Size: Minimum Number 22 AWG , unless otherwise indicated on the Drawings.
- J. Fabrication:
 - 1. Twist insulated conductors into pairs with varying lengths of lay.
 - 2. Apply non-hygroscopic core tape over cable core as a dielectric and heat barrier.

2.05 RELATED MATERIALS

- A. Splicing Material:
 - 1. In conformance with ANSI C119.1, IEEE 383, and ICEA 5-19-81.
 - 2. Manufacturers: One of the following or equal:
 - a. Elastimold.
 - b. Thomas-Betts.
 - c. Raychem, FCSM Series.
- B. Wire Nuts:
 - 1. Rated 600 volt with live-spring feature for tight fitting connections.
 - 2. Manufacturers: One of the following or equal:
 - a. 3M.
 - b. Thomas and Betts.

- C. Junction Boxes and Terminal Cabinets: As specified in Section 16134.
- D. Pulling Compound: As recommended by conductor manufacturer.

2.06 WIRE AND CABLE FABRICATION

- A. Permanently mark American Wire Gauge (AWG) size, grade of insulation, voltage, and manufacturer's name on outer covering at maximum 24 inch intervals.
- B. Identify and mark conductors in accordance with NEC Article 310.
- C. Color code wire and cable as specified in Section 16075.
 - 1. Integrally color insulation for Number 2 AWG and smaller.
 - 2. Wrap colored tape around cable larger than Number 2 AWG.
- D. Fabricate cable ends with provisions for field testing.

2.07 SOURCE QUALITY CONTROL

- A. Test full lengths in accordance with ASTM and ICEA Standards.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install continuous circuit conductors from source to load without splices or terminations in intermediate manholes or pull boxes, except for Number 10 AWG and smaller conductors for lighting and receptacles.
- B. Splices:
 - 1. Where splices are necessary because of extremely long wire or cable lengths that exceed standard manufactured lengths, install and label junction boxes for power conductors or termination cabinets for control and instrument conductors.
 - 2. Power and control conductors routed in common raceways may be spliced in common junction boxes.
 - 3. Install NEMA 4X junction and terminal boxes in wet and outdoor locations. Clearly label junction and terminal boxes containing splices with the word "SPLICE."
 - 4. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.
 - 5. Splices in below grade pull boxes or in any box subject to flooding shall be made watertight using:
 - a. A heat shrink insulating system listed for submersible applications.
 - b. Or an epoxy resin splicing kit.
- C. Properly coat wires and cables with pulling compound before pulling into conduits and prevent mechanical damage to conductors during installation.

3.02 600-VOLT CLASS CABLE

- A. Size power conductors in accordance with National Electrical Code when sizes are not indicated on the Drawings.
- B. Install minimum Number 12 AWG wiring for power circuits unless otherwise specified or indicated on the Drawings, and minimum Number 14 AWG for control wiring unless otherwise specified.
- C. Install minimum 14 AWG for internal panel control wiring with type MTW or SIS insulation.
- D. Do not exceed cable manufacturer's pulling tension and side-wall pressures.
- E. Terminations and Splices (600 Volt or Less):
 - 1. Terminations: Terminate control and instrument conductors in terminal boxes in accordance with Section 1613.4.
 - 2. Splicing: Join conductors mechanically with splice connectors and install heat-shrink type insulation. Splice conductors in accordance with manufacturer's instructions. Make waterproof heat shrink type splices in wet and below grade locations.
 - 3. Splice or weld grounding conductors of different sizes.
 - 4. Conductor Number 10 AWG and smaller for lighting and receptacle circuits may be spliced in junction boxes with wire nuts.
- F. All conductors for installation in underground duct banks, in sizes No. 10 AWG and smaller shall be of the multi-conductor type with overall jacket.
- G. All conductors of size No. 1/0 AWG and smaller for installation in cable trays and continuing without splices via other conduits; they shall be of the multi-conductor type with overall jacket.

3.03 INSTRUMENTATION CLASS CABLE

- A. Install instrumentation class cables in separate raceway systems.
 - 1. Install instrument cable in metallic conduit within non-dedicated manholes or pull boxes.
 - 2. Install cable without splices between instruments or between field devices and instrument enclosures or panels.
- B. Do not make intermediate terminations, except in designated terminal boxes indicated on the Drawings.
- C. Ground cable shields at only one location, typically at panels, not at field instruments.

3.04 COMMUNICATION AND SECURITY SYSTEM CABLE

- A. Install communication cables in dedicated raceways, including through ductbanks, manholes, and pull boxes.
- B. For wire/cable runs in the Operations Building above suspended ceilings, clamp cable to underside of deck or use wire hangers. Do not allow any cable or wire to lie

on top of the ceiling panels. Install wire hangers at 4-foot intervals for every wire run. Run wires at least 1 foot above the ceiling where possible. Run wires above other crossing items where possible. In no case shall wiring or cabling rest on the ceiling tiles unless specifically approved by the ENGINEER in writing.

- C. After installation, visually inspect all wiring for flaws such as cuts, punctures, and abrasions. If any flaws are found, replace the wire at no additional cost to the OWNER.
- D. Run wires continuously from termination to termination without splices. ASSUME NO SPLICES. Splices at certain junction box locations may be allowed at the discretion of the ENGINEER. Make recommendations for splices at such points to ENGINEER and obtain written approval to proceed.
- E. Make all connections at terminal boards with full tagging, labeling, and documentation.
- F. Tag each cable with a written tag at each end. The designation for the tag shall be the point number of the field point plus letters indicating the cable in the group. For example, tagging for an AA detail would be as follows.

Card Reader	##### - CR
Request to Exit	##### - REX
Door Switch	##### - DSM
Lockset	##### - EL

In each case, “#####” stands for the individual security system point number assigned to the specific location.

- G. At no time shall wires cross over terminal boards. Arrange cables neatly to allow inspection, removal, and replacement. Lace cables as required. Spot tie wire bundles with plastic cable ties and secure to panels.

3.05 SIGNAL CABLE AND CONDUIT INSTALLATION

- A. Separate and isolate electrical signal cables from sources of electrical noise and power cables by minimum 12 inches.
- B. Install signal cables in dedicated raceways, including through underground vaults and pull boxes.

3.06 FIELD QUALITY CONTROL

- A. Testing: As specified in Section 16950.
- B. Grounding

3.07 FIELD CONDITIONS AND RELATED REQUIREMENTS

- A. Existing underground water table is near or above the location for new ductbanks.

- B. Existing underground pull boxes, handholes, ductbanks, and manholes contain excessive amounts of water, conductors and debris.
- C. CONTRACTOR shall include cost for necessary dewatering, equipment cost to identify raceways, and cleaning equipment to perform the work required for new underground ductbanks, manholes and pull boxes.
- D. CONTRACTOR shall include necessary cost to clean all underground ductbanks and pull boxes prior to installation of required new conductors.

3.08 WIRING SUPPLEMENTAL REQUIREMENTS

- A. CONTRACTOR shall include necessary conductors and termination to provide any and all motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of location shown on the Drawings.
- B. CONTRACTOR shall include necessary conductors and related materials to provide any and all pull boxes, manholes and ductbanks within 20 linear feet of location shown on the Drawings.
- C. Prior installation of any raceway or related items identified in paragraphs A and B above, the OWNER shall have the right to make changes related to preferred location, at no additional cost.
- D. CONTRACTOR shall provide necessary conductors for all equipment specified, identified in wiring/raceway schedules, equipment schedules, panelboards schedules, electrical single line diagrams, block diagrams, process and instrumentation diagrams (P&IDs), fixture schedules, and devices. Said necessary conductors may not be shown on the plan drawings, but they shall be sized by CONTRACTOR in accordance with requirements of the National Electrical Code, and included in this allowance if the conductor are necessary for the complete operation of the included device or equipment.
- E. Include cost for supplemental wiring to provide the following wiring for potential extra items not included in the Drawings:
 1. Two thousand (2,000) linear feet of No. 12 AWG-XHHW-2 copper single conductor for installation in conduit.
 2. Two thousand (2,000) linear feet of No. 14 AWG-XHHW-2 for installation in conduit.
 3. One thousand (1,000) linear feet of No. 16 AWG shielded one pair cable for installation in conduit.

END OF SECTION

SECTION 16133

CONDUITS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Galvanized rigid steel conduit.
 - 2. Flexible conduit, polyvinyl chloride-coated rigid steel conduit, and rigid nonmetallic polyvinyl chloride conduit.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. Electrical Manufacturers Association (NEMA):
 - 1. RN-1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- C. National Electrical Code (NEC):
 - 1. Article 348 - Electrical Metallic Tubing.
 - 2. Table 300-5 - Minimum Cover Requirements (0 to 600 volts, Nominal).
 - 3. Article 500 - Hazardous (Classified) Locations.
 - 4. Table 10-4(b) - Minimum Cover Requirements (over 600 volts, Nominal).
- D. Underwriters' Laboratories, Inc (UL):
 - 1. UL 6 - Rigid Metal Conduit.

1.03 SUBMITTALS

- A. Product data.
- B. Shop Drawings:
 - 1. Submit shop drawings for installation of conduits in ductbanks per additional requirements specified in section 16155.
 - 2. Installation drawing shall include individual conduit numbers, routing, conduit sizes, circuit numbers contained in each conduit, and number and size of wires in each conduit.

PART 2 PRODUCTS

2.01 CONDUIT

- A. Galvanized Rigid Steel Conduit:
 - 1. Domestic raw steel, made smooth, clean, and free of burrs and rough spots to enhance wire pulling; interior and exterior surfaces coated with solid, unbroken layer of zinc; threads hot dip galvanized after cutting; entire surface finish

coated with secondary bichromate treatment applied over galvanizing able to extend surface protection and prevent oxidation; threads protected by color coded end caps to provide quick trade size identification.

2. Manufacturers: One of the following or equal:
 - a. LTV Steel Tubular Products Company, Galvite.
 - b. Triangle PWC, Inc.
 - c. Allied Tube and Conduit Corporation.

B. Liquid-tight Flexible Conduit: Grounding type, weatherproof, watertight, maximum 60-inch lengths.

1. Manufacturers: One of the following or equal:
 - a. American Brass Company.
 - b. General Electric.

C. Flexible Metal Conduit: Aluminum with minimum trade size of 1/2-inch, maximum length allowed 60 inches.

1. Manufacturers: One of the following or equal:
 - a. ALFLEX.
 - b. Allied Tube and Conduit Corporation.

D. Polyvinyl Chloride-coated Rigid Steel Conduit:

1. Galvanized rigid steel conduit with coating conforming to ANSI C80.1 and UL 6; bendable without damage to coatings.
2. Manufacturers: One of the following or equal:
 - a. Perma Kote by Robroy Industries.
 - b. OCAL, Inc.

E. Rigid Nonmetallic Polyvinyl Chloride Conduit:

1. High density, Schedule 40, 90 degrees Celsius, heavy-duty polyvinyl chloride, made from virgin polyvinyl chloride compound; maximum 6 grams per 100 grams smoke emission.
2. Manufacturers: One of the following or equal:
 - a. Carlon.
 - b. Triangle Conduit and Cable.

2.02 RELATED MATERIALS

A. Couplings, Connectors, and Fittings:

1. Threaded.
2. Manufactured with same materials and process as corresponding conduit.

B. Condulet Fittings:

1. With wedge nut covers, weathertight when located outdoors or in wet or corrosive locations indicated on the Drawings, matching type for corresponding conduit systems.
2. Manufacturers: One of the following or equal:
 - a. Crouse-Hinds.
 - b. Appleton.

C. Galvanized Rigid Steel Conduit Expansion Fittings for Exposed Locations:

1. Manufacturers: One of the following or equal:
 - a. OZ/Gedney, Type AX with jumper.
 - b. Appleton, Type XJ with Jumper.

- D. Galvanized Rigid Steel Conduit Expansion Fittings at Structural Expansion Joints:
 - 1. Manufacturers: One of the following or equal:
 - a. Spring City, Type D.
 - b. Crouse-Hinds, Type D.
- E. Conduit Seals:
 - 1. Manufacturers: One of the following or equal:
 - a. Appleton.
 - b. Crouse-Hinds.
- F. Polyvinyl Chloride-coated Rigid Steel and Aluminum Conduit Couplings:
 - One provided loose with each length of conduit.
- G. Fasteners for Polyvinyl Chloride-Coated Rigid Steel Conduit: Polyvinyl chloride-coated steel fasteners with Type 316 stainless steel bolts, nuts, and hardware.
- H. Fasteners for Galvanized Rigid Steel Conduit: Galvanized steel fasteners with Type 316 stainless steel bolts, nuts, and hardware.
- I. Conduit Mounting Strut:
 - 1. Type 316 stainless steel for mounting of polyvinyl chloride-coated rigid steel conduit.
 - 2. Hot-dip galvanized for other conduit types.
- J. Conduit Thruwall Seals:
 - 1. Hot-dip galvanize.
 - 2. Polyvinyl chloride oversize sleeve.
 - 3. Manufacturers: One of the following or equal:
 - a. O-Z/Gedney, Type "WSK."
- K. Chemical Containment Area Sealing:
 - 1. To seal conduits from the passage of liquid chemicals, a polyurethane elastomeric caulking material shall be provided at the locations as noted on the Drawings and installed in accordance with the manufacturer's instructions. The material shall be SikaFlex-2C used with primer No. 449 or No. 260 as appropriate for the conduit.
- L. Firestopping:
 - 1. Manufacturer: 3M Company or Equal.
 - 2. Provide fire barriers sealants, designed to resist high temperature, and to prevent fire, smoke, toxic fumes and moisture from passing through conduit penetrations in fire rated walls and floors.

2.03 POLYVINYL CHLORIDE-COATED RIGID STEEL CONDUIT FABRICATION

- A. Coat rigid steel conduit, conduit fittings, and hangers with polyvinyl chloride.
- B. Conduit:
 - 1. Ensure that surfaces, including galvanizing, remain intact and undisturbed on both inside and outside of conduit throughout preparation and application processing.
 - 2. Bond polyvinyl chloride coating to outer surfaces of conduit except threads.

3. Provide bond between polyvinyl chloride coating and conduit surface that is greater than tensile strength of plastic.
4. Provide minimum 40 mil thick coating on conduit.
5. Coat interior of conduit and condulet fittings with nominal 2 mil thick corrosion-resistant urethane finish.
6. Coat threads with clear urethane finish.

C. Couplings:

1. Bond polyvinyl chloride coating to outer surfaces of couplings.
2. Extend polyvinyl chloride sleeve equal to outside diameter of uncoated conduit beyond both ends of coupling approximately 1 pipe diameter or 1-1/2 inches, whichever is smaller.
3. Provide minimum 40 mil thick coatings on couplings and sleeves.
4. Bond polyvinyl chloride coating to outer surface of conduit bodies and fittings.
5. Extend polyvinyl chloride sleeves from hubs.
6. Provide same coating thickness on conduit bodies, fittings, and sleeve walls as on couplings in length and thickness.
7. Coat covers on conduit bodies on both sides so covers are completely interchangeable.
8. Coat interior of conduit couplings, sleeves, and conduit bodies with corrosion-resistant urethane finish.

D. Ensure that inside of conduit bodies remain undisturbed during processing and retain manufacturer's finish.

E. Polyvinyl Chloride Coated, Mounting Hardware, and Associated Fittings:

1. All mounting hardware and associated fittings shall be polyvinyl chloride coated in accordance with the intent of reference NEMA RN-1.
2. The polyvinyl chloride exterior coating shall have a normal thickness of 40 mils (.040 inch) except where part configuration or application otherwise dictate.
3. All fasteners for polyvinyl chloride coated fittings and mounting hardware shall be of the Type 316 stainless steel.

F. Electrical Pullboxes: As specified in Section 16134.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install conduit runs in accordance with schematic representation as indicated on the Drawings and as specified. Modify conduit runs to suit field conditions, as accepted by the ENGINEER.
- B. Install conduit runs for lighting and receptacle circuits, for telephone and data outlets whether or not indicated on the Drawings, for circuit numbers indicated on the Drawings.
- C. Install straight and true conduit runs with uniform and symmetrical elbows, offsets, and bends. Make changes in direction with long radius bends or with condulet fittings.

- D. Install conduit runs so that runs do not interfere with proper and safe operation of equipment and not block or interfere with ingress or egress, including equipment removal hatches.
- E. Expose conduit runs in buildings and structures, unless otherwise indicated on the Drawings.
- F. Securely fasten exposed conduits with clamps or straps. Run exposed conduit on walls and ceilings only, parallel to planes of walls or ceilings. Do not run conduit diagonally. Securely fasten exposed polyvinyl chloride-coated rigid steel conduits with Type 316 stainless steel clamps or straps.
- G. Use flexible conduit for short lengths required to facilitate connections between rigid conduit and motors, vibrating equipment, or control equipment. Maximum length shall be per NEC, Article 350.
- H. Support conduit runs on water-bearing walls 1 inch away from wall on an accepted channel. Use hot-dip galvanized steel or stainless steel channels, consistent with type of conduit being installed unless otherwise indicated on the Drawings. Do not run conduit in water-bearing walls unless otherwise indicated on the Drawings.
- I. Encase underground conduit runs, including conduit runs below slabs-on-grade, in a concrete envelope as specified in Section 03300 and indicated on the Drawings.
- J. Install underground installations of direct buried cable, conduit, or other raceways to meet minimum cover requirements of NEC Table 300-5 and Table 710-4(b). Exceed minimum NEC requirements where indicated on the Drawings or specified.
- K. Thoroughly ream conduit after threads have been cut to remove burrs. Seal joints with accepted conductive sealant compound and make watertight. Set up joints tight. Use bushings or conduit fittings at conduit terminations.
- L. Install runs between pull boxes or junction boxes with total bends equaling not more than 270 degrees. Install NEC required pull boxes at locations acceptable to the ENGINEER. Plug conduits brought into pull boxes, manholes, handholes, and other openings until used to prevent entrance of moisture. Cap spare conduits and provide plastic pulling tape below threaded cap. Provide bonding bushing and bond wire.
- M. Provide appropriate hangers, supports, fasteners, and seismic restraints to suit applications.
- N. After complete installation of 2 inch and larger conduit runs, snake conduits with conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of conduit. Remove and replace conduits through which mandrel will not pass.
- O. Clean and ensure that new and existing conduit runs are not crushed or creased. Verify internal dimensions of existing conduit prior to installation of conductors. Verify that no foreign objects or obstructions are present in conduit prior to installing conductors.

- P. Install conduit system to provide firm mechanical assemblies with electrical conductivity throughout.
- Q. Install expansion fittings across expansion joints and at other locations where necessary to compensate for thermal or mechanical expansion and contraction as indicated on the Drawings.
- R. Install conduits complete between outlets, boxes, and circuit source before conductors are installed.
- S. Install minimum 2 inch ductbank raceways, unless otherwise indicated on the Drawings.
- T. Make ductbank raceway to external conduit size transitions at pullboxes and manholes.
- U. Install spare conduits in underground duct banks towards top center of runs to allow for ease of installation of future cables as conduits enter underground manholes and pullboxes.
- V. Install conduit thruwall seals where underground conduits penetrate walls and at other locations as indicated on the Drawings.
- W. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with duct sealing compound.
- X. Where conduits, wireways, and other electrical raceways pass through fire partitions, firewalls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases. Completely fill and seal clearances between raceways and openings with the fire stop material.
- Y. Provide 1/4-inch polypropylene pull line in each empty electrical conduit.
- Z. Open-ended conduits containing SO (or similar) cable that continues outside the conduit to the utilization equipment shall be sealed with conduit sealing bushings.
- AA. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc., shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.
- BB. Conduits terminating at a wireway shall be supported independently from the wireway. Provide a conduit support within 1 foot of the wireway. The weight of the conduit shall not bear on the wireway.
- CC. Rigid galvanized steel conduits which have been field cut and threaded shall be painted with cold galvanizing compounds. Provide polyvinyl chloride coating to match original on field cut threads for polyvinyl chloride coated rigid galvanized steel conduit.
- DD. PVC-coated galvanized rigid steel elbows shall be used for pad-mounted transformer stub-ups.

- EE. Underground conduits shall be temporarily sealed to prevent intrusion of foreign material before conductors are installed.
- FF. Provide a protective liquid tight flexible nonmetallic conduit for isolation of low voltage wiring installed in underground vaults or pull boxes and install it on low voltage cable rack separate from power cable rack.

3.02 POLYVINYL CHLORIDE-COATED RIGID STEEL

- A. Attach cover to conduit body with Type 316 stainless steel screws.
- B. Where patching is required, apply 40 mil thick polyvinyl chloride coating in accordance with manufacturer's instructions.

3.03 RIGID NONMETALLIC POLYVINYL CHLORIDE

- A. Reinforce encasement as indicated on the Drawings. Install conduit supports at 30-inch intervals.

3.04 CONDUIT SEALS

- A. Install conduit entering or leaving NEC Article 500 hazardous areas with conduit seals.
- B. Install conduit entering or leaving chlorination facilities, or areas of buildings in which chlorine storage or distribution equipment is located with conduit seals.
- C. Install conduit seals in other hazardous locations as required by NEC.
- D. Provide drains on conduit seals in locations where water condensation and accumulation is likely to enter a device or enclosure.

3.05 SCHEDULES

- A. Conduit Sizes: In accordance with NEC, unless otherwise indicated on the Drawings or specified as follows:
 1. Concealed Conduit in Partitions or Accessible Ceilings: Minimum 3/4 inch.
 2. Exposed Conduit: Minimum 3/4 inch.
 3. Rigid Steel Encased in Concrete: Minimum 1 inch.
 4. Rigid Non-Metallic Polyvinyl Chloride Encased in Concrete: Minimum 2 inches.
 5. Direct Buried Conduit Size: Minimum 2 inches.
- B. Conduit Uses and Applications:
 1. Rigid Steel Conduit: Typical, Exposed Conduit Runs in dry and non-corrosive locations, unless otherwise noted.
 2. Liquid Tight Flexible Conduit: Final motor and instrument connection in non-hazardous areas.
 3. Flexible Metal Conduit: Allowed only within accessible ceilings at Operations/Control Building, for the connection of lighting fixtures. No other applications allowed.
 4. Polyvinyl Chloride-Coated Rigid Steel Conduit: Entering or exiting concrete including minimum 12 inches above and below grade or finished floor, in

corrosive NEMA 4X designated areas, plus exposed outdoor locations, and where indicated on the Drawings.

5. Rigid Nonmetallic Polyvinyl Chloride Conduit: Runs concealed or concrete encased in walls, floors, and underground duct banks.
6. Explosion Proof Flexible Conduit: Final connection of equipment in hazardous areas.

3.06 FIELD CONDITIONS AND RELATED REQUIREMENTS

- A. Underground water table may be near or above the location of new ductbanks.
- B. CONTRACTOR shall include cost for necessary dewatering, cleaning equipment to perform work in underground ductbanks, pull boxes and manholes, prior to installation of required new conductors.

3.07 RACEWAYS SUPPLEMENTAL REQUIREMENTS

- A. CONTRACTOR shall include necessary raceways and supports to provide any and all motorized equipment, electrical outlets, fixtures, communication outlets, instruments and devices within 10 linear feet of location shown on the Drawings.
- B. CONTRACTOR shall include necessary raceways, trench, excavation, backfill, and related materials to provide any and all pull boxes, manholes and ductbanks within 20 linear feet of location shown on the Drawings.
- C. Prior to installation of any raceway or related items identified in paragraphs A and B above, the OWNER shall have the right to make reasonable changes related to preferred location, at no additional cost.
- D. CONTRACTOR shall provide necessary raceways for all equipment specified, identified in wiring schedules, equipment schedules, panel boards schedules, electrical single line diagrams, block diagrams, process and instrumentation diagrams (P&IDs), fixtures schedules, and devices. Said necessary conduits may not be shown on the plan drawings, but they shall be sized by CONTRACTOR in accordance with requirements specified and the National Electrical Code, and include in this allowance, the raceways necessary for the installation of the conductors and for the complete operation of the included device or equipment.

3.08 RACEWAYS IDENTIFICATION

- A. Each new conduit, new wireway, and new boxes shall be identified by a specific number. The numbering system shall be in accordance with identification named on the Drawings or the process equipment identification. Products for identification of raceways is specified in Section 16075.

END OF SECTION

SECTION 16134

BOXES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Outlet boxes, device boxes, metallic pull boxes, junction boxes, termination boxes and precast small handholes.
 - 2. Fasteners used with wiring devices.

1.02 REFERENCES

- A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):
 - 1. OS1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
 - 2. OS2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- B. National Electrical Code (NEC):
 - 1. Article 370 - Outlet, Device, Pull and Junction Boxes, Conduit Bodies and Fittings.
- C. National Electrical Safety Code (NESC)
- D. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA FB1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 2. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.03 SUBMITTALS

- A. Product Data.
- B. Shop Drawings: Include identification and sizes of pull boxes for ENGINEER's acceptance prior to fabrication and installation.
- C. Submit structural calculations and construction details of each underground handholes, with plan view and sections showing dimensions.
 - 1. Submit statement of compliance with the requirements of applicable codes.
 - 2. Submit the proposed locations for cable racks.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Device Boxes, Metallic Pull Boxes and Junction Boxes: One of the following or equal:
 - 1. Crouse-Hinds.

- 2. Appleton.
- 3. O - Z Gedney.

B. Floor Outlet Boxes with 1 Inch Conduit Knockouts: One of the following or equal:

- 1. Steel City, 640 Series.
- 2. Hubbell.

C. Precast Handholes: One of the following or equal:

- 1. Old Castle Precast
- 2. Brooks Products
- 3. Utility Vault Company

2.02 DEVICE BOXES AND JUNCTION BOXES

- A. Materials: Heavy-duty rigid steel or rigid copper free aluminum, compatible with the location and conduit system being used, unless otherwise specified or indicated on the Drawings.
- B. For Indoor or Non-corrosive Areas: Provide cast FD type device boxes with epoxy finish, and compatible with the location and conduit system being used.
- C. For Outdoor Locations, Corrosive Areas, or Wet Process Locations: Provide cast FD type boxes with PVC coating for outdoor locations, corrosive areas and wet process locations and compatible with the location and conduit system being used.
- D. Coverplates:
 - 1. Indoor: Provide lighting switch and receptacle boxes of Type 302 stainless steel cover plates with cover gaskets, except where otherwise specified or indicated on the Drawings. Provide other boxes with Type 304 stainless steel cover screws and with cover gaskets.
 - 2. Outdoor and Corrosion Resistant: Provide lighting switch and receptacle boxes, weatherproof with yellow fiberglass lift cover plates with cover gaskets.

2.03 FLOOR OUTLET BOXES

- A. Suitable for receptacles, communications and data outlets as specified and indicated on the Drawings, complete with gaskets and cover plates.
- B. Dual-gang, heavy-duty cast iron, suitable for wiring devices to be installed to make a complete and operable system and installation.

2.04 CONCRETE HANDHOLES BOXES

- A. Precast concrete handholes in locations indicated on the Drawings and as required by NEC, and National Electrical Safety Code (NESC)
- B. Designed for heavy traffic conditions, with pull box and cover designed for heavy traffic bridge loading.
- C. Minimum 2 feet by 3 feet by depth as necessary for conduit depth, or larger dimensions shown on pull box schedule.
- D. Constructed of reinforced Class A concrete.

- E. Identification: Furnish covers with "Electrical" engraved on top side.
- F. Handholes with Metallic Covers:
 - 1. The heavy duty covers shall include a spring loaded mechanism to facilitate opening. Also, the metal covers shall include a foam insulation layer in the interior, to minimize the radiation of exterior sun heat towards the interior of the box.
- G. Pulling Eyes: Secured to reinforcement on interior walls.
- H. Provide fiberglass cable racks with adequate supports on pull boxes.

2.05 METALLIC PULL BOXES

- A. Boxes for applications in dry and non-corrosive location:
 - 1. Fabricated from 11 gauge (minimum) steel or aluminum, completely weatherproof with gasketed removable covers; compatible with type of conduit systems being used; manufactured, furnished, and installed complete with grounding lug.
- B. Boxes for applications in wet areas, outdoor locations and NEMA 4X designated areas: Fabricated from 11 gauge, 316 stainless steel, with gasketed covers and labeled NEMA 4X. Boxes shall include a drain fitting to facilitate continuous draining of moisture condensation.

2.06 FASTENERS

- A. Electroplated or stainless steel in boxes with wiring devices.
- B. Screws, Nuts, Bolts, and Other Threaded Fasteners: Stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Comply with the National Electrical Code.
- B. Terminal blocks installed in junction/terminal boxes as specified in Section 16050.
- C. Install concrete handholes on 12 inches of compacted clean aggregate base course, and in such a manner that the cover of the pull box will be 2 inches above and sloped with finish grade.
 - 1. Route signal cable such as instrumentation and communication cables separate from power and control cables.
 - 2. Identify cables and conductors in pull boxes.
 - 3. Provide ties on all conductors, to prevent interference and damage during work access.
 - 4. Install surveyor markings to establish finish grade.
 - 5. Provide seals on box covers to minimize water leakage from grade into box.
- D. Provide weatherproof conduit hubs for all conduit connections to metallic pull boxes.

- E. Phosphatize and prime with rust-resistant paint metallic pull box surfaces. Finish shall be 2 coats of ANSI 61 gray enamel paint.
- F. Size pull boxes to meet National Electrical Code requirements and to provide sufficient room for the future conduits and cables indicated on the Drawings.
- G. Furnish and install pull boxes as indicated on the Drawings and as specified. Install additional pull boxes as required to meet cable manufacturer's pulling tension requirements.
- H. Install pull boxes such that access to them is not restricted by obstructions such as pipes, valves, ladders.
- I. Secure metallic pull box covers with Type 316 stainless steel screws or bolts with coated threads.
- J. Provide adequate supporting pillar(s) for boxes to be located above ground or above decks, where there is no structural wall or surface for box mounting.

END OF SECTION

SECTION 16135

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Cabinets and enclosures to house electrical controls, instruments, terminal blocks, and similar equipment.

1.02 REFERENCES

- A. National Electrical Code (NEC).
- B. National Electrical Manufacturers' Association (NEMA).

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Unless otherwise specified or indicated on the Drawings, enclosures to house electrical controls, instruments, terminal blocks, and similar equipment shall be NEMA 12 for indoor, dry and non-corrosive locations; and NEMA 4X - 316 stainless steel for outdoor installations, wet locations and corrosive designated areas and shall be compatible with the conduit system being used.
 - 2. Provide sunshields for equipment enclosures that contain electronic equipment.
 - 3. Provide air conditioning heat exchangers for control cabinets that contain electronic equipment or other temperature sensitive equipment not rated for ambient temperature greater than 40 degrees Celsius.
 - 4. Specific control panel enclosures shall be as specified in Division 17 of these Specifications or as indicated on the Drawings.

1.04 SUBMITTALS

- A. Product Data.
- B. Calculations:
 - 1. Conditioning System Sizing: Submit calculations.

1.05 WARRANTY

- A. Submit manufacturer's standard warranty.

1.06 SUBMITTALS

- A. Submit product data and mounting supports.
- B. Air conditioning data when applicable, including sizing calculations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. NEMA 12 Steel Enclosures: One of the following or equal:
 - 1. Hoffman Engineering Company.
 - 2. Rittal.
- B. NEMA 4X Stainless Steel Enclosures: One of the following or equal:
 - 1. Hoffman Engineering Company.
 - 2. Hennessy Products Inc.
 - 3. Carlon.
- C. NEMA 3R Enclosures:
 - 1. Hoffman Engineering Company.
 - 2. Rittal.
- D. Enclosure Air Conditioner: One of the following or equal:
 - 1. Hoffman Engineering Company.

2.02 FABRICATION

- A. NEMA 12 Steel Enclosures:
 - 1. Fabricate enclosures from 14 gauge steel with continuous welded seams.
 - 2. Doors: Doors shall have full length piano hinges with the door removable by pulling the hinge pin.
 - 3. Provide a rolled lip around 3 sides of the door and around all sides of the enclosure opening.
 - 4. Gaskets: Attach gasket with oil-resistant adhesive and hold it in place with steel retaining strips.
 - 5. Provide hasp and staple for padlocking.
 - 6. Provide a print pocket for each enclosure.
- B. NEMA 4X Stainless Steel Enclosures:
 - 1. Provide enclosures that consist of base and cover which shall be of Type 316 stainless steel with minimum thickness of 12 gauge. The enclosures shall be provided with cover hinges to form a weathertight seal between the cabinet and door.
- C. NEMA 3R Enclosures:
 - 1. Enclosures shall be of minimum 14 gauge steel construction with continuous welded seam, gasket door with continuous hinges and stainless steel cover bolts.
 - 2. Enclosures shall be custom built for specific application and provided with ample space for mounting and wiring electrical equipment.

2.03 FINISHES

- A. Steel Enclosures:
 - 1. Do not paint NEMA 4X enclosures. Door fronts shall be ground smooth.
 - a. Print pockets and interior panels shall be steel with a white enamel finish.

2. Provide NEMA 12 and NEMA 4 enclosures with white enamel interior finish: The finish shall be light gray enamel, ANSI 61 exterior, over phosphatized surfaces. Panels shall be white enamel.
3. Special finishes and colors shall be furnished for wet locations.

B. Other portions of these Contract Documents shall be checked for special conditions.

2.04 ENCLOSURE AIR CONDITIONERS

- A. Provide electrical equipment enclosures with complete air conditioning system as indicated on the Drawings and as specified.
 1. Enclosures to be climate controlled, equipped with integral self-contained air conditioning units complete with thermostats.
 2. The industrial grade air conditioners to constantly cool and recirculate the internal enclosure air which is kept completely separated from the external, or ambient air (closed-loop system).
 3. Provide units suitable for operation in the environment as specified in Section 16010. The units to be complete with all gaskets, mounting hardware, and air inlet filter.
- B. Electrical Requirements:
 1. Power supply to the air conditioners to be as indicated on the Drawings.
 2. Make adjustments to the power supply circuits (conduits and wires and other components) as necessary to accommodate the air conditioning equipment.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner. Install in accordance with Section 16050.
- C. Install cabinet fronts plumb.
- D. Top mounted air conditioning units installation shall not allow condensation to damage electrical equipment or enclosure.
- E. Provide size of pull boxes to meet National Electric Code requirements and ample space for conductors and devices.
- F. Provide adequate supports and anchors to resist seismic forces.
- G. Provide adequate supporting pillar(s) for cabinets to be located above decks, above slabs or where there are no structural wall or surface for cabinet mounting.

END OF SECTION

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SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Wiring devices including the following:
 - 1. Snap switches and toggle switches.
 - 2. Fluorescent dimmer switches.
 - 3. Plugs and receptacles.
 - 4. Control and push-button stations.
 - 5. Pilot devices.

1.02 SUBMITTALS

- A. Product Data.

1.03 QUALITY ASSURANCE

- A. Provide industrial grade products for wiring devices. Commercial grade products are not acceptable, unless otherwise specified or indicated on the Drawings.
- B. Coordinate lighting fixture ballasts with dimming switches.

PART 2 PRODUCTS

2.01 SNAP OR TOGGLE SWITCHES

- A. Manufacturers: One of the following or equal:
 - 1. Hubbell.
 - 2. General Electric.
 - 3. Leviton.
 - 4. Bryant.
- B. Number of Poles: As indicated on the Drawings.
- C. Rating: 20 amperes, 125 volt.
- D. Special Switches and Covers: As specified or indicated on the Drawings.

2.02 FLUORESCENT DIMMER SWITCHES

- A. Manufacturers: One of the following or equal:
 - 1. Hunt.
 - 2. Lutron.
 - 3. Leviton.
 - 4. Bryant.
- B. Circuitry: Built-in, solid state, able to compensate for line voltage dips, with an on-off switch.

C. Rating: For operation of minimum 40 watt rapid start lamps at 120 volts.

2.03 120 VOLT RECEPTACLES

- A. Manufacturers: One of the following or equal:
 - 1. Hubbell.
 - 2. General Electric.
 - 3. Leviton.
 - 4. Bryant.
- B. Duplex Receptacles: 2-pole, 3-wire, grounded, 125 volts, industrial, rated at 20 amperes.
 - 1. Special Receptacles and Covers: As specified in Section 16134 or as indicated on the Drawings.
- C. Ground Fault Interrupter Receptacles (GFI): Rated at 20 amperes at 125 volts alternating current.

2.04 240 VOLT RECEPTACLES

- A. Manufacturers: One of the following or equal:
 - 1. Hubbell.
 - 2. General Electric.
 - 3. Leviton.
 - 4. Bryant.
- B. Types: Single and 3-phase; suitable for equipment served.
- C. Rating: 20 amperes at 250 volts alternating current, unless otherwise indicated on the Drawings.

2.05 480 VOLT PLUGS AND RECEPTACLES

- A. Manufacturers: One of the following or equal:
 - 1. Killark W Series.
 - 2. Crouse-Hinds.
 - 3. Leviton.
 - 4. Bryant.
- B. Types: Heavy duty, 3-phase, weather resistant, grounding type, 4-wire, 4-pole device, suitable for equipment served.
- C. Rating: 30 amperes at 480 volts alternating current, unless otherwise indicated on the Drawings or specified.

2.06 DISTRIBUTED CONTROL SYSTEM RECEPTACLES

- A. Manufacturers: One of the following or equal:
 - 1. Hubbell.
 - 2. Square D Company.
 - 3. Leviton.
 - 4. Bryant.

- B. Type: Surge suppression/isolated ground, red, minimum 20 amperes rated at 125 volts alternating current, with gasketed cover plate.

2.07 UNINTERRUPTIBLE POWER SYSTEM RECEPTACLES

- A. Manufacturers: One of the following or equal:
 - 1. Hubbell.
 - 2. Square D Company.
 - 3. Leviton.
 - 4. Bryant.
- B. Type: Surge suppression/isolated ground, orange, minimum 20A rated at 125 volts alternating current, with gasketed cover plate.

2.08 LOCAL PUSH-BUTTON MOTOR CONTROL STATIONS

- A. Manufacturers: One of the following or equal:
 - 1. Furnas Electric Company.
 - 2. Square D Company.
 - 3. Allen-Bradley.
 - 4. Siemens.
 - 5. Cutler-Hammer.
 - 6. General Electric.
- B. Types: Heavy duty, oiltight/watertight.
- C. Components: Selector Switches, pilot light, and push buttons.
- D. Enclosures: As follows, unless otherwise indicated on the Drawings or specified:
 - 1. For Nonhazardous Indoor Locations: NEMA 12.
 - 2. For Hazardous Indoor Locations: NEMA 7.
 - 3. For Outdoor Locations: NEMA 4X or NEMA 3R, as designated on Drawings.
 - 4. For Hazardous Outdoor Locations: NEMA 4 and NEMA 7.
 - 5. In Chemical Building, and areas designated NEMA 4X on Drawings: NEMA 4 and NEMA 4X, stainless steel.
- E. Field Located Maintained Push Buttons: Red mushroom head, push-to-stop, pull-to-reset, with maintained contacts.

2.09 PILOT DEVICES

- A. Manufacturers: One of the following or equal:
 - 1. Furnas Electric Company.
 - 2. Square D Company.
 - 3. Allen-Bradley.
 - 4. Siemens.
 - 5. Cutler-Hammer.
 - 6. General Electric.
- B. Type: Heavy duty, suitable for mounting in control stations, on switchgear, switchboards, variable frequency drives, motor control centers, control panels, and other electrical equipment.
- C. Components: Oiltight/watertight push buttons, selector switches, LED pilot light, and incidental items.

- D. Casting: Durable 1 piece with chrome plated octagonal mounting nuts.
- E. Push Buttons: Heavy-duty plastic.
- F. Pilot Light Lenses: Shatter resistant plastic, push-to-test.
- G. Potentiometer, 20 turn, 10k to match VFD manufacturers requirements.

2.10 CORD CONNECTOR GRIPS

- A. Non-Hazardous Areas:
 - 1. Manufacturers: One of the following or equal:
 - a. Killark, Series Z.
 - 2. Aluminum cord connector.
 - 3. Stainless steel mesh grip.
- B. Hazardous Areas:
 - 1. Manufacturers: One of the following or equal:
 - a. Killark, Series ZE.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install wiring devices in accordance with manufacturer's instructions.
- B. Mount wiring devices as indicated on the Drawings.
 - 1. Provide adequate supporting pillars for wiring devices to be located above ground or above decks, where there is no structural wall or surface for box mounting.

3.02 LOCAL PUSH-BUTTON MOTOR CONTROL STATION INSTALLATION

- A. Install Start-Lockout-Stop push-button control stations adjacent to every motor unless otherwise indicated on the Drawings.

3.03 PROTECTION

- A. Protect products until acceptance by OWNER.

END OF SECTION

SECTION 16144

DISCONNECT SWITCHES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Fusible and nonfusible disconnect switches.

1.02 SUBMITTALS

- A. Product Data: Include manufacturer's specifications and description.
 - 1. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit.
- B. Shop Drawings.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.03 WARRANTY

- A. Submit manufacturer's standard warranty.

1.04 MAINTENANCE

- A. Spare Parts: Furnish 1 set of spare fuses for each fused disconnect switch.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Disconnect Switches: One of the following or equal:
 - 1. Square D Company.
 - 2. Cutler-Hammer.
 - 3. General Electric.
 - 4. Siemens.

2.02 DISCONNECT SWITCHES

- A. Type:
 - 1. Heavy-duty safety switches with a quick-make, quick-break operating mechanism, full cover interlock and indicator handle.
 - 2. Where required, furnish with fuses where indicated on the Drawings.
 - 3. Provide auxiliary contact for VFD applications as indicated on the drawings.

- B. Unless otherwise specified herein or indicated on the Drawings, disconnect switches shall be in NEMA 12 enclosures for indoor installations and in NEMA 4X enclosures with 316 stainless steel material for outdoor installations, as designated on Drawings.
 - 1. Disconnect switch enclosures shall be compatible with type of conduit system being used.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install devices in accordance with manufacturer's instructions and accepted shop drawings.
- B. Provide adequate supporting pillar(s) for disconnect switches to be located above ground or above decks, where there is no structural wall or surface for box mounting.

END OF SECTION

SECTION 16222

MOTORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Single phase motors, direct current motors, and 3-phase motors up to and including 300 horsepower.
- B. Related Sections:
 - 1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its sub-Contractors to review all sections to insure a complete and coordinated project.

1.02 REFERENCES

- A. American Bearing Manufacturers Association (ABMA):
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Institute of Electrical and Electronic Engineers (IEEE).
 - 1. IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
 - 2. IEEE 841 - Recommended Practice For Chemical Industry Severe Duty Squirrel Cage Induction Motors.
 - 3. IEEE 43 - Recommended Practice For Testing Insulation Resistance of Rotating Machinery.
- C. National Electrical Manufacturers' Association (NEMA):
 - 1. MG-1 - Motors and Generators.
 - 2. NEMA MG-2 - Safety Standards for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.

1.03 DEFINITIONS

- A. Solid-State Motor Controller: Includes variable frequency drives and solid-state reduced voltage starters.
- B. Nominal Efficiency: The average full load efficiency value of a large population of the manufacturer's motors of the same design.
- C. Minimum Efficiency: The minimum full load efficiency value of any individual motor associated with the nominal motor efficiency.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Descriptive bulletins.
 - 2. Outline drawings with dimensions.

3. Cut-away and exploded view drawings.
4. Parts list with material designations.
5. Nameplate data.
6. Motor weight, frame size and conduit box location.
7. Description of insulation system.

B. Design and Performance Data:

1. Bearing design and bearing life calculations.
2. Performance Data Required by Schedule A, Nameplate Data, and Following Information:
 - a. Service factor.
 - b. Efficiency at 1/2 and 3/4 load.
 - c. Power factor at 1/2 and 3/4 load.
3. Special features including condensation heaters and winding temperature detectors.
4. Performance data for motors with synchronous speed of 900 revolutions per minute and below.
5. Factory test reports with test reference standard identified.
6. Condensation heaters and winding temperature detectors.
7. Factory test reports with test reference standard identified.

1.05 QUALITY ASSURANCE

A. Certification:

1. When motors are driven by variable speed drive systems, submit certification that selected motor:
 - a. Is capable of satisfactory performance under the intended load.
 - b. Is suitable for operation with the proposed variable speed drive unit.

1.06 PROJECT/SITE CONDITIONS

- A. Provide motors designed to produce their nameplate horsepower, service factor, Speed (RPM) and suitable enclosure for the project altitude, temperature, humidity and process environment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Motors: One of the following or equal:

1. U. S. Motors.
2. General Electric.
3. Reliance.
4. Toshiba.

2.02 ELECTRICAL MOTORS

A. General:

1. Manufactured with cast iron frames in accordance with NEMA MG 1, and in accordance with specified requirements.
2. Alternating Current Motors: Squirrel cage induction type suitable for 60 hertz power.

3. Where not otherwise specified or indicated on the Drawings:
 - a. Motors 1 Horsepower and Larger: 3-phase, 460 volt.
 - b. Motors less than 1 Horsepower: Single phase, 120 volt.
4. 2-Speed Motors: Dual winding design.
5. Temperature Rating and Altitude Requirements: Where not otherwise specified or indicated on the Drawings, provide motors that are rated suitable for continuous operation in 40 degrees Celsius ambient temperature at project site altitude.
 - a. Temperature Rise under Full Load: Not to exceed that for Class B insulation (80 degrees Celsius).
6. Motor Data: Specific motor data including horsepower, speed, and enclosure type are indicated on the Drawings and specified under equipment for which motor is required.
7. Torque and Power of Motors:
 - a. Provide motors that develop sufficient torque for required service throughout acceleration range at voltage 10 percent less than motor nameplate rating.
 - b. Provide motors that develop sufficient torque when started using reduced voltage starters.
8. Motor Leads and Insulating Material: Insulated leads with non-wicking, non-hydroscopic material. Class F insulation.
9. Grounding Lugs: Provide inside conduit boxes for motor frame grounding.
10. Hardware: Type 316 stainless steel.

B. Provide motors that are special premium efficiency type, except motors that are to be used on hoisting equipment, heat pumps, unit heaters, sump pumps, and lubricating oil transfer pumps.

1. Provide premium efficiency type motors having nominal full load efficiencies and power factors as specified in Schedule A appended to this Section.
2. Actual full load efficiency of individual motors within the nominal efficiency band shall not be less than the minimum efficiency value specified in Schedule A.

C. Condensation Heaters:

1. Use: Required in motors in outdoor applications.
2. Type: Cartridge or flexible wrap-around type installed within motor enclosure adjacent to core iron.
3. Rating, Phase and Wattage: Rated for 120 volt, single phase with wattage as required.
4. Bring power leads for heaters into conduit box.

D. Winding Temperature Detectors:

1. When specified for individual equipment and on alternating current motors connected to a solid-state motor controller, provide factory installed winding temperature detector with leads terminating in conduit box.
2. Provide detectors that protect motor against damage from overheating caused by single phasing, overload, high ambient temperature, abnormal voltage, locked rotor, frequent starts, or ventilation failure.
 - a. For Motors Less than 200 Horsepower: Provide detector that has normally closed contacts.
 - b. For Motors 200 Horsepower and Larger: Provide with 3-wire 100-ohm platinum resistance temperature detectors, 2 per each phase.

3. Auxiliary Relays and Controls: Provide relays and controls and mount them in controller enclosure which is suitable for the environment.
4. Provide auxiliary low voltage interface module with intrinsically safe circuit for motors located in Hazardous Classified Areas.

E. Internal Cooling Motors: Design motors having speeds of 900 revolutions per minute and less, and motors that are connected to solid-state motor controllers with special attention to internal cooling.

F. Provide oversize terminal boxes for termination of shielded cables.

2.03 SINGLE PHASE MOTORS

- A. Capacitor start type rated for operation at 115 volts, 60 hertz, unless otherwise specified or indicated on the Drawings.
- B. Totally enclosed, fan cooled motors manufactured in accordance with NEMA MG 1-10.35.
- C. Ball Bearings: Sealed.
- D. 1/2 Horsepower or Less Fan Motors:
 1. Split-phase or shaded pole type when standard for the equipment.
 2. Open type when suitably protected from moisture, dripping water, and lint accumulation.
- E. Wound rotor or commutator type single phase motors only when their specific characteristics are necessary for application and their use is acceptable to the ENGINEER.

2.04 DIRECT CURRENT MOTORS

- A. Designed to operate from direct current.
- B. Sealed ball bearings having ABMA B-10 life of 60,000 hours or more.
- C. Insulation System: NEMA 1-1.65, Class F, resistant to attack by moisture, acids, alkalies, and mechanical or thermal shock.
- D. Totally enclosed fan cooled enclosures.

2.05 3-PHASE MOTORS

- A. Suitable for 460 volt 3-phase power unless otherwise specified or indicated on the Drawings.
- B. NEMA Design B except where driven load characteristics require other than normal starting torque.
 1. Starting kilovolt ampere per horsepower (locked rotor) are not to exceed values specified in NEMA MG-1-10.37.
 2. Motors for use with variable frequency drives shall be inverter duty rated and meet requirement of IEEE 841.

3. All motors greater or equal to 1 horsepower shall meet the requirements of IEEE 841.
- C. Motor Bearings: Antifriction, regreasable, and filled initially with grease suitable for ambient temperatures to 40 degrees Celsius.
 1. Suitable for intended application and have ABMA B-10 rating life of 60,000 hours or more.
 2. Fit bearings with easily accessible grease supply, flush, drain, and relief fittings using extension tubes where necessary.
 3. Provide two pole motors with sleeve type bearings.
 4. Provide special trust bearings on vertical motors of suitable applications and reliable for long term life rating not less than 100,000 hours.
- D. Insulation Systems:
 1. Comply with NEMA 1-1.65.
 2. Class F system with Class B temperature rise.
 3. Resistant to attack by moisture, acids, alkalies, and mechanical or thermal shock.
 4. Winding Coils for motors 150 horsepower and smaller shall be of 100 percent copper material and the coils may be random wound.
 5. Winding Coils for motors larger than 150 horsepower shall be of 100 percent copper material and they shall be form wound. The coils insulation shall have a heavy duty glass film to prevent coil turn to turn short circuit, and resist stress for severe duty.
- E. Conduit Boxes: Cast iron or stamped steel, split from top to bottom and capable of being rotated to 4 positions.
 1. Provide gaskets between following:
 - a. Frames and conduit boxes.
 - b. Conduit boxes and box covers.
 2. Provide separate motor conduit boxes for power leads and instrumentation and control cable leads on all VFD-supplied motors and on motors over 50 hp.
- F. Motor Enclosures: Provide one of the following types:
 1. Open Drip Proof: Stamped steel conduit boxes; 1.15 service factor at 40 degrees Celsius only for application indoor, non-humid and dry locations.
 2. Totally Enclosed Fan Cooled (TEFC): Cast iron conduit box; 1.15 service factor at 40 degrees Celsius ambient; tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller, and automatic breather and drain devices for frames 324T and larger; upgraded insulation by minimum of 3 dips and bakes and sealer coat of epoxy or silicone. The TEFC enclosure shall be provided for all motors in wet and humid locations, outdoor locations, and indoor locations where the application requires periodic water hose cleaning.
 3. Explosion-proof: 1.15 service factor at 40 degrees Celsius; tapped drain holes with corrosion resistant plugs for frames 286T and smaller and automatic breather and drain devices for frames 324T and larger; UL label for Class I, Division 1, Group D hazardous area.
 4. Severe Duty: Corrosion resistant type conforming to motors designated by manufacturer as "Chemical Duty," "Mill and Chemical," "Custom Severe Duty," or similar applicable manufacturer's quality designation with 1.15 service factor at 40 degrees Celsius; tapped drain holes with Type 316 stainless steel plugs

for frames 286T and smaller and automatic breather and drain devices for frames 324T and larger; epoxy finish; and upgraded insulation using encapsulated or dip and bake windings.

5. Submersible: Watertight casing with insulated windings which are moisture resistant.
 - a. Pump Motors Specified to be Submersible: Provide motors having cooling characteristics suitable for continuous operation in totally, partially, or nonsubmerged condition without overheating or other damage.
 - b. Electrical Cables: Provide cables of adequate length to allow unit to be wired without splices.
 - c. Provide separate cables for power leads and for instrumentation and detector leads.
 - d. When submersible motors are supplied from VFDs, motors shall be inverter-duty rated.
6. All motors installed indoors and in wet areas shall have TEFC enclosures.
7. All motors installed outdoors shall have TEFC enclosures and suitable for severe and corrosion resistant duty, unless otherwise the application specifications explosion proof enclosure.
8. All motors with application speed of 1200 RPM and lower and driven by VFDs shall have special provisions for proper cooling. Verify motor cooling provisions suitable for minimum application speed.

2.06 MOTOR SIZES

- A. Motor sizes specified in the Specifications and indicated on the Drawings are minimum sizes.
- B. Provide motors, electrical circuits, and equipment of ample horsepower capacity to operate equipment without exceeding rated nameplate horsepower, full-load current at rated nameplate voltage, or overheating at maximum load capacity.

2.07 SOURCE QUALITY CONTROL

- A. Factory Testing of 3-Phase Motors:
 1. When specified in individual equipment specifications, factory test motors. Include testing of:
 - a. No load current.
 - b. Locked rotor current.
 - c. Winding resistance.
 - d. High potential.
 2. Perform in accordance with applicable NEMA Standards.
 3. Furnish copies of test reports.
- B. Efficiency Testing: Factory test in accordance with IEEE 112, using method A or B of Section 5, as appropriate for motor rating.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install motors in accordance with manufacturer's instructions.

3.02 SCHEDULES

A. Schedule A: Full load motor efficiency and power factor rating requirements for premium efficiency, 460 volt, 3-phase horizontal motors.

<u>SCHEDULE A</u>							
FULL LOAD MOTOR EFFICIENCY AND POWER FACTOR RATING REQUIREMENTS FOR PREMIUM EFFICIENCY, 460 VOLT, 3 PHASE HORIZONTAL AND VERTICAL MOTORS							
		Protected (Open Drip Proof)⁽¹⁾			Totally Enclosed Fan Cooled⁽¹⁾		
Nominal Horsepower (Horsepower)	Syn. (revolutions per minute)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)	Minimum Efficiency (Percent)	Nominal Efficiency (Percent)	Power Factor (Percent)
1	1,800	81.5	84.0	70.9	81.5	84.0	77.7
	1,200	78.5	81.5	57.0	78.5	81.5	57.0
1-1/2	3,600	81.5	84.0	86.0	81.5	84.0	86.0
	1,800	81.5	84.0	73.0	81.5	84.0	77.4
	1,200	81.5	84.0	67.8	84.0	86.5	67.8
2	3,600	81.5	84.0	87.7	84.0	86.5	87.7
	1,800	81.5	84.0	76.7	81.5	84.0	78.8
	1,200	84.0	86.5	68.1	85.5	87.5	68.1

Notes:

(1) Motor data for continuous duty, NEMA Design B, 1.15 service factor, 40 degrees Celsius ambient, Class F insulation, 3 phase, 460 volt, at listed speed rating.

(2) Correct to 95 percent power factor and submit capacitor size in KVAR as specified in Article titled "Submittals."

(3) Totally enclosed fan cooled efficiencies apply to both horizontal and vertical motors.

END OF SECTION

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SECTION 16262

VARIABLE FREQUENCY DRIVES BELOW 75 HORSEPOWER

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Complete, solid-state variable frequency drive (VFD) unit(s) and VFD system(s) including design, fabrication, software, technical data, spare parts, testing, installation and support requirements for speed control of 3-phase squirrel cage rotor, induction motors, for control of RAS pump
- B. Related Sections:
 - 1. Section 16010 - Electrical Requirements.
 - 2. Section 16075 - Electrical Identification.
 - 3. Section 16422 - Motor Control.
 - 4. Section 16950 - Electrical Testing.
 - 5. Section 17410 - Basic Measurement and Controls
 - 6. Section 17452 - Programmable Logic Controller System

1.02 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. Standard 250 - Enclosures for Electrical Equipment (1,000 volts maximum).
 - 2. NEMA MGI, Part 31 - Motors with higher peak voltage capability.
 - 3. NEMA ICS7 – Industrial Controls and Adjustable Speed Drives.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. Standard 519 - 1992 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
- C. Underwriters' Laboratories, Inc. (UL):
 - 1. UL label is required on VFD unit
 - 2. UL 508 – Industrial Control Equipment
 - 3. UL 508 label is required on VFD equipment and enclosure assembly
 - 4. UL 50 – Enclosures for Electrical Equipment

1.03 SYSTEM DESCRIPTION

- A. The CONTRACTOR and variable frequency drive system Supplier are cautioned regarding the review and compliance with the total Contract Documents. Typical required auxiliary devices may include circuit breakers, motor circuit protectors, relays, timers, pilot devices including pushbuttons, selector switches and pilot lights, enclosures, conduit, disconnect switches, terminal boxes, and other equipment. These auxiliary items may be provided by separate supplier; however, they shall be integrated as complete VFD working system.
- B. See Division 11 for a control description and verify data of the motors and driven equipment including full load current, torque, speed, and performance requirements

and provide all supplementary equipment and services to accomplish the necessary operation.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. General non-specific "catalog data" are not acceptable.
 - 2. Layout drawings of each VFD in control cabinet or separate enclosure dimensions, access details, weights, arrangement, color, and nameplates, door mounted devices and conduit stub-ups.
 - 3. Internal VFD schematic and interconnection wiring diagrams among internal devices, external devices including terminal blocks, and wire numbering.
 - 4. Specific equipment names, relay and timer coil, respective contact identification numbers shall be consistent with the design Drawings.
 - 5. Complete single line diagrams including, but not limited to, electrical ratings, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete system.
 - 6. Complete Bills of Material and catalog data sheets for all equipment and devices.
 - 7. Complete drawings to provide the OWNER with operations and maintenance capabilities.
- B. Product Data:
 - 1. Functional diagrams that identify major system functional blocks and interfaces.
 - 2. Special requirements or restrictions of the motor-load combination that may result from operation on the VFD.
- C. Test Reports:
 - 1. Submit certified copies of field test reports verifying adequate performance.
 - 2. Submit factory standard bench-test data verifying that the manufacturer's proposed equipment has been tested after product assembly.
- D. Operation, Maintenance and Installation Instructions.
- E. Guides and Manuals: If the variable frequency drive systems require settings or configuration, provide copies of all settings.
- F. Record Drawings:
 - 1. Drawings of each VFD type representing the as-built condition of the equipment and respective settings. Final or corrected as-built drawing shall be delivered 4 weeks after field system acceptance.
- G. Warranty documents.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Variable frequency drive manufacturer shall maintain, as part of a national network, engineering service facilities within 150 miles of the equipment installation to provide quick responsive start-up service, training of customer

personnel, periodic maintenance service contracts, and emergency troubleshooting and repair service.

2. The manufacturer shall have produced the specified type of VFDs for a minimum period of five (5) years.

1.06 WARRANTY

- A. Contractor and manufacturer shall warrant that the material and workmanship of all components, and the operation of the VFD system shall be free of any limitations and deficiencies. Also, the warranty shall include:
 1. Replace components found to be faulty and make changes in equipment, substitution arrangement, include system rewiring, rebuilt or additional equipment required, or adjustments necessary during trial operation or subsequent operation of the unit during the warranty period, to meet the equipment or functional requirements of this Specification.

1.07 MAINTENANCE

- A. Spare Parts: As a minimum, provide the following spare parts:
 1. One complete main control key pad for each type and rated size of VFD.
 2. Any special dedicated tool for emergency service and troubleshooting.
- B. Field Services: Manufacturer shall describe the field service system available to support the proposed variable frequency drive system. As a minimum describe:
 1. Type of technical support available (e.g. system engineering and technician).
 2. Location of field service personnel.
 3. Field service daily rates in dollars per hour and dollars per day.
 4. Guaranteed response times to service requests.
- C. Local Service Representative:
 1. Provide cell phone number and office phone numbers of local service and parts contacts for emergency repairs and callouts.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Yaskawa, to match existing controllers for RAS pumps.

2.02 GENERAL REQUIREMENTS

- A. VFD system shall be rated for the following:
 1. Supply the amperage demand and speed control of motor size(s) scheduled or indicated on the Drawings.
 2. Maintain output frequency (setpoint) with a steady state accuracy of 0.5 percent of rated frequency of 60 hertz for a 24 hour period.
 3. Provide smooth, stepless changes in motor speed, acceleration and deceleration over the entire operating speed (revolutions per minute) range.
 4. Automatic current limit feature during startup and provide a "soft start" torque profile for the motor-load combination. Also, it shall limit current due to motor winding or motor lead phase-to-phase short circuit or phase-to-ground short

circuit. The current limit protection setting shall be field adjustable and it shall withstand available short circuit currents of the operating environment.

5. Operate the motor load continuously within the range of 10 percent to 105 percent of rated speed. The minimum and maximum continuous operating speeds shall each be field adjustable setpoints within this speed range. Provide 2 field-adjustable speed setpoints for the variable frequency drive to skip equipment resonant frequencies.
6. VFD shall have linear acceleration capability to ramp up the speed, in revolutions per minute, of the selected minimum to maximum operating speed range in a maximum of 30 seconds. Provide controlled linear deceleration capability. The acceleration and deceleration time limits shall be field adjustable to values up to 120 seconds.
7. VFD shall be capable of supplying indefinitely 110 percent of the motor nameplate full load current. Also, the unit shall have a one (1) minute overload current rating of 150 percent of the motor nameplate full load current.

B. The VFD unit overall efficiency shall be a minimum of 95 percent at rated voltage, frequency, and current. This efficiency shall be calculated as follows:

$$Efficiency (\%) = \frac{Power (Load)}{Power (Supply)} \times 100$$

Power (Load) is the total 3-phase power measured at the output terminals of the drive system, including VFD, output filters or transformers. Power (Supply) is the total power measured at the input terminals of the VFD including input filters, line reactors, isolation transformers, harmonic distortion attenuation equipment and auxiliary equipment (e.g., controls, fans) for complete system operation.

- C. The VFD and/or protective relay system shall continuously monitor the output voltages and generate an alarm condition when the unbalance exceeds 1 percent. The system shall detect and generate a separate alarm for loss of any output phase voltage (single phasing). Phase unbalance shall be as defined by NEMA Standard MG-1.
- D. VFD shall operate continuously without interruption of service or damage to equipment during transient input voltage variations of minus 40 percent for a duration of 15 cycles. Unacceptable voltage fluctuations on the supply bus shall cause under or over-voltage protection to trip and remove supply voltage from the drive system.

2.03 SYSTEM FEATURES AND CHARACTERISTICS

- A. VFD system shall have microprocessor based controls it shall include the following:
 1. Input section rectifier shall consist of a 6-pulse full wave diode system and direct current link.
 2. The inverter shall use insulated gate bipolar transistors (IGBTs) with space vector pulse width modulation (PWM) technology. The inverter shall invert the direct current voltage into an alternating current voltage at a frequency which shall be proportional to the desired speed. This alternating current voltage and frequency shall both vary simultaneously at a constant "Volts-Per-Hertz" ratio to operate the induction motor at the desired speed.

- B. VFD output voltage regulation shall be plus or minus 2 percent and carrier frequency shall be field-adjustable.
- C. Controls and indicators to accomplish operation functions shall be located on the VFD. As a minimum, the required controls and indicators shall consist of the following features via the keypad or auxiliary devices:
 1. Digital Output Speed Indicator: Revolutions per minute.
 2. Variable Frequency Drive Mode Indicator: ON-OFF-TEST.
 3. Input Voltage:
 4. Output Voltage:
 5. Output Current:
 6. Output Frequency:
 7. Drive Ready Indicator.
 8. Running time meter.
 9. Control Mode Selector Switches: As required .
 10. Manual speed control and HAND-AUTO selector switch.
 11. Alarm Read-Out: Display on keypad.
 12. Alarm reset button.
 13. Alarm, Auxiliary Contacts and Other Devices: as indicated on the Drawings.
 14. Molded case circuit breaker disconnect with lockout mechanism
- D. VFD system shall provide a 4 to 20 milliamperes direct current output signal that is proportional to the drive output frequency for use as speed feedback or control and remote speed indication.
- E. VFD system shall accept a 4 to 20 milliamperes direct current input command signal to control the output frequency in the automatic and/or manual control modes. The controls shall accept the input increase/decrease command with a resolution that permits incremental changes in speed, revolutions per minute, equal to or less than 0.1 percent of rated speed.
- F. When operating in the automatic mode, the VFD system shall shut down during a power outage. Upon restoration of normal power and after an adjustable time delay (0 to 2 minutes; motor has coasted to zero speed and there is no backspin), the VFD system shall automatically restart and then ramp up to speed as required by the control system. The process operator shall not be required to reset the system manually after a shutdown caused by a power outage.
- G. Furnish door mounted selector switch or keypad pilot device for selection of local/remote speed reference signal (e.g., analog output from a programmable logic controller) supplied to the VFD.
- H. Include in each variable frequency drive system an automatic trip feature which will remove the drive output from the motor and allow it to decelerate safely. This automatic system shall trip and indicate the fault only upon the following conditions:
 1. Motor overload.
 2. Motor stator winding fault (phase-to-ground, phase-to-phase).
 3. Loss of input power to the variable frequency drive or unacceptable voltage variation.
 4. High variable frequency drive equipment temperature.
- I. Provide each VFD system with transmitted and received radio interference protection. In addition, provide protection against starting a rotating motor, both

directions (coasting to zero speed and backspin). In the event that a motor automatic restart feature (catch the motor "on-the-fly") is provided in the drive controller as standard, this feature shall be capable of being disabled.

- J. VFD shall include on-line diagnostics with an automatic self-check feature, that will detect a failure which in turn affects motor operation and generates an alarm output, contact rated for 125 volts-direct current.
 - 1. Diagnostics shall operate a visual and audible alarm indicator(s) on the VFD cabinets without opening cabinet doors.
 - 2. Diagnostics shall provide an easily readable output that will indicate a failure.

2.04 OPERATING CONDITIONS

- A. The following operating conditions are applicable for all VFD equipment.
 - 1. As listed in Section 15050.
 - 2. Utility Power Supply: 480 volts, 3-phase, fixed frequency of 60 hertz.
 - 3. Suitable to operate, at times, on a limited power source with waveform distortion engine-generator set.
 - 4. Short Circuit Fault Withstand: 42,000 amperes symmetrical at rated voltage.

2.05 ENCLOSURES

- A. Unless otherwise specified or indicated on the Drawings, each VFD system enclosure shall be in NEMA 4, with 316 stainless steel, gasketed force ventilated dead front with front accessibility, and maximum dimensions per equipment layout on drawings. Design enclosures for bottom entry of power supply cables and top exit of motor cables. Design VFD system so that rear cabinet access is not required for operations, maintenance, and repair tasks.
 - 1. Treat metal surfaces and structural parts by phosphatizing, or equal, prior to painting.
 - 2. Apply a gun-metal gray undercoat to enclosures which is equal to zinc chromate.
 - 3. Finish exterior of the enclosures in ANSI-Ivory color enamel.
 - 4. Brace each door to prevent sag when fully open.
- B. Main disconnecting means shall have external operating handle interlocked with the door so that it cannot be opened unless the disconnect is in the OFF position. Power supply to the motor from the VFD shall be capable of being positively locked out in the OFF position. The disconnect shall be interlocked so that equipment cannot be energized when the door is open.
- C. Electrical ground bus shall be tin-plated copper. Power and control wiring shall be copper, and identified in accordance with Section 16075.
- D. Equipment to be of modular construction allowing normal maintenance and repair to be done with ordinary hand tools. Design and install device assemblies so that a single failed item can be individually removed and replaced.

2.06 SOURCE QUALITY CONTROL

- A. Factory Wiring Labels:
 - 1. Provide all VFD internal wiring with identification numbers or labels and connected to terminal blocks:

B. Factory Testing:

1. Factory test each VFD system in accordance with IEEE and NEMA standards for operational integrity.
2. VFD system components, including power transistors, GTOs, SCRs, and diodes shall be 100 percent inspected, including temperature cycling and ambient high temperature of 65 degrees Celsius load testing. All integrated circuits shall be inspected, pass/fail tested, temperature cycled and ambient high temperature tested. Small components, including small signal semiconductors, resistors, capacitors, diodes, etc. shall be lot sampled and tested for functionality.
3. Auxiliaries, including fans, that are required for rated load operation at maximum ambient temperature, shall be 100 percent redundant. A new and unused spare replacement fan(s), shipped in original carton, may be acceptable.
4. VFD system shall not be shipped from the manufacturing and assembly facility until the acceptance tests are completed and the results approved by the test representative.
5. Acceptance of a shop test does not relieve CONTRACTOR from requirements to meet field installation tests under specified operating conditions, nor does the inspection relieve the CONTRACTOR of responsibilities.

PART 3 EXECUTION

3.01 GENERAL

- A. Variable frequency drives rated below 75 hp shall be installed in NEMA 4 gasketed enclosure - control panels, to match existing control equipment for RAS pumps and in accordance with drawings.

3.02 FIELD QUALITY CONTROL

- A. The CONTRACTOR shall successfully complete Acceptance Test Procedures on the assembled drive system. The test plan shall be submitted for acceptance at least 30 days prior to the planned test date.
- B. Provide the services of an experienced, factory trained technician or service engineer of the variable frequency drive manufacturer, for minimum of 2 days for VFD unit test and startup, beginning at a date mutually agreeable to the CONTRACTOR and the OWNER. The technician shall be on duty at the site for at least 6 hours per each required day of each VFD normal test and startup; and he shall be available 24 hours per day when required to advise concerning special problems with equipment and systems.
- C. Include in the bid the training of personnel in the operation and maintenance of each furnished variable frequency drive pump control system. Training shall include 2 separate days - 4 hour sessions for 5 designated plant operators, plus 2 separate days - 4 hour sessions for 5 designated plant maintenance staff.

END OF SECTION

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SECTION 16273

50 KILOVOLT-AMPERE AND BELOW LOW VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Single-phase and 3-phase low voltage lighting and power distribution transformers rated 50 kilovolt-ampere and less.

1.02 REFERENCES

- A. American National Standards Institute (ANSI).
- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA TP-1 - Guild for Determining Energy Efficiency for Distribution Transformers.
 - 2. NEMA TP-2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.
 - 3. NEMA TP-3 - Standard for Labeling of Distribution Transformer Efficiency.
- C. The California Code of Regulations:
 - 1. Title 24, Part 6 - Building Standards.
 - 2. Title 20, Division 2 - Appliance Efficiency Regulations.
- D. Institute of Electrical and Electronic Engineers (IEEE).
- E. National Electrical Code (NEC):
 - 1. Article 450 - Transformers and Transformer Vaults.

1.03 SUBMITTALS

- A. Product Data: Include specifications and ratings.

1.04 WARRANTY

- A. Submit manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Low Voltage Lighting and Power Transformers: One of the following or equal:
 - 1. Cutler-Hammer.
 - 2. General Electric Company.
 - 3. Square D Company.

2.02 DISTRIBUTION TRANSFORMERS - LOW VOLTAGE LIGHTING AND POWER

- A. Premium high efficiency quiet type, with 2 primary winding taps 2-1/2 percent above and below nominal, and copper windings.
- B. Furnish with a BIL of 10 kilovolt with a temperature class of 185 degrees Centigrade for transformers up to 25 kilovolt-ampere and a temperature class of 220 degrees Centigrade for transformers rated at 30 kilovolt-ampere and larger.
- C. Noise Level: Sound level shall not exceed 44 dBA measured at 5 feet from transformer after installation.
- D. Rating:
 - 1. 3-phase: As indicated on the Drawings.
 - 2. Single phase: As indicated on the Drawings.
- E. Primary and secondary voltage, phase, and kilovolt-ampere shall be as indicated on the Drawings.
- F. Transformers to be UL listed.
- G. Transformers shall meet State of California Title 24 requirements.

2.03 SOURCE QUALITY CONTROL

- A. Core and coil assemblies shall conform to ANSI Standard C89.2 sound rating.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer printed instructions and approved shop drawings.
- B. Provide adequate anchors for floor applications.
- C. Provide adequate support racks for transformers install above ground and submit data for the supports.
- D. Provide flexible conduit for termination of wiring on both sides of the transformers.

END OF SECTION

SECTION 16412
LOW VOLTAGE CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Low voltage circuit breakers as indicated on the Drawings and as specified.

1.02 REFERENCES

- A. National Electrical Manufacturers Association (NEMA): Standards Publication No. AB1.
- B. National Electrical Code (NEC): Article 430-52.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Circuit Breakers: Manufacturers: One of the following or equal:
 1. Cutler-Hammer.
 2. General Electric Company.
 3. Siemens.
 4. Schneider Electric / Square D.
 5. Match the manufacturer brand in existing panelboards.

2.02 CIRCUIT BREAKERS - LOW VOLTAGE

- A. Circuit Breaker Frame and Trip Ratings: As indicated on the Drawings and coordinated with the ratings of the equipment actually furnished. Modify ratings where necessary to suit this equipment and in accordance with the short circuit fault analysis and protective device coordination study.
- B. Circuit Breakers for Motor Control Centers: As specified and indicated on the Drawings. Where no indication of type is given on the Drawings, the following governs:
 1. When an integral part of a UL-listed combination controller: Motor circuit protectors.
 2. All other circuit breakers: Molded case circuit breakers.
- C. Provide motor circuit protectors and circuit breakers with non-aluminum line and load terminals suitable for the required conductor type, size, and number of conductors.
- D. Panelboard Circuit Breakers: Bolt-in type. Snap-in circuit breakers are not acceptable.

2.03 MOLDED-CASE CIRCUIT BREAKERS

- A. Molded-Case Circuit Breakers: Ambient compensating which provides inverse time delay overload and instantaneous short circuit protection by means of a thermal magnetic element. Accomplish compensation by a secondary bimetal that will allow the breaker to carry rated current between 25 degrees Centigrade and 50 degrees Centigrade with tripping characteristics which are approximately the same throughout this temperature range.
- B. Circuit Breaker Ratings and Modifications: As indicated on the Drawings.
- C. MCC Main Circuit Breaker shall be manually operated circuit breaker with electronic trip unit including adjustable longtime current setting, adjustable long time delay, adjustable short time pick-up, adjustable short time delay and frame size as indicated on the Drawings.
- D. On Breakers with Interchangeable, Thermal, Adjustable Magnetic Trip: The accessibility and position of the adjustment knob shall not be changed from those on the standard breaker.
- E. Circuit Breakers for Mounting in Motor Control Centers or for Separate Mounting: Air-break type, quick-make and quick-break, 600 volt, with number of poles as indicated on the Drawings. Minimum Frame Size: 100 amperes.
 - 1. Provide each breaker pole with inverse time delay and instantaneous circuit protection.
- F. Breakers: Operated by a handle and provided with a quick-make, quick-break switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents.
 - 1. Tripping Due to Overload, Short Circuit, or Ground Fault: Clearly indicate tripping by the handle automatically assuming a position between the manual ON and OFF positions.
 - 2. Latch Surfaces: Ground and polished.
 - 3. Poles: Constructed so they all open, close and trip simultaneously.
 - 4. Conform to the applicable requirements of NEMA Standard No. AB1.
- G. Breakers: Completely enclosed in a molded case.
 - 1. Non-Interchangeable Trip Breakers: Sealed covers.
 - 2. Interchangeable Trip Breakers: Sealed trip unit to prevent tampering.
 - 3. Ampere Ratings: Clearly visible.
 - 4. Contacts: Non-welding silver alloy.
 - 5. Arc Extinction: Accomplished by means of arc chutes.
- H. Minimum Interrupting Ratings: At least equal to the available short circuit at the line terminals as determined by the CONTRACTOR's short circuit fault analysis and as accepted by the ENGINEER, but not less than 65,000 RMS amperes.

2.04 MOTOR CIRCUIT PROTECTORS

- A. Motor Circuits: Protected by motor circuit protectors, as permitted by Item I below.

- B. Motor Circuit Protectors: Operated by a handle and provided with a quick-make, quick-break switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits.
 - 1. Tripping: Clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions.
 - 2. Latch Surfaces: Ground and polished.
 - 3. Poles: Constructed so they all open, close, and trip simultaneously.
- C. Motor Circuit Protectors: Completely enclosed in a molded case.
 - 1. Trip Unit: Sealed to prevent tampering.
 - 2. Ampere Ratings: Clearly visible.
 - 3. Contacts: Non-welding silver alloy.
 - 4. Arc Extinction: Accomplished by means of arc chutes.
- D. Provide each pole of motor circuit protectors with instantaneous short circuit protection by means of a single adjustable magnetic only element. The single adjustment screw is to adjust all poles simultaneously.
- E. Furnish motor circuit protectors with provision for locking the maximum achievable trip setting to values less than maximum obtainable trip setting. Each adjustment typically to have 8 main setting points and mid-setting points following a linear scale so that each point has a significant value within calibration tolerances.
- F. Motor Circuit Protectors: Suitable for use with current limiters, having 100,000 ampere interrupting capacity and a built-in trip indicator, that are fully coordinated with the motor circuit protectors so that the motor circuit protectors will open all 3 phases if the limiter operates.
 - 1. Current limiters shall be so constructed that they can only be replaced by an identical or similar limiter having the same interrupting capacity.
- G. Minimum Interrupting Rating: At least equal to the available short circuit current at the line terminals as determined by the CONTRACTOR's short circuit fault analysis, but not less than 65,000 RMS amperes.
- H. Motor Circuit Protectors Continuous Current Rating: As specified herein or as indicated on the Drawings.
 - 1. Setting: The motor circuit protectors setting shall be in accordance with the CONTRACTOR's protective device coordination study as accepted by the ENGINEER and in accordance with the motor circuit protectors manufacturer's recommendation based on motor nameplate current .
- I. Utilize an instantaneous trip circuit breaker or motor circuit protector only as part of a listed combination motor controller which provides coordinated motor branch-circuit overload, and short-circuit and ground-fault protection in accordance with NEC Article 430-52.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 16414

600 VOLT FUSES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: 600 volt class fuses.

1.02 REFERENCES

- A. Underwriters' Laboratories, Inc. (UL):
 1. I-508 Industrial Control Equipment.
- B. International Electrotechnical Commission (IEC).

1.03 SUBMITTALS

- A. Shop Drawings: Include drawings of spare fuse cabinet(s) and complete list of fuses indicating manufacturer, UL Class, and ampere rating for each location where fuses are to be installed.
- B. Product Data: Include time-current and peak let-through curves for each class of fuse.

1.04 WARRANTY

- A. Submit manufacturer's standard warranty.

1.05 MAINTENANCE

- A. Spare Fuses:
 1. Zero to 2,000 Amperes: 10 percent minimum, but not less than 3 of each size and type installed under any Division of these Specifications.
 2. Over 2,000 Amperes: Minimum 3 of each type and size.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fuses - 600 V and Accessories:
 1. UL Class L Fuses: Manufacturers: One of the following or equal:
 - a. KLPC by Littelfuse.
 - b. KRP-C by Bussmann.
 2. UL Class L 600 V ac/dc Fuses: Manufacturers: One of the following or equal:
 - a. LDC by Littelfuse.
 3. UL Class RK1 Fuses: Manufacturers: One of the following or equal:
 - a. LLN-RK/LLS-R by Littelfuse.
 - b. LPN-RK/LPS-RK by Bussmann.

4. UL Class RK5 Fuses: Manufacturers: One of the following or equal:
 - a. FLNR/FLSR by Littelfuse.
 - b. FRN-R/FRS-R by Bussmann.
5. UL Class J Fuses: Manufacturers: One of the following or equal:
 - a. JTD by Littelfuse.
 - b. LPJ by Bussmann.
6. UL Class T Fuses: Manufacturers: One of the following or equal:
 - a. JLLN/JLLS by Littelfuse.
 - b. JJN/JJS by Bussmann.
7. UL Class CC Fuses: Manufacturers: One of the following or equal:
 - a. CCMR/KLDR by Littelfuse.
 - b. FNQ-R by Bussmann.
8. Fuses for Fluorescent Ballasts: Manufacturers: One of the following or equal:
 - a. LGR by Littelfuse.
 - b. GLR by Bussmann.
9. Fuse-Holders for Fluorescent Ballasts: Manufacturers: One of the following or equal:
 - a. LHR by Littelfuse.
 - b. HLR by Bussmann.
10. Fuse-Holders for HID Fixtures: Manufacturers: One of the following or equal:
 - a. 5710CC/5710CCP by Littelfuse.
 - b. HPF-RR by Bussmann.

2.02 GENERAL

- A. Provide fuses 600 volt and below as indicated on the Drawings and as specified.
- B. Fuses shall have a minimum interrupting rating of 200,000 amperes.
- C. Completely install, connect, and test for insulation integrity distribution, conversion, or utilization equipment requiring fuses, prior to installation of fuses.
- D. Provide fuses bolted in place with "Belleville" washers between each bolt head or nut, or fuse blade.
- E. Affix a label indicating recommended torque for fuse mounting bolts or studs to the inside of fuse access doors.
- F. Provide durable, readily visible label inside each fuse enclosure, clearly indicating the correct type and size of replacement fuse. Label shall not cover or interfere with equipment manufacturer's instructions.
- G. Provide UL Class and type fuses as indicated on the Drawings and as specified. The specifications are non-proprietary, but not generic. Fuse classes shall conform to the detailed requirements of these Specifications.
- H. To Assure Selective Coordination of Protective Devices:
 1. Provide fuses for new facilities by the same manufacturer.
 2. Provide fuses for renovations of the same manufacturer as existing fuses. When modifying or expanding existing facilities, remove existing one-time and renewable cartridge fuses with 10,000 ampere interrupting ratings and replace with dual-element RK5 fuses as specified.

2.03 FUSING OF CONTROL CIRCUITS

- A. Utilize UL listed branch-circuit fuses for required control circuit protection. Provide RK1 fuses as specified, or time-delay Class CC fuses installed in UL listed Class CC fuse blocks.
- B. Provide minimum protection for control circuits in accordance with the latest revision of UL Standard 508 for Industrial Control.
- C. Control Power Transformers: Fuse primary circuit of control power transformers. Provide fuse ratings in accordance with NEC requirements. Provide RK1 fuses or time-delay UL listed Class CC fuses installed in UL listed Class CC fuse blocks.

2.04 FUSING FOR FLUORESCENT AND H.I.D. LIGHTING FIXTURE BALLASTS

- A. Individually fuse 300 volts and below fluorescent fixture ballasts. Electronic ballasts containing both internal fusing and Class P thermal protection are not required to have external fusing.
- B. Fuse other ballasts in accordance with fixture or ballast manufacturer's recommendations. Mount fuse-holders in ballast wiring channel. Fuse-holders and fuses may be Littelfuse LHR with LGR fuses or Bussmann HLR with GLR fuses.
- C. Individually fuse HID lighting fixture ballasts and discharge lighting fixtures over 300 volts with fuses rated in accordance with fixture manufacturer's recommendations.
- D. Locate fuse-holders on ballast or fixture housing, accessible from outside of fixture. Provide UL Class CC fuses.

2.05 FUSES FOR METERING CENTERS, LOAD CENTERS, AND FOR BACKUP PROTECTION OF CIRCUIT BREAKERS

- A. Provide RK1, Class J or Class L fuses as specified, or UL listed Class T fuses.
- B. Littelfuse JLLN and JLLS Series, or Bussmann JJN and JJS Series. Fuse ampere ratings shall not exceed maximum recommended by equipment manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Evenly torque mounting bolts and nuts to ASTM recommendations for type and diameter of mounting bolts or studs provided. Affix a label to the inside of fuse access doors indicating recommended torque for fuse mounting bolts or studs.

3.02 INITIAL START-UP AND SPARE FUSES

- A. Replace fuses opened during start-up and testing. At Contract completion, each fuse-holder shall contain serviceable fuses as specified.

- B. After completion of testing, deliver spare fuses in quantities specified. Fuses shall be new, in manufacturer's original packaging, and stored in a clean, dry location.

3.03 DEMONSTRATION

- A. Demonstrate equipment in accordance with Articles 2.02, 2.08, 3.01, and 3.02.

3.04 PROTECTION

- A. Protect products until acceptance by OWNER.

END OF SECTION

SECTION 16416
TRANSIENT VOLTAGE SURGE SUPPRESSORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Transient voltage surge suppressors (TVSS) for use on 480 and 208 volt, alternating current systems, including motor control center mounted applications, and power distribution switchboard and panel applications.

1.02 REFERENCES

- A. Underwriters' Laboratories, Inc. (UL):
 - 1. 1449 - High Performance Suppression System.
 - 2. 1283 - High Frequency Extended Range Power Filter.
- B. American National Standards Institute (ANSI):
 - 1. C62.41 - Category C3 (Service Entrance).
 - 2. C62.45 - Category C Surge.

1.03 SUBMITTALS

- A. Shop Drawings: Include component layout and wiring terminations.
- B. Product data.
- C. Manufacturer's installation instructions.
- D. Operating and maintenance data.
- E. Warranties.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of transient voltage surge suppressor systems for minimum 5 years with satisfactory performance record.
- B. Regulatory Requirements: UL rating of Transient voltage surge suppressor shall meet or exceed UL rating of panelboard, motor control center, or other equipment in which suppressor is installed. UL rating of equipment in which suppressor is installed shall not be affected by suppressor.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate with and furnish suppressors to motor control center, switchgear switchboard, and distribution panel manufacturer prior to shipment of equipment to site.

PART 2 PRODUCTS

2.01 TRANSIENT VOLTAGE SURGE SUPPRESSORS

- A. Ratings: 277/480 volt grounded wye and 120/208 volt grounded wye.
- B. Manufacturers: One of the following or equal:
 1. Current Technology, TransGuard Model for motor control center installation or Series TG300 for external mounting.
 2. Transtector, equivalent product.
 3. Advanced Protection Technologies, equivalent product.
 4. If furnished integral with MCC, switchboard or panelboard, the manufacturer of the TVSS unit can be the same as the equipment in which it is installed.
- C. Components:
 1. 30 ampere circuit breaker and disconnect
 2. Status indicating pilot lights.
 3. Two dry contacts for remote status annunciation.
 4. NEMA 12 enclosure or stab-in housing compatible with motor control center or mounted integral in distribution panel.
- D. Characteristics:
 1. Single Pulse Surge Current Capacity per Phase: 600,000 amperes.
 2. Capacity Per Protection Modes:
 - a. L-N Mode: 300,000 amperes.
 - b. L-G Mode: 300,000 amperes.
 - c. N-G Mode: 300,000 amperes.
 - d. L-L Mode: 300,000 amperes.
 3. Surge Life Cycle: 1.2 by 50 micro-seconds 20 kilovolt open circuit voltage, 8/20 micro-second waveform 10 kiloamperes short circuit current Category C3 Bi-wave in accordance with ANSI C62.41 and C62.45.
 4. Suppression and Filter Technology: Manufacturer's standard.
 5. Continuous Operating Voltage: Minimum 115 percent of nominal.
 6. Suppression Voltage In Protective Modes: As follows when tested in accordance with UL 1449:
 - a. For 480 volt systems:
 - 1) L-N: 800.
 - 2) L-G: 800.
 - 3) N-G: 800.
 - 4) L-L: 2000.
 - b. For 208 volt systems:
 - 1) L-N: 500.
 - 2) L-G: 500.
 - 3) N-G: 400.
 7. EMI/RFI High Frequency Noise Power Filter:

Frequency	100 KHz	1 MHz	10 MHz	100 MHz
Attenuation (dB)	34	51	54	48
Attenuation Ratio	50:1	350:1	500:1	250:1
 8. Minimum American Wire Gauge Copper in Surge or Noise Suppression Path: Number 6.
 9. Field Replaceable Fusing: Current limiting, protecting each pole.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install suppressors in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 16422

MOTOR CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Manual starters, magnetic contactors, overload relays, combination starters and related motor controllers.

1.02 REFERENCES

- A. National Electrical Code (NEC):
 - 1. Article 430 - Motors, Motor Circuits and Controllers.
- B. National Electrical Manufacturers Association (NEMA).

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manual Motor Starters: One of the following:
 - 1. Cutler Hammer
 - 2. General Electric
 - 3. Schneider / Square D Company.
 - 4. Siemens
- B. Full Voltage Magnetic Starters: One of the following:
 - 1. Cutler Hammer
 - 2. General Electric
 - 3. Siemens
 - 4. Schneider / Square D Company.

2.02 STARTERS

- A. Suitable for the horsepower ratings specified, and in accordance with NEC Article 430.
- B. Verify motor ratings and coordinate starter and overload trip ratings with actual horsepower and nameplate current ratings of motors installed.
- C. Magnetic Contactors: Factory adjusted and chatter free.
- D. Overload Relays: Install bimetallic type overload relays in each line conductor as indicated on the Drawings. Provide contacts for remote monitoring of overload status as indicated on the Drawings.

- E. Mount extended overload reset buttons to be accessible for operation without opening door of enclosure. Plastic overload relay reset buttons with plastic operator shafts are unacceptable.
- F. Provide starters Size 2 and larger with arc quenchers on load breaking contacts.
- G. Minimum Size Starter: NEMA Size 1, and not smaller than size indicated on the Drawings.
- H. Provide starters of sufficient size to accommodate motors furnished, including larger starters required for larger motors supplied by CONTRACTOR.
- I. Combination Starters: Furnish complete with a 120 volt control transformer unless otherwise noted.
- J. Control Fuses: Size and furnish as required and where indicated in the schematics.

2.03 MANUAL MOTOR STARTERS

- A. Across-the-line manual motor starters for motors up to 1 horsepower, 600 volts shall have the electrical characteristics indicated on the Drawings.
- B. Provide single-pole or 3 pole as indicated on the Drawings with overload devices.
- C. Provide handles that clearly indicate the ON, OFF with lockout, and TRIPPED positions, pilot light, and positive, quick-make, quick-break mechanisms.
- D. Provide enclosures as indicated on the Drawings. Where not indicated, provide NEMA 12 enclosures for indoor location and NEMA 4X enclosures for outdoor locations. Provide enclosures compatible with type of conduit system being used for each specific application.

2.04 FULL VOLTAGE MAGNETIC STARTERS

- A. Across-the-line full voltage magnetic starters for up to 600 volts shall have electrical characteristics indicated on the Drawings.
- B. Provide positive, quick-make, quick-break mechanisms; padlockable enclosure doors; 3 overload relays with plus or minus 15 percent adjustment from nominal heater rating on the overload relay; cover mounted reset button, and at least 3 reversible contacts in addition to hold-in contact.
- C. Provide magnetic starter enclosures as indicated on the Drawings. Where not indicated, provide NEMA 12 enclosures for indoor locations and NEMA 4X enclosures for outdoor locations. Provide enclosures compatible with type of conduit being used for each specific application.
- D. Provide magnetic starters in accordance with latest NEMA Standards.

PART 3 EXECUTION

3.01 APPLICATION

- A. Supply circuit breaker trip elements and starter overload trip elements to meet above normal ambient temperatures where such conditions are anticipated (subject to ENGINEER's acceptance).

3.02 DEMONSTRATION

- A. Demonstrate operation of equipment and provide training of Owner Operations and Maintenance Personnel

3.03 PROTECTION

- A. Protect products until acceptance by OWNER.

END OF SECTION

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SECTION 16448

PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Dead-front panelboards, including lighting distribution and control panelboards.

1.02 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
- B. Underwriters' Laboratories, Inc. (UL):
 - 1. UL 67 - Panelboards.

1.03 PERFORMANCE REQUIREMENTS

- A. Minimum Interrupting Capacity of Device: Equal to available short circuit current at line terminals as determined by CONTRACTOR's short circuit fault analysis as accepted by ENGINEER, but not less than 65,000 amperes for 480 volt panel boards and 10,000 amperes for 208 volt panelboards.
- B. Provide main bus rating of panelboards, number of poles, and provisions for number of circuits as indicated on the Drawings.

1.04 SUBMITTALS

- A. Product Data: Include manufacturer's specifications and description.
- B. Shop Drawings: Include panelboard layout.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Panelboards: One of the following or equal:
 - 1. Cutler-Hammer.
 - 2. Square D Company.
 - 3. General Electric Company.
 - 4. Siemens

2.02 INTERIOR

- A. Bus: Size main bus bars in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50 degrees Centigrade above specified ambient maximum.

1. No plating, except at joints.
- B. Install protective devices such that they can be replaced without disturbing adjacent units. Wire connectors shall be suitable for wire sizes indicated on the Drawings.
- C. Number branch circuits and spares as indicated on the Drawings and furnish complete typed circuit schedule in directory cardholder affixed to panel under a transparent cover.
- D. Phase busing shall be full size and height without reduction. Include full size neutral bars with suitable lugs for the maximum number of circuits which can be connected to the panel.
- E. Spares and spaces for future protective devices in panels indicated on the Drawings shall be bussed for panel rating or the main circuit breaker rating.
- F. Provide panels with tin-plated copper ground bus separate from neutral bars. Ground bus to have suitable lug for each circuit breaker installed including future circuits.

2.03 ENCLOSURES

- A. Size panelboards sufficiently to provide minimum 4 inches of gutter space on all sides. Doors shall be such that:
 1. Live parts shall not be exposed when circuit breakers or switches are put in service.
 2. Hinges and latches shall not require tools to operate.
- B. Furnish lock and minimum 2 keys each panelboard. Key all panelboard locks alike.
- C. Enclosure type as indicated on the Drawings. Where not indicated on the Drawings:
 1. Indoor Enclosures: NEMA 12, or NEMA 3R as indicated on the drawings.
 2. Outdoor Enclosures: NEMA 4X.
- D. Mounting shall be as indicated on the Drawings.
- E. Finish stand alone panelboards with a primer, rust-resistant phosphate undercoat and 2 coats of oven-baked enamel with finish color ANSI 61 gray or a color to be selected by the ENGINEER.
- F. Finish motor control center mounted panelboards to match the MCC finish and color, unless directed otherwise.

2.04 TRANSIENT VOLTAGE SURGE SUPPRESSORS

- A. Provide transient voltage protectors in accordance with characteristics specified in section 16416.

2.05 CIRCUIT BREAKERS

- A. Circuit Breakers: As specified in Section 16412.

2.06 IDENTIFICATION

- A. Label panelboards to indicate use as service entrance equipment where indicated on the Drawings or specified.
- B. Label panelboards with UL short circuit current rating.
- C. Provide each panelboard which is not an integral part of a motor control center with a lamicoid nameplate on outside of door, as specified in Section 16075, Electrical Identification.

PART 3 EXECUTION

3.01 INSTALLATION

- A. As indicated on the Drawings, or as required, in a workmanlike manner.

3.02 FIELD QUALITY CONTROL

- A. Test main circuit breaker(s) as specified in Section 16950.

END OF SECTION

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SECTION 16500

LIGHTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Lighting fixtures, lamps, ballasts, poles, and accessories.

1.02 REFERENCES

- A. Underwriters' Laboratories, Inc. (UL):
 - 1. UL 1029 - High-Intensity Discharge Lamp Ballasts.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, beam lumens.
 - 2. Submit pole and wind-load design calculations before fixtures and poles are manufactured.
 - 3. Lighting control system product data and wiring diagrams specific for each lighting control system.
 - 4. Lighting control system operation and maintenance manuals.
- B. Samples: Include finish Sample for lighting fixtures and poles.
- C. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Lighting Fixtures: As noted on Lighting Fixture Schedule.
- B. Lamps: One of the following or equal:
 - 1. General Electric Company.
 - 2. GTE Sylvania Lighting.
 - 3. Philips Lighting Company.
- C. Ballasts for Fluorescent Lamps: One of the following or equal:
 - 1. Advance.
 - 2. Universal.
 - 3. GTE Sylvania Lighting.
- D. Ballasts, HID Lamps: One of the following or equal:
 - 1. Advance.
 - 2. Holophane.

3. GTE's Sylvania Lighting.

E. Plugs and Receptacles: As specified in Section 16140.

2.02 FIXTURES

- A. Lighting Fixtures: As described in Lighting Fixture Schedule, as specified, and as indicated on the Drawings.
 1. Fixtures shall include lamps, ballasts, poles, mounting hardware, and appurtenances to provide complete operating units.
- B. HID Lamps:
 1. Metal Halide Lamps shall be of the pulse start type.
- C. Fluorescent Lamps:
 1. Rapid start type.
 2. T8 type, 32W; 2900 lumens.

2.03 BALLASTS

- A. General:
 1. Energy saving type suitable for use with energy saving lamps.
 2. High power factor type, with power factor not less than 90 percent.
 3. Cold weather (low temperature) rated for outdoor use.
 4. Internally fused ballast.
- B. Ballasts for Fluorescent Lamps:
 1. Bear CBM and ETL labels certifying that ballasts meet pertinent requirements.
 - a. Electronic ballasts for T8 32W.
 - b. Energy saving ballasts for T12 40W lamps.
 2. Contain a built-in thermal protector to disconnect ballast permanently prior to failure, or be fused.
 3. High efficiency and constant wattage type.
 4. Of 2 windings where required by applicable codes.
 5. Use dimming ballasts with dimmer controlled fluorescent fixtures where indicated on the Drawings.
 6. Rated for location of installation.
- C. Ballasts for High Intensity Discharge Lamps:
 1. Meet requirements of UL 1029.
 2. The ballast for metal halide lamps shall include the igniter necessary for the lamp.
 3. Copper windings.
 4. Be internally fused.

2.04 POLES

- A. Design for wind design criteria as specified in Section 01614.
- B. Anchor Bolts, Washers, and Nuts: Stainless steel.

2.05 LIGHTING CONTACTORS

- A. Silver-cadmium-oxide, double-break contacts.
- B. 20 ampere rating for lighting circuits.
- C. Mechanically held.
- D. Number of poles as indicated on the Drawings with a minimum of 2 poles and a maximum of 12 poles for each contactor provided.
- E. Manufacturers: One of the following or equal:
 1. Square D Company, Type LX.
 2. ASCO, Model 917.

2.06 LIGHTING CONTROL SYSTEM

- A. Provide lighting control systems as indicated on the drawings.
- B. Manufacturers:
 1. Douglas Lighting Controls, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Surface and Flush Mounted Fixtures: Solidly connected to a junction box.
- B. Suspended Fixtures: Hung utilizing pendant mounting or stainless steel chains and hooks. Electrically connect each fixture, or row of fixtures, by a length of Type SO flexible cord, 3 conductor Number 14 American Wire Gauge minimum, with a twist-lock plug to a twist-lock receptacle mounted in an individual junction box by conduit as specified elsewhere herein.
- C. Pole Mounted Fixtures: Mount on steel, aluminum, or fiberglass poles as described in Lighting Fixture Schedule and as indicated on the Drawings.
 1. Ground or bond metal poles to the plant grounding system.
 2. Poles shall have adequate handholes in accordance with NEC requirements.
 3. Poles shall have weatherproof switches, receptacles, photo cells where indicated on the Drawings.

3.02 LIGHTING FIXTURE SCHEDULE

- A. As indicated on the Drawings.

3.03 PROTECTION

- A. Protect products until accepted by OWNER.

3.04 LIGHTING CONTROL SYSTEM TESTING

- A. Site Test: After the system is completely installed, perform all tests recommended

by the manufacturers.

3.05 LIGHTING CONTROL SYSTEM TRAINING

- A. Provide manufacturer-trained personnel.
- B. Provide a minimum of 4 hours total operator and management training time. Training shall include system operation and database management.
- C. Provide a minimum of 4 hours total technical maintenance training time.

END OF SECTION

SECTION 16950

ELECTRICAL TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Acceptance testing of electrical system, wiring, equipment, and grounding.

1.02 REFERENCES

- A. National Electrical Testing Association (NETA):
 - 1. ATS-2009: Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems.
- B. ANSI: Test Procedures for Electrical Equipment.
- C. ASTM: American Society for Testing and Materials.
- D. ANSI/IEEE: Recommended Practices for Testing: Machinery, Ground Impedance, Cables and Terminations.

1.03 SUBMITTALS

- A. Pre-Test Submittals:
 - 1. Testing service qualifications.
 - 2. Test personnel qualifications (resumes).
 - 3. Equipment testing schedule.
 - 4. Test data forms, custom edited for difference types of electrical equipment.
- B. Post-Test Submittals: Summary Test Report consists of the following:
 - 1. Summary of testing for the project.
 - 2. Description of the equipment tested.
 - 3. Description of the test and test procedures.
 - 4. Test results for each apparatus and motorized equipment.
 - 5. Conclusions and recommendations.
 - 6. Completed test forms, including witness's signatures.
 - 7. List of test equipment and calibration documents.
 - 8. Date and time.
 - 9. A copy of this specification section with each paragraph check marked indicating compliance or marked with explicit deviations.
- C. Submit Equipment Testing Schedule no later than 7 days prior to scheduled date of testing.
- D. Project Record Documents: Note or indicate wiring deviations from Contract Documents on Project Record Documents.

1.04 QUALITY ASSURANCE

1. Prequalified Testing Services:
 - a. Provide the services of certified electricians to perform testing of conductor insulation.
 - b. Provide adequate test instruments for testing of conductors insulation.
 - c. Submit certification data and experience of personnel for required testing.
2. Testing service or testing personnel may be accepted or rejected based upon, but not limited to, the testing equipment intended to be used, the qualifications of the firm, and personnel.

B. Test Equipment Traceability:

1. Testing firm shall have a calibration program to maintain test instrumentation and equipment within rated accuracy, including stickers with calibration dates record.
2. Equipment and instruments used to evaluate electrical performance shall be calibrated to a standard traceable to the National Institute of Standards and Technology.
3. Test equipment operating instructions and procedures shall be with the test equipment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 SAFETY AND PRECAUTIONS

- A. Testing firm shall perform tests following a safe practice in accordance with OSHA and accident prevention procedures by National Safety Council and applicable codes.
- B. Tests shall be performed with apparatus de-energized, except as necessary for equipment performance and functional test.

3.02 EXAMINATION

- A. Verify that electrical work is free from improper grounds, short circuits, and overloads.
- B. Verify correctness of wiring first by visual comparison of the conductor connections with connection diagrams.
- C. Make individual circuit continuity checks by using electrical circuit testers.
- D. Verify correctness of wiring by actual electrical operation of electrical and mechanical devices in both manual and automatic modes of operation.

3.03 VERIFICATION OF EQUIPMENT RATINGS

- A. Prior to perform acceptance testing, the testing personnel shall inspect and verify adequate short circuit rating of electrical equipment.

3.04 ACCEPTANCE TESTING

- A. General Requirements:
 1. Perform testing and allow OWNER and ENGINEER to witness testing.
 2. Perform tests to assure that electrical equipment will operate within industry and manufacturer's published tolerances, and will perform safely. Record test result data, to be used as a baseline for future tests.
 3. Test motorized equipment to verify conformance with the Contract Documents and for acceptance.
 4. Equipment for which acceptable test data has not been submitted, or has been submitted but rejected, shall be deemed as not meeting Contract requirements.
- B. Equipment and Materials Inspection and Test Procedures. Complete test reports for each individual piece of equipment and systems:
 1. Panelboard Assemblies (Low Voltage):
 - a. Visual and Mechanical Inspection:
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical, electrical, and mechanical condition.
 - 3) Confirm correct application of manufacturer's recommended lubricants.
 - 4) Verify appropriate anchorage, required area clearances, physical damage, and correct alignment.
 - 5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.
 - 6) Confirm correct operation and sequencing of electrical and mechanical interlock systems.
 - a) Attempt closure on locked-open devices. Attempt to open locked-closed devices.
 - b) Make key exchange with devices operated in off-normal positions.
 - 7) Clean panelboard.
 - b. Electrical Tests:
 - 1) Perform ground-resistance tests.
 - 2) Perform resistance tests through ball bus joints with a low-resistance ohmmeter.
 - 3)
 2. Metering :
 - a. Visual and Mechanical Inspection
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Verify tightness of electrical connections.
 3. Motor Starters: Low Voltage:
 - a. Visual and Mechanical Inspection:

- 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
- b. Electrical Tests:
 - 1) Insulation Tests:
 - a) Measure insulation-resistance of each combination starter, phase-to-phase and phase-to-ground, with the starter contacts closed and the protective device open.
 - b) Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.
 - c. Test Values:
 - 1) Bolt-torque levels shall be in accordance with data specified by manufacturer.
 - 2) Insulation-resistance values.
 - 3) Overload trip times shall be in accordance with manufacturer's published data.
4. Circuit Breakers: Low-Voltage Molded Case - 100 Amp or Larger Only:
 - a. Visual and Mechanical Inspection:
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect circuit breaker for correct mounting.
 - 3) Operate circuit breaker to insure smooth operation.
 - 4) Inspect case for cracks or other defects.
 - 5) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - b. Electrical Tests:
 - 1) Perform an insulation-resistance test at 1,000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
 - 2) Perform adjustments for the final settings in accordance with the coordination study.
 - 3) Perform long-time delay time-current characteristics tests by passing 300 percent through each pole separately unless series testing is required to defeat ground fault functions.
 - 4) Determine short-time pickup and delay by primary current injection.
 - 5) Determine ground-fault pickup and time delay by primary current injection.
 - 6) Determine instantaneous pickup current by primary injection using run-up or pulse method.
 - 7) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.
 - c. Test Values:
 - 1) Bolt-torque levels shall be in accordance with data specified by manufacturer.

- 2) Compare microhm or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than 25 percent. Investigate any value exceeding manufacturer's recommendations.
- 3) Insulation resistance shall not be less than 100 megohms.
- 4) Trip characteristics of breakers shall fall within manufacturer's published time-current tolerance bands, including adjustment factors.

5. Rotating Machinery: AC Motors:

- a. Visual and Mechanical Inspection:
 - 1) Compare equipment nameplate and data with Drawings and Specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Inspect for correct anchorage, mounting, grounding, connection, and lubrication.
 - 4) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - 5) When applicable, perform special tests such as air gap spacing and pedestal alignment.
 - 6) Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.
- b. Electrical Tests: Induction Motors:
 - 1) Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43.
 - a) Motors larger than 200 horsepower: Test duration shall be for ten minutes. Calculate polarization index.
 - b) Motors 200 horsepower and less: Test duration shall be for one minute. Calculate the dielectric-absorption ratio.
 - 2) Test motor starter in accordance with Section 7.16 of these specifications.
 - 3) Verify that resistance temperature detector (RTD) circuits conform to drawings. Verify that metering or relaying devices using the RTD's have the correct rating.
 - 4) Verify that the motor space heater is functional.
 - 5) Perform a rotation test to insure correct shaft direction.
 - 6) Measure running current and evaluate relative to load conditions and nameplate full-load amperes.

6. Low-Voltage Surge Protection Devices (TVSS):

- a. Visual and Mechanical Inspection:
 - 1) Compare equipment nameplate and data with drawings and specifications.
 - 2) Inspect physical and mechanical condition.
 - 3) Inspect for correct mounting and adequate clearances.
 - 4) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - 5) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

7. Dry Type Transformers:

- a. Air-Cooled, 600 Volt and Below (50 kVA Single-Phase, 50 kVA Three-Phase and Smaller):
 - 1) Compare equipment nameplate and data with the Drawings and Specifications.

- 2) Inspect physical and mechanical condition.
- 3) Verify that resilient mounts are free and that any shipping brackets have been removed.
- 4) Perform insulation-resistance test. Calculate polarization index. Measurements shall be made from winding-to-winding and each winding-to-ground. Test voltages and minimum resistance.
- 5) Verify that winding turns-ratio measurements and polarities are in accordance with nameplate.
- 6) Verify that as-left tap connections are as specified.

8. Grounding Systems:

- a. Visual and Mechanical Inspection
 - 1) Verify ground system is in compliance with drawings and specifications.
- b. Electrical Tests:
 - 1) Perform fall-of-potential test or alternative in accordance with IEEE Standard 81-1991 on the main grounding electrode or system.
 - 2) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
- c. Test Values:
 - 1) The resistance between the main grounding electrode and ground should be no greater than five ohms for commercial or industrial systems and one ohm or less for generating grounds unless otherwise specified.
 - 2) Investigate point-to-point resistance values which exceed 0.5 ohm.

9. Low-Voltage Cables: 600 Volt:

- a. Visual and Mechanical Inspection:
 - 1) Compare cable data with drawings and specifications.
 - 2) Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.
 - 3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - 4) Inspect compression-applied connectors for correct cable match and indentation.
 - 5) Verify cable color coding with applicable engineer's specifications and National Electrical Code standards.
- b. Electrical Tests:
- c. Perform an insulation resistance test on all cables.

10. Lighting System Controllers:

- a. Perform lighting system controller function tests upon completion of equipments, to prove correct interaction of switches, controllers, and photocells.

3.05 SUMMARY TEST REPORT

A. Upon completion of testing of all electrical equipment, submit summary test report.

END OF SECTION

SECTION 16951
ELECTRICAL FUNCTIONAL TESTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Electrical equipment and system testing requirements for the complete facility, including the following:
 1. Testing Plans.
 2. Operational Testing.

1.02 SUBMITTALS - START-UP PLAN

- A. Provide functional testing plans and procedures for all project equipment and systems and for all modes of operation. Functional testing procedures shall be in the cause and effect format. The person conducting the operating test shall initiate an action (cause) and, upon the systems or subsystems producing the required result (effect), the specific test requirement will have been satisfied. A sample form illustrating this concept and which shows the level of detail required in the CONTRACTOR-developed functional testing form is appended to the end of this Section. Only computer-generated functional testing forms shall be submitted; handwritten forms are unacceptable.

1.03 GENERAL TESTING PROCEDURES

- A. Electrical Systems: As specified in Section 16950, Section 17410, and the individual equipment specification sections.
 1. Electrical testing shall be performed in three stages. The first stage shall consist of electrical equipment testing prior to energization and operation of electrical equipment. The following shall be submitted for OWNER and ENGINEER review prior to equipment startup and energization:
 - a. The following completed electrical equipment testing data forms required by Section 16950 (omit thermographic testing):
 - 1) Low-Voltage Cables.
 - 2) Grounding Systems.
 - 3) Rotating Machinery: AC Motors.Unsatisfactory equipment test results shall require that the equipment be repaired and re-tested until acceptable results are obtained at no additional cost to the OWNER.
 2. The second stage of electrical testing shall occur after energization and start-up of equipment and shall consist of performing the thermographic survey portion of the tests specified in paragraph 1.05 B 1 b as well as complete testing of all other equipment specified in Section 16950. Thermographic survey results shall be submitted in the post-testing submittals as specified in Section 16950. Thermographic survey results which show "hot spots" shall be corrected by the CONTRACTOR and re-surveyed until acceptable results are obtained at no additional cost to the OWNER.

3. The third stage of testing shall involve the completion of functional testing forms which include all possible operating scenarios, alarm conditions, prohibitive interlocks, and indication functions. A sample form showing the level of detail required in the CONTRACTOR-developed functional testing form is appended to the end of this Section. Contractor shall perform a “dry run” for all functional tests to ensure that systems are working properly prior to witnessing by the OWNER. After the “dry run” is successfully completed, CONTRACTOR shall provide minimum 48 hours notice to the OWNER that systems are ready for witnessed functional testing. The OWNER will witness functional testing and will initial all functional testing forms upon successful operation of systems.

B. Instrumentation Systems: As specified in Section 17410 and the individual equipment specification sections:

1. Requirements for field calibration, loop acceptance, and end-to-end acceptance testing are specified in Section 17410.
2. Field calibration, loop acceptance, and end-to-end acceptance testing shall not begin until design submittals required by Section 17410 and CONTRACTOR-prepared drawings required by Section 16075 have been reviewed by the ENGINEER and returned marked as “No Exceptions Noted”.
3. General:
 - a. Bench or field calibrate instruments and make required adjustments and control point settings.
 - b. Energize transmitting and control signal systems, verify proper operation, ranges, and settings.

1.04 FUNCTIONAL TESTING

- A. Functional testing shall not begin until Stages 1 and 2 of Electrical Testing (described in paragraph 1.03 B) have been completed for individual systems or pieces of equipment.
- B. The CONTRACTOR is responsible for functional testing for all project equipment and systems in all modes of operation. This includes remote SCADA modes of operation where the OWNER does software programming and configuration. The OWNER will assist in developing functional procedures only for those testing steps involving operational testing of a remote SCADA functional mode of operation programmed and/or configured by the OWNER. Verifying the required functional testing result for these modes of operation will be a joint effort between the CONTRACTOR and the OWNER. OWNER verification responsibility will only include those required results involving a control action, status, or alarm indication at the remote SCADA.
- C. Functional testing plan shall list the personnel who will be present to assist with and witness the functional test. This list shall include any CONTRACTOR personnel, subcontractors, manufacturer's representatives, OWNER staff, ENGINEER, and any other required personnel.
- D. Functionally test mechanical and electrical equipment for proper operation after general start-up and testing tasks have been completed for individual systems or pieces of equipment. Functional test of mechanical and electrical equipment

required for operation of the plant shall be completed prior to performing the operational test of the entire facility.

- E. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration over the full operating range of equipment and systems. Perform initial checks in the presence of and with the assistance of the manufacturer's representative.
- F. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.
- G. Conduct continuous 8 hour test under full load conditions. If any equipment or system fails the functional test, the CONTRACTOR shall correct the problem and shall repeat the test until it is successful.

1.05 RECORD KEEPING

- A. Maintain and submit following records generated during functional testing:
 1. Daily logs of equipment testing identifying all tests conducted and outcome.
 2. Data sheets of testing.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

SAMPLE FUNCTIONAL TESTING FORM

PROCESS SYSTEM:

PROCESS AREA:

P&ID:

SCHEM DIAG NO.:

EQUIPMENT:

Testing Step	Mode Set-up	Operational Test	Required Result

All Operational Tests Successfully Completed:

Contractor's Initials: _____ Date: _____

Engineer's Initials: _____ Date: _____

END OF SECTION

SECTION 16995

RACEWAY AND WIRING SCHEDULE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. A list of the majority of raceways and conductors to be provided, but it does not list all raceways and conductors necessary for all complete working systems. See additional requirements in Section 16995 and on the Drawings.

1.02 GENERAL PERFORMANCE REQUIREMENTS

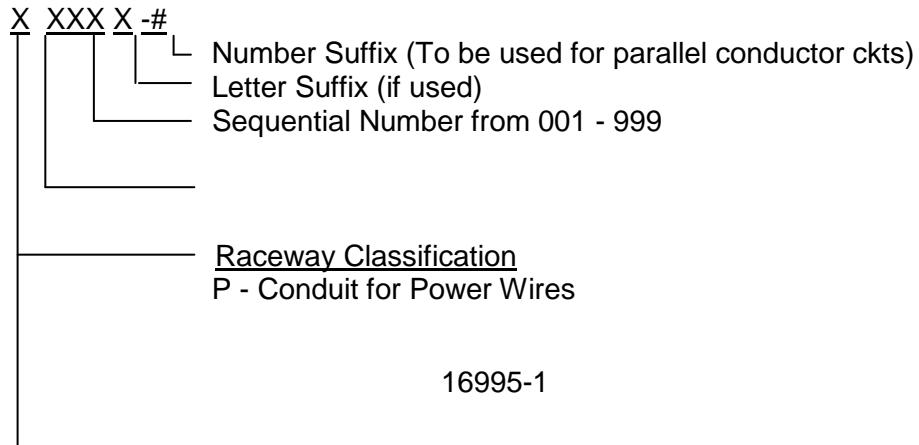
- A. Additional Design Requirements:
 - 1. Provide design services to supplement the attached raceways and wiring schedule with additional field engineering, to design, edit and include all raceways and wiring from different miscellaneous equipment into a complete raceways and wiring schedule.
- B. Additional Raceways and Wiring Schedule Requirements:
 - 1. Provide a supplemental raceway and wiring schedule from any additional requirements of equipment manufacturers or from other divisions of work. The format of the supplemental schedule shall follow the format and text font of the attached schedule. The supplemental schedule shall be created using Microsoft Excel spreadsheet and it shall be submitted as part of as-built documents.

1.03 CONDUCTORS SCHEDULED AND DESCRIPTION

- A. The conductors columns in the schedule do not distinguish requirements between insulation, single conductors and/or multiconductor cables. Nevertheless, the type of conductor shall be properly provided to comply with the adequate material and application specified in Sections 16123.

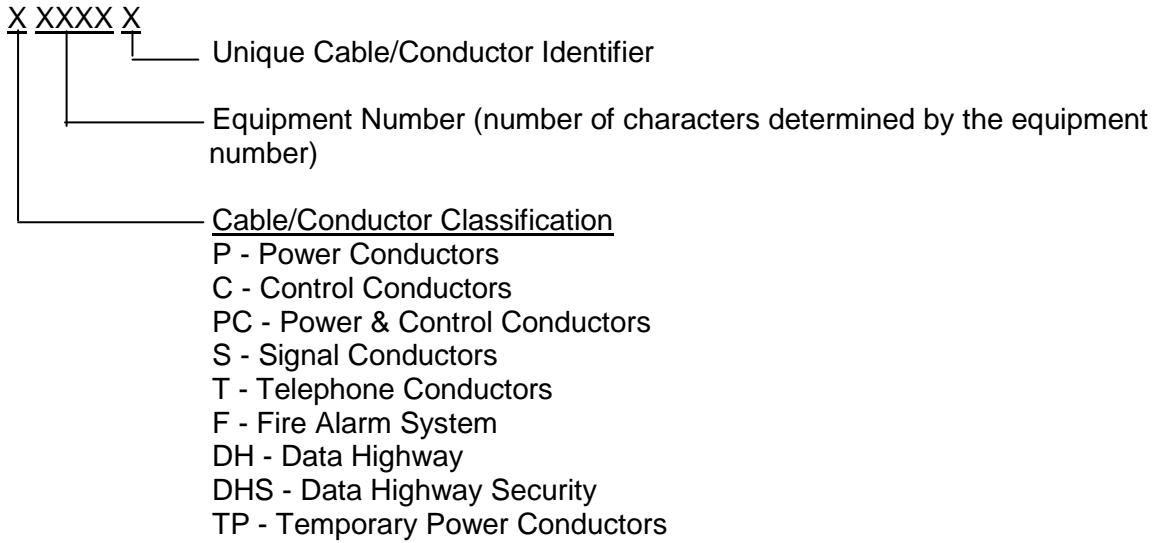
1.04 RACEWAYS AND WIRING SYSTEM NUMBERING

- A. Raceway Numbering: Each raceway shall be identified by a unique number. The number shall be derived as follows:

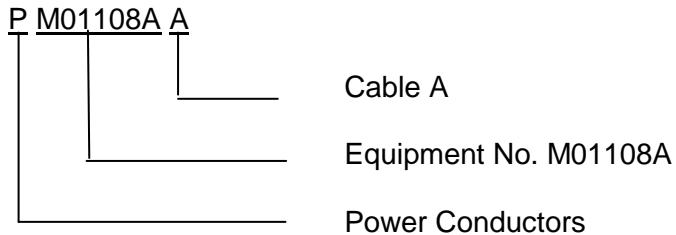


C - Conduit for Control Wires
PC - Conduit for Power & Control Wires
S - Conduit for Signal Wires (Instrumentation)
PE, DHE, SE, CE, etc. - Spare Conduit
T - Telephone Conductors
F - Fire Alarm System
DH - Data Highway
DHS - Data Highway Security System (also used "S")
TP - Temporary Power Conductors

B. Circuit Numbering: Each circuit shall be identified by a unique number and cable/conductors in the circuit shall be marked accordingly. The number shall be derived as follows:



Example:



1.05 SUBMITTALS

- A. As-built documents with revisions plus field additions to Raceways and Wiring Schedules.
- B. Submit copy of the schedule pages pertinent to conductors with field performance and acceptance test.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 VERIFICATION FOR ADEQUACY OF RACEWAYS AND WIRING

- A. Prior to raceway installation, verify that size and type of raceways scheduled are adequate for the application and conductors to be installed and for electrical equipment to be connected.
- B. Prior to conductors installation, verify that size and type of conductors scheduled are adequate for the application.
- C. Conduits and wiring for lighting fixtures, receptacles, and HVAC systems are not included on raceway schedule. Conduits and wiring for security system panels to individual security devices are not included on raceway schedule. However, Contractor shall provide all necessary raceways and wiring in accordance with NEC and requirements indicated on the drawings for a complete working system.

3.02 INSTALLATION

- A. Field Quality Control and Record Keeping
 - 1. Correct conduit and wiring identification discrepancy which become evident during construction.
 - 2. Perform operational testing as specified in section 16950.
 - 3. Verify adequate termination of all conductors.

3.03 RACEWAY AND WIRING SCHEDULES

- A. Not all raceway schedules are in numerical order.
- B. See the following raceway and wiring schedule attached.

END OF SECTION

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CONDUIT SCHEDULE

CLARIFIER 1 & 2 REHABILITATION

CONDUIT			CONDUCTORS			GROUND					
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION		CONNECTING SEGMENTS
P1000	E-05 E-10	3"	3	350	XHHW-2	1	#2	XHHW-2	FR: EXIST MCC-E2 TO: OUTDOOR WALL MOUNTED PULL BOX 3 350 >> POWER TO PANEL DP-4		
P1000A	E-04 E-05 E-09 E-10	3"	3	350	XHHW-2	1	#2	XHHW-2	FR: OUTDOOR WALL MOUNTED PULL BOX TO: PANEL DP-4 3 350 >> VIA EXISTING DUCTBANK INTERCEPT EXIST CONDUIT AND EXTEND TO DP-4		
P1002	E-05 E-09	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: PANEL DP-4 TO: WAS PUMP No.2 STARTER 3 #12 >> POWER TO EXIST STARTER		
P1003A	E-05 E-09	1"	3	#6	XHHW-2	1	#10	XHHW-2	FR: PANEL DP-4 TO: RAS PMP No.2 VFD 3 #6 >> POWER		
PC1003B	E-05 E-09	1"	3 2	#6 #14	XHHW-2 XHHW-2	1	#10	XHHW-2	FR: RAS PMP No.2 VFD TO: RAS PUMP No. 2 3 #6 >> POWER 2 #14 >> MOTOR TEMP SWITCH		
C1003A	E09	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: RAS PMP No.2 VFD TO: EXIST CONTROL TERM CABINET 6 #14 >> CONTROL I/O POINTS		
S1003A	E09	0.75"	2	2/C-#16S	9342	1	#14	XHHW-2	FR: RAS PMP No.2 VFD TO: EXIST CONTROL TERM CABINET 1 2/C-#16S >> SPEED CTL SIGNAL 1 2/C-#16S >> SPEED FEEDBACK SIGNAL		
C1004	E04 E06 E09 E10 E12 N03 N04 N05 N06	3"	36 1	#14 PULL	XHHW-2 ROPE	1	#14	XHHW-2	FR: EXIST CONTROL TERM CABINET OUTDOOR WALL MOUNTED PULL BOX 1 PULL >> NEW MULTICONDUCTOR CABLE 2 #14 >> RAS No 2 -RUN MODE 2 #14 >> RAS No. 2 FAIL 2 #14 >> RAS No. 2 REMOTE MODE 2 #14 >> RAS No. 2 START 2 #14 >> RAS No. 2 STOP 2 #14 >> MOTOR TEMP HIGH 2 #14 >> SCUM PUMP No1 RUN 2 #14 >> SCUM PUMP No 1 FAIL 2 #14 >> SCUM PUMP No2 RUN 2 #14 >> SCUM PUMP No 2 FAIL 2 #14 >> SECONDARY CLARIFIER 1 RUN 2 #14 >> SECONDARY CLARIFIER 1 FAIL 2 #14 >> SECOND CLARIFIER 1 HIGH TORQUE 2 #14 >> SECONDARY CLARIFIER 2 RUN 2 #14 >> SECONDARY CLARIFIER 2 FAIL 2 #14 >> SECOND CLARIFIER 2 HIGH TORQUE 4 #14 >> SPARES VIA EXISTING DUCTBANK		
S1004	E04 E07 E09 E10 E12 N05	3"	3 1	2/C-#16S PULL	9342 ROPE	1	#14	XHHW-2	FR: EXIST CONTROL TERM CABINET TO: EXIST OUTDOOR WALL MOUNTED PULL BOX 1 PULL >> EXIST MULTICONDUCTOR CABLE 1 2/C-#16S >> RAS No 2 -RUN COMMAND 1 2/C-#16S >> RAS No 2 -SPEED INDICATION 1 2/C-#16S >> SPARE NOTE: EXIST SPARE WIRES IN CABLE MAY BE USED IN LIEU OF NEW WIRES HOWEVER, PROVIDE NEW WIRES IF NO AVAILABLE SPARES AND INSTALL VIA EXIST CONDUIT		

CONDUIT SCHEDULE

CLARIFIER 1 & 2 REHABILITATION

CONDUIT			CONDUCTORS			GROUND					
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION		CONNECTING SEGMENTS
C1005	E10 E12 N03 N04 N05 N06	2.5"	36 1	#14 PULL	XHHW-2 ROPE	1	#14	XHHW-2	FR: TO:	OUTDOOR WALL MOUNTED PULL BOX EXIST PLC CABINET SP-1 1 PULL >> NEW MULTICONDUCTOR CABLE 2 #14 >> RAS No 2 -RUN MODE 2 #14 >> RAS No. 2 FAIL 2 #14 >> RAS No. 2 REMOTE MODE 2 #14 >> RAS No. 2 START 2 #14 >> RAS No. 2 STOP 2 #14 >> MOTOR TEMP HIGH 2 #14 >> SCUM PUMP No1 RUN 2 #14 >> SCUM PUMP No1 FAIL 2 #14 >> SCUM PUMP No2 RUN 2 #14 >> SCUM PUMP No2 FAIL 2 #14 >> SECONDARY CLARIFIER 1 RUN 2 #14 >> SECONDARY CLARIFIER 1 FAIL 2 #14 >> SECOND CLARIFIER 1 HIGH TORQUE 2 #14 >> SECOND CLARIFIER 2 RUN 2 #14 >> SECOND CLARIFIER 2 FAIL 2 #14 >> SECOND CLARIFIER 2 HIGH TORQUE 4 #14 >> SPARES VIA NEW CONDUIT	
S1006	E10 E12 N05	2"	3 1	2/C/#16S PULL	9342 ROPE	1	#14	XHHW-2	FR: TO:	EXIST OUTDOOR WALL MOUNTED PULL BOX EXIST PLC CABINET SP-1 1 PULL >> EXIST MULTICONDUCTOR CABLE 1 2/C/#16S >> RAS No 2 -RUN COMMAND 1 2/C/#16S >> RAS No 2 -SPEED INDICATION 1 2/C/#16S >> SPARE EXIST MULTICONDUCTOR CABLE MAY BE USED IN LIEU OF NEW WIRES HOWEVER, NEW CONDUIT AND PULL WIRE SHALL BE PROVIDED.	
P1009	E05 E09	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: TO:	PANEL DP-4 MINIPOWER CENTER XLC >> POWER	
P1010A	E05 E09	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: TO:	EXIST PANEL DP-2 PULL BOX PB-11 >> POWER FOR CLARIFIER No.1	
C1010A	E07 E09	0.75"	10	#14	XHHW-2	1	#14	XHHW-2	FR: TO:	EXIST CONTROL TERM CABINET PULL BOX PCB-11 2 #14 >> SECONDARY CLARIFIER 1 RUN 2 #14 >> SECONDARY CLARIFIER 1 FAIL 2 #14 >> SECOND CLARIFIER 1 HIGH TORQUE 4 #14 >> SPARES	
P1012A	E05 E09	1"	8	#10	XHHW-2	2	#10	XHHW-2	FR: TO:	MINIPOWER CENTER XLC PULL BOX PB-11 2 #10 >> CLARIFIER No1 BRIDGE RECEPTACLE 2 #10 >> CLARIFIER No1 PERIM. RECEPTACLES 2 #10 >> CLARIFIER No1 PERIM. LIGHTS 2 #10 >> CLARIFIER No1 BRIDGE LIGHTS	
P1010B P1012B	E08 E09	2"	11	#10	XHHW-2	3	#10	XHHW-2	FR: TO:	PULL BOX PB-11 PULL BOX PPB10 3 #10 >> POWER FOR CLARIFIER No.1 2 #10 >> CLARIFIER No1 BRIDGE RECEPTACLE 2 #10 >> CLARIFIER No1 PERIM. RECEPTACLES 2 #10 >> CLARIFIER No1 PERIM. LIGHTS 2 #10 >> CLARIFIER No1 BRIDGE LIGHTS	
C1010B	E07 E08	2"	10	#14	XHHW-2	1	#14	XHHW-2	FR: TO:	PULL BOX PCB-11 PULL BOX PCB-10 2 #14 >> SECONDARY CLARIFIER 1 RUN 2 #14 >> SECONDARY CLARIFIER 1 FAIL 2 #14 >> SECOND CLARIFIER 1 HIGH TORQUE 4 #14 >> SPARES	
P1010C	E08	1"	3	#10	XHHW-2	1	#10	XHHW-2	FR: TO:	PULL BOX PPB-10 CLARIFIER No1 CTL PANEL LCP-001 3 #10 >> POWER FOR CLARIFIER No.1	

CONDUIT SCHEDULE

CLARIFIER 1 & 2 REHABILITATION

CONDUIT			CONDUCTORS			GROUND					
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION		CONNECTING SEGMENTS
C1010C	E08	1"	10	#14	XHHW-2	1	#14	XHHW-2	FR: CLARIFIER No1 CTL PANEL LCP-001 TO: 2 #14 >> SECONDARY CLARIFIER 1 RUN 2 #14 >> SECONDARY CLARIFIER 1 FAIL 2 #14 >> SECOND CLARIFIER 1 HIGH TORQUE 4 #14 >> SPARES	PULL BOX PCB-10	
PC1010D	E08 N03	1.5"	3 8	#10 #14	XHHW-2 XHHW-2	1 1	#10 #14	XHHW-2	FR: CLARIFIER No1 CTL PANEL LCP-001 TO: CLARIFIER No1 DRIVE 3 #10 >> POWER FOR CLARIFIER No.1 2 #14 >> SECOND CLARIFIER 1 HIGH TORQUE 2 #14 >> SECONDARY CLARIFIER 1 SHEAR PIN 2 #14 >> SECOND CLARIFIER 1 HIGH TEMP 2 #14 >> SPARES	CLARIFIER No1 CTL PANEL LCP-001	
P1013	E08	0.75"	2	#10	XHHW-2	1	#10	XHHW-2	FR: SECOND CLARIFIER BRIDGE LIGHTS TO: 2 #10 >> CLARIFIER No1 BRIDGE LIGHTS	PULL BOX PPB-10	
P1014	E08	0.75"	2	#10	XHHW-2	1	#10	XHHW-2	FR: SECOND CLARIFIER 1 BRIDGE RECEPTACLES TO: 2 #10 >> CLARIFIER No1 BRIDGE RECEPTACLE	PULL BOX PPB-10	
P1015	E08	0.75"	4	#10	XHHW-2	1	#10	XHHW-2	FR: SECOND CLARIFIER 1 PER LIGHTS & RECEPTACLES TO: 2 #10 >> CLARIFIER No1 PERIM. RECEPTACLES 2 #10 >> CLARIFIER No1 PERIM. LIGHTS	SECOND CLARIFIER 1 PER LIGHTS & RECEPTACLES	
P1020A	E05 E09	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: EXIST PANEL DP-2 TO: PULL BOX PB-21 3 #10 >> POWER FOR CLARIFIER No.2	EXIST PANEL DP-2	
C1020A	E07 E09	0.75"	10	#14	XHHW-2	1	#14	XHHW-2	FR: EXIST CONTROL TERM CABINET TO: PULL BOX PCB-21 2 #14 >> SECONDARY CLARIFIER 2 RUN 2 #14 >> SECONDARY CLARIFIER 2 FAIL 2 #14 >> SECOND CLARIFIER 2 HIGH TORQUE 4 #14 >> SPARES	PULL BOX PCB-21	
P1021A	E05 E09	1"	8	#10	XHHW-2	2	#10	XHHW-2	FR: MINIPOWER CENTER XLC TO: PULL BOX PB-21 2 #10 >> CLARIFIER No2 BRIDGE RECEPTACLE 2 #10 >> CLARIFIER No2 PERIM. RECEPTACLES 2 #10 >> CLARIFIER No2 PERIM. LIGHTS 2 #10 >> CLARIFIER No2 BRIDGE LIGHTS	PULL BOX PB-21	
P1020B P1021B	E08 E09	2"	11	#10	XHHW-2	3	#10	XHHW-2	FR: PULL BOX PB-21 PULL BOX PPB20 TO: 3 #10 >> POWER FOR CLARIFIER No.2 2 #10 >> CLARIFIER No2 BRIDGE RECEPTACLE 2 #10 >> CLARIFIER No2 PERIM. RECEPTACLES 2 #10 >> CLARIFIER No2 PERIM. LIGHTS 2 #10 >> CLARIFIER No2 BRIDGE LIGHTS	PULL BOX PB-21 PULL BOX PPB20	
C1020B	E07 E08	2"	10	#14	XHHW-2	1	#14	XHHW-2	FR: PULL BOX PCB-21 PULL BOX PCB-20 TO: 2 #14 >> SECONDARY CLARIFIER 2 RUN 2 #14 >> SECONDARY CLARIFIER 2 FAIL 2 #14 >> SECOND CLARIFIER 2 HIGH TORQUE 4 #14 >> SPARES	PULL BOX PCB-21 PULL BOX PCB-20	
P1020C	E08	1"	3	#10	XHHW-2	1	#10	XHHW-2	FR: PULL BOX PPB-20 TO: CLARIFIER No2 CTL PANEL LCP-002 3 #10 >> POWER FOR CLARIFIER No.2	PULL BOX PPB-20	
C1020C	E08	1"	10	#14	XHHW-2	1	#14	XHHW-2	FR: CLARIFIER No2 CTL PANEL LCP-002 TO: 2 #14 >> SECONDARY CLARIFIER 2 RUN 2 #14 >> SECONDARY CLARIFIER 2 FAIL 2 #14 >> SECOND CLARIFIER 2 HIGH TORQUE 4 #14 >> SPARES	CLARIFIER No2 CTL PANEL LCP-002	

CONDUIT SCHEDULE

CLARIFIER 1 & 2 REHABILITATION

CONDUIT			CONDUCTORS			GROUND			DESCRIPTION	CONNECTING SEGMENTS
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE		
PC1020D	E08 N03	1.5"	3 8	#10 #14	XHHW-2 XHHW-2	1 1	#10 #14	XHHW-2	FR: TO: 3 #10 >> POWER FOR CLARIFIER No.2 2 #14 >> SECOND CLARIFIER 2 HIGH TORQUE 2 #14 >> SECOND CLARIFIER 2 SHEAR PIN 2 #14 >> SECOND CLARIFIER 2 HIGH TEMP 2 #14 >> SPARES	CLARIFIER No2 CTL PANEL LCP-002 CLARIFIER No2 DRIVE
P1023	E08	0.75"	2	#10	XHHW-2	1	#10	XHHW-2	FR: TO: 2 #10 >> CLARIFIER No2 BRIDGE LIGHTS	PULL BOX PPB-20 SECOND CLARIFIER BRIDGE LIGHTS
P1024	E08	0.75"	2	#10	XHHW-2	1	#10	XHHW-2	FR: TO: 2 #10 >> CLARIFIER No2 BRIDGE RECEPTACLE	PULL BOX PPB-20 SECOND CLARIFIER 2 BRIDGE RECEPTACLES
P1025	E08	0.75"	4	#10	XHHW-2	1	#10	XHHW-2	FR: TO: 2 #10 >> CLARIFIER No2 PERIM. RECEPTACLES 2 #10 >> CLARIFIER No2 PERIM. LIGHTS	PULL BOX PPB-20 SECOND CLARIFIER 2 PER LIGHTS & RECEPTACLES
P1030A	E05 E09	1"	3	#8	XHHW-2	1	#10	XHHW-2	FR: TO: 3 #8 >> POWER FOR SCUM PUMPS CTL PANEL	PANEL DP-4 JUNCTION BOX
C1030B	E07 E09 E12	0.75"	10	#14	XHHW-2	1	#14	XHHW-2	FR: TO: 2 #14 >> SCUM PUMP No1 RUN 2 #14 >> SCUM PUMP No 1 FAIL 2 #14 >> SCUM PUMP No2 RUN 2 #14 >> SCUM PUMP No 2 FAIL 2 #14 >> SPARES	JUNCTION BOX EXIST CONTROL TERM CABINET
PC1030	E09 E12	2"	3 10	#8 #14	XHHW-2 XHHW-2	1 1	#10 #14	XHHW-2	FR: TO: 3 #8 >> POWER FOR SCUM PUMPS CTL PANEL 2 #14 >> SCUM PUMP No1 RUN 2 #14 >> SCUM PUMP No 1 FAIL 2 #14 >> SCUM PUMP No2 RUN 2 #14 >> SCUM PUMP No 2 FAIL 2 #14 >> SPARES	JUNCTION BOX PULL BOX PB21
PC1030	E08 E12	2"	3 10	#8 #14	XHHW-2 XHHW-2	1 1	#10 #14	XHHW-2	FR: TO: 3 #8 >> POWER FOR SCUM PUMPS CTL PANEL 2 #14 >> SCUM PUMP No1 RUN 2 #14 >> SCUM PUMP No 1 FAIL 2 #14 >> SCUM PUMP No2 RUN 2 #14 >> SCUM PUMP No 2 FAIL 2 #14 >> SPARES	PULL BOX PB21 EXIST SCUM PUMP CONTROL PANEL
		0.75"							FR: TO:	

END OF CONDUIT SCHEDULE

SECTION 17410

BASIC MEASUREMENT AND CONTROL INSTRUMENTATION MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This Section includes general design, material, equipment fabrication, installation, calibration, testing, commissioning, training and documentation requirements for instrumentation and control systems.
 - 2. Additional or more stringent requirements, when given in other Sections, shall prevail.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI B16.5 - Pipe Flanges and Flanged Fittings.
- B. American National Standards Institute/ American Petroleum Institute (ANSI/API):
 - 1. API RP550 - Manual on Installation of Refinery Instruments and Control Systems.
 - 2. ANSI/API 551-1992 - Process Measurement Instrumentation.
- C. American Society of Testing and Materials (ASTM):
 - 1. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- D. Instrumentation, Systems, and Automation Society (ISA):
 - 1. ISA S5.1 - Instrumentation Symbols and Identification.
 - 2. ISA S5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems.
 - 3. ISA S5.4 - Instrument Loop Diagrams.
 - 4. ISA S5.5 - Graphic Symbols for Process Displays.
 - 5. ISA RP7.1 - Pneumatic Control Circuit Pressure Test.
 - 6. ISA S7.3 - Quality Standard for Instrument Air.
 - 7. ISA S12.4 - Instrument Purging for Reduction of Hazardous Area Classification.
 - 8. ISA S18.1 - Annunciator Sequences and Specifications.
 - 9. ISA S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.
 - 10. ISA S51.1 - Process Instrumentation Terminology.
 - 11. ISA RP60.3 - Human Engineering for Control Centers.
 - 12. ISA S71.04 - Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants.
- E. Milspec:
 - 1. MIL-I-46058C - Electrical Insulating Compound.

- F. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1,000 volts maximum).
- G. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electric Code (NEC).
 - 2. NFPA 496 - Purged and Pressurized Enclosures for Electrical Equipment.
 - 3. NFPA 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
- H. Scientific Apparatus Makers Association (SAMA):
 - 1. SAMA PMC-5 - Resistance Thermometers.
 - 2. SAMA PMC-6 - Filled System Thermometers.
 - 3. SAMA PMC-8 - Thermocouple Thermometers.
 - 4. SAMA PMC-17 - Bushings and Wells for Temperature Sensing Elements.
- I. Underwriters' Laboratories, Inc. (UL):
 - 1. UL 508 - Industrial Control Equipment.

1.03 DEFINITIONS

- A. Where a term is used relating to instrumentation, and the meaning is not defined therein or elsewhere in the Contract Documents, the meaning of the term shall be as defined in ISA S51.1 Process Instrumentation Terminology, or if not contained in ISA 51.1, as defined in listed reference standards under "References".
- B. Control Circuit: Any circuit operating at 80 volts AC or DC or more, whose principal purpose is the conveyance of information and not the conveyance of energy for the operation of an electrically powered device.
- C. Panel: An instrument support system which may be either a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Unless otherwise specified or clearly indicated by the context, the term "panel" in these Contract Documents shall be interpreted as a general term, which includes flat panels, enclosures, cabinets and consoles.
- D. Power Circuit: Any circuit operating at 80 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.
- E. SCADA: Supervisory Control and Data Acquisition.
- F. Signal Circuit: Any circuit operating at less than 80 volts AC or DC.
- G. Two-Wire Transmitter: A transmitter which derives its operating power supply from the signal transmission circuit and therefore requires no separate power supply connections. As used in this Specification, two-wire transmitter refers to a transmitter, which provides a 4 to 20 milliampere current regulation of signal in a series circuit with an external 24 volt direct current driving potential and a maximum external circuit resistance of 600 ohms.
- H. WAN: Wide Area Network.

1.04 INSTRUMENTATION AND CONTROL SYSTEM DESCRIPTION

A. Existing System:

1. The existing PLC system consists of Allen-Bradley SLC 500 series
2. Contractor and I&C subcontractor are strongly encouraged to visit the existing site to have more understanding of the existing plant SCADA system.
3. The existing PLC cabinet has prewired system between PLC modules and terminal blocks for field wiring.
4. All the detailed interface requirements may or may not be stated all in this specification. The site visit shall be carried out to obtain supplementary information for the project.

B. Modified System:

1. The SWWRF clarifiers will have process improvements and modifications to meet this new project objective.
2. Upgrade, append, and modify the existing OIS (Operator Interface Stations) with more process graphic displays and equipment graphic displays. Upgrade hardware/firmware as needed. Upgrade computer's memory as needed for processing the additional software points.

C. Additional PLC Requirements:

1. See specification section 17452

1.05 DESIGN REQUIREMENTS

A. Review other Sections and Divisions of the Contract Documents and ensure full compliance with the total Contract Documents. In the event of a conflict between Sections, the CONTRACTOR shall promptly seek clarification from the ENGINEER.

B. Unless different requirements are clearly specified or shown elsewhere, instrumentation and control design, materials, equipment, installation, and testing shall comply with the requirements of Division 16.

C. Completeness:

1. Provide a complete and fully functional instrumentation and control system ready for use.
2. Components which are not identified on the Drawings and Specifications, but necessary to meet the full functional operation and performance requirements, shall be provided.
3. Equipment shall be designed and installed in full conformity with the Drawings, Specifications, and instructions and recommendations of the related equipment manufacturer.

D. Connections and Appurtenances:

1. The instrumentation and control systems shall include all necessary connections to sources of electrical power, air, water, drains and vents, with all required valves, switches, and accessories as specified or as recommended for best operation by the manufacturer of the equipment furnished.
2. All necessary mounting panels, stands, hangers, and brackets shall be furnished and installed and shall comply with the relevant Sections of these Specifications.

E. Coordination:

1. Systems and equipment provided under this Section shall be designed and coordinated for proper operation with related equipment and materials provided under other Sections of these Specifications, and where applicable, under other referenced contracts, and with identified existing equipment.

F. Control Functions: The complete instrumentation and control system shall perform functions as specified in Section 17411, Control Strategies.

G. Instrument Tagging:

1. All field mounted instruments shall be provided with stainless steel tags stamped or engraved with the instrument's full tag number. Tags shall be affixed with stainless steel wire fasteners.
2. All back of panel instruments shall be provided with black-white-black plastic laminate nameplates engraved with the instrument's full tag number. Nameplates shall be secured to the panel with stainless steel screws.
3. All front of panel instruments shall include the instrument's full tag number and service description in the nameplate legend. Unless it is part of the instrument, the nameplate shall be engraved black-white-black plastic laminate, secured with stainless steel screws.

H. Electrical Marking:

1. All electrical devices, terminal blocks, terminals, cables and conductors shall be clearly labeled. Terminal blocks shall have labels on both sides.
2. Cables and conductors shall be fitted with heat shrink identification sleeves. Adhesive tape identification markers shall not be used. A unique numbering system shall be provided by the CONTRACTOR, but this shall conform with requirements specified in Division 16. Cables shall be tagged at both ends and at any intermediate pull box or manhole through which the cables are routed. All cables shall be identified on the CONTRACTOR's cable schedule.

I. Cable and Conductor Termination:

1. All cables and conductors shall be terminated on terminal blocks with full identification.
2. Terminal Block Enclosures: Field mounted terminal blocks shall have NEMA 4 enclosures or NEMA 4X enclosures in wet or corrosive areas unless otherwise specified.
3. Terminal blocks, except those which are part of a manufactured unit, shall be capable of terminating 22-12 AWG wire with contact resistance no greater than 3 milli-ohms. Screws shall be captive and have metal on metal friction locking such that when wire is clamped into the metal body self-loosening is not possible. Metal components shall be manufactured from 85 percent copper alloy and be nickel-plated over 100 percent of their surface area.
4. Manufacturers:
 - a. Terminal Blocks: Allen-Bradley 1492-J3 or J4. No equal.

J. Signal Transmission:

1. Unless otherwise specified, analog signal transmission between electronic (and electric) instruments not located within a common panel shall be 4 to 20 milliamperes and operate at 24 volt DC.
2. Milliampere signals shall be current regulated and not affected by changes in supply voltage and load resistance within the unit's rating.

- K. Loop Impedance:
 - 1. Total loop impedance for 4 to 20 milliamperes signals shall not exceed the rated value for the regulating device at the loop operating voltage.
 - 2. Where necessary, loop impedance shall be reduced by providing current-to-current (I/I) isolation amplifiers for signal re-transmission.
- L. Grounding:
 - 1. Instrument panels shall be provided with a signal ground bus which shall be isolated from the power ground bus. Multiple panels in one location shall have a common point for signal ground bus connection to ground.
 - 2. Shields and measurement loops shall be single point grounded at the source panel external terminals by bonding to the instrument panel signal ground bus.
 - 3. Isolating amplifiers shall be provided within the panel for field equipment possessing a grounded input or output, except when the panel circuit is galvanically isolated.
- M. Discrete Circuit Configuration:
 - 1. Discrete control circuits shall be configured to fail safe, i.e., on loss of continuity or loss of power. Alarm contacts shall fail to the alarm condition which shall be open. Control contacts shall fail to the inoperative condition unless otherwise indicated on the Drawings. Provide individual fuse for each and every loop.
- N. Instrument and Loop Power:
 - 1. Power to instruments and instrument loops shall be from sources providing the highest integrity: e.g., from the loop primary receiving instrument/module, or from a UPS when so specified. A loop shall not be dependent on a diversity of power sources, unless otherwise indicated on the Drawings. Provide individual fuse for each and every loop.
- O. Field Instruments Installation Design:
 - 1. Field instruments shall be installed in accordance with the Contract Documents, ANSI/API 550 and 551, and the manufacturer's instructions.
 - 2. Flow conditioning devices or other required accessories shall be furnished and installed if necessary to meet the accuracy requirements in the Contract Documents.
 - 3. Field instruments shall be mounted so that they can be easily read, can be readily approached and easily serviced, and so they do not restrict access to mechanical equipment. Field instruments not directly mounted shall be mounted on a pipe stand or local panel, unless otherwise indicated on the Drawings.
 - 4. Field electronic instruments exposed to direct sunlight shall be provided with sun shields. LED, LCD or other digital readouts shall be oriented and shielded to eliminate exposure to direct sunlight.
 - 5. Field instrument enclosures shall be NEMA 4 minimum. For corrosive environments, or where otherwise specified, enclosures shall be NEMA 4X.
 - 6. Connections from rigid conduit systems to field instruments shall be made with jacketed flexible conduit with a maximum length of 3 feet.
 - 7. Field instruments shall be connected with cable as specified in Division 16, except when the manufacturer requires the use of special cable, or otherwise specified herein. Special cable applications shall be in accordance with the NEC.

8. Provide a power disconnect switch (NEMA 4) for 120 VAC powered instrument which does not have a built-in power disconnect.

P. Hazardous (Classified) Areas:

1. Instrumentation and control equipment specified, is subject to the requirements for hazardous (classified) areas as specified in Division 16 and indicated on the Drawings.
2. Two-wire transmitters to be installed in a hazardous (classified) area shall be Factory Mutual approved intrinsically safe, and made safe by means of suitably rated Factory Mutual approved intrinsically safe barriers installed in a nonhazardous area.
3. Switches to be installed in a hazardous (classified) area shall be made safe by means of suitably rated Factory Mutual approved intrinsically safe barriers or intrinsically safe relays installed in a nonhazardous area.

Q. Corrosion Protection:

1. The CONTRACTOR is specifically cautioned that the treatment plant ambient air contains airborne contaminants, including but not limited to, the corrosive gases: hydrogen sulfide, chlorine and ammonia. The corrosion severity level will vary according to specific location, temperature, relative humidity, rate of change of relative humidity, wind speed and wind direction, and may, therefore, also be subject to seasonal variation.
2. Unless otherwise specified, electronic equipment (except for modifications to existing units) shall be installed such that no significant or detrimental corrosion shall occur over a 20 year period. Installation in a NEMA 4X enclosure is acceptable.

R. Documentation to be Provided:

1. All aspects of the instrumentation and control systems design shall be fully documented, and subsequently revised to conform with the "As-Built" installation. Special care and preparation shall be taken in dealing with the modification of existing panels. For example, digital pictures shall be taken on all external incoming field wires with wire markers shown properly. Supplement with written notes in clarifying digital pictures. Dimensions shall be noted and documented. The new back panel shall be designed based upon critical dimensions on terminal strip locations and heights. Any dimensions shown on the new back panel without the existing backup information by digital pictures or notes will be rejected during the shop drawings review period.
2. This documentation shall include a fully annotated record of all application programming, e.g., for microprocessor based instruments, programmable logic controllers, SCADA computers, etc.
3. The numbering of all instruments, equipment, terminal blocks, conductors and cables shall be shown on all related documents.
4. Where an existing installation is subject to minor modifications, a comprehensive upgrade of existing documentation may satisfy the documentation requirements; however, prior acceptance by the ENGINEER shall be obtained.
5. In each and every drawing submitted, provide project number, instrument-area, and drawing number.
6. Provide as-built drawings to show interconnect with manufacturer's equipment and contractor installed equipment. Include manufacturer's terminal numbers,

wire numbers, ad panel terminal numbers Supply manufacturer's drawings as well as panel drawings with as-built.

S. Surge Protection:

1. Provide outdoor field instrument loops with voltage surge protection units at instruments, capable of limiting voltage to 30 volt DC peak with a response time of 5 nano-seconds, and dissipating a 15,000 watt, 1 millisecond surge. Provide 24 VDC line to line, and line to ground protection.
2. Individually fuse each 4 to 20 mA DC loop with a 1/16 ampere slow blow fuse between power supplies and receiver surge protectors.
3. Provide voltage/surge protection for 4 wire transmitters and analyzers with 120 VAC power sources. Protect both 120 VAC power source and 24 VDC signal loop.

1.06 SUBMITTALS

A. General:

1. Submittal data shall be grouped in a logical manner to facilitate review of subsystems and each submittal shall be substantially complete. Individual drawings and data sheets submitted at random intervals will not be accepted for review.
2. Incomplete submittals will be returned to the CONTRACTOR without the ENGINEER's review and without contract time extension.
3. Design Data submittals shall be reviewed and returned with resubmittal not required, before fabrication is started.
4. All panel drawings additions and loop drawings shall be produced with latest version of AutoCAD software.

B. Design Submittals:

1. Bill of Material for all equipment.
2. Instrument Data Sheets using ISA S20 format, with variations/enhancements to accommodate specific types of instruments.
3. Catalog Data for all instruments and equipment, with applicable features and options "arrowed."
4. System Configuration Diagrams.
5. Panel Arrangement Drawings for panels or enclosures showing size, arrangement, cut-outs, color, item identification, nameplate legends, and annunciator engravings.
6. Panel Wiring/Piping Drawings.
7. Loop Diagrams for Analog and Discrete Signals, in accordance with ISA S5.4 and the Drawings: "Typical Loop Diagrams".
 - a. The diagrams shall be fully detailed including all equipment and locations, new and existing, reached by the loop and its branches.
 - b. The diagrams shall include instruments, electrical equipment, mechanical packaged equipment, and terminal strip, wire, and cable numbers. Loops with associated inputs and outputs shall be drawn compositely.
 - c. Loop continuity via programmable control functions shall be depicted schematically using P&ID symbology.
8. Schematic Diagrams (also known as elementary diagrams, control diagrams, and logic diagrams) shall be provided for hardwired and programmable logic/control. Diagrams (including printouts) shall include full annotation of all elements, cross references, and explanation of annotation.

9. Electrical cable and wire marking (identification) system, for all analog and discrete loops.
10. All drawings and documents produced by the CONTRACTOR or Subcontractor shall reference the identical tag numbers as shown on P&IDs.
11. PLC process control logic, equipment control logic programs, OIS graphic display screens and HMI graphic display screens.
12. One list of I/O shall be submitted. Identify analog tags which are logged for reporting.

C. Installation Submittals:

1. Installation, Operation and Maintenance Manuals for proprietary instruments and systems. Upon acceptance of equipment and before installation, submit 3 sets for information only.
2. Retrofit Schedules: 70 days prior to scheduled start of retrofit.
3. Cable and Wire Schedules, including existing which are not removed under retrofit or demolition work.

D. Testing Submittals:

1. Test Plan: 70 days prior to scheduled start of testing.
2. Test Procedures: 70 days prior to scheduled start of testing.
3. Factory test data records, certified.
4. Field test data records.

E. Training Program Submittals: 70 days prior to scheduled start of training, submit training program course outline and training schedule.

1. Training Program course outline and training schedule shall be submitted with: technical or operation heading, subjects, times, duration of sessions, name of instructor. There shall be a description of each subject-session. There shall be a list of instructors with their employer's name, job title and qualifications. Be prepared to tailor the training schedule for compatibility with the plant operations staffing requirements.

F. Project Closeout Submittals:

1. Recommended Spare Parts List.
2. Operation and Maintenance Manuals for project, fully indexed, incorporating all instrumentation and control system documentation submitted and produced, and revised to conform with the "As-Built" installation. Application specific operation and maintenance instruction and application program records shall be included. Submit 1 set for review and 4 sets of the final accepted manuals.
3. Submit reproducible mylar copies of all drawings revised to conform with the "As-Built" installation for the OWNER's records after acceptance of the project Operation and Maintenance Manuals.
4. Magnetic Media, 2 sets, in the form of CD-ROM , bearing all electronically formatted documents including "As-Built" CAD drawings and application programs, shall be submitted for information only and the OWNER's records; after acceptance of Operation and Maintenance Manuals for project. The media shall contain a table of contents, ASCII formatted, identifying the contents of each file and the software program/version with which it was produced. The media shall contain a CAD plotting document providing definition of, and correlation between layers/colors and line types for all CAD files.

1.07 QUALITY ASSURANCE

A. Procurement Restriction:

1. Certain equipment manufacturers with marketing operations based on local agents, have terms where the selling agent has responsibility for after sales service. In such cases, the CONTRACTOR's procurement of such equipment is restricted to the selling agent within whose service area the equipment will be finally installed, thus assuring the OWNER of the availability of local after sales service.

B. CONTRACTOR or Subcontractor Qualifications:

1. Instrumentation and Control Systems shall be provided under the supervision of a single contractor or subcontractor, which has been regularly engaged over the previous 5 years in supervision of projects of similar scope and complexity.
2. Supervision shall include responsibility for, but not be limited to design, procurement, fabrication, installation, field loop integrity, programming, calibration, testing, commissioning, training, documentation, and interfacing requirements.
3. Existing PLC cabinet and related hardware was manufactured and supplied by Revere Control Systems, Birmingham, AL. (727)-431-2011

C. Quality Assurance Procedure:

1. A quality assurance procedure shall be defined and implemented by the CONTRACTOR or subcontractor supervising instrumentation and control systems. The procedure shall:
 - a. Require that the project manager schedule and budget for in-house and inter-Contractor checking.
 - b. Specify qualifications required for engineering and technical personnel in the execution and checking of specific tasks.
 - c. Identify the responsibilities of the executor and the checker. Submit a check-off sheet with all points.
 - d. Provide quality assurance data sheets listing specific tasks and stages of tasks, with space for the printed names of the executor and checker, and the checker's signature and date.
2. The quality assurance procedure shall form part of the contractual requirements for subcontractors, and manufacturers or suppliers with unit responsibility.
3. The quality assurance data sheets shall be maintained current and shall be available for inspection upon request.

D. Unit Manufacturer or Supplier Responsibility Qualifications:

1. Specific control system(s) shall be contracted or subcontracted as a whole to one manufacturer or supplier who shall have unit responsibility. This shall apply to the following system(s):
 - a. Programmable Logic Controller System - Section 17452.
2. Unit responsibility shall include, but not be limited to, design, procurement, fabrication, installation, field loop integrity, programming, calibration, testing, commissioning, training, documentation, and interfacing requirements. This shall also include obtaining final acceptance. Final acceptance shall be dependent on a complete system, fully tested and operating in a manner satisfactory to the OWNER and the ENGINEER, and in accordance with the Contract Documents.

3. A unit manufacturer or supplier, shall have been regularly engaged over the previous 5 years in the business of providing comparable control systems with the same level of responsibility.
4. The bid proposal shall include a "Statement of Qualifications" listing dates, projects, scopes of work, and instrumentation and control contract dollar values.
5. The bid proposal shall include a "Statement of Qualifications" listing dates, projects, system size in terms of inputs/outputs (I/O), and system equipment.
6. Additional qualifications or a prequalification proposal shall be provided where required in the relevant Section.

E. Instrumentation and Control Systems Installation Supervisor:

1. Installation and wiring of instrumentation and controls shall be supervised by an on-site experienced Electrical Engineer or Control Systems Engineer. This supervisor shall be employed for a minimum of 20 hours per week, for a minimum of 25 weeks.
2. The supervisor shall be subject to acceptance by the ENGINEER. The supervisor's resume shall be submitted showing relevant and sufficient experience. If so required, the supervisor shall attend an interview at the ENGINEER's facility. The ENGINEER's decisions shall be final.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery Timing:

1. No instrumentation or control system equipment shall be delivered to the job site until required for integration with other construction, and all necessary environmental preparations have been made.

B. Intermediate Storage and Handling:

1. When the CONTRACTOR is obliged to take delivery in advance of this time, the CONTRACTOR shall do so at a bonded air-conditioned warehouse.
2. The CONTRACTOR shall provide for storage at the warehouse and transport of the equipment to the jobsite by suitably qualified movers with moving equipment (e.g., floating bed truck) as recommended by the manufacturer.

C. Non-Compliance:

1. Should the equipment be delivered to the jobsite and be stored in adverse conditions or installed in improper environmental conditions, then at the ENGINEER's discretion, prior testing may be declared void.
2. The prior testing (e.g., factory acceptance testing) shall be repeated and/or, at the discretion of the ENGINEER, a reduced value dollar credit shall be provided by the CONTRACTOR.
3. The equipment shall still be required to satisfy site testing performance criteria.

1.09 SITE CONDITIONS

A. General: Instrumentation and control systems equipment shall be suitable, or made suitable, for site conditions at the project location.

B. Temperature:

1. Electrical and Control Room Temperature: 60 to 100 degrees Fahrenheit.
2. Field Locations Temperature: 20 to 120 degrees Fahrenheit.
3. Above temperatures do not include affects of direct sunlight or wind chill.

- C. Relative Humidity (RH):
 - 1. Electrical and Control Rooms RH: 20 to 98 percent.
 - 2. Field Locations RH: 10 to 100 percent.
- D. Atmospheric Contaminants:
 - 1. Atmospheric contaminants include hydrogen-sulfide, chlorine, ammonia and dust in indeterminate concentrations.
 - 2. Corrosive atmosphere testing shall be conducted, where specified.
- E. Hazardous Areas:
 - 1. Hazardous areas shall be as specified in Division 16 and as shown on the electrical Drawings.
- F. Electromagnetic Radiation:
 - 1. Electromagnetic radiation: 27 to 500 MHz: 10 volts/m.

1.10 SEQUENCING AND SCHEDULING

- A. General:
 - 1. Sequence and schedule instrumentation and control system provisions and the progress schedule.
 - 2. Coordinate instrumentation and control system delivery and installation with other portions of the Work.
- B. Special Planning:
 - 1. Retrofit of the existing plant shall be specifically scheduled and sequenced. Shutdown of existing plant shall be minimized. All shutdown operations shall be scheduled with the OWNER. Detailed planning and careful execution shall be conducted to limit risk of accidental shutdown of adjoining existing facilities.
 - 2. The work shall be divided into stages that shall be individually scheduled with the OWNER. For each stage, a detailed retrofit schedule shall be submitted. The retrofit schedule shall list each individual action in step order, identifying individual devices, terminals and wire numbers. Prior to commencing each stage of retrofit work, and prior to shutdown the CONTRACTOR shall make a "dummy run" through the schedule to add identification markers to all unmarked devices, terminals and wires.
 - 3. Planning of work shall include allowance for testing requirements detailed in Part 3.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Refer to other instrumentation and control Sections.

2.02 SOURCE QUALITY CONTROL

- A. Factory Testing:
 - 1. Instrumentation and control systems shall be factory tested and calibrated.
 - 2. Factory test/calibration records shall be submitted to the ENGINEER to show that the equipment has achieved the specified performance and accuracy.

3. Additional Factory Testing: Refer to other instrumentation and control Sections.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 1. Install instrumentation and control systems in accordance with Drawings and Specifications, final submittals, manufacturers instructions, and (where applicable) American Petroleum Institute RP550/551.
- B. Electrical: Install cable and wiring in accordance with applicable Sections in Division 16.
- C. Piping: Install piping and fittings in accordance with applicable Sections of Divisions 2 and 15.
- D. Field Equipment:
 1. Install field equipment such that ports, terminals and adjustments have unobstructed access for in-place testing and calibration. Equipment shall not obstruct walkways. Where possible, hand controls and indicators shall be 48 to 60 inches above the floor or a permanent work platform.
 2. Equipment shall be installed suitably protected from environmental conditions. Equipment shall be mounted such that shock or vibration will not impair its operation.
 3. Sun Shade:
 - a. Each instrument transmitter with a readout and each control panel located outdoors shall be provided with a sun shield.
 - b. Sun shield shall be designed and installed to minimize heat gain in instruments and panels.
 - c. Where practical, outdoor instruments shall be installed so readouts face north to minimize direct sun exposure.
 - d. Design and install sun shield to prevent direct sunlight from striking instrument readouts.

3.02 FIELD QUALITY CONTROL

- A. Testing - General:
 1. The requirements given in this Section are a minimum and may be augmented, but not replaced, by more specific requirements in subsequent Sections.
 2. 70 days before the commencement of any testing activity, the CONTRACTOR shall submit a detailed test plan; and detailed step-by-step test procedures, complete with forms for the recording of test results, testing equipment used, and space for signature identification of the individual witnessing the test.
 3. No required test shall be applied without prior notice to the OWNER. Testing shall not be conducted without being witnessed unless with the prior acceptance of the OWNER or OWNER's representative.
 4. Each unit of test equipment used shall have a certified calibration report traceable to the National Institute of Standards and Technology (NIST), and issued within 6 months of the testing date. These calibration reports shall be

submitted with the test records. Test instruments shall have an accuracy 3 times better than that of the device under test. Analog devices shall be tested at 5 equally spread points over the full range.

B. Field Calibration Testing:

1. Field test and calibrate all control systems and instrumentation in accordance with the reviewed Testing Procedure submittal and the manufacturer's instructions.
2. Field test/calibration data sheets shall be submitted to the ENGINEER to show that the equipment has achieved the specified performance and accuracy.
3. Unless identified by the CONTRACTOR as an exception in the bid, accuracy shall be within the specified tolerance. Accuracy shall be within the manufacturer's stated tolerance where this is a lesser value.
4. Field-testing shall include all discrete and analog loops.
5. Use ISA standard calibration sheets whenever available.

C. Acceptance Testing - General:

1. Conduct control system and loop acceptance tests proving control system performance, and loop integrity and accuracy, in accordance with the reviewed Testing Procedure submittal and the manufacturer's instructions.
2. Acceptance tests shall be witnessed by the ENGINEER and data sheets shall be submitted recording results and acceptance.
3. Where equipment or systems fail to meet the manufacturer's specified performance and accuracy, the CONTRACTOR shall provide the on-site services of the manufacturer's field service engineer to resolve the problem at no cost to the OWNER.

D. Loop Acceptance Testing:

1. For each and every analog and discrete circuit, verify the proper operation of all hardwired circuits, functions, and logic.
2. Test the accuracy of each hardwired loop. Overall loop accuracy shall not exceed the sum of the accuracies of the loop components as determined under Field Calibration Testing.

E. End-to-End Acceptance Tests:

1. For each and every analog and discrete circuit, perform an end-to-end test. Also test each signal circuit transmitted over digital networks (i.e., valve networks, RS-422 links, etc.).
2. Check each loop from the field element to the respective computer control display. Include all intermediate field instruments, control devices, panels, indicators and other devices in the loop to ensure proper operation and linkage to computer control station displays.
3. Analog signals shall be tested at 0, 50, and 100 percent of scale to verify the proper receipt on computer control displays.
4. Discrete input circuits shall be tested to verify proper state when the field device is switched between state. Discrete output circuits shall be tested to verify equipment responds properly (start, stop, etc.).

F. Control Strategy Acceptance Tests:

1. For each control strategy and for each electrical schematic diagram, demonstrate the proper operation of all hardware and software logic and

control functions. Perform a step by step test of each function described in each control strategy.

2. Perform separate tests on each individual piece of equipment, and for each control loop.
3. Perform the proper operation of each discrete control loop to ensure the proper operation of motors, hand switches, interlocks, solenoid valves, other auxiliary devices, status lights, computer control operator interfaces, and alarms.

3.03 TRAINING

A. General:

1. The requirements given in this Section that follow are a minimum and may be augmented, but not replaced, by more specific requirements in subsequent Sections.
 - a. Provide training to the OWNER in the maintenance, programming and operation of the instrumentation and control systems. Instructors shall have in-depth knowledge and experience in the subjects they cover. Instructors on major systems, complex instruments or analyzers shall be employed or certified by the manufacturer.
 - b. Each attendee shall be provided with a set of documentation covering the subject matter.
 - c. One set of documentation and 1 copy of any video tapes used shall be provided to the OWNER.
 - d. The OWNER shall be permitted to video tape all live training sessions.
2. The costs associated with training of the OWNER's and ENGINEER's designated staff shall be included in the Contract Price, including travel, accommodation and per diem for instructors visiting the plant and/or attendees visiting the manufacturer.

B. Factory Training:

1. Factory training shall be provided for complex instrumentation and major control systems. Factory training shall include: fundamentals, features, testing and maintenance techniques, set-up, calibration, system programming and configuration, application programming. Both theory and hands-on experience shall be provided.
2. Allow for a total of 4 persons in 2 groups, each group separately attending 24 hours of factory training.

C. On-Site Training:

1. Provide on-site training for all instrumentation and control systems. On-site training shall include: testing and maintenance techniques, set-up, calibration, operation, application programming, system reconfiguration, a thorough description and explanation of the on-site control system, failure and recovery procedures (inducing failures), and operation during failures. Both theory and hands-on experience shall be provided.
2. Allow for 40 hours of operational training and 20 hours of technical training with no limitation on the number of allowable attendees.
3. Allow each training in two groups, each group separately attending the same amount of time as stated above.

3.04 CLEANING

- A. Clean area during construction.
- B. Vacuum panels, cabinets, and enclosures to remove dust and debris. Wipe surfaces clean.

END OF SECTION

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SECTION 17411

CONTROL STRATEGIES

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section specifies control strategies for the programmable controller based Supervisory Control and Data Acquisition (SCADA) system. Control strategies describe sequential and interlocking control functions, analog control functions, color-graphic video display operator interfaces and alarm and event logging. The CONTRACTOR shall provide all necessary software and applications programming to implement the control strategies. The existing wastewater treatment plant control logic shall be maintained except as modified/expanded in the Contract Documents.
- B. In each control strategy, the required SCADA monitoring, display, control and annunciation functions are described. See the referenced P&ID and related drawings on the required quantity. Provide all alarms as shown on electrical schematic diagrams even when they are not shown on P&ID's. If an "overload" is shown on electrical drawing, provide this alarm even when it is not stated in the Control Strategies. P&ID drawings and electrical drawings are supplementary to each other.
- C. H/O/A and L/O/R selector switches are both three-position selector switches and nomenclatures are used interchangeable between the two. H/A and L/R are two-position switches and nomenclatures are used interchangeable between the two. However, during the software programming, use the terminologies shown on the P&ID's without any deviation.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 CONTROL STRATEGIES

- A. The following control strategies are included in this section:
 1. General.
 2. Analog Point Status.
 3. SCADA Inputs and Outputs Distribution and Control Requirements.
 4. General Recording System.
 5. General Contact/Logic System.
 6. General Process Control Function (Analog) System.
 7. Color Notation for Dynamic Objects on Control Graphic Display Screens.
 8. Digital Alarm System.
 9. Duty/Standby Control Logic.
 10. Digital Status System and Software Elapsed Time Meters for rotary electrical equipment.

11. Modifications associated with secondary clarifiers No. 1 and No. 2

3.02 CONTROL STRATEGY 1

- A. General:
 - 1. Each motor-driven piece of equipment shall have "RUNNING" status inputs to the Supervisory Control and Data Acquisition (SCADA).
 - 2. The failure of driven equipment shall be monitored by the SCADA. Equipment shall be considered failed under the following conditions:
 - a. The equipment is in AUTO and the SCADA attempts to operate the equipment and it does not respond within an adjustable time period.
 - b. The equipment is in AUTO and running and for whatever reason other than the SCADA requesting the equipment to "STOP," the equipment stops.
 - 3. The SCADA system shall be used to the extent that it shall facilitate monitoring of the equipment.

3.03 CONTROL STRATEGY 2

- A. Discrete Point Status:
 - 1. Reference Drawings:
 - a. All P&ID's.
 - 2. System Components:
 - a. In accordance with P&ID's.
 - 3. Description:
 - a. 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 several discrete input points.
 - b. 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.
 - 4. SCADA Logic:
 - a. Calculate and maintain the status of all logical discrete status points in the SCADA database.

3.04 CONTROL STRATEGY 4

- A. PLC Inputs and Outputs Distribution and Control Requirements:
 - 1. Reference Drawings:
 - a. Various P&ID's.
 - 2. Description:
 - a. Whenever there are sufficient modules based upon the physical inputs and outputs, PLC-I/O assignment shall be as shown on the PLC based SCADA Block Diagram and single line diagrams. Each pump/VFD I/Os shall be routed to its designated I/O modules. For example, pump/VFD 1 related I/Os shall be routed to its designated I/O modules while pump/VFD's 2, 3, 4, and 5 shall be routed to I/O modules designed for 2, 3, 4, and 5 respectively. No cross wiring will be permitted. Whenever there are not sufficient modules based upon the physical inputs and outputs for one pump/one dedicated module arrangement, then break signals for pumps into groups to minimize failure impact. For example, only two DI's and two DO modules are needed for 4 pumps, group two pumps into one

DI and one DO, so that at least two pumps will still be available for service based upon one DI or DO module failure. Arrange inputs and outputs to PLC the most reliable method in minimizing module failure impact on the system. All the common I/Os shall be consolidated together in either one or two modules or as required at its respective PLC.

b. Upon failure of a pump/VFD, SCADA shall intervene using equipment controlled by PLC and select the next pump/VFD in the lead-lag1-lag2-lag3 sequence for duty service.

3.05 CONTROL STRATEGY 5

A. General Recording System:

1. Reference Drawings:
 - a. All P&ID's.
2. Description:
 - a. The SCADA workstations shall generate reports based upon process variables (pressure, flow, temperature, level and analytical) and equipment status (run time, speed, and motor current) in real-time and from recent historical data. All instruments shown on the P&ID's with PI(R)xxxx, FI(R)xxxx, TI(R)xxxx, LI(R)xxxx, and AI(R)xxxx shall also be included under this recording requirement (where xxxx indicates instrument tag number). The exact report format will be determined by the OWNER during the submittal review period. Note that PI(R) stands for either PI or PIR. The same concept is applicable for process FI, TI, LI, and AI.
 - b. All motors shall be included for recording of total elapsed time requirement. In other words, motor run times shall be programmed into the PLC and recorded by RSSQL.

3.06 CONTROL STRATEGY 6

A. General Contact/Logic System:

1. Reference Drawings:
 - a. All P&ID's.
2. Description:
 - a. All digital/logic control functions shall be provided as required and shall include but not be limited to the following:
 - 1) Digital/Logic Functions: The ability to perform logic and sequencing functions shall be supported to provide control interlocks, event sequencing and other logic operations.
 - 2) Boolean Algebra requirements: AND gate, OR gate, NAND gate, NOR gate, XOR gate, and NXOR gate.
 - 3) Logic requirements: Logic switch, logic compare, bi-directional time delay, and on-off with feedback.
 - 4) 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.

3.07 CONTROL STRATEGY 9

A. Color Notation for Dynamic Objects on Control Graphic Display Screens:

1. Reference Drawings:

- a. All P&ID's.
- b. All control strategies.

2. Description:

- a. 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	Green (to be verified during construction)
Motor	Stop	Red (to be verified during construction)
All above	Fault	Blinking Red-before acknowledgement Steady Yellow- after acknowledgement (to be verified during construction)

- b. If an "open" command has been given to a valve in its "closed" position, the green light shall be blinking during opening period.
- c. If a "close" command has been given to a valve in its "open" position, the red light shall be blinking during closing period.

3.08 CONTROL STRATEGY 10

- A. Digital Alarm System:
 - 1. Reference Drawings:
 - a. All P&ID's, electrical control diagrams, and vendor drawings.
 - 2. System Components:
 - a. In accordance with P&ID's.
 - 3. Description:
 - a. All digital input alarms shall be provided as shown on P&ID's. 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 of packaged units).
 - b. Digital alarms shall be configured as alarms in SCADA and shown on screen.

Alarm Red Blinking	In alarm and unacknowledged
Solid Yellow	In alarm and acknowledged

- c. Touching the graphic alarm on screen shall acknowledge the alarm if the operator logged in has permission. SCADA alarm shall be logged with:
 - 1) When in alarm.
 - 2) When the alarm was acknowledged.
 - 3) Who acknowledged the alarm.
 - 4) When its alarm was out.

3.09 CONTROL STRATEGY 12

- A. Digital Status System:
 - 1. Reference Drawings:
 - a. All P&ID's, electrical control diagrams, and vendor drawings.
 - 2. System Components:
 - a. In accordance with P&ID's.

3. Description:
 - a. All digital input status shall be displayed on SCADA screens as required by the reference drawings and specifications. 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, power management related contact inputs, level switches, pressure switches, etc.), local control panels (relay outputs, alarm module outputs, switches), and packaged systems (designated terminals of packaged units).
 - b. Whenever an electrical rotary equipment is started successfully, a run contact input will be fed to PLC input module. The PLC shall start the software time to totalize the elapsed time of the equipment, such as an electrical motor. This is applicable to all KQI's shown on P&ID's.

3.10 SECONDARY CLARIFIER(S)

- A. References:
 1. P&ID's
 2. Electrical and mechanical drawings.
- B. General Description:
 1. A master local control panel supplied by the manufacturer provides control of all the equipment in the clarifier system.
 2. Spray water, controlled by a solenoid valve and timer, is applied to the scum trough during each pass of the clarifier mechanism. The solenoid is activated when the scum skimming arm trips a position switch mounted in the secondary clarifier. The spray water shall be activated for an operator adjustable time limit.
 3. One Local Control Panel shall be provided by the clarifier drive manufacturer in having an overall coordinated control system for the entire packaged system. This packaged system shall have the Local Manual (start/stop) and Local Automated operation modes. When the system is placed in Local Manual Position and a Start Command has been initiated, the mechanical drive shall run continually. The permissive interlocks could shut down the system. The reset pushbutton shall be activated in order to restart after the start-up permissive interlocks are satisfied. When the system is placed under the Local Automated operation mode, the system shall be able to start automatically either by the high differential level (upstream and downstream) or by the cycle timer (on/off). The high differential level set point and the cyclic timers (on timer and off timer) shall be adjustable and shall also be adjustable from the plant PLC/SCADA, when the L/O/R selector switch is placed in Remote Position.
 4. All the mechanical and electrical devices status shall be fed back to the PLC/SCADA as shown on P&ID and as specified in mechanical and electrical specification.
- C. PLC/SCADA Control:
 1. The plant PLC/SCADA has no control over the packaged system. The plant PLC/SCADA will have the monitoring and alarm functions as required by the packaged system manufacturer and as shown on P&IDs and as specified in the specifications.

3.11 RAS PUMP No. 2

- A. References:
 - 1. P&IDs
 - 2. Electrical and mechanical drawings
- B. General Description:
 - 1. There are three return activated sludge (RAS) pumps located between Secondary Clarifiers Nos. 1 & 2, which pump RAS from the secondary clarifiers to the aeration basins. Two of the pumps have dedicated variable frequency drives (VFDs). This project will add a VFD to the RAS pump No. 2 only.
- C. Local Control:
 - 1. Manual Control:
 - a. The RAS pump shall have a local LOCAL/OFF/REMOTE selector switch at the VFD. When the selector switch is in the LOCAL position, the STOP and START pushbuttons on the pump will be enabled. When the selector switch is in the LOCAL position, the pump speed can be adjusted at the VFD.
 - b. When the selector switch is in the REMOTE position, the pumps shall be controlled through the SCADA system.
 - 2. Automatic Control:
 - a. Each RAS pump shall contain temperature probes with contacts that will shut down the pump should the temperature of the motor reach a factory setpoint.
 - 3. Alarming (at VFD):
 - a. Pump fail alarm.
 - b. High pump motor temperature.
- D. PLC/SCADA Control:
 - 1. Manual Control:
 - a. The SCADA system shall have AUTO/MANUAL selector switch at the workstation. With the switch in MANUAL, the pump may be operated manually from the SCADA system using START/STOP push buttons at the workstation. The speed can be manually controlled using INCREASE and DECREASE push buttons at the workstation.
 - 2. Automatic Control:
 - a. With the system in AUTO, the plant operator may control the RAS pumps based on a total RAS flow rate.
 - 3. Monitoring:
 - a. The SCADA system shall indicate RAS pump AUTO ready status.
 - b. The SCADA system shall indicate RAS pump RUN status.
 - c. The SCADA system shall indicate the VFD pump speed signal as a percentage (0 to 100 percent).
 - 4. Alarming:
 - a. A pump fail alarm shall be transmitted to the SCADA system from each VFD.
 - b. High pump motor temperature alarm.

END OF SECTION

SECTION 17427

PANEL INSTRUMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Panel instruments for instrumentation and control systems.
- B. Related Documents: Drawings and General Provisions of the Contract, including General and Supplementary Conditions and apply to work of this Section.

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. Panel elevation and device layout diagrams.
 - 2. Schematic diagrams.
 - 3. Wiring diagrams.
 - 4. Loop diagrams.
- B. Manufacturer's installation instructions and mounting details.
- C. Factory and field calibration data sheets for instruments and devices that require set-up and calibration.

PART 2 PRODUCTS

2.01 PANEL INSTRUMENTS

- A. General Requirements:
 - 1. Electronic panel instruments shall be industrial grade instruments with a proven reliability record. Scales shall be calibrated in engineering units.
 - 2. Panel controllers and recorders shall be of a rail mounted draw-out type of depth suitable for the panel but not more than 20 inches deep. Instrument operation, tuning, and fine adjustment shall be possible without disconnecting the instrument from the process.
 - 3. Instruments shall have matching or compatible fascia such as height, finish, color and display color with arrangement to provide a logically grouped panel display.
 - 4. Provide programming equipment. Where this includes the use of an IBM compatible PC, only the software, registered to the OWNER, shall be provided.
 - 5. Analog signal indicators shall be LED bar graph or numeric displays. LED bar graph shall have an accuracy of plus or minus 0.5 percent of span. An LED bar graph duplicated by a digital display shall have an accuracy of plus or minus 1.0 percent of span. Digital displays shall have an accuracy of plus or minus 0.1 percent of span for setpoints and measured variables; and plus or minus 0.3 percent of span for retransmitted and output variables. Temperature

drift shall not affect accuracy by more than an additional plus or minus 0.01 percent per degree Celsius.

6. Electronic panel instruments shall be able to operate from 120 volts AC plus or minus 10 percent, 60 Hertz, and 24 volts DC plus or minus 10 percent power supply. Instruments in the same panel shall be powered from the same power supply.
7. Panel instruments shall be capable of providing loop power (nominally 24 volts DC) for all analog inputs and outputs. Signal circuits and power supply circuits shall be galvanically isolated from each other and the instrument case.
8. Operating temperature range shall be from 40 degrees Fahrenheit to 120 degrees Fahrenheit and relative humidity to 90 percent noncondensing.
9. Panel instrument enclosures shall be NEMA 4X unless otherwise specified.

B. Indicating Lights:

1. Manufacturers: One of the following or equal:
 - a. Allen-Bradley 800T-QTH10.
 - b. Eaton Corporation.
 - c. Cutler Hammer Products, Type T.
 - d. General Electric Company, Type CR.
2. Heavy-duty, oil-tight type, which utilizes a 6 VDC lamp and a built-in transformer. Engrave legends on the lens or on a legend faceplate. Lamps shall be easily replaceable from the front of the indicating light.
3. Integrate a push-to-test feature with each indicating light, or a common test of all panel indicating lights.

C. Selector Switches:

1. Manufacturers: One of the following or equal:
 - a. AB 800T-N2KN4B.
 - b. Eaton Corporation.
 - c. Cutler Hammer Products, Type T.
 - d. General Electric Company, Type CR.
 - e. Allen-Bradley Company.
2. Selector Switches: Heavy duty oil-tight type with gloved-hand or wing lever operators. Engrave position legends on switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 volts AC.
3. Contact Configuration: Switches used in electronic circuits shall have contacts with a minimum rating of 2 amperes.

D. Indicating Selector Switches:

1. Manufacturers: One of the following or equal:
 - a. AB 800T GJR2KB7AX.
2. Multi-light oil-tight with cover plates as indicated on the Drawings or as required for the application.

2.02 PANEL DEVICES

A. Horn:

1. Manufacturers: One of the following or equal:
 - a. Panalarm Division of Ametek, Inc.
 - b. BETA Products.

2. Furnish audible alarm device and a 24 volts DC power supply. Where indicated on the Drawings, furnish separately mounted pushbuttons, flasher unit, and a horn with adjustable volume range of 78 to 103 decibels.

B. Control Relays:

1. Manufacturers: One of the following or equal:
 - a. AB700-HT series for current above 6 amp and AB700-HL series for 6 amps and below.
 - b. Eagle Signal Controls, Series 22 or 80.
 - c. Manufacturers of Struthers-Dunn, Inc., Series A3 or A4.
2. Provide control relays indicated in instrument and control panels and enclosures with plug-in socket base type with dustproof plastic enclosures.
3. Relays: Relays shall function as indicated on the Drawings, in accordance with design requirements, and with not less than 4 pole, Form "C" double-throw contacts.
4. Control circuit relays shall have silver-cadmium oxide contacts rated for 10 amperes at 120 volts AC.
5. Electronic switching-duty relays shall have gold-plated or gold alloy contacts suitable for use with low level signals.
6. Relays utilized for computer input, alarm input, or indicating light service shall have contacts rated not less than 5 amperes.
7. Time delay relays shall have dials or switch settings engraved in seconds, with timing repeatability of plus or minus 2.0 percent of setting.
8. Provide latching and special purpose relays as indicated for the specific application.
9. Relays shall have a built-in lamp, LED or neon, to indicate an energized relay.

C. Audible and Visual Alarm Devices (for vendor furnished LCP):

1. Manufacturers: One of the following or equal:
 - a. Federal Signal Corporation.
 - b. Edwards Company, Inc.
2. Provide a nominal 4 inch 120 volts AC vibrating 65 decibels to 110 decibels adjustable volume industrial grade weather resistant device as required by the panel layout, schematic diagram, or 1 line diagram.
3. Provide a nominal 5 inch diameter red flashing strobe alarm light, 200 watt, where indicated on the panel layout, schematic diagram, or 1 line diagram.
4. Power requirements: 120 volts AC or 24 volts DC per the Drawings.

2.03 SIGNAL CONDITIONING MODULES

A. Requirements:

1. Signal conditioning modules and converters shall be of industrial grade, high quality instruments. Modules shall be of a plug-in circuit board design. Converters shall be mounted in a common 19-inch rack with a common power supply for powering the rack.
2. External power supply for the rack shall be 24 volts DC plus or minus 10 percent or 120 volts AC plus or minus 10 percent, 60 Hertz with internal power supply of 24 volts DC.
3. Analog input signals shall be 4 to 20 milliamperes DC into 50 ohms or 1 to 5 volts DC into 1 Mohm input impedance.
4. Analog output signals shall be 4 to 20 milliamperes into 0 to 600 ohms or 1 to 5 volts DC into 20 Kohm.

- 5. Discrete output contacts shall be double-pole double-throw rated 5A at 120 volts AC or 28 volts DC.
- 6. Electronic trips shall make output contacts to open in case of loss of signal or power supply.
- 7. Span and zero adjustments shall be made by front mounted multi-turn potentiometers.
- 8. Electronic trip modules shall be provided with LEDS for relay status indication.
- 9. Signal terminals and power supply terminals shall be galvanically isolated.
- 10. Converters shall be provided with radio frequency interference (RFI) traps to shunt conducted radio interference to ground.
- 11. Converter outputs shall be galvanically isolated from the input circuits.
- 12. Temperature rating shall be 0 degrees Celsius to 120 degrees Celsius for specified performance.
- 13. Individually mounted signal conditioning modules shall be able to operate from a 24 volts DC plus or minus 10 percent or 120 volts AC plus or minus 10 percent, 60 Hertz power supply.
- 14. Signal conditioning modules shall be the product of one manufacturer.
- 15. Manufacturer shall be Action Industries, Slim Pac series to match the plant existing devices.

B. Current-to-Current Converters (for vendor furnished LCP's):

- 1. Manufacturers:
 - a. Action Industries, Slim Pac series to match.
- 2. Solid-state or microprocessor circuitry with electrical isolation between the power supply, the input signal, and the output signal.
- 3. Each current-to-current converter shall be designed to accept 4 to 20 milliamperes DC analog input and produce an identical 4 to 20 milliamperes DC output signal. Input and output(s) shall be galvanically isolated. Input impedance shall be 50 ohm and output driving impedance shall be 0 to 650 ohm.
- 4. Accuracy shall be within plus or minus 0.1 percent of span with temperature effect within plus or minus 0.0025 percent of span per degree Fahrenheit. Power supply effect shall not exceed plus or minus 0.05 percent of span.

2.04 POWER SUPPLIES AND CONDITIONING EQUIPMENT

A. General Requirements:

- 1. Solid-state electronic instrumentation loads shall be supplied with AC power which has been conditioned to suit the instrumentation manufacturer's specified requirements. Power supplies to panels housing electronic instrumentation shall include a noise isolation transformer.
- 2. This provision is not necessary where the electronic instrumentation includes an integral isolation transformer or equivalent noise isolation is provided by an alternative UPS power supply conditioning device.

B. Noise Isolation Transformers:

- 1. Manufacturers: One of the following or equal:
 - a. Topaz/Square D Company.
 - b. Cutler-Hammer.
 - c. Cooper Industries.
- 2. Noise isolation transformers shall be of the triple box shield type. Each coil shall be completely enclosed in a grounded conductive faraday shield, and the

overall transformer enclosed in a faraday shield. Common mode noise attenuation between primary and secondary shall exceed 130 decibels at up to 100 KHz. Transverse mode noise attenuation shall exceed 20 decibels at up to 100 KHz. Isolation transformer dielectric strength shall be 2,500 volts minimum.

3. Isolation transformers serving panel boards and control panels shall have a load capacity not less than 200 percent of the connected load. Isolation transformers serving individual instruments shall have a load capacity not less than 125 percent of the connected load. Loss in the isolation transformer shall not exceed 2 percent of the maximum load rating.
4. Harmonic distortion introduced by the isolation transformer shall not exceed 0.1 percent. Three phase units shall be 4-wire Y connected and capable of supporting 100 percent unbalanced load.

C. Direct Current Power Supplies:

1. Manufacturers: One of the following or equal:
 - a. Lambda Electronics, Inc.
 - b. Solar Power Supplier SDN 5-24-150P.
2. Direct current power supply units shall be switching type. Line regulation shall not exceed plus or minus 0.4 percent for 95 to 132 volts AC input variation. Load regulation shall not exceed plus or minus 0.2 percent for 0 to 100 percent load variation. Ripple shall not exceed 150 millivolts peak to peak. Temperature coefficient shall not exceed 0.03 percent per degree Celsius.
3. Automatic adjustable overvoltage shutdown and overtemperature protection shall be included. An integral or external undervoltage relay shall provide an alarm on undervoltage, overvoltage, or overtemperature. Transient voltage response to a 50 percent step change in load shall not exceed 0.25 volts or plus or minus 0.1 percent after 20 milliseconds. Hold-up time shall be 16.7 milliseconds or greater. Efficiency shall be 75 percent or greater. Conducted electro-magnetic interference (EMI) shall conform to FCC Docket 20780, Class A. Radiated EMI shall be minimized with suitably designed screened enclosures.
4. 24 volt nominal power supply systems shall be of redundant configuration and shall provide 26.4 volts at the distribution terminals at no load. An allowance for voltage drop across redundant unit isolation diodes will typically necessitate the selection of 28 volt nominal power supply units with outputs adjusted to suit. The capacity of each unit shall be 50 percent greater than the maximum system connected load.
5. Internal built-in switchable from single to parallel mode without using an external diode circuitry.

D. Uninterruptible Power Supplies (UPS):

1. Manufacturers: One of the following or equal:
 - a. Sola.
 - b. Best Power Technology, Inc.
 - c. Emerson Industrial Controls.
 - d. Topaz/Square D Company.
2. General Requirements: The UPS shall be configured as a single channel, normally on-line, with automatic bypass switching on channel failure, and with manual bypass switching for maintenance. The UPS shall include rectifier/battery charger, batteries, inverter, static transfer switch, and solid state controls and shall be pulse width modulation (PWM) technology.

3. Input Voltage: Single phase, 120 volts AC plus or minus 10 percent, without reduction in DC bus voltage; 120 volts AC minus 20 percent without drawing DC power from batteries.
4. Input Frequency: 60 Hertz.
5. Output Voltage: Single phase, 120 volts AC plus or minus 5 percent for line and load changes.
6. Output Harmonic Distortion: Not greater than 5 percent (voltage) total.
7. Output Frequency: 60 Hertz plus or minus 0.5 percent free-running; 60 Hertz plus or minus 2 percent synchronized.
8. Static Switching Response Time: Not greater than 4 milliseconds.
9. KVA Rating: Not less than 150 percent of connected load. 1 KVA.
10. KVA In-Rush Rating: 1.5 x total connected load in-rush.
11. Battery Capacity: 30 minutes minimum.
12. Noise Emission: Not greater than 60 decibels at 1 meter.
13. Batteries shall be sealed, no maintenance type, designed for 5 years minimum service.
14. An output distribution board shall have a minimum of 6 circuit breakers suitably rated for the application.
15. Displays Shall Include: On-line or bypass mode, input power failure, UPS fault, UPS overload, battery discharging, UPS input volts, UPS output volts, UPS output percent load.
16. Common fault alarm output dry contacts (open on alarm).
17. Bypass mode alarm output dry contacts (open on alarm).
18. The UPS manufacturer shall provide a 1 year 24 hour field service warranty.

2.05 MINITREND ELECTRONIC RECORDERS

- A. Manufacturer shall be Honeywell. Model number shall be Honeywell EW-80661-36.
- B. Technical Requirements:
 1. Password protect electronic data for 21CFR Part 11 Compliance. Four levels of password protection and up to 10 different password options shall be provided.
 2. Up to 16 universal analog inputs enable process monitoring from multiple sensors.
 3. Date integrity shall be maintained by storing data in secure files based on pen designation. Data retrieval shall be simple and easy.
 4. Display: 5-1/2-inch color LCD display.
 5. Provide the operator interface, which shall provide easy access to the recorder menus for quick set up and replaying if date. A real time clock shall automatically stamp time and date of all logged data.
 6. Recording: The data shall be monitored if no changes and observed the data is only logged periodically. If the data is changing rapidly, it shall be recorded normally at the programmed rate. Data compression shall be used up to 100:1.
 7. Backup: A 4 MB EEPROM battery powered back up shall prevent the loss of data in the event of power interruption or loss.
 8. Logging rate and display rate shall be independently programmable allowing data to be displayed and stored at the rates that best suit the application.
- C. See electrical drawings and mechanical drawings for the property grouping of input signals to a recorder or more than one recorder to suit the project need. Recorder and input signal field devices shall not be longer than 550 feet.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are satisfactory for installation of products.

3.02 DEMONSTRATION

- A. Demonstrate operation of equipment.

3.03 PROTECTION

- A. Protect products until acceptance by OWNER.

END OF SECTION

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SECTION 17429

MISCELLANEOUS INSTRUMENTS AND ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Permanently installed control system instruments not specified in other Sections.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. C 37-90a - Relays and Relay Systems Associated with Electrical Power Apparatus.

1.03 SUBMITTALS

- A. Product Data: Include factory and field data calibration data sheets for instruments requiring field set-up and calibration.
- B. Shop Drawings: Include connection diagrams.
- C. Manufacturer's Installation Instructions.

1.04 MAINTENANCE

- A. Maintenance Service: Contract with OWNER to Provide maintenance service at mutually agreed upon terms.

PART 2 PRODUCTS

2.01 FIELD-MOUNTED DIGITAL PROCESS INDICATORS

- A. Manufacturers: One of the following or equal:
 - 1. Action Instruments, Model V460.
 - 2. Yellow Springs Instruments, Model 4400.
 - 3. Fischer and Porter, equivalent product.
 - 4. Leeds and Northrup, equivalent product.
- B. Features and Characteristics:
 - 1. Loop powered 2 wire, 24 volt direct current that accepts 4-20 milliampere direct current input.
 - 2. NEMA 4X corrosion-resistant weatherproof housing with operating ambient temperature range from minus 10 to 55 degrees Celsius.
 - 3. Scales in engineering units.
 - 4. Nameplate describing function and scale units.
 - 5. Liquid crystal diode, 3-1/2 digit digital display with accuracy of 0.1 percent, nominal 0.8 inch high.

6. NEMA 4X enclosure.

2.02 FLOW RATE AND FLOW TOTAL INDICATORS

- A. Manufacturers: One of the following or equal:
 1. Signet Scientific.
- B. Features and Characteristics:
 1. Loop powered 2-wire, 24 volt direct current that accepts 4-20 milliampere direct current input.
 2. Engineering unit calibration with accuracy to within 2 percent and repeatability of 1 percent of full scale.
 3. Ambient operating temperature range of 0 to 60 degrees Celsius.
 4. Square root extraction within transmitter where indicated on the Drawings.

2.03 LOCAL TRANSMITTER INDICATORS

- A. Manufacturers: One of the following or equal:
 1. Signet Scientific.
- B. Features and Characteristics:
 1. Loop powered 2-wire, 24 volt direct current that accepts 4-20 milliampere direct current input.
 2. NEMA 4X corrosion-resistant housing.
 3. Minimum 2 inch scale with accuracy of within 2 percent, matching transmitter range or span, and calibrated in engineering units, not percentages.

2.04 ELECTRICAL TRANSDUCERS

- A. Manufacturers: One of the following or equal:
 1. General Electric Company.
 2. Cutler-Hammer.
 3. Square D Company.
 4. Crompton Instrument-Paladin.
- B. Features and Characteristics:
 1. Root mean square current, root mean square voltage, active power in watts, volt-ampere reactive power, apparent volt-ampere power, frequency, phase angle, and integrating current (maximum demand) as indicated on the Drawings.
 2. Input capacity to accept zero to 5 amperes current and zero to 120 volt alternating current voltage.
 3. Output capacity of 4-20 milliamperes direct current into zero to 500 ohm load.
 4. Able to withstand surges in accordance with ANSI C 37-90a where applicable.

2.05 2 VALVE MANIFOLDS

- A. Manufacturers: One of the following or equal:
 1. Anderson Greenwood and Co., Model PTM.
- B. Features and Characteristics:
 1. Type 316 stainless steel construction.

2. 1/2 inch national pipe thread process connection and bleed/calibrate valve between block valve and outlet port.

2.06 3 VALVE MANIFOLDS

- A. Manufacturers: One of the following or equal:
 1. Anderson Greenwood and Co., Model N4T.
 2. HEX, Model HIM53.
- B. Features and Characteristics:
 1. Made with Type 316 stainless steel with Teflon stem packing.
 2. 1/2 inch National Pipe Thread process and purge connections, unless specified otherwise.
 3. 1/8 inch National Pipe Thread water purge connections.

2.07 ROOT VALVES

- A. Manufacturers: One of the following or equal:
 1. Anderson Greenwood, Model M5.
 2. Hoke, Model 6800.
- B. Features and Characteristics:
 1. Made with Type 316 stainless steel.
 2. One 1/2 inch National Pipe Thread male process connections.
 3. Three 1/2 inch National Pipe Thread female instrument connections, one with bleed valve and unused ports with plugs.
 4. Extended for installation on insulated pipes and vessels.

2.08 GAUGE VALVES

- A. Manufacturers: One of the following or equal:
 1. Anderson Greenwood, Model H1.
 2. Hoke, Model 2100.
- B. Features and Characteristics:
 1. Made with Type 316 stainless steel.
 2. Globe or angle pattern.
 3. Two 1/2 inch National Pipe Thread ports.

2.09 DIAPHRAGM SEALS

- A. Manufacturers: One of the following or equal:
 1. Dresser Industrial Valve and Instrument, Ashcroft Type 101.
 2. Ametek, Inc., Mansfield and Green Division, Type AG.
- B. Features and Characteristics:
 1. Type 316 stainless steel diaphragm and bottom housing, unless otherwise specified.
 2. Bottom housing fitted with flushing connection, Type 316 stainless steel close nipple and valve cock.
 3. Silicone oil fill fluid.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install two 2-valve instrument manifolds for each gauge pressure transmitter.
- B. Bolt 3 valve manifolds at non-flange diaphragm type differential pressure transmitters in place of standard flange adapters.
- C. Install root valves at process taps except insertion elements.
- D. Install gauge valves on process connections to instruments where multiple instruments are connected to one tap or here root valves are not readily accessible.

END OF SECTION

SECTION 17442
INSTRUMENT AND CONTROL PANELS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Additions to existing PLC control panels, as necessary for the monitoring of secondary clarifiers equipment.

1.02 REFERENCES

- A. National Electrical Code (NEC): Article 250 Grounding.
- B. National Electrical Manufacturer's Association (NEMA):
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
- C. Instrument Society of America (ISA):
 - 1. ANSI/ISA-S5.4 Instrument Loop Diagrams.

1.03 SYSTEM DESCRIPTION

- A. The existing PLC panel was manufactured in about 1998, and it includes an Allen Bradley PLC5-30.
 - 1. The existing PLC panel controls the existing Secondary Clarifiers No. 1 through No. 5, the RAS pump station, the WAS pumps, the mixed liquor pumps, the Reuse water pumps, the Chlorine Contact Basins and other plant processes.
 - 2. The panel shall be maintained in continues operation during the addition of points associated with monitoring the Secondary Clarifiers No. 1 and No. 2.
 - 3. Provide additional I/O control modules for the connection of new associated monitoring points.
 - 4. Provide necessary surge protective devices for each additional points connected to the PLC panel.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Internal interconnecting wiring diagrams showing terminal strips and all external devices connected to the panel as specified in Section 17410, design submittal for loop and schematic diagrams.
 - 2. Complete schematic and diagrams including terminal block and wire identification numbers and device location symbols consistent with the Contract Documents.
 - 3. Complete schematic and diagrams including terminal block and wire identification numbers and device location symbols consistent with the Contract Documents.
 - 4. Panel bill of material with detailed description of components and equipment data sheets.
 - 5. Field cable number/I.D. and terminations.

6. Factory data sheets for instrumentation.

1.05 QUALITY ASSURANCE

- A. Loop Field Tests.
- B. Verification of satisfactory performance for points associated with Secondary Clarifiers No. 1 and No. 2

PART 2 PRODUCTS

2.01 PANEL MODIFICATION

- A. The general fabrication requirements for the instrument and control panels including enclosures and sub-panels shall be as specified herein.
- B. Interconnecting wiring and wiring to terminals for external connection shall be MTW or SIS 16 AWG, stranded copper wire, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 degrees Celsius except for electronic circuits and special instrument interconnect wiring which shall be in accordance with manufacturer requirements.
- C. Panel Wiring Size:
 1. Power distribution wiring on line side of panel fuses minimum 12 AWG.
 2. Secondary Power Distribution Wiring and Wiring for Control Circuits: Minimum number 14 AWG.
 3. Annunciator and Indicating Light Circuits: Minimum 18 AWG (within panel).
 4. Electronic Analog Circuits Within Instrument and Control Panels: Minimum 18 AWG twisted and shielded pairs or triads rated not less than 600 volts.
- D. Analog Circuits and AC Power Circuits: Separated.
- E. Internal Panel Wiring Colors:
 1. AC Power Distribution: Red
 2. DC Power and Control: Blue
 3. Instrument: Black and white twisted shielded pair.
 4. Other and in agreement with manufacturer's wiring diagrams as stated on manufactured drawing legend.
- F. Surge Protection Device for Power Entrances: Nominal 120 volts AC with a nominal clamping voltage of 200 volts; nonfaulting and noninterrupting design with a response time of not more than 5 nanoseconds.
- G. Terminal Blocks for External Connections: Suitable for specified AWG wire, rated 30 amperes at not less than 600 volts; with marking strip, covers, pressure connectors, and labeled terminals, each conductor of external circuits plus one ground terminal for each shielded cable. Provide minimum 25 percent spare terminals.
- H. Group cables, and firmly support wiring to the panel. Provide minimum 8 inches clearance between terminal strips and the base of vertical panels for conduit and

wiring space. Individually fuse each control loop or system, and clearly label and locate fuses or circuit breakers for maintenance.

- I. Furnish and install equipment grounding conductor in accordance with NEC 250. Provide power ground lugs. Provide signal insulated and isolated ground lugs.
- J. Nameplates on Internal and External Instruments and Devices: Materials approximate dimensions with legends as indicated on the Drawings made of laminated phenolic material having engraved letters approximately 3/16 inch high extending through the black face into the white layer; firmly screwed to panels with stainless steel fasteners. No penetration through the panel front will be permitted. Refer to Section 17410.
- K. Fabricated Custom Panels: Thoroughly clean, sand, and apply minimum 2 coats of rust inhibiting primer both inside and out of panels. Apply minimum 2 coats of white enamel or lacquer on panel interior surfaces. Smooth exterior surfaces and apply minimum 2 coats of enamel, polyurethane, or lacquer finish. Furnish 2 quarts of finish color paint with the panels to cover future scratches.
- L. Provide panels with an inside pocket to hold the panel drawings. Ship panels with 1 copy of accepted submittal drawings in a sealed plastic bag stored in the panel drawing pocket.

2.02 EXISTING PANEL MODIFICATIONS

- A. Provide labor and materials for complete modifications to existing panels as specified herein and indicated on the Drawings.
- B. Design and arrange regulated 24 volt DC power supplies for instrument loops so that loss of 1 loop does not affect more than 1 instrument loop or system. Provide power supplies suitable for an input voltage variation of plus or minus 10 percent. Fuse or short circuit protect the supply output.
- C. Selectively fuse the power distribution from multi-loop supplies so that a fault in one instrument loop will be isolated from the other loops being fed from the same supply. Label and locate fuses for easy access.
- D. Output Voltage Regulation: As required by the instrument or control equipment being supplied.
- E. Backup power supply units shall be provided to automatically supply the load upon failure of the primary supply. Provide redundant backup power supply systems so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation.
- F. Provide 2 SOLA SDN 5-24-100P and 1 SOLA SDN2.5-20RED, which allows parallel connection without installing an external diode bridge.
- G. Over size the multi-loop supply systems for an additional 25 percent future load. Indicate failure of a multi-loop supply on the respective instrument panel or enclosure.

H. Furnish and install signal repeaters for instrument loops that exceed the load impedance of the power supplies. Indicating fuses: Neon bulb type for 120 VAC circuit and glass indicating fuse type for 24 VDC circuits.

2.03 PANEL ACCESSORIES

A. Surge Protectors:

1. Manufacturers: One of the following or equal:
 - a. Transector ACP-100 BW.
 - b. Power Integrity Corporation ZTAS.
 - c. Entrelec.
 - d. Weidmuller.
 - e. Phoenix Contact.

B. Terminal Blocks:

1. Manufacturers: One of the following or equal:
 - a. Allen-Bradley.
 - b. Entrelec.
 - c. Phoenix Contact.
 - d. Wago.
2. Nickel plated copper only; DIN rail; universal foot with the following as required for the application:
 - a. Universal type.
 - b. Feed through.
 - c. Ground.
 - d. Neutral disconnect.
 - e. Intrinsically safe.
 - f. Explosion-proof.
 - g. Fuse.
 - h. Knife disconnect.
 - i. Ground fault indicator.
 - j. Bolt connecting.
3. Terminal Block Labeling: Each terminal and each conductor as previously specified with machine labels only.

C. Signal Interface Modules:

1. Manufacturers: One of the following or equal.
 - a. Phoenix Contact.
 - b. Entrelec.
 - c. Action.
2. Analog isolating converter.
3. Ground loop isolations.
4. Signal amplification.
5. Signal level matching.
6. 24 VDC power supply (120 VAC input).

D. Fiber Patch Panels: The fiber patch panel shall be for cabinet mounting and include the necessary fiber connectors for incoming cable and outgoing patch cords. Patch panels shall be manufactured by Corning Cable Systems or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install gasket and sealing material under panels with floor slab cutouts for conduit. Undercoat floor mounted panels.
- B. Install conduit gasket, sealing material, and NEC Article 500 Seal-Off as specified in Division 16.
- C. CONTRACTOR shall install grounding conductor and grounding electrode as required by the panel manufacturer.
- D. Connect panel equipment grounding (safety) terminal to the building or facility ground grid with 6 AWG green insulated conductor.
- E. No panel penetrations shall be made in the top of a panel. Conduit connections to panel shall be made by using "O" ring Myers hub with bonding screw nut and maintain spacing per UL recommendations.

3.02 PROTECTION

- A. Protect products until acceptance by OWNER.

END OF SECTION

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SECTION 17444

I/O LIST

PART 1 GENERAL

1.01 SUMMARY

- A. See P&IDs drawings, electrical drawings, control strategies and packaged systems related shop drawings for the actual I/O requirements and materials take-off, for connections to existing PLC terminal blocks and control modules.
- B. All signal originating devices, when connected to PLC, shall be labeled as either DI (Digital input or contact input) or AI (Analog input). There are cases where input devices originating from electrical discipline, such as an electrical starter run "M" contacts which do not have instrument tag, then the recipient device will be labeled as DI to count as one digital input for the project.
- C. See additional I/O points related to electrical equipment. At the existing PLC panel provide the required I/O connections.
- D. There are also cases where the input to PLC cannot be shown as a separate signal (to avoid the signal congestion on P&IDs). The recipient device will be listed as a DI to count as one digital input.
- E. Consider 2 digital (contact) outputs for dual modes of operation, such as "Opening" and "Closing" modes of operation for a motorized valve or a motorized gate.
- F. Pilot lights are usually shown without any tag numbers. Provide appropriate type of DO modules for indication or alarming functions.
- G. Special care and attention is needed when reading P&IDs, especially regarding to incidental or auxiliary control items like temperature instruments. Due to limited available space on P&ID, all auxiliary, temperature and related instruments are not shown for clarity.
- H. Whenever multiple process trains are involved, for clarity tables will be used in lieu of one train per drawing. The second train related instruments will no longer appear. Follow the notes and table for the proper material take-off and I/O count. However for OIS (Operator Interface Station) or HMI (Human Machine Interface) usage, configure and program all and provide graphic display screens on a one screen/train approach.

1.02 I/O LIST

- A. I/O List attached.

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SECTION 17452

PROGRAMMABLE LOGIC CONTROLLER SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Additions to existing solid state programmable controller and PLC cabinet

1.02 SUBMITTALS

- A. Shop Drawings and Product Data: Include description of components, methods of connecting components, and the following:
 - 1. Copy of additions and /or revisions to the programmable logic controller program on CDs.
- B. Statement of Installation Engineer's Training and Experience: Submit in accordance with requirements for and with Product Data.
- C. Operating and Maintenance Manuals. Include the following:
 - 1. Programming procedures.
 - 2. System specifications.
 - 3. Electrical power requirements.
 - 4. Application considerations.
 - 5. Explanation of internal fault diagnostics.
 - 6. Assembly and installation procedures.
 - 7. Troubleshooting procedures.
 - 8. Powering up procedures.
 - 9. Shutdown procedures.
 - 10. Recommend spare parts list.

1.03 QUALITY ASSURANCE

- A. Existing PLCs are Allen-Bradley SLC-500 Series at the Main Electrical Building
- B. Programming Qualifications and Services:
 - 1. Contractor shall provide services for testing all control loops and any additional services necessary, to verify adequate termination of new wiring in existing PLC cabinet.
 - 2. All software /programming services in existing PLC controllers and SCADA computer will be provided by Owner.
- C. Provide a single source responsibility for terminating new wiring in programmable logic controller system
- D. Design and test the additions to the programmable logic controller system to operate in an industrial environment per NEMA Standard UCS 2-230 (Arc Test) and IEEE C37.90a CSWC.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Environmental Rating for Components of the Programmable Logic Controller System, Except the Programming Equipment:
 - 1. Humidity: Maximum 95 percent, non-condensing.
 - 2. Ambient Temperature:
 - a. Operational: Zero to 60 degrees Celsius.
 - b. Storage: Minus 40 to 80 degrees Celsius.
- B. Electrical Service: 120 VAC, single phase, 50/60 Hertz.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Existing Programmable Logic Controller System:
 - 1. Allen-Bradley SLC500 Series

2.02 PROGRAMMABLE LOGIC CONTROLLER SYSTEM DESCRIPTION

- A. Existing PLC is Allen-Bradley Contrologix 1756 system, with appropriate DH+ communication module .

2.03 FIELD WIRING CONNECTORS AND TERMINAL BLOCKS

- A. I/O Connectors: Attached directly to I/O housings so that modules can be quickly and easily removed without disturbing or flexing the field wiring; with screw terminals. Model number shall be 1492-ACABLE XX Series or 1492-CABLE-XX Series.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install devices related to the programmable logic controller system in accordance with the programmable logic controller manufacturer's instructions and recommendations, including grounding specifications.

3.02 FIELD QUALITY CONTROL

- A. Perform conducted susceptibility (RFI, EMI) test as outlined in NEMA ICS 2-230, NEMA ICS 3-304-42, section 2 of IEEE 472-1974 and ANSI C37.90A-1974.
- B. Subject completed programmable logic controller units to a burn-in test of 60 degrees Celsius for at least 96 hours.

3.03 DEMONSTRATION

- A. Establish a mutually agreed upon time for demonstrations with the ENGINEER.

- B. Deliver written notification of demonstrations to ENGINEER at least 7 days before demonstrations. Include an agenda for the demonstration and testing procedures with notification.
- C. Demonstrate functional operation of programmable logic controller system hardware and logic program at system assembly location prior to shipment.
- D. Demonstrate full functional operation of programmable logic controller system hardware and logic program at the Project jobsite when fully integrated to the field I/Os.

END OF SECTION

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STATEMENT OF NO BID

If you do not intend to bid please complete and return this form immediately to:

Manatee County Purchasing
1112 Manatee Avenue West, Suite 803
Bradenton, Florida 34205

We, the undersigned, have declined to bid on Bid No.: 11-2873DC SWWRF Clarifier 1 and 2 Rehabilitation for the following reason(s):

- Specifications too restrictive, i.e., geared toward one brand or manufacturer.
- Insufficient time to respond
- We do not offer this product or service
- Our schedule would not permit us to perform
- Unable to meet specifications
- Unable to meet Bond requirement
- Specifications unclear (explain below)
- Unable to meet insurance requirements
- Remove us from your "Bidders List"
- Other (specify below)

REMARKS:

We understand that if we do not submit a Bid and this Statement of No Bid is not executed and returned, our company may not be contacted by you for this commodity or service.

Company Name: _____

Company Address: _____

Telephone: _____ Fax: _____

Date: _____

Signature: _____

(Print or type name and title of above signer)

email address: _____