IFBC NO. 20-TA003182AJ
LAKE MANATEE WTP SCADA SYSTEM REPLACEMENT
PROJECT NO. 6042370
(910-17)
October 10, 2019

Manatee County BCC
Procurement Division
1112 Manatee Avenue West Ste 803
Bradenton, FL 34205
purchasing@mymanatee.org

ADVERTISEMENT

INVITATION FOR BID CONSTRUCTION, NO. 20-TA003182AJ
LAKE MANATEE WTP SCADA SYSTEM REPLACEMENT

Manatee County, a political subdivision of the State of Florida (hereinafter referred to as County), will receive sealed bids from individuals, corporations, partnerships, and other legal entities authorized to do business in the State of Florida, to provide Lake Manatee Water Treatment Plant (WTP) Supervisory Control and Data Acquisition (SCADA) System Replacement , as specified in this Invitation for Bid Construction to include installing a new SCADA system and removal of the existing HSQ Technology SCADA system at the Lake Manatee WTP and remote facilities.

DATE, TIME AND PLACE DUE:
The Due Date and Time for submission of Bids in response to this IFBC **is November 14, 2019 at 3:00 P.M. ET.** Bids must be delivered to the following location: Manatee County Administration Building, 1112 Manatee Ave. W., Suite 803, Bradenton, FL 34205 prior to the Due Date and Time.

SOLICITATION INFORMATION CONFERENCE:
A mandatory Information Conference will be held at 9:00 AM on October 21, 2019, at the Lake Manatee Water Treatment Plant, 17915 Waterline Road, Bradenton, FL with mandatory site tours to follow at the locations listed below:

- Lake Manatee Water Treatment Plant, 17915 Waterline Road, Bradenton, FL
- Elwood I Booster Pump Station, 4825 44th Ave E, Bradenton, FL
- Cortez Elevated Tank, Corner of 59th St W @ Cortez, Bradenton, FL

All persons driving a vehicle that enters the Water Treatment Plant (WTP) facility for the Information Conference and site tour shall present a valid driver's license to the County representative. All persons entering the facility for the Information Conference and site tour as a passenger shall present a state issued photo identification to the County representative. Only those individuals meeting these requirements will be granted entry into the WTP facility to attend the mandatory Information Conference and site tour.

NOTE: Attending the mandatory information conference and the mandatory site tour is optional if you attended the Information Conference and site tours that were held in July 2019 for cancelled IFBC 19-TA003016AJ.

DEADLINE FOR QUESTIONS AND CLARIFICATION REQUESTS:
The deadline to submit all questions, inquiries, or requests concerning interpretation, clarification or additional information pertaining to this Invitation for Bid Construction to the Manatee County Procurement Division is October 31, 2019. Questions and inquiries should be submitted via email to the Designated Procurement Contact shown below.

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

DESIGNATED PROCUREMENT CONTACT: Abigail Jenkins, Sr. Procurement Agent, Construction
(941) 749-3014 X 3062, Fax (941) 749-3034
Email: abigail.jenkins@mymanatee.org
Manatee County Financial Management Department
Procurement Division

AUTHORIZED FOR RELEASE: Chris Daley, CPPO, CPPB

Digitally signed by Chris Daley, CPPO, CPPB
DN: cn=Chris Daley, CPPO, CPPB, o=manatee County Government, ou=Procurement Manager, email=chris.daley@mymanatee.org, c=US
Date: 2019.10.09 16:46:17 -04'00'

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SECTION A, INFORMATION FOR BIDDERS

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

A.01 BID DUE DATE

The Due Date and Time for submission of Bids in response to this Invitation for Bid (IFBC) **is November 14, 2019 at 3:00 P.M. ET.** Bids must be delivered to the following location: Manatee County Administration Building, 1112 Manatee Ave. W., Suite 803, Bradenton, FL 34205 and time stamped by a Procurement representative prior to the Due Date and Time.

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

A.02 SOLICITATION INFORMATION CONFERENCE:

A mandatory Information Conference will be held at 9:00 AM on October 21, 2019, at the Lake Manatee Water Treatment Plant, 17915 Waterline Road, Bradenton, FL with mandatory site tours to follow at the locations listed below:

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NOTE: Attending the mandatory information conference and the mandatory site tour is optional if you attended the Information Conference and site tour that was held in July 2019 for IFBC cancelled IFBC 19-TA003016AJ.

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

A.03 PUBLIC OPENING OF BIDS

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

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

A.04 SUBMISSION OF BIDS

The contents of the Bid sealed package must include:

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

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

Submit the Bid package in a sealed container with the following information clearly marked on the outside of the package: IFBC No. 20-TA003182AJ, Lake Manatee WTP SCADA System Replacement , Bidder’s name, and Bidder’s address. Bids must be delivered to the Manatee County Procurement Division prior to the Due Date and Time at the following address:

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

A.05 DISTRIBUTION OF SOLICITATION DOCUMENTS

All documents issued pursuant to this IFBC are distributed electronically and available for download at no charge at www.mymanatee.org > *Bids and Proposals.* Documents may be viewed and downloaded for printing using Adobe Reader® software.

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

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

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

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

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

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

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

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

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

A.07 ADDENDA

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

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

A.08 BID FORMS

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

A.09 BID EXPENSES

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

A.10 QUESTION AND CLARIFICATION PERIOD

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

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

A.11 FALSE OR MISLEADING STATEMENTS

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

A.12 CONFIDENTIALITY OF SECURITY RELATED RECORDS

a. Pursuant to Florida Statutes § 119.071(3), the following records (hereinafter referred to collectively as "the Confidential Security Records") are confidential and exempt from the disclosure requirements of Florida Statutes § 119.07(1):

   i. A Security System Plan or portion thereof for any property owned by or leased to County or any privately owned or leased property held by County.
   ii. Building plans, blueprints, schematic drawings, and diagrams, including draft, preliminary, and final formats, which depict the internal layout and structural elements of a building, arena, stadium, water treatment facility, or other structure owned or operated by County.
   iii. Building plans, blueprints, schematic drawings, and diagrams, including draft, preliminary, and final formats, which depict the internal layout or structural elements of an attractions and recreation facility, entertainment or resort complex, industrial complex, retail and service development, office development, or hotel or motel development in the possession of, submitted to County.

b. Successful Bidder agrees that, as provided by Florida Statute, it shall not, as a result of a public records request, or for other reason disclose the contents of, or release or provide copies of the Confidential Security Records to any other party absent the express written authorization of County's Property Management Director or to comply with a court order requiring such release or disclosure. To the extent successful Bidder receives a request for such records, it shall immediately contact the County's designated Contract administrator who shall coordinate County's response to the request.

A.13 LOBBYING

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

A.14 UNBALANCED BIDDING PROHIBITED

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

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

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

A.15 FRONT LOADING OF BID PRICING PROHIBITED

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

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

A.16 WITHDRAWAL OR REVISION OF BIDS

Bidders may withdraw Bids under the following circumstances:

a. If Bidder discovers a mistake(s) prior to the Due Date and Time. Bidder may withdraw its

Bid by submitting a written notice to the Procurement Division. The notice must be received in the Procurement Division prior to the Due Date and Time for receiving Bids. A copy of the request shall be retained, and the unopened Bid returned to the Bidder; or

b. After the Bids are opened but before a contract is signed, Bidder alleges a material mistake of fact if:

    1. The mistake is clearly evident in the solicitation document; or
    2. Bidder submits evidence which clearly and convincingly demonstrates that a mistake was made in the Bid. Request to withdraw a Bid must be in writing and approved by the Procurement Official.

A.17 IRREVOCABLE OFFER

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

A.18 RESERVED RIGHTS

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

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

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

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

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

A.19 APPLICABLE LAWS

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

A.20 COLLUSION

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

a. All prices and/or cost data submitted have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices and/or cost data, with any other bidder or with any competitor;

b. All prices and/or cost data quoted for this bid have not been knowingly disclosed by the Bidder and will not knowingly be disclosed by the Bidder, prior to the scheduled opening, directly or indirectly to any other bidder or to any competitor;

c. No attempt has been made, or will be made, by Bidder to induce any other person or firm to submit or not to submit a bid for the purpose of restricting competition;

d. The only person or persons interested in this bid is/are named in Bidder's Bid and that no person other than those identified has any interest in the Bid or in the resulting Agreement to be entered into.

e. No person or agency has been employed or retained to solicit or secure the resulting Agreement upon an agreement or understanding or a commission, percentage, brokerage, or contingent fee except bona fide employees or established commercial agencies maintained by Bidder for purpose of doing business.

A.21 CODE OF ETHICS

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

A.22 PUBLIC CONTRACTING AND ENVIRONMENTAL CRIMES

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

In addition, the Manatee County Code of Laws prohibits the award of any bid to any person or entity who/which has, within the past five (5) years, been convicted of, or admitted to in court or sworn to under oath, a public entity crime or of any environmental law that, in the

reasonable opinion of the Procurement Official, establishes reasonable grounds to believe the person or business entity will not conduct business in a responsible matter.

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

A.23 SCRUTINIZED COMPANIES

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

A.24 AGREEMENT

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

A.25 LEGAL NAME

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

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

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

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

A.26 DISCOUNTS

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

A.27 TAXES

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

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

A.28 QUALITY

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

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

A.29 AUTHORIZED PRODUCT REPRESENTATION

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

A.30 ROYALTIES AND PATENTS

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

A.31 AMERICANS WITH DISABILITIES ACT

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

A.32 EQUAL EMPLOYMENT OPPORTUNITY

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

A.33 MINORITY AND/OR DISADVANTAGED BUSINESS ENTERPRISES

The State of Florida Office of Supplier Diversity provides the certification process and maintains the database of certified MBE/DBE firms. Additional information may be obtained at

https://www.dms.myflorida.com/agency_administration/office_of_supplier_diversity_osd or by calling (850) 487-0915.

A.34 DELIVERY

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

A.35 MATHEMATICAL ERRORS

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

A.36 SUBCONTRACTORS

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

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

A.37 E-Verify

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

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

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

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

A.38 DISCLOSURE

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

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

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

If County rejects all bids and concurrently notices its intent to reissue the solicitation, the rejected bids are exempt from public disclosure until such time as County provides notice of an intended decision concerning the reissued solicitation or until County withdraws the reissued solicitation. A bid is not exempt for longer than twelve (12) months after the initial notice rejecting all bids.

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

a. Keep and maintain public records required by public agency to perform the service.

b. Upon request from the public agency's custodian of public records, provide the public agency with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost provided in Florida Statutes, Chapter 119, or as otherwise provided by law.

c. Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the contract term and following completion of the contract if the successful Bidder does not transfer the records to the public agency.

d. Upon completion of the contract, transfer, at no cost, to the public agency all public records in possession of contractor or keep and maintain public records required by the public agency to perform the service. If the successful Bidder transfers all public records to the public agency upon completion of the contract, the successful Bidder shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If the successful Bidder keeps and maintains public records upon completion of the contract, the successful Bidder shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the public agency, upon request from public agency's custodian of public records, in a format that is compatible with the information technology systems of the public agency.

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

Phone: (941) 742-5845
Email: debbie.scaccianoce@mymanatee.org
Mail: Manatee County BCC
Attn: Records Manager
1112 Manatee Ave W.
Bradenton, FL 34205.

A.39 LOCAL PREFERENCE

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

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

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

A.40 VENDOR REGISTRATION

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

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

A.41 ENVIRONMENTAL SUSTAINABILITY

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

Bidder shall acknowledge in its Bid if Bidder has an environmental sustainability initiative. In

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

A.42 ePAYABLES

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

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

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

A.43 BASIS OF AWARD

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

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

Multiple schedules for completion of Work shall be considered. Two bids shall be submitted and considered, Bid 'A' based on 600 calendar days completion time and Bid 'B' based on 686 calendar days completion time. County, at its sole discretion, shall select either Bid A or Bid B, whichever is in the best interest of the County. Only one (1) award will be made.

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

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

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

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

A.44 SCOPE OF WORK

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

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

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

The work consists of installing a new SCADA system and removal of the existing HSQ SCADA system at the Lake Manatee WTP and remote facilities. The work includes design, fabrication, demolition, installation, programming, startup and commissioning of the new SCADA system in accordance with applicable law and inclusive of all equipment, materials, and labor required for a complete, tested, and fully operational system per the plans and specifications included in this solicitation.

A.45 COMPLETION OF WORK

The Work will be completed and ready for final inspection within the specified calendar days from the date the Contract Time commences to run. Completion time shall be based on Bid 'A' for 600 calendar days or Bid 'B' based on 686 calendar days completion time at the County's sole discretion.

A.46 LIQUIDATED DAMAGES

If the successful Bidder fails to achieve substantial completion of the Work within the contract time and as otherwise required by the Agreement (to include not only the entire Work but any portion of the Work as set forth therein), the County shall be entitled to retain or recover from the successful Bidder, as liquidated damages and not as a penalty, the sum of $1027.00 per calendar day, commencing upon the first day following expiration of the contract time and continuing until the actual date of substantial completion.

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

A.47 CONTRACT CONTINGENCY WORK

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

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

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

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

A.48 LICENSES AND PERMITS

The successful Bidder shall be solely responsible for obtaining all necessary license and permit fees, including, but not limited to, all license fees, permit fees, impact fees, or inspection fees,

and responsible for the costs of such fees. Successful Bidder is solely responsible for ensuring all work complies with all Federal, State, local, and Manatee County ordinances, orders, codes, laws, rules, regulations, directives, and guidelines.

A.49 PROTEST

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

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

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

A.50 ACCESSIBILITY

The County is committed to making its documents and information technologies accessible to individuals with disabilities by meeting the requirements of Section 504 of the Rehabilitation Act and best practices (W3C WCAG 2). **For assistance with accessibility regarding this solicitation, contact the Manatee County Procurement Division via email**

at purchasing@mymanatee.org or by phone at 941-748-4501 X3014.

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

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

A.51 SOLICITATION SCHEDULE

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

Scheduled Item	Scheduled Date
Mandatory Solicitation Information Conference and mandatory site tour at: •Lake Manatee Water Treatment Plant, 17915 Waterline Road, Bradenton, FL (STARTING LOCATION) •Elwood I Booster Pump Station, 4825 44th Ave E, Bradenton, FL •Cortez Elevated Tank, Corner of 59th St W @ Cortez, Bradenton, FL	October 21, 2019 @ 9:00 AM
Question and Clarification Deadline	October 31, 2019
Final Addendum Posted	November 7, 2019
Bid Response Due Date and Time	November 14, 2019, 3:00 PM, ET
Due Diligence Review Completed	November 2019
Projected Award	December 2019

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

END OF SECTION A

SECTION B, BID FORMS

(To be completed and returned with Bid)

APPENDIX A, MINIMUM QUALIFICATIONS

APPENDIX A

MINIMUM QUALIFICATIONS
IFBC No. 20-TA003182AJ

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

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

   No documentation is required. The County will verify registration.

2. Bidder, or its representative, attended the mandatory Solicitation Information Conference and Site Tour held in July 2019 or the mandatory Solicitation Information Conference and site tour held on October 21, 2019.

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

3. Bidder or Bidder's Sub-Contractor possessed an Electrical Contractor's license issued by the Florida Department of Business and Professional Regulation for a period of at least five (5) consecutive years since October 1, 2014. License must be current and valid through the Due Date for submission of bids for this IFBC.

   Provide a copy of Bidder or Bidder's Sub-Contractor Electrical Contractor's license issued by the Florida Department of Business and Professional Regulation and documentation confirming Bidder has been licensed and/or certified for the period of October 1, 2014 through the date of submission of the Bid.

4. Bidder or Bidder's Sub-Contractor installed a Supervisory Control and Data Acquisition system (SCADA) for at least five (5) clients that included the following components: installation of a new SCADA system and removal of the existing SCADA system, design, fabrication, demolition, installation, programming, startup and commissioning of the new SCADA system.

   Provide the following information for the 5 qualifying clients.
   - **a) Name of client**
   - **b) Location (City/State)**
   - **c) Client contact name**
   - **d) Contact phone**
   - **e) Contact email**
   - **f) Service dates (Start/End)**
   - **g) Removal of the existing SCADA system and Installation new SCADA system.**
   - **h) Installation dates (start /End)**

5. Bidder's instrumentation and control system contractor (ICSC), or representative, attended the Solicitation Information Conference and the mandatory site tour held in July 2019 or the mandatory Solicitation Information Conference and site tour held on October 21, 2019.

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

6. Bidder's ICSC contractor is registered with the State of Florida, Division of Corporations to do business in Florida.

   No documentation is required. The County will verify registration.

7. Bidder or Bidder's ICSC Contractor successfully completed installation for three (3) projects in a water or wastewater system with a total project cost of at least $1M. Each project must have included all of the following components: (i) system engineering, (ii) system fabrication and installation, (iii) documentation (including schematic, wiring and panel assembly drawings), (iv) software configuration and documentation, (v) field testing, (vi) calibration and process start-up, (vii) operator instruction, and (viii) maintenance training.

   Provide the following information for the ICSC subcontractor and the qualifying project.

   a) **Name of client**
   b) **Location (City/State)**
   c) **Client contact name**
   d) **Contact phone**
   e) **Contact email**
   f) **Name of Project**
   g) **Project Budget**
   h) **Design Criteria for a SCADA system**
   i) **Construction dates (Start/End)**

8. Bidder's key personnel, project manager and work-site superintendent to be assigned to the County's project, as outlined in Spec Section 17050- Article 1.06.B.3, ISCS Project team members, have performed SCADA replacement projects working in a similar capacity to the one designated for the County's project.

   Provide the names of the key personnel and provide the resumes for each that demonstrates the individual has previously served in in the role designated for the County's project. Indicate which of the above referenced projects in Items 4 and 7, or other pertinent project(s) with another company or companies, they have worked on.

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

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

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

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

APPENDIX B, BIDDER'S QUESTIONNAIRE

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

THIS QUESTIONNAIRE MUST BE COMPLETED AND SUBMITTED WITH YOUR BID

1. Contact Information:

   FEIN #: _____

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

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

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

   _____
   _____
   _____
   _____

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

   For how many years? _____

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

   _____

   Is this firm in bankruptcy? _____

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

BIDDER: _____

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

_____

_____

_____

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

_____

_____

_____

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

_____

_____

_____

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

_____

_____

_____

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

_____

_____

_____

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

_____

_____

_____

BIDDER: _____

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

_____

_____

_____

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

_____

_____

_____

15. If applicable to the Work for this IFBC, Drilling Supervisor Qualifications: Contractor shall provide a boring specialist who shall remain on the project site during the entirety of the directional boring operation. This includes, but is not limited to, drilling fluid preparation, seaming, boring and pulling. The boring specialist shall have a minimum of five (5) years' experience in supervising directional bores of similar nature, diameter, materials and lengths. (Reference: Specification Section 02619, Horizontal Directional Drilling).
Provide the contact information for a minimum of three (3) projects wherein the boring specialist has performed this type of work, diameter, materials and lengths.

Boring specialist's name: _____
Boring specialist's years of experience in supervising directional bores _____
Provide contact name, and contact number for projects:

_____

_____

_____

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

Thermal butt fusing pipe and fittings contractor or subcontractor's name: _____
Attach a copy of contractor's/subcontractor's manufacturer certification to this Questionnaire
OR
Provide contractor's/subcontractor's years of experience in thermal butt fusing pipe and fittings _____
If manufacturer certification is not provided, include contact name, and contact number for projects that confirms five years of experience:

_____

_____

_____

BIDDER: _____

17. If applicable to the Work for this IFB, Pipe Bursting Qualifications: The Contractor shall be certified by the manufacturer of the pipe bursting system that they are fully trained licensed installer of the manufacturer's pipe bursting system. Contractor shall provide a letter to the County documenting this

requirement. (Reference: Specification Section 02619A, Pipe Bursting (PB) of Existing Mains).

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

Surety's Name: _____

Address: _____

_____

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

Agent's Name: _____

Address: _____

_____

Phone: _____

Email: _____

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

☐ Yes ☐ No

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

BIDDER: _____

BY: _____

PRINTED NAME: _____

TITLE/DATE: _____

PHYSICAL ADDRESS OF QUALIFYING LOCAL LOCATION: _____

_____

NAME OF QUALIFYING EMPLOYEE AT LOCAL LOCATION: _____

20. Confirm if Bidder has an environmental sustainability initiative as defined in Section A.41.

☐ Yes ☐ No

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

BIDDER: _____

APPENDIX C, ENVIRONMENTAL CRIMES CERTIFICATION

SWORN STATEMENT PURSUANT TO ARTICLE V, MANATEE COUNTY PROCUREMENT CODE

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

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

_____

[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 an Owner's Agreement for public improvements, procurement of goods or services (including professional services) or an Owner's lease, franchise, concession or management agreement, or shall receive a grant of Owner's monies unless such person or entity has submitted a written certification to Owner that it has not:

(1) been convicted of bribery or attempting to bribe a public officer or employee of Manatee County, the State of Florida, or any other public entity, including, but not limited to the Government of the United States, any state, or any local government authority in the United States, in that officer's or employee's official capacity; or

(2) been convicted of an agreement or collusion among bidders or prospective bidders in restraint of freedom of competition, by agreement to bid a fixed price, or otherwise; or

(3) been convicted of a violation of an environmental law that, in the sole opinion of Owner's Purchasing Official, reflects negatively upon the ability of the person or entity to conduct business in a responsible manner; or

(4) made an admission of guilt of such conduct described in items (1), (2) or (3) above, which is a matter of record, but has not been prosecuted for such conduct, or has made an admission of guilt of such conduct, which is a matter of record, pursuant to formal prosecution. An admission of guilt shall be construed to include a plea of nolo contendere; or

(5) where an officer, official, agent or employee of a business entity has been convicted of or has admitted guilt to any of the crimes set forth above on behalf of such an entity and pursuant to the direction or authorization of an official thereof (including the person committing the offense, if he is an official of the business entity), the business shall be chargeable with the conduct herein above set forth. A business entity shall be chargeable with the conduct of an affiliated entity, whether wholly owned, partially owned, or one which has common ownership or a common Board of Directors. For purposes of this Form, business entities are affiliated if, directly or indirectly, one business entity controls or has the power to control another business entity, or if an individual or group of individuals controls or has the power to control both entities. Indicia of control shall include, without limitation, interlocking management or ownership, identity of interests among family members, shared organization of a business entity following the ineligibility of a business entity under this

Article, or using substantially the same management, ownership or principles as the ineligible entity.
(Continued)

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

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

_____
[Signature]

STATE OF _____
COUNTY OF _____

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

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

My commission expires _____

_____
Notary Public Signature

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

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

APPENDIX D, FLORIDA TRENCH SAFETY ACT

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

1. This Sworn Statement is submitted with **IFBC NO. 20-TA003182AJ**
2. This Sworn Statement is submitted by_____ whose business address is_____ and, if applicable, its Federal Employer Identification Number (FEIN) is_____. If the entity has no FEIN, include the Social Security Number of the individual signing this sworn statement _____.
3. Name of individual signing this Sworn Statement is: _____, Whose relationship to the above entity is: _____.
4. The Trench Safety Standards that will be in effect during the construction of this project shall include, but are not limited to: Laws of Florida, Chapters 90-96, TRENCH SAFETY ACT, and OSHA RULES AND REGULATIONS 29 CFR 1926.650 Subpart P, effective October 1, 1990.
5. The undersigned assures that the entity will comply with the applicable Trench Safety Standards and agrees to indemnify and hold harmless the County and Engineer of Record, and any of their agents or employees from any claims arising from the failure to comply with said standard.
6. The undersigned has appropriated the following costs for compliance with the applicable standards:

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

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

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

_____
(Authorized signature / Title)

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

Notary Public, State of Florida: _____

My commission expires: _____

Angelina M. Colonneso
CLERK OF THE CIRCUIT COURT AND COMPTROLLER OF MANATEE COUNTY
1115 Manatee Avenue West, Bradenton, Florida 34205 - Phone (941) 749-1800 Fax (941) 741-4082, P.O. Box 25400, Bradenton, Florida 34206 - www.manateeclerk.com

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

APPENDIX E: ePAYABLES APPLICATION

Company name_____

Contact person_____

Phone number_____

Email Address_____

FINANCE USE ONLY

Open orders: YES or NO

PEID _____

CREATE DATE _____

CONFIRMED WITH

_____

Name and phone number

IFAS _____

BANK _____

INITIALS_____

Return completed form to:
Via email to: lori.bryan@manateeclerk.com
Via fax to: (941) 741-4011
Via mail:
PO Box 1000
Bradenton, Fl 34206

Revised: September 30, 2015

APPENDIX F, Scrutinized Company Certification

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

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

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

Company _____ FID or EIN No. _____

Address _____

City _____ State _____ Zip _____

I, _____, as a representative of _____

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

_____ _____

Signature Title

_____ _____

Printed Name Date

APPENDIX G, INSURANCE STATEMENT

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

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

Bidder Name: _____ Date: _____

Signature (Authorized Official): _____

Printed Name/Title: _____

Insurance Agency: _____

Agent Name: _____ Agent Phone: _____

APPENDIX H, ACKNOWLEDGMENT OF ADDENDA

The undersigned acknowledges receipt of the following addenda:

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

Print or type Bidder's information below:

Name of Bidder | Telephone Number

Street Address | City/State/Zip

Email Address

Print Name & Title of Authorized Officer | Signature of Authorized Official Date

APPENDIX I, AFFIDAVIT OF NO CONFLICT

COUNTY OF _____
STATE OF _____

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

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

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

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

Affiant makes this affidavit for the purpose of inducing Manatee County, a political subdivision of the State of Florida, to enter into an Agreement for Lake Manatee WTP SCADA System Replacement.

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

_____
Signature

_____
Print Name

SUBSCRIBED to and sworn before me this ____ day of _____, 20__.

[Notary Seal]

Notary Public

My commission expires: _____

_____
Notary Signature

_____
Print Name

Personally known OR produced identification. Type of identification produced _____ _____.

APPENDIX J, BID PRICING FORM

APPENDIX J BID PRICING FORM
IFBC NO. 20-TA003182AJ LAKE MANATEE WTP SCADA SYSTEM REPLACEMENT

FOR

PROJECT NO. 6042370

Total Bid Price/Offer for Bid "A": $_____ Complete. Based on a completion time of 600 calendar days.

Total Bid Price/Offer for Bid "B": $_____ Complete. Based on a completion time of 686 calendar days.

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

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

Authorized Signature(s): _____

Name and Title of Above Signer(s): _____

Date: _____

BID FORM A

PROJECT NAME: LAKE MANATEE WTP SCADA SYSTEM REPLACEMENT, PROJECT NO. 6042370

IFB# 20-TA003182AJ

BID "A" BASED ON COMPLETION TIME OF 600 CALENDAR DAYS

ITEM	DESCRIPTION	U/M	EST. QTY.	UNIT PRICE	EXTENDED PRICE
1	MOBILIZATION/DEMOBILIZATION	LS	1		$ -
2	DEMOLITION AND ELECTRICAL WORK	LS	1		$ -
3	INSTRUMENTATION AND CONTROLS	LS	1		$ -
4	SCADA NETWORK MODIFICATIONS AND ADDITIONS	LS	1		$ -
5	RELOCATION/MODIFICATION OF EXISTING FIBER OPTIC CONDUIT AND CABLES.	LS	1		$ -
	TOTAL BID "A" PRICE - Based on Completion Time of 600 Calendar Days				$ -
6	**CONTRACT CONTINGENCY WORK (USED ONLY WITH COUNTY APPROVAL) 10% OF TOTAL BASE BID**			**10%**	$ -
7	**TOTAL OFFER BID "A" with Contract Contigencey - Based on Completion Time of 600 Calendar Days**				$ -

Authorized Signature(s): _____

Name and Title of Above _____

Signer(s): _____

Date: _____

BID FORM B

PROJECT NAME: LAKE MANATEE WTP SCADA SYSTEM REPLACEMENT, PROJECT NO. 6042370

IFB# 20-TA003182AJ

BID "B" BASED ON COMPLETION TIME OF 686 CALENDAR DAYS

ITEM	DESCRIPTION	U/M	EST. QTY.	UNIT PRICE	EXTENDED PRICE
1	MOBILIZATION/DEMOBILIZATION	LS	1		$ -
2	DEMOLITION AND ELECTRICAL WORK	LS	1		$ -
3	INSTRUMENTATION AND CONTROLS	LS	1		$ -
4	SCADA NETWORK MODIFICATIONS AND ADDITIONS	LS	1		$ -
5	RELOCATION/MODIFICATION OF EXISTING FIBER OPTIC CONDUIT AND CABLES.	LS	1		$ -
	TOTAL BID "B" PRICE - Based on Completion Time of 686 Calendar Days				$ -
6	**CONTRACT CONTINGENCY WORK (USED ONLY WITH COUNTY APPROVAL) 10% OF TOTAL BASE BID**			**10%**	$ -
7	**TOTAL OFFER BID "B" with Contract Contigencey - Based on Completion Time of 686 Calendar Days**				$ -

Authorized Signature(s): _____

Name and Title of Above _____

Signer(s): _____

Date: _____

SECTION C, BID ATTACHMENTS

Bid Attachment 1, INSURANCE AND BOND REQUIREMENTS

The CONTRACTOR will not commence work under the resulting Agreement until all insurance coverages indicated by an "X" herein have been obtained. The CONTRACTOR shall obtain and submit to the Procurement Division within ten (10) calendar days from the date of notice of intent to award, at its expense, the following minimum amounts of insurance (inclusive of any amounts provided by an umbrella or excess policy): Work under this Agreement cannot commence until all insurance coverages indicated herein have been obtained on a standard ACORD form (inclusive of any amounts provided by an umbrella or excess policy):

☒ **Automobile Liability Insurance Required Limits**

Coverage must be afforded under a per occurrence policy form including coverage for all owned, hired and non-owned vehicles for bodily injury and property damage of not less than:

- $1,000,000 Combined Single Limit; OR
- $ 500,000 Bodily Injury and $500,000 Property Damage
- $10,000 Personal Injury Protection (No Fault)
- $500,000 Hired, Non-Owned Liability
- $10,000 Medical Payments

This policy shall contain severability of interests' provisions.

☒ **Commercial General Liability Insurance Required Limits (per Occurrence form only; claims-made form is not acceptable)**

Coverage shall be afforded under a per occurrence policy form, policy shall be endorsed and name 'Manatee County, a political subdivision of the State of Florida' as an Additional Insured, and include limits not less than:

- $1,000,000 Single Limit Per Occurrence
- $2,000,000 Aggregate
- $1,000,000 Products/Completed Operations Aggregate
- $1,000,000 Personal and Advertising Injury Liability
- $50,000 Fire Damage Liability
- $10,000 Medical Expense, and
- $1,000,000, Third Party Property Damage
- $ Project Specific Aggregate (Required on projects valued at over $10,000,000)

This policy shall contain severability of interests' provisions.

☒ **Employer's Liability Insurance**

Coverage limits of not less than:

- $100,000 Each Accident
- $500,000 Disease Each Employee
- $500,000 Disease Policy Limit

☒ **Worker's Compensation Insurance**

☐ **US Longshoremen & Harbor Workers Act**

☐ **Jones Act Coverage**

Coverage limits of not less than:

- Statutory workers' compensation coverage shall apply for all employees in compliance with the laws and statutes of the State of Florida and the federal government.
- If any operations are to be undertaken on or about navigable waters, coverage must be included for the US Longshoremen & Harbor Workers Act and Jones Act.

Should 'leased employees' be retained for any part of the project or service, the employee leasing agency shall provide evidence of Workers' Compensation coverage and Employer's Liability coverage for all personnel on the worksite and in compliance with the above Workers' Compensation requirements. NOTE: Workers' Compensation coverage is a firm requirement. Elective exemptions are considered on a case-by-case basis and are approved in a very limited number of instances.

☐ **Aircraft Liability Insurance Required Limits**

Coverage shall be afforded under a per occurrence policy form, policy shall be endorsed and name 'Manatee County a political subdivision of the State of Florida' as an Additional Insured, and include limits not less than:

- $ Each Occurrence Property and Bodily Injury with no less than $100,000 per passenger each occurrence or a 'smooth' limit.
- $ General Aggregate.

☐ **Un-Manned Aircraft Liability Insurance (Drone)**

Coverage shall be afforded under a per occurrence policy form, policy shall be endorsed and name 'Manatee County a political subdivision of the State of Florida' as an Additional Insured, and include limits not less than:

- $ Each Occurrence Property and Bodily Injury; Coverage shall specifically include operation of Unmanned Aircraft Systems (UAS), including liability and property damage.
- $ General Aggregate

☐ **Installation Floater Insurance**

When the contract or agreement **does not** include construction of, or additions to, above ground building or structures, but does involve the installation of machinery or equipment, Installation Floater Insurance shall be afforded under a per occurrence policy form, policy shall be endorsed and name "Manatee County, a political subdivision of the State of Florida" as an Additional Insured, and include limits not less than:

- 100% of the completed value of such addition(s), building(s), or structure(s)

☐ **Professional Liability and/or Errors and Omissions (E&O) Liability Insurances**
Coverage shall be afforded under either an occurrence policy form or a claims-made policy form. If the coverage form is on a claims-made basis, then coverage must be maintained for a minimum of three years from termination of date of the contract. Limits must not be less than:

- $ 1,000,000 Bodily Injury and Property Damage Each Occurrence
- $ 2,000,000 General Aggregate

☒ **Builder's Risk Insurance**
When the contract or agreement includes the construction of roadways and/or the addition of a permanent structure or building, including the installation of machinery and/or equipment, Builder's Risk Insurance shall be afforded under a per occurrence policy form, policy shall be endorsed and name "Manatee County, a political subdivision of the State of Florida" as an Additional Insured, and include limits not less than:

- An amount equal to 100% of the completed value of the project, or the value of the equipment to be installed
- The policy shall not carry a self-insured retention/deductible greater than $10,000

Coverage shall be for all risks and include, but not be limited to, storage and transport of materials, equipment, supplies of any kind whatsoever to be used on or incidental to the project, theft coverage, and Waiver of Occupancy Clause Endorsement, where applicable.

☐ **Cyber Liability Insurance**

Coverage shall comply with Florida Statute 501.171, shall be afforded under a per occurrence policy form, policy shall be endorsed and name 'Manatee County, a political subdivision of the State of Florida' as an Additional Insured, and include limits not less than:

- $ Security Breach Liability
- $ Security Breach Expense Each Occurrence
- $ Security Breach Expense Aggregate
- $ Replacement or Restoration of Electronic Data
- $ Extortion Threats
- $ Business Income and Extra Expense
- $ Public Relations Expense

NOTE: Policy must not carry a self-insured retention/deductible greater than $25,000.

☐ **Hazardous Materials Insurance (As Noted Below)**
Hazardous materials include all materials and substances that are currently designated or defined as hazardous by the law or rules of regulation by the State of Florida or federal government.
All coverage shall be afforded under either an occurrence policy form or a claims-made policy form, and the policy shall be endorsed and name 'Manatee County, a political subdivision of the State of

Florida' as an Additional Insured. If the coverage form is on a claims-made basis, then coverage must be maintained for a minimum of three years from termination of date of the contract. Limits must not be less than:

☐ ***Pollution Liability***
Amount equal to the value of the contract, subject to a $1,000,000 minimum, for Bodily Injury and Property Damage to include sudden and gradual release, each claim and aggregate.

☐ ***Asbestos Liability (If handling within scope of Contract)***
Amount equal to the value of the contract, subject to a $1,000,000 minimum, for Bodily Injury and Property Damage to include sudden and gradual release, each claim and aggregate.

☐ ***Disposal***
When applicable, CONTRACTOR shall designate the disposal site and furnish a Certificate of Insurance from the disposal facility for Environmental Impairment Liability Insurance covering liability.

- Amount equal to the value of the contract, subject to a $1,000,000 minimum, for Liability for Sudden and Accidental Occurrences, each claim and an aggregate.
- Amount equal to the value of the contract, subject to a $1,000,000 minimum, for Liability for Non-Sudden and Accidental Occurrences, each claim and an aggregate.

☐ **Hazardous Waste Transportation Insurance**
CONTRACTOR shall designate the hauler and have the hauler furnish a Certificate of Insurance for Automobile Liability insurance with Endorsement MCS-90 for liability arising out of the transportation of hazardous materials. EPA identification number shall be provided.

All coverage shall be afforded under either an occurrence policy form or a claims-made policy form and the policy shall be endorsed and name "Manatee County, a political subdivision of the State of Florida" as an Additional Insured. If the coverage form is on a claims-made basis, then coverage must be maintained for a minimum of three years from termination of date of the contract. Limits must not be less than:

- Amount equal to the value of the contract, subject to a $1,000,000 minimum, per accident.

☐ **Liquor Liability Insurance**
Coverage shall be afforded under a per occurrence policy form, policy shall be endorsed and name "Manatee County, a political subdivision of the State of Florida" as an Additional Insured, and include limits not less than:

- $1,000,000 Each Occurrence and Aggregate

☐ **Garage Keeper's Liability Insurance**

Coverage shall be required if the maintenance, servicing, cleaning or repairing of any County motor vehicles is inherent or implied within the provision of the contract.

Coverage shall be afforded under a per occurrence policy form, policy shall be endorsed and name "Manatee County, a political subdivision of the State of Florida" as an Additional Insured, and include limits not less than:

- Property and asset coverage in the full replacement value of the lot or garage.

☐ **Bailee's Customer Liability Insurance**

Coverage shall be required for damage and/or destruction when County property is temporarily under the care or custody of a person or organization, including property that is on, or in transit to and from the person or organization's premises. Perils covered should include fire, lightning, theft, burglary, robbery, explosion, collision, flood, earthquake and damage or destruction during transportation by a carrier.

Coverage shall be afforded under a per occurrence policy form, policy shall be endorsed and name "Manatee County, a political subdivision of the State of Florida" as an Additional Insured, and include limits not less than:

- Property and asset coverage in the full replacement value of the County asset(s) in the CONTRACTOR'S care, custody and control.

☐ **Hull and Watercraft Liability Insurance**

Coverage shall be afforded under a per occurrence policy form, policy shall be endorsed and name "Manatee County, a political subdivision of the State of Florida" as an Additional Insured, and include limits not less than:

- $ Each Occurrence
- $ General Aggregate
- $ Fire Damage Liability
- $10,000 Medical Expense, and
- $ Third Party Property Damage
- $ Project Specific Aggregate (Required on projects valued at over $10,000,000)

☐ **Other [Specify]**

BOND REQUIREMENTS

☒ **Bid Bond**

A Bid Bond in the amount of 5% of the total offer. Bid bond shall be submitted with the sealed response and shall include project name, location, and / or address and project number. In lieu of the bond, the bidder may file an alternative form of security in the amount of 5_% of the total offer. in the form of a money order, a certified check, a cashier's check, or an irrevocable letter of credit issued to Manatee County. NOTE: A construction project over $200,000 requires a Bid Bond in the amount of 5% of the total bid offer.

☒ **Payment and Performance Bond**

A Payment and Performance Bond shall be submitted by Successful Bidder for 100% of the award amount and shall be presented to Manatee County within ten (10) calendar days of issuance of the notice of intent to award. NOTE: A construction project over $200,000 requires a Payment and Performance Bond.

INSURANCE REQUIREMENTS

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

1. Commercial General Liability and Automobile Liability Coverages

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

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

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

c. The insurance policies must be on an occurrence form.

2. Workers' Compensation and Employers' Liability Coverages

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

II. GENERAL INSURANCE PROVISIONS APPLICABLE TO ALL POLICIES:

1. Prior to the execution of contract, or issuance of a Purchase Order, and then annually upon the anniversary date(s) of the insurance policy's renewal date(s) for as long as this contract remains in effect, successful Bidder shall furnish the County with a Certificate(s) of Insurance (using an industry accepted certificate form, signed by the Issuer, with applicable endorsements, and containing the solicitation or contract number, and title or description) evidencing the coverage set forth above and naming "Manatee County, a Political Subdivision of the State of Florida" as an Additional Insured on the applicable coverage(s) set forth above.

2. If the policy contains an aggregate limit, confirmation is needed in writing (letter, email, etc.) that the aggregate limit has not been eroded to procurement representative when supplying Certificate of Insurance.

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

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

3. The project's solicitation number and title shall be listed on each certificate.

4. successful Bidder shall provide thirty (30) days written notice to the Risk Manager of any cancellation, non-renewal, termination, material change, or reduction in coverage of any insurance policies to procurement representative including solicitation number and title with all notices.

5. successful Bidder agrees that should at any time successful Bidder fail to meet or maintain the required insurance coverage(s) as set forth herein, the County may terminate this contract.

6. The successful Bidder waives all subrogation rights against Manatee County, a Political Subdivision of the State of Florida, for all losses or damages which occur during the contract and for any events occurring during the contract period, whether the suit is brought during the contract period or not.

7. The successful Bidder has sole responsibility for all insurance premiums and policy deductibles.

8. It is the successful Bidder's responsibility to ensure that his agents, representatives and subcontractors comply with the insurance requirements set forth herein. successful Bidder shall include his agents, representatives, and subcontractors working on the project or at the worksite as insured under its policies, or successful Bidder shall furnish separate certificates and endorsements for each agent, representative, and subcontractor working on the project or at the worksite. All coverages for agents, representatives, and subcontractors shall be subject to all of the requirements set forth to the procurement representative.

9. All required insurance policies must be written with a carrier having a minimum A.M. Best rating of A- FSC VII or better. In addition, the County has the right to review the successful Bidder's deductible or self-insured retention and to require that it be reduced or eliminated.

III. Successful Bidder understands and agrees that the stipulated limits of coverage listed herein in this insurance section shall not be construed as a limitation of any potential liability to the County, or to others, and the County's failure to request evidence of this insurance coverage shall not be construed as a waiver of successful Bidder's obligation to provide and maintain the insurance coverage specified.

IV. The enclosed Hold Harmless Agreement shall be signed by the successful Bidder and shall become a part of the contract.

V. Successful Bidder understands and agrees that the County does not waive its immunity and nothing herein shall be interpreted as a waiver of the County's rights, including the limitation of waiver of immunity, as set forth in Florida Statutes 768.28, or any other statutes, and the County expressly reserves these rights to the full extent allowed by law.

VI. No award shall be made until the Procurement Division has received the Certificate of Insurance and Hold Harmless Agreement in accordance with this section.

[Remainder of page intentionally left blank]

BID ATTACHMENT 2, TECHNICAL SPECIFICATION(S)

MANATEE COUNTY
BRADENTON, FLORIDA

LAKE MANATEE WTP SCADA SYSTEM REPLACEMENT

TECHNICAL SPECIFICATIONS

FINAL SUBMITTAL

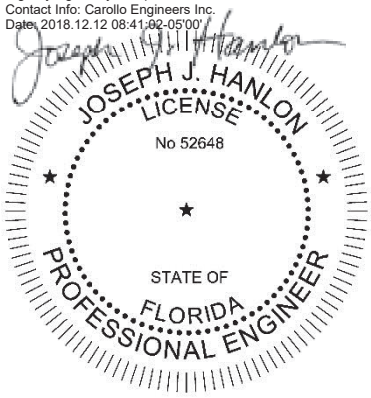
DECEMBER 2018

MANATEE COUNTY
BRADENTON, FLORIDA

LAKE MANATEE WTP SCADA SYSTEM REPLACEMENT

CLIENT PROJECT NO. 10716I10

Digitally signed by Joseph J. Hanlon
Contact Info: Carollo Engineers Inc.
Date: 2018.12.12 08:41:02-05'00'



CA 8571
Carollo Engineers, Inc.
10117 Princess Palm Avenue, Suite 340
Tampa, Florida 33610
P. 813.888.9572

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Digitally signed by Richard C Warner
Contact Info: Carollo Engineers, Inc.
Date: 2018.12.12 08:57:06-05'00'

CA 8571
Carollo Engineers, Inc.
10117 Princess Palm Avenue, Suite 340
Tampa, Florida 33610
P. 813.888.9572

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

MANATEE COUNTY
BRADENTON, FLORIDA

LAKE MANATEE WTP SCADA SYSTEM REPLACEMENT

CLIENT PROJECT NO. 10716I10

12-10-18

CA 26631
WSW Engineering, Inc.
15 Burlington Ave
Rockledge, FL 32955
P. 321.230.3716

MANATEE COUNTY

LAKE MANATEE WTP SCADA SYSTEM REPLACEMENT

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17720	CONTROL SYSTEMS: PROGRAMMABLE LOGIC CONTROLLERS	Joseph Hanlon
17721	CONTROL SYSTEMS: LOCAL OPERATOR INTERFACE (LOI)	Joseph Hanlon
17730	CONTROL SYSTEMS: SCADA COMPUTER EQUIPMENT	Joseph Hanlon
17733	CONTROL SYSTEMS: NETWORK MATERIALS AND EQUIPMENT	Joseph Hanlon
17750	CONTROL SYSTEMS: WIRELESS COMMUNICATIONS	Joseph Hanlon
17762	CONTROL SYSTEMS: SCADA SOFTWARE	Joseph Hanlon
17765	CONTROL SYSTEMS: PROGRAMMING REQUIREMENTS	Joseph Hanlon
17903	SCHEDULES: I/O LIST	Joseph Hanlon
17950	TESTING, CALIBRATION, AND COMMISSIONING	Joseph Hanlon

SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Identification and summary description of the Project, the Work, location, Owner-furnished products, activities by others, and coordination.

1.02 THE WORK

A. The Work consists of installing a new SCADA system and removal of the existing HSQ SCADA system at the Lake Manatee WTP and remote facilities. The work includes design, fabrication, demolition, installation, programming, startup and commissioning of the new SCADA system. All HSQ RTU's will be removed and replaced with Allen Bradley PLC's. The HSQ SCADA system will be replaced with CiTect SCADA software. Included in the scope of work is repair and reconstruction of existing improvements affected by the Work, and incidentals for complete and usable facility.

B. ICSC as defined in specification section 17050 must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.

1.03 LOCATION OF PROJECT

A. The Work is located at 17915 Waterline Road Bradenton, FL 34212 and at various remote facilities in the County system as detailed in the project drawings.

1.04 OWNER ASSIGNED SUBCONTRACTORS

A. Employ Owner-assigned subcontractors for:
   1. N/A.

1.05 OWNER FURNISHED EQUIPMENT AND SERVICES

A. Owner will furnish the following services: PLC and SCADA/HMI Programming services only. Referred to in other sections of the project specifications as PROGRAMMER.

B. Owner will:
   1. Arrange for and deliver necessary shop drawings (if available), product data, and samples to Contractor.
   2. Arrange and pay for product delivery to site in accordance with construction schedule.
   3. Deliver supplier's bill of materials to Contractor.
   4. Inspect deliveries jointly with Contractor.
   5. Submit claims for transportation damage.

6. Arrange for replacement of damaged, defective, or missing items.
7. Arrange for manufacturer's warranties, bonds, service, and inspections.

C. Owner is furnishing NO Equipment for this project.

1.06 ALTERNATES

A. As specified in Section 01230 - Alternates.

1.07 COORDINATION OF WORK

A. Contractor shall have a preconstruction video made that records the project sites (with the Engineer and Owner present) including all concrete and asphalt pavements, curb and gutter, fencing to remain, structures to be demolished, and existing structures and facilities that are to be modified.
   1. The original and 2 copies of the DVD shall be turned over to Engineer and Owner prior to beginning construction activities.
   2. The format of the video file on the DVD shall be 1 file that can be played on a desktop in the windows media player.
   3. The video shall clearly identify existing site and structural conditions prior to construction.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01116

CONTRACT DOCUMENT LANGUAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Explanation of arrangement, language, reference standards and format.

1.02 REFERENCES

A. Construction Specifications Institute (CSI):
   1. MasterFormat™.
   2. SectionFormat™.
   3. PageFormat™.

1.03 PROJECT MANUAL ARRANGEMENT

A. Document and Section numbers used in Project Manual, and Project Manual arrangement are in accordance with CSI MasterFormat™, except where departures have been deemed necessary.

B. Sections are written in CSI SectionFormat™, Three-Part Section Format, except where departures have been deemed necessary.

C. Page format for Sections in the Project Manual is in PageFormat™, except where departures have been deemed necessary.

1.04 CONTRACT DOCUMENT LANGUAGE

A. Specification Section Paragraphs entitled "Section Includes" summarize briefly what is generally included in the section.
   1. Requirements of Contract Documents are not limited by "Section Includes" paragraphs.

B. Specifications have been partially streamlined by intentionally omitting words and phrases, such as "the Contractor shall," "in conformity therewith," "shall be" following "as indicated," "a," "an," "the" and "all."
   1. Assume missing portions by inference.

C. Phrase "by Engineer" modifies words such as "accepted," "directed," "selected," "inspected," and "permitted," when they are unmodified.

D. Phrase "to Engineer" modifies words such as "submit," "report," and "satisfactory," when they are unmodified.

E. Colons (:) are used to introduce a list of particulars, an appositive, an amplification, or an illustrative quotation:
   1. When used as an appositive after designation of product, colons are used in place of words "shall be."

F. Word "provide" means to manufacture, fabricate, deliver, furnish, install, complete, assemble, erect in place, test, render ready for use or operation, including necessary related material, labor, appurtenances, services, and incidentals.

G. Words "Contractor shall" are implied when direction is stated in imperative mood.

H. Term "products" includes materials and equipment as specified in Section 01600 - Product Requirements.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01140

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and plant operations.

1.02 GENERAL CONSTRAINTS ON SEQUENCE AND SCHEDULING OF WORK

A. Water projects:
   1. The Lake Manatee Water Treatment Plant is the Owner's sole source of drinking water.
   2. Conduct Work such that the Owner's ability to meet its customers' demands for treated drinking water shall not be impaired or reduced in terms of the required quantity or quality of treated water. Do not impair the operational capabilities of essential elements of the treatment process or reduce treatment capacity below levels sufficient to meet demands for water throughout the contract time. The quantities of and quality of treated water required are described in this Section.
   3. Conduct commissioning and process start-up activities as specified in Section 01756 - Commissioning in a manner that will not impair capabilities of essential elements of the treatment process or reduce treatment capacity below levels sufficient to meet demands for water throughout the contract time. The quantities of and quality of treated water required are described in this Section.
   4. The status of the treatment plant shall be defined as "operational" when the plant is capable of meeting the Owner's customers' demands for treated drinking water in terms of the required quantity or quality of treated water as defined in this Section.

B. Work sequence and constraints:
   1. Utilize description of critical events in work sequence in this Section as a guideline for scheduling and undertaking the Work.
   2. Work sequence and constraints presented do not include all items affecting completion of the Work, but are intended to describe critical events necessary to minimize disruption of the existing facilities and to ensure compliance with water quality permit requirements.

C. Instrumentation and controls process performance testing:
   1. Test PCIS system as specified in Section 01756 - Commissioning.

1.03 SHUTDOWN AND CONSTRUCTION CONSTRAINTS

A. General shutdown constraints:
   1. Execute the Work while the existing facility is in operation.
   2. Some activities may be accomplished without a shutdown.

3. Apply to activities of construction regardless of process or work area.
4. Activities that disrupt plant or utilities operations must comply with these shutdown constraints.
5. Organize work to be completed in a minimum number of shutdowns.
6. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.
7. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
8. Final determination of the permitting of shutdowns will be the sole judgment of the Owner.
9. Owner maintains the ability to abort on the day of the scheduled shutdown.

B. General maximum plant flow work limitations:
   1. Activities that disrupt plant operations are prohibited during the following flow conditions, unless otherwise approved in writing by the Engineer.
      a. Flow condition: Maximum.

C. Unit process availability work limitations:
   1. Shutdowns and tie-ins or other activities that disrupt plant operations are prohibited unless otherwise approved in writing by the Owner and Engineer. The following list details RTU operational and signal dependency. The designated RTU depends on the "signals or controlled from" RTU. Contractor shall make all necessary accommodations to operate the new RTU/PLC while the existing RTU's are still operational or under modifications per the contractors cut over plan.

      A. <u>Clear Well B:</u>
      Designated RTU/DCU 2
      Pump 1, 2 and 3
      Runtimes pumps 1-5

      Signals or Controlled from or by RTU/DCU 5
      Pumps 4 and 5
      Level
      Pressure

      B. <u>Tainter Gates:</u>
      Designated RTU 20

      Signals or Controlled from or by RTU/DCU 5
      Open/Close Gates 1, 2 and 3

      C. <u>Basin A:</u>
      Designated RTU/DCU 5

      Signals or Controlled from or by RTU 50
      A1 Post Mix pH
      A2 Post Mix pH

      D. <u>Filters 1-6:</u>
      Designated RTU 50

Signals or Controlled from or by RTU/DCU 5
Effluent set point
Back Wash Control
Flume Level control
Turbidity

E. Basin B:
Designated RTU/DCU 5

Signals or Controlled from or by RTU 50
Post Mix pH

F. Filters 7-12:
Designated RTU 51

Signals or Controlled from or by RTU/DCU 5
Effluent Set Point
Flume Level

G. A/B Lime Feeder:
Signals or Controlled from or by RTU/DCU 3
North and South Feeder (Signals from Feeders PLC)

Signals or Controlled from or by RTU/DCU 5
North and South Slaker
Slurry Mixer

2. At a minimum, the following facilities must be in service in order to proceed with a scheduled shutdown.
   a. See Section 1.06 below.

D. Shutdown activities:
   1. Scheduling:
      a. Approved by Owner in advance.
   2. Unplanned shutdowns due to emergencies are not defined in this Section.

E. Process area construction constraints:
   1. The following sequences and constraints shall be observed while working in and around each of the following process areas:
      a. All.
      b. Material hauling operations:
         1) Contractor shall comply with restrictions regarding Contractor's use of site and premises as specified in Section 01110 - Summary of Work.

1.04 METHOD OF PROCEDURE (MOP)

A. MOP Instructions: See Appendix A.

B. Prepare MOP for the following conditions:
   1. Shutdowns, diversions, and tie-ins to the existing facility.

2. Process start-up activities.
3. Power interruption and tie-ins.
4. Switch over between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
5. Process constraints requiring interruption of operating processes or utilities.

C. Other Work not specifically listed may require MOPs as determined necessary by the Contractor, Owner, or Engineer.

D. Submit Baseline Schedule, as specified in Section 01324B - Progress Schedules and Reports - Medium Projects, with proposed MOPs.

E. Submit MOP Log at construction progress meetings.

F. No consideration will be given to claims of additional time and cost associated to preparing MOPs required by the Owner and Engineer to complete this work in a manner that facilitates proper operation of the facility and compliance with effluent discharge criteria.

G. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.

1.05 COMPLIANCE WITH DRINKING WATER PERMIT

A. The existing facility is operating under the terms of a Drinking Water permit issued by the Florida Department of Environmental Protection. This permit specifies the water quality limits that the plant must meet prior to discharge of finished water. A copy of the existing permit is on file for review at the LMWTP.

B. Perform work in a manner that will not prevent the existing facility from achieving the finished water quality requirements established by regulations.

C. Bear the cost of penalties imposed on the Owner for water quality violations caused by actions of the Contractor.

1.06 REQUIREMENTS FOR OPERATION OF PLANT AND MAINTAINING CONTINUOUS OPERATION OF EXISTING FACILITIES

A. Facilities or conditions required to keep the existing plant operational include, but are not limited to, the following:
1. Electrical power including transformers, distribution wiring, and motor control centers.
2. Plant water.
3. Plant air.
4. Laboratory facilities.
5. Office, toilets, and washrooms.
6. Fencing and gates.
7. Lighting.
8. Heating, ventilation, and air conditioning.
9. Instrumentation, meters, controls, and telemetry equipment.
10. Safety equipment and features.

11. Parking for County employees and vehicles required for operation and maintenance of the LMWTP.
12. Telephone system.
13. Storm drainage.
14. Natural gas service.

B. Conduct the Work and provide temporary facilities required to keep the existing plant continuously operational.

C. Do not remove or demolish existing facilities required to keep the existing plant operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or equipment.
   1. Test replacement facilities to demonstrate operational success prior to removing or demolishing existing facilities.

1.07 OPERATIONS AND MAINTENANCE ACCESS

A. Provide safe, continuous access to process control equipment for plant operations personnel.

1.08 UTILITIES

A. Provide advance notice to and utilize services of Underground Services Alert (U.S.A.) for location and marking of underground utilities operated by utility agencies other than the Owner.

B. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.

C. New yard utilities were designed using existing facility drawings.
   1. Field verification of utilities locations was not performed during design.
   2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
   3. Pipe alignments as indicated on the Drawings.

1.09 WORK SEQUENCE

A. Keep existing HSQ System operational while new CiTect/Allen Bradley SCADA system is installed. After successful testing and commissioning of new SCADA system, HSQ System can begin to be removed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

APPENDIX A
"Method of Procedure" (MOP)
Instructions and Forms

Definition and Purpose

"Method of Procedure" (MOP) is a detailed document submitted by the Contractor to request process shutdown(s), utility tie-in(s), work in areas that may risk unanticipated outages, or flow diversions to accommodate site construction activities during a project. Such activities may include (but are not limited to) new tie-ins to utilities or structures, mechanical modifications to process piping or equipment, demolition, bulkhead installation, and cleaning processes.

The MOP provides a detailed plan to the Owner and Engineer that describes specific aspects of the work including purpose, time of execution, and anticipated impacts on treatment processes. The MOP also includes contingency measures and provisions for rapid closure in the event that shutdown or work progress difficulties are encountered. Information from relevant trades associated with the requested shutdown, diversion, or tie-in is also included.

The Owner should use the information within the MOP to define operational procedures and methods to safely and successfully assist the Contractor.

MOP Process Summary

WHO	STEP	TIMING
Contractor	1. Identify MOPs needed on MOP Log and Baseline Schedule.	7 days prior to Preconstruction Scheduling Meeting
Contractor, Owner, Engineer	2. Pre-MOP Meeting.	More than 28 days prior to work
Contractor	3. Submits MOP.	No later than 28 days prior to work
Owner	4. Reviews MOP.	
Owner	5. MOP finalized.	7 days prior to work
Contractor	6. Complete Readiness Checklist.	5 days prior to work
Contractor	7. Complete Safety Checklist.	Just prior to commencing work
Contractor	8. Complete Work.	
Contractor	9. Update MOP Log and Progress Schedules.	Monthly

MOP Process Detail

STEP 1. Identifies MOPs needed on MOP Log and Baseline Schedule.

Contractor submits a preliminary list of anticipated project MOPs on MOP Log. MOPs identified but not limited to those shutdowns, diversions, or tie-ins described in the Contract Documents. Incorporate MOPs as tasks in Baseline Schedule. Date scheduled MOPs to coincide with the appropriate construction activities.

STEP 2. Pre-MOP Meeting.

Contractor requests a Pre-MOP Meeting with the Owner and Engineer to discuss the nature of the shutdown, diversion, or tie-in, and to gather the information necessary to complete the MOP Form. The pre-MOP meeting may be waived by the Owner or Engineer if the work is deemed to be minor.

STEP 3. Submits MOP.

Contractor completes the MOP Form and submit 3 copies for approval to the Owner's Project Manager (OPM).

STEP 4. Reviews MOP.

OPM distributes MOP Form for review by the Owner's Construction Coordinator, O&M Representative, and Engineer's Project Representative. Review MOP Form for completeness, accuracy, compliance with both the construction schedule, constraints defined in contract documents, and to ensure that the requested work does not negatively impact plant operations or other concurrent project activities. Additional information may be requested to better understand the nature of and method for completing the Work.

STEP 5. MOP finalized.

Once the MOP is agreed to by all parties, the MOP will be finalized by signature. Copies are distributed to the Owner, Engineer, and Contractor.

STEP 6. Complete Readiness Checklist.

Contractor verifies everything is ready for the work.

STEP 7. Complete Safety Checklist.

Contractor ensures safety.

STEP 8. Complete work.

Contractor complete work.

STEP 9. Update MOP Log and Progress Schedules.

Contractor updates MOP Log weekly and distributes at the regularly scheduled construction progress meetings.

METHOD OF PROCEDURE (MOP) FORM

Owner: _____ **Date:** _____

Contractor: _____ **Carollo Project No.:** _____

Project Name: _____ **Submittal No.:** _____

Submittal Title: _____ **Spec/Dwg. Reference:** _____

MOP #	Task Title *(Provide <10 word title)*:	Submittal Date: *(No later than 28 days prior to work)*

SCHEDULE OF WORK ACTIVITY START: *(Date/Time)* END: (Date/Time)

REQUESTOR:

PRIMARY POINT OF CONTACT: PHONE/PAGER:

SECONDARY POINT OF CONTACT: PHONE/PAGER:

NOTIFY ☐ Control Room, Phone ☐ Security, Phone

BUILDING: LOCATION OF WORK FLOOR/LEVEL:

DESCRIPTION OF WORK: *(Provide sufficient details on process isolation, work sequencing, and safety (i.e., control of significant hazards unique to the work) to demonstrate an understanding of the work and how it will be completed within the constraints, and its impact on the processes and facility.)*

Task Summary: _____

Processes Affected: _____

Trades Affected: _____

WORK PLAN:

Work Sequencing: _____

Process Isolation: _____

Spill Prevention Plan: _____

Contingency Plans: _____

CRITICAL EQUIPMENT/TOOLS: *(pumps and discharge hoses with correct fittings, blind flanges and pipe plugs, no-hub fittings, properly sized electrical service components, generators, portable lighting, chlorine for potable water pipe breaks, etc.)*

☐	Acoustic Ceiling/or Walls Access	☐	Excavation Permit	☐	Lock Out/Tag Out
☐	Chemical Use Approval	☐	Fire Sprinkler Impairment	☐	Life Safety Systems
☐	Confined Space Permit	☐	Flammable Materials	☐	Roof Protocol
☐	Critical Lift Plan	☐	Flush / Discharge	☐	Work After Dark
☐	Energized Electrical Work	☐	High Pressure Test	☐	
☐	Elect. Panel Schedules	☐	Hot Work/Open Flame	☐	

EXISTING SERVICE(S) AT RISK:

☐	Breathing Air	☐	Elect Normal	☐	Process Access	☐	Telephones
☐	Chemical Distribution	☐	Fire Protection	☐	Safety Showers	☐	UPS
☐	City Water	☐	HVAC	☐	SCADA	☐	VAX/DATA
☐	Communication	☐	Inert Gas	☐	Security	☐	
☐	Domestic Drain	☐	Instrument - Air	☐	Solvent Drain	☐	
☐	Elect-Bus Duct	☐	Life Safety System	☐	Specialty Gases	☐	
☐	Elect Emergency	☐	Natural Gas	☐	Storm Drain	☐	

REVIEWER'S INSTRUCTIONS / COMMENTS:				
☐ PREJOB BRIEFING MUST BE COMPLETED PRIOR TO COMMENCING WORK:				
	Full Name (printed)	**Signature**	**Phone**	**Date**
Submitted By				
System Owner				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				

READINESS CHECKLIST
(5 days prior to work)

Checklist provided as a guide but is not all inclusive.

1. Confirm all parts and materials are on site: _____
2. Review work plan: _____
3. Review contingency plan: _____

SAFETY CHECKLIST
(Just prior to commencing work)

Checklist provided as a guide but is not all inclusive.

1. Location awareness:
   a. Emergency exits: _____
   b. Emergency shower and eyewash: _____
   c. Telephones and phone numbers: _____
   d. Shut-off valve: _____
   e. Electrical disconnects: _____
2. Inspect work area:
   a. Take time to survey the area you are working in. Ensure that what you want to do will work. Do you have enough clearance? Is your footing secure? Do you have adequate lighting and ventilation? Are surrounding utilities out of the way for you to perform your work?
3. SDS (Safety Data Sheets):
   a. Understand the chemicals and substances in the area you are working in by reading the SDS.
4. Lockout/Tagout Procedure:
   a. Lockout/tagout energy sources before beginning work.
   b. Make sure all valves associated with the work are locked out and tagged out on each side of the penetration.
   c. Make sure the lines are depressurized.
5. Overhead work:
   a. Use appropriate personal protective equipment; i.e., safety harness, lifeline, etc.
   b. Select appropriate tie-off points; i.e., structurally adequate, not a pipe or conduit, etc.
   c. Spotter assigned and in position.
   d. Pipe rack access; i.e., check design capacity, protective decking or scaffolding in place, exposed valves or electrical switches identified and protected.
6. Safety equipment:
   a. Shepherd's hook.
   b. ARC flash protection.
   c. Fire extinguisher.
   d. Other: _____.
7. Accidents:
   a. Should accidents occur, do not shut off and do not attempt to correct the situation, unless you are absolutely positive that your action will correct the problem and not adversely affect other people or equipment.
8. Review process start-up documents:
   a. In the event the system is shutdown, the Control Center should have a working knowledge of the process start-up procedures in order to deal effectively with unforeseen events.
9. Evacuation procedures:
   a. Do not obstruct evacuation routes.
   b. Take time to survey the area for evacuation routes.

Method of Procedure (MOP) Log
Sample

MOP Number	Task Title	Date Requested	Date Approved	Date Work Planned	Work Completed (yes/no)
001					
002					
003					

SECTION 01210

ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Listing of allowance items:
      a. Related responsibilities of Contractor and procedures.

1.02 ALLOWANCE AMOUNTS

A. Include following amounts in Contract Price:
   1. $**[TBD]** for furnishing of computer equipment.

1.03 COSTS INCLUDED AND EXCLUDED IN ALLOWANCES

A. Costs included in allowances for furnishing products only:
   1. Net cost of product.
   2. Delivery and unloading at site.
   3. Applicable taxes and fees.

B. Costs included in Contract Price, but not included in allowances for furnishing products only:
   1. Handling at site, including uncrating and storage.
   2. Protection from elements, theft, and damage.
   3. Labor, installation, testing, and finishing.
   4. Other expenses required to complete installation.
   5. Overhead and profit.

C. Costs included in allowances for furnishing and installing products:
   1. Net cost of product.
   2. Delivery and unloading at site.
   3. Applicable taxes.
   4. Handling at site, including uncrating and storage.
   5. Protection from elements and from damage.
   6. Labor, installation, testing, and finishing.
   7. Other expenses required to complete installation.

1.04 DUTIES OF CONTRACTOR IN PROVIDING PRODUCTS BY ALLOWANCE

A. Advise Engineer at least 60 days in advance of purchase date necessary to avoid impacts to Progress Schedule.

B. Obtain proposals from suppliers, including:
   1. Quantity.
   2. Complete description of product and services provided under allowance.
   3. Unit cost.

4. Total amount of purchase.
5. Taxes and delivery charges.

C. On notification of selection, enter into purchase agreement with designated supplier.

D. Arrange for delivery and unloading.

E. Install products in accordance with Contract Documents.

1.05 ADJUSTMENT OF COSTS

A. When actual cost is more or less than amount of allowance, Contract Price will be adjusted by Change Order.

1.06 ALLOWANCES

A. Allowance:
1. Allowance **[ ]**: Specified in Section **[ ]**.
2. Allowance **[ ]**: Specified in Section **[ ]**.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01220

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.

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. The costs for mobilization shall include preparatory work and operations in mobilizing for beginning work on the project, including, but not limited to, those operations necessary for the movement of personnel, equipment, supplies and incidentals to the project site, and for the establishment of temporary offices, buildings, safety equipment, first aid supplies, sanitary and other facilities, as required by the contract documents.

Payment for mobilization shall not exceed 5 percent (5%) of the total Contract cost unless the Contractor can prove to the Owner that his actual mobilization cost exceeds 5 percent (5%). Partial Payments for this Bid Item will be made in accordance with the following schedule:

Percent of Original Contract Amount	Percent Allowable Payment of Mobilization/Demobilization Bid Item Price
5	25
10	35
25	45
50	50
75	75
100	100

BID ITEM NO 2 – DEMOLITION AND ELECTRICAL WORK

Payment for all work included under this Bid Item shall represent full compensation in accordance with the lump sum price bid to complete demolition and Electrical work including, but not limited to, demolish equipment electrical systems, instrumentation and control systems and other items 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.

Installation of new conduit, wiring and fiber optic cable; control panels; manhole; re-routing of existing fiber optic cable and all other materials and equipment necessary for a complete and fully operable system, including testing and start-up, O&M documents, and record drawings, 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 price 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 3 – INSTRUMENTATION AND CONTROLS

Payment for all work included under this Bid Item shall represent full compensation in accordance with the lump sum price bid for the Instrumentation & Controls work including new control panels, wireless telemetry including radio towers, RTU's, and all other materials and equipment necessary for a complete and fully operable system, including testing and start-up, O&M documents, and record drawings, 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 - SCADA NETWORK MODIFICATIONS AND ADDITIONS

Payment for all work included in this bid item will be made at the applicable Contract lump sum price listed in the bid form, and shall represent full compensation for providing additional PLC input module and related hardware in existing SCADA PLC, plus services for SCADA software configurations at the existing SCADA command center, including submittals of custom shop drawings for additions to existing SCADA PLC equipment and additional software services for SCADA computers, in accordance with scope of work on the Technical Documents. This item includes submittal of detail shop drawings for additions to SCADA network, instrument calibrations, startup and testing services, training and providing complete documentation in digital format.

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 – RELOCATION/MODIFICATION OF EXISTING FIBER OPTIC CONDUIT AND CABLES (FOR RAW WATER PUMP STATIONS)

Provide lump sum cost for relocation/modification of existing fiber optic conduit and cables between Filter Buildings B and C for the Raw Water Pump Stations. This cost shall include all necessary temporary patch panels, fusion splicing, new conduits and fittings, new fiber optic cables, supports, labor, testing, etc. for a complete and functional fiber optic system in place. Based on the requirements of upfront construction sequence and implementation timing requirements, this bid item will be included in both "Lake Manatee WTP Filter Upgrade" project and "Lake Manatee WTP SCADA Upgrade" project due to the approximately concurrent bidding schedules for these two projects. Depending on which of the above two construction projects is first mobilized and this work is ultimately performed in, the corresponding contractor for the other project shall accordingly credit the associated lump sum cost back to the Owner.

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.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01260

CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for executing a change in the Work.

1.02 PRELIMINARY REQUIREMENTS

A. Change Order Cost Basis Summary Form:
   1. Submit a sample to Engineer for review within 15 calendar days following Notice to Proceed.
      a. Items will be reviewed and their value, percentage, or calculation method mutually agreed to by the Contractor and Owner prior to executing a Change Order on the Project.
   2. Used by the Contractor for pricing each Change Order required for additions, deletions, or revisions in the Work.
   3. Include the following information:
      a. Agreed upon markups, percentages, and procedures for calculating all surcharges, etc. associated with the Cost of the Change Order Work.
      b. References for unit price information and special unit price information.
      c. Attachments with the following information:
         1) Certified labor rates breakdown.
         2) Equipment rates.
         3) Bond and insurance rates (PI&I).

1.03 REQUEST FOR INFORMATION OR INTERPRETATION (RFI)

A. Contractor may issue RFIs to request interpretation of the documents or to request for information that may be missing.

B. General Instructions:
   1. Use RFI Form as specified in Document 00632 - Request for Information or Interpretation (RFI).
      a. Use of other RFI Forms is acceptable if the form includes the information in the form provided in the referenced form, at a minimum.
   2. Number RFIs consecutively.
      a. Add a consecutive letter to the RFI number on modified submittals of the same RFI (i.e., RFI 4B).
   3. Provide RFI for 1 item.
      a. There may be exceptions when multiple items are so functionally related that expediency indicates review of the group of items as a whole.
      b. RFIs with multiple items will be rejected without review.
   4. Contractor sign and date RFIs indicating review and approval.
      a. Contractor’s signature indicates that they have satisfied RFI review responsibilities and constitutes Contractor's written approval of RFI.

b. RFIs without Contractor's signature will be returned to the Contractor unreviewed. Subsequent submittal of this information will be counted as the first resubmittal.

C. Engineer will render a written clarification, interpretation, or decision on the issue submitted or initiate an amendment or supplement to the Contract within 21 days.
   1. In the event the Contractor identifies an RFI as critical to the progress of the project, Engineer will make every effort to reduce the RFI response time.

1.04 PRELIMINARY PROCEDURES

A. Owner or Engineer may initiate changes by submitting a Request for Proposal (RFP) to Contractor including the following information:
   1. Detailed description of the Change, Products, and location of the change in the Project.
   2. Supplementary or revised drawings or specifications.
   3. Projected time span for making the change, and a specific statement if overtime work is authorized.
   4. A specific 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, or to stop work in progress.

B. Contractor may initiate changes by submitting a Change Proposal to Engineer containing the following:
   1. Description of proposed changes.
   2. Reason for making changes.
   3. Specific period of time during which requested price will be considered valid.
   4. Effect on Total Contract Cost and/or Contract Time.
   5. Documentation supporting any change in Total Contract Cost and/or Contract Time, as appropriate.

1.05 WORK CHANGE DIRECTIVE AUTHORIZATION

A. In lieu of a Request for Proposal (RFP), Engineer may issue a Work Change Directive Authorization for Contractor to proceed with a change for subsequent inclusion in a Change Order.

B. Authorization will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change, and will designation method of determining any change in the Contract Sum and/or the Contract Time, as appropriate.

C. Owner and Engineer will sign and date the Work Change Directive Authorization as authorization for the Contractor to proceed with the changes.

D. Contractor may sign and date the Work Change Directive Authorization to indicate agreement with the terms.

1.06 DOCUMENTATION OF CHANGE PROPOSALS

A. Change proposal:
   1. Support with sufficient substantiating data to allow Engineer to evaluate the quotation.
      a. Lump sum.
      b. Unit prices: Use previously established unit prices.
      c. Time-and-material/force account basis:
         1) Name of the Owner's authorized agent who ordered the work, and date of the order.
         2) Dates and times work was performed, and by whom.
         3) Time record, summary of hours worked, and hourly rates paid.
         4) Receipts and invoices for:
            a) Equipment used, listing dates and times of use.
            b) Products used, listing of quantities.
            c) Subcontracts.
   2. Provide additional data to support time and cost computations:
      a. Labor required.
      b. Equipment required.
      c. Products required:
         1) Recommended source of purchase and unit cost.
         2) Quantities required.
      d. Taxes, insurance, and bonds.
      e. Credit for work deleted from Contract, similarly documented.
      f. Overhead and profit.
      g. Justification for change to Contract Time.

1.07 PREPARATION OF CHANGE ORDERS AND FIELD ORDERS

A. Engineer will prepare each Change Order and Field Order.

B. Change Orders:
   1. Will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change.
   2. Will provide an accounting of the adjustment in the Contract Sum and in the Contract Time.
   3. Recommendation of Change Proposal is indicated by Engineer's signature.
   4. Upon signature and execution by Owner, the Change Proposal becomes a Change Order altering the Contract Time and Total Contract Cost, as indicated.
      a. Owner's Representative will transmit one signed copy each to Contractor and Engineer.
   5. Contractor may only request payment for changes in the Work against an approved Change Order.
   6. If either Engineer or Owner's Representative disapproves the Change Proposal, the reason for disapproval will be stated.
      a. A request for a revised proposal or cancellation of the proposal will be shown.

C. Field Orders:
   1. Order minor changes in the Work without changes in Contract Price or Contract Times.

1.08 LUMP-SUM/FIXED PRICE CHANGE ORDER

A. Content of Change Orders will be based on, either:
   1. Engineer's Proposal Request and Contractor's responsive Change Proposal as mutually agreed between Owner and Contractor.
   2. Contractor's Change Proposal for a change, as recommended by Engineer.

B. Owner and Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time and serve as authorization for the Contractor to proceed with the changes.

C. Contractor will sign and date the Change Order to indicate agreement with the terms.

1.09 UNIT PRICE CHANGE ORDER

A. Content of Change Orders will be based on, either:
   1. Engineer's definition of the scope of the required changes.
   2. Contractor's Change Proposal for a change, recommended by Engineer.
   3. Survey of completed work.

B. The amounts of the unit prices to be:
   1. Those stated in the Contract.
   2. Those mutually agreed upon between Owner and Contractor.

C. When quantities of each of the items affected by the Change Order can be determined prior to start of the work:
   1. Owner and Engineer will sign and date the Change Order as authorization for Contractor to proceed with the changes.
   2. Contractor will sign and date the Change Order to indicate agreement with the terms.

D. When quantities of the items cannot be determined prior to start of the work:
   1. Engineer or Owner will issue a Work Change Directive authorization directing Contractor to proceed with the change on the basis of unit prices, and will cite the applicable unit prices.
   2. At completion of the change, Engineer will determine the cost of such work based on the unit prices and quantities used.
   3. Contractor shall submit documentation to establish the number of units of each item and any claims for a change in Contract Time.

E. Owner and Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time and serve as authorization for the Contractor to proceed with the changes.

F. Contractor will sign and date the Change Order to indicate their agreement with the terms.

1.10 TIME AND MATERIAL/FORCE ACCOUNT CHANGE ORDER/WORK CHANGE DIRECTIVE AUTHORIZATION

A. Engineer will issue a Work Change Directive for the Owner's signature authorizing Contractor to proceed with the changes.

B. At completion of the change, Contractor shall submit itemized accounting and supporting data as specified in this Section.

C. Engineer will determine the allowable cost of such work, as provided in the Contract Documents.

D. Owner and Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time and serve as authorization for the Contractor to proceed with the changes.

E. Contractor will sign and date the Change Order to indicate their agreement.

1.11 CORRELATION WITH CONTRACTOR'S SUBMITTALS

A. Periodically revise Schedule of Values and Applications for Payment forms to record each Change Order 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 subschedules 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 01294

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Procedures for preparation and submittal of Applications for Payment.

1.02 FORMAT

A. Develop satisfactory spreadsheet-type form generated by downloading cost data from the Progress Schedule.
   1. Submit payment requests using Document 00620 - Contractor's Application for Payment and attach spreadsheet with cost data related to Progress Schedule.

B. Fill in information required on form.

C. When Change Orders are executed, add Change Orders at end of listing of scheduled activities:
   1. Identify change order by number and description.
   2. Provide cost of change order in appropriate column.

D. After completing, submit Application for Payment.

E. Engineer will review application for accuracy. When accurate, Engineer will transmit application to Owner for processing of payment.

F. Execute application with signature of responsible officer of Contractor.

1.03 SUBSTANTIATING DATA

A. Provide Substantiating Data with cover letter identifying:
   1. Project.
   2. Application number and date.
   3. Detailed list of enclosures.
   4. For stored products with item number and identification on application, description of specific material, and proof of insurance coverage for offsite stored products.
   5. Submit "certified" payroll, if applicable.

1.04 SUBMITTALS

A. Submit 5 copies of Application for Payment and Substantiating Data with cover letter.

1.05 PAYMENT REQUESTS

A. Prepare progress payment requests on a monthly basis. Base requests on the breakdowns of costs for each scheduled activity and the percentage of completion for each activity.

B. Indicate total dollar amount of work planned for every month of the project. Equate sum of monthly amounts to Lump Sum Contract Price.

C. Generate Progress Payment request forms by downloading cost data from the schedule information to a spreadsheet type format.

D. Identify each activity on the Progress Schedule that has a cost associated with it, the cost for each activity, the estimated percent complete for each activity, and the value of work completed for both the payment period and job to date.

E. Prepare summary of cost information for each Major Item of Work listed in the Schedule of Values. Identify the value of work completed for both the payment period and job to date.

F. Payment period:
   1. Monthly Application for Payment period shall begin on the 1st day of each month, and end on the last day of each month.
   2. Submit Application for Payment to Engineer no later than the 5th day of each month for work completed the previous month.
   3. Engineer will finalize and submit recommendation for Application for Payment to Owner by the 15th day of each month to allow time for processing and approval.

1.06 COST SUMMARIES

A. Prepare Summary of Cost Information for each Major Item of Work listed in the Schedule of Values. Identify the Value of Work Completed for both the payment period and job to date.

B. Cash flow summary: Prepare cash flow summary, indicating total dollar amount of work planned for each month of the project. Equate sum of monthly amounts to Lump Sum contract price.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01312

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest, and includes the following:
   1. Qualifications of Meeting Participants.
   2. Preconstruction Conference.
   3. Progress Meetings.
   4. Pre-Installation Meetings.
   5. Schedule Update Meetings.
   6. Quality Control Meetings.
   7. Pre-Shutdown Meetings.
   8. Pre-Process Start-up Meetings.
   9. Electrical and Instrumentation Coordination Meetings.
   10. Close-out meeting.
   11. Post Construction Meeting.

1.02 QUALIFICATIONS OF MEETING PARTICIPANTS

A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of entity each represents.

1.03 PRECONSTRUCTION CONFERENCE

A. Upon issuance of Notice to Proceed, or earlier when mutually agreeable, Engineer will arrange preconstruction conference in place convenient for most invitees.

B. Preconstruction Conference invitees: Contractor's project manager and superintendent, Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda.

C. Engineer will preside at conference.

D. Purpose of conference: To establish working understanding between parties and to discuss Construction Schedule, shop drawing and other submittals, cost breakdown of major lump sum items, processing of submittals and applications for payment, and other subjects pertinent to execution of the Work.

E. Agenda will include:
   1. Adequacy of distribution of Contract Documents.
   2. Distribution and discussion of list of major subcontractors and suppliers.
   3. Proposed progress schedules and critical construction sequencing.
   4. Major equipment deliveries and priorities.
   5. Project coordination.

6. Designation of responsible personnel.
7. Procedures and processing of:
    a. Field decisions.
    b. Proposal requests.
    c. Submittals.
    d. Change Orders.
    e. Request for Information/Interpretations.
    f. Applications for Payment.
    g. Record Documents.
8. Use of premises:
    a. Office, construction, and storage areas.
    b. Owner's requirements.
9. Construction facilities, controls, and construction aids.
10. Temporary utilities.
11. Safety and first aid procedures.
12. Security procedures.
13. Housekeeping procedures.

F. Engineer will record minutes of meeting and distribute copies of minutes within 7 days of meeting to participants and interested parties.

1.04 PROGRESS MEETINGS

A. Engineer will schedule and administer meetings throughout progress of the Work at maximum weekly intervals.

B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance required: Owner, Engineer, Contractor, Contractor’s Project Manager, superintendent, quality control manager, project scheduler, major subcontractors and suppliers as appropriate to agenda topics for each meeting.

D. Additional invitees: Owner utility companies when the Work affects their interests, and others necessary to agenda.

E. Agenda:
1. Review minutes of previous meeting/minutes.
2. Safety and security.
3. Construction schedule summary.
4. Review of 6 weeks’ schedule.
5. Review of off-site fabrication and delivery schedules.
6. Review of submittals schedule and status of submittals.
7. Request for information (RFI’s) status.
8. MOP’s/shutdown coordination.
9. Change order management status.
10. Maintenance of quality standards (QA/QC).
11. Field observations, problems, and conflicts.
12. Commissioning and process start-up.
13. Partnering recognition status (optional).
14. General Items.
15. Action items.
16. Next meeting.

F. Engineer will record minutes and distribute copies within 5 calendar days after meeting to participants, with copies to Contractor, Owner, and those affected by decisions made.

1.05 PRE-INSTALLATION MEETINGS

A. When required in individual specification sections or requested by Engineer, convene pre-installation meeting at Project site before commencing work of specific section.

B. Require attendance of parties directly affecting, or affected by, Work of specific section.

C. Notify Engineer 7 calendar days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of installation, preparation and installation procedures.
   2. Review coordination with related work.

E. Contractor will record minutes and distribute electronic copies within 7 calendar days after meeting to participants, with copies to Engineer, Owner, and those affected by decisions made.

1.06 SCHEDULE UPDATE MEETINGS

A. Engineer will schedule meetings throughout progress of the Work at maximum monthly intervals.

B. Engineer will make arrangements for meetings; Contractor will prepare agenda with copies for participants, and preside at meetings.

C. Attendance required: Owner, Engineer, Contractor, Contractor's Project Manager, General Superintendent, project scheduler, major subcontractors and suppliers as appropriate to agenda topics for each meetings.

D. Additional invitees: Owner utility companies when the Work affects their interests and others necessary to the agenda.

E. Agenda:
   1. Review Monthly Schedule, (Actual Progress and Variance).
      a. "Activities Started/Completed" this period.
      b. "Activities Started/Completed" "Variance" Baseline vs. current.
      c. "Added/Deleted Activities".
      d. "Revised Activity Descriptions".
      e. Any significant Proposed Logic Changes.
   2. Review milestone "Substantial Completion" Schedule:
      a. "Critical" Activities - "Critical Area, Float and Vital Statistics".
   3. Review "Cumulative and Monthly Costs" graph.
   4. Review "Budgeted Cost" indicating the Current Project Budgeted Cost.

F. Contractor will record changes for update and distribute electronic copies within 7 calendar days after meeting to participants and interested parties.

1.07 QUALITY CONTROL MEETINGS

A. Contractor will schedule and administer meetings throughout progress of the Work at maximum weekly intervals.

B. Contractor will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance Required: Construction Manager and staff, Contractor's Quality Control Manager and staff.

D. Agenda:
   1. Review minutes of previous meetings.
   2. Review of Work progress and schedule.
   3. Review of out-of-compliance inspection or test results.
   4. Field observations, problems, and decisions.
   5. Review of offsite fabrication and delivery schedules.
   6. Planned progress during succeeding work period.
   7. Coordination of required inspections and tests.
   8. Review 6-week schedule report with upcoming inspections and special tests.
   9. Maintenance of quality and work standards.
   10. Other business relating to Work.

E. Contractor will record minutes and distribute electronic copies within 5 calendar days after meeting to participants, and those affected by decisions made.

1.08 PRESHUTDOWN MEETINGS

A. Follow Owner's standard Construction Method of Procedure (MOP). See Appendix A of Section 01140 - Work Restrictions for MOP format.

B. All short-term and longer-term shutdowns and other tie-ins that require an Owner approved MOP also require a pre-shutdown meeting at Project site prior to commencing shutdown for tie-in or modification of specific plant systems.

C. Require attendance of parties directly affecting, or affected by shutdown, including Engineer, specific work crews, Owner's construction, operations, and maintenance staff.

D. Notify Engineer 7 calendar days in advance of meeting date.

E. Prepare agenda and preside at meeting:
   1. Review accepted MOP including conditions of shutdown, preparation, and installation procedures.
   2. Review timelines and sequences.
   3. Review responsibilities.
   4. Review dry run plan and schedule, as necessary.
   5. Review coordination with related work.

F. Contractor will record minutes and distribute copies within 5 calendar days after meeting and prior to scheduled shutdown to participants, with copies to Engineer, Owner, and those affected by decisions made.

1.09 PRE-PROCESS START-UP MEETINGS

A. All processes and equipment that requires testing and process start-up also requires a pre-startup meeting at Project site before commencing process start-up of specific plant systems.

B. Require attendance of parties directly affecting, or affected by process start-up and testing, including Engineer, specific work crews, Owner's construction operations, and maintenance staff.

C. Notify Engineer 7 calendar days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review accepted MOP including conditions of process start-up and testing, preparation, and installation procedures.
   2. Review timelines and sequences.
   3. Review responsibilities.
   4. Review dry run plan and schedule, as necessary.
   5. Review coordination with related work.

E. Contractor will record minutes and distribute electronic copies within 5 calendar days after meeting and prior to scheduled process start-up to participants, with copies to Engineer, Owner, and those affected by decisions made.

F. Follow Owner's standard Construction Method of Procedure (MOP). See Appendix A of Section 01140 - Work Restrictions for MOP format.

1.10 ELECTRICAL AND INSTRUMENTATION COORDINATION MEETINGS

A. Electrical Meetings:
   1. Pre-submittal review meeting as specified in Section 16050 - Common Work Results for Electrical.
   2. Other meetings as required and as otherwise specified.

B. Instrumentation and Control Meetings:
   1. Pre-Submittal Conference as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
   2. System Configuration Meetings (3 separate meetings) as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
   3. Graphics Meetings (2 separate meetings) as specified in Section 17762 - Control Systems: SCADA Software.
   4. Report Meetings (2 separate meetings) as specified in Section 17762 - Control Systems: SCADA Software.
   5. Other meetings as required and as otherwise specified.

1.11 CLOSE-OUT MEETING

A. Engineer will schedule close-out meeting.

B. Engineer will make arrangements for meeting, prepare agenda with copies for participants, and preside at meeting.

C. Attendance required: Owner, Engineer, Contractor, Contractor's Project Manager, Superintendent.

D. Agenda:
   1. Review punch list completion.
   2. Transfer of record documents.
   3. Finalize payment.

E. Engineer will record minutes and within 5 calendar days after meeting distribute copies to participants.

1.12 POST CONSTRUCTION MEETING

A. Meet with and inspect the Work 11 months after date of Substantial Completion with Owner and Engineer.

B. Owner will arrange meeting at least 7 days before meeting.

C. Meet in Owner's office or other mutually agreed upon place.

D. Inspect the Work and draft list of items to be completed or corrected.

E. Review service and maintenance contracts, and take appropriate corrective action when necessary.

F. Complete or correct defective work and extend correction period accordingly.

G. Require attendance of Contractor, Project Manager, or Superintendent, appropriate manufacturers and installers of major units of constructions, and affected subcontractors.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01324C

PROGRESS SCHEDULES AND REPORTS - SMALL PROJECTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preparation, submittal, and maintenance of computerized progress schedule and reports, Contract time adjustments, and payment requests, including the following:
   1. Preliminary Schedule.
   2. Baseline Schedule.
   3. Monthly Schedule Updates.
   4. Weekly Summary Schedule.
   5. Schedule of Submittals.
   6. Manpower Schedule.
   7. Equipment Schedule.
   8. Commissioning and Process Start-up Schedule.
   9. As-built Schedule.

1.02 SCHEDULER

A. Designate, in writing and within 5 calendar days after Notice of Award, person responsible for preparation, maintenance, updating, and revision of all schedules.

B. Qualifications of scheduler:
   1. Authority to act on behalf of Contractor.
   2. 5 years verifiable experience in preparation of complex construction schedules for projects of similar value, size, and complexity.
   3. Knowledge of critical path method (CPM) scheduling utilizing Primavera Project Planner or SureTrak or Microsoft Project software.

1.03 SCHEDULING FORMAT AND SOFTWARE

A. Schedule format: Utilize CPM format.

B. Prepare computerized schedule utilizing Primavera P6 Professional or Microsoft Project, most current version.
   1. Provide 1 licensed copy of the scheduling software to the Engineer, registered in the Engineer's name, for the duration of the project.
   2. The provided copy of the software shall be an unmanaged version for installation on a standalone computer.

1.04 PRECONSTRUCTION SCHEDULING MEETING

A. Engineer will conduct Preconstruction Scheduling Meeting with Contractor's Project Manager, General Superintendent, and scheduler within 7 calendar days after Notice To Proceed. This meeting is separate from the Preconstruction Conference Meeting and is intended to cover schedule issues exclusively.

B. At the meeting, review scheduling requirements. These include schedule preparation, reporting requirements, updates, revisions, and schedule delay analysis. Present schedule methodology, planned sequence of operations, cost and resource loading methodology, and proposed activity coding structure.

C. Naming convention: Name schedule files with the year, month and day of the data date, revision identifier, and a description of the schedule.
   1. Example 1: 2014_07_30 rev 1 draft baseline schedule.xer.
   2. Example 2: 2014_09_30 rev 2 sep final update.xer.

D. Filing: Post submitted files to Owner’s construction document control system.

1.05 SCHEDULE PREPARATION

A. Preparation and submittal of Progress Schedule represents Contractor's intention to execute the Work within specified time and constraints. Failure to conform to requirement may result in termination for cause as specified in Manatee County Front end document. IFBC No. XXXX.

B. Contractor's bid covers all costs associated with the execution of the Work in accordance with the Progress Schedule.

C. During preparation of the preliminary Progress Schedule, Engineer will facilitate Contractor's efforts by being available to answer questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.

D. Prepare schedule utilizing Precedence Diagramming Method (PDM).

E. Prepare schedule utilizing activity durations in terms of working days. Do not exceed 15 working day duration on activities except concrete curing, submittal review, and equipment fabrication and deliveries. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work. Coordinate holidays to be observed with the Owner and incorporate them into the schedule as non-working days.

F. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Contract. Contract requirements are not waived by failure of Contractor to include required schedule constraints, sequences, or milestones in schedule. Contract requirements are not waived by Owner’s acceptance of the schedule. In event of conflict between accepted schedule and Contract requirements, terms of Contract govern at all times, unless requirements are waived in writing by the Owner.

G. Reference schedule to working days with beginning of Contract Time as Day "1".

H. Should Contractor submit a Baseline Schedule showing project completion more than 20 working days prior to Contract completion date, Owner may issue Change Order, at no cost to Owner, revising time of performance of Work and Contract completion date to match Contractor’s schedule completion date. Adjust Contract milestone dates, if any, accordingly.

I. Contract float is for the mutual benefit of both Owner and Contractor. Changes to the project that can be accomplished within this available period of float may be made by Owner without extending the Contract time, by utilizing float. Time extensions will not be granted nor delay damages owed until Work extends beyond currently accepted Contract completion date. Likewise, Contractor may utilize float to offset delays other than delays caused by Owner. Mutual use of float can continue until all available float shown by schedule has been utilized by either Owner or Contractor, or both. At that time, extensions of the Contract time will be granted by Owner for valid Owner-caused or third party-caused delays which affect the planned completion date and which have been properly documented and demonstrated by Contractor.

J. Non-sequestering of float: Pursuant to float sharing requirements of Contract, schedule submittals can be rejected for use of float suppression techniques such as preferential sequencing or logic, special lead or lag logic restraints, extended activity durations or imposed dates.

K. Interim milestone dates, operational constraints. In event there are interim milestone dates and/or operational constraints set forth in Contract, show them on schedule. Do not use Zero Total Float constraint or Mandatory Finish Date on such Contract requirements.

L. Schedule windows for Owner-furnished, Contractor-installed equipment or materials: Immediately after Award of Contract obtain from Engineer anticipated delivery dates of Owner furnished equipment or materials. Show these dates in the schedule in same manner indicated by Engineer.

1.06 NETWORK DETAILS AND GRAPHICAL OUTPUT

A. Produce a clear, legible, and accurate calendar based, time scaled, graphical network diagram. Group activities related to the same physical areas of the Work. Produce the network diagram based upon the early start of all activities.

B. Include for each activity, the description, activity number, estimated duration in working days, total float, and all activity relationship lines.

C. Illustrate order and interdependence of activities and sequence in which Work is planned to be accomplished. Incorporate the basic concept of the precedence diagram network method to show how the start of 1 activity is dependent upon the start or completion of preceding activities and its completion restricts the start of following activities.

D. Indicate the critical path for the project.

E. Delineate the specified contract duration and identify the planned completion of the Work as a milestone. Show the time period between the planned and Contract completion dates, if any, as an activity identified as project float unless a Change Order is issued to officially change the Contract completion date.

F. Identify system shutdown dates, system tie-in dates, specified interim completion or milestone dates and contract completion date as milestones.

G. Include, in addition to construction activities:

1. Submission dates and review periods for major equipment submittals, shoring submittals, and indicator pile program:
    a. Shoring reviews: Allow 4-week review period for each shoring submittal.
    b. Pile indicator program: Allow 3-week review period for analysis of program.
2. Any activity by the Owner or the Engineer that may affect progress or required completion dates.
3. Equipment and long-lead material deliveries over 8 weeks.
4. Approvals required by regulatory agencies or other third parties.

H. Produce network diagram on 22-inch by 34-inch sheets with grid coordinate system on the border of all sheets utilizing alpha and numeric designations.

I. Identify the execution of the following:
1. Mobilization.
2. All required submittals and submittal review times showing 30 calendar day duration for such activities and equal amount of time for re-submittal reviews.
3. Equipment and materials procurement/fabrication/delivery.
4. Other electrical work including lighting, heating and cooling, and special systems, including identification of ordering lead-time.
5. Instrumentation and controls, including identification of ordering lead-time.
6. Preliminary testing of equipment, instrumentation, and controls.
7. Commissioning Phase:
    a. Source Testing.
    b. Owner Training.
    c. Installation Testing.
    d. Functional Testing.
    e. Clean Water Facility Testing.
8. Process Start-up Phase:
    a. Process Start-up.
    b. Process Operational Period.
    c. Instrumentation and Controls Performance Testing.
9. Substantial completion.
10. Punch list work.
11. Demobilization.

1.07 SUBMITTAL OF PROGRESS SCHEDULES

A. Submit preliminary and baseline schedule.

B. Submit, on a monthly basis, updated schedules as specified.

C. Submit final schedule update as specified.

D. Submit revised schedules and time impact analyses as specified.

E. Submit schedules in the media and number of copies as follows:
1. 3 sets of the CPM network and/or bar chart (as specified by the Owner) on D-size sheets. Color-coding to be specified by the Owner.
2. 3 sets of Tabular reports listing all activities sorted numerically identifying duration, early start, late start, early finish, late finish, total float, and all predecessor/successor information.

3. 2 sets of CPM Schedule data electronic files in a native backed-up file (.xer) stored on CD/DVD.

1.08 PRELIMINARY SCHEDULE

A. Submit Preliminary Schedule within 14 calendar days after Notice To Proceed. Include a detailed plan of operations for first 90 calendar days of Work after receipt of Notice to Proceed.

B. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule to review and make necessary adjustments. Submit revised preliminary schedule within 5 calendar days after meeting.

C. Incorporate unchanged, the Accepted Preliminary Schedule as first 90 calendar days of activity in Contractor's Baseline Schedule.

D. Update monthly during first 90 calendar days after Notice to Proceed.

1.09 BASELINE SCHEDULE

A. No more than 30 calendar days after Notice to Proceed, submit the Baseline Schedule for all Work of the project. Show sequence and interdependence of all activities required for complete performance of all Work, beginning with date of Notice to Proceed and concluding with date of final completion of Contract.

1.10 WEATHER DAYS ALLOWANCE

A. Include as a separate identifiable activity on the critical path, an activity labeled "Weather Days Allowance." Insert this activity at the end of the schedule.

B. Insert an activity in critical path to reflect weather day occurrences when weather days are experienced and accepted by Engineer. Identify this activity as a weather delay.

C. Reduce duration of Weather Days Allowance activity as weather delays are experienced and inserted into the schedule. Remaining weather days in Weather Day Allowance at completion of project is considered float.

D. Weather conditions that prevent or inhibit the Contractor's performance of the Work and affect the Critical Path indicated on the Schedule shall be referred to as a Weather Day. A Weather Day is defined as the Contractor being unable to perform at least 4 hours of work on the Critical Path. The Contractor shall provide a written notice to the Engineer of the occurrence of a weather day within 2 days after the onset of such weather and shall describe in reasonable detail the type of weather encountered and the Work interfered with or interrupted. A schedule update will not suffice as a written notice. The Engineer will determine if the weather day constitutes a use of a portion of the Weather Day Allowance. After use of all the Weather Day Allowance, the Engineer will determine if the Contractor is entitled to an extension of the Contract Time due to weather conditions. Weather days are considered excusable delay as defined in this Section.

1.11 REVIEW AND ACCEPTANCE OF SCHEDULES

A. Engineer will review Baseline Schedule, Schedule Updates, Schedule Revisions, and Time Impact Analyses to ascertain compliance with specified project constraints, compliance with milestone dates, reasonableness of durations and sequence, accurate inter-relationships, and completeness.

B. Engineer and Owner will issue written comments following completion of review of Baseline Schedule within 21 calendar days after receipt.

C. Written comments on review of Schedule Updates and Schedule Revisions and Time Impact Analyses will be returned to Contractor within 14 calendar days after receipt by Engineer.

D. Revise and resubmit schedule in accordance with Engineer's comments within 7 calendar days after receipt of such comments, or request joint meeting to resolve objections.

E. If Engineer requests a meeting, the Contractor and all major subcontractors must participate in the meeting with Engineer.
   1. Revise and resubmit schedule within 7 calendar days after meeting.

F. Use accepted schedule for planning, organizing, and directing the work and for reporting progress.

G. Engineer’s submittal review response:
   1. When schedule reflects Owner's and Contractor's agreement of project approach and sequence, schedule will be accepted by Owner.
   2. Engineer’s submittal review response for schedule submittal will be “Receipt Acknowledged - Filed for Record” including applicable comments.

H. Acceptance of the schedules by the Owner is for general conformance with the Contract Documents and for Owner’s planning information, and does not relieve the Contractor of sole responsibility for planning, coordinating, and executing the Work within the contract completion dates. Omissions and errors in the accepted schedules shall not excuse performance less than that required by the Contract Documents. Acceptance by the Owner in no way constitutes an evaluation or validation of the Contractor’s plan, sequence or means, methods, and techniques of construction.

1.12 SCHEDULE UPDATES

A. Any update:
   1. Prepare update using most recent accepted version of schedule including:
      a. Actual start dates of activities that have been started.
      b. Actual finish dates of activities that have been completed.
      c. Percentage of completion of activities that have been started but not finished.
      d. Actual dates on which milestones were achieved.
      e. Update activities by inputting percent complete figures with actual dates.
      f. Use retained logic in preparing Schedule Updates.
      g. When necessary, input remaining durations for activities whose finish dates cannot be calculated accurately with a percent complete figure only.

h. Revisions to the schedule may be included that have been previously approved as specified in this Section under Revisions to Schedule.

B. Monthly updates:
1. Submit written narrative report in conjunction with each Schedule Update including descriptions of the following:
a. Activities added to or deleted from the schedule are to adhere to cost and other resource loading requirements.
1) Identify added activities in manner distinctly different from original activity designations.
b. Changes in sequence or estimated duration of activities.
c. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.
d. Assumptions made and activities affected by incorporating change order work into the schedule.
2. Submit updated schedule and materials specified under Submittal of Progress Schedules, 5 calendar days before the monthly schedule update meeting.
3. Since Monthly Schedule Update is the application for progress payment required as specified in Section 01294 - Applications for Payment, submittal and acceptance of the monthly Schedule Update is a condition precedent to the making of any progress payments.

C. Weekly progress meeting:
1. Update the schedule prior to weekly progress meeting.
a. Identify overall progress of each Major Item of Work in the Summary Schedule.
b. If there are significant changes to the schedule, submit a written report at the weekly progress meeting.
2. Should monthly Schedule Update show project completion earlier than current Contract completion date, show early completion time as schedule activity, identified as “Project Float”.
3. Should monthly Schedule Update show project completion later than current Contract completion date, prepare and submit a Schedule Revision in accordance with the Revisions to Schedule.

1.13 REVISIONS TO SCHEDULE

A. Submit Revised Schedule within 5 calendar days:
1. When delay in completion of any activity or group of activities indicates an overrun of the Contract Time or milestone dates by 20 working days or 5 percent of the remaining duration, whichever is less.
2. When delays in submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
3. When the schedule does not represent the actual progress of activities.
4. When any change to the sequence of activities, the completion date for major portions of the work, or when changes occur which affect the critical path.
5. When Contract modification necessitates schedule revision, submit schedule analysis of change order work with cost proposal.

B. Create a separate submittal for Schedule Revisions.
1. Comply with schedule updates as specified in this Section.
2. Do not submit with Schedule Updates.

C. Schedule Revisions will not be reflected in the schedule until after the revision is accepted by the Owner.
    1. This includes Schedule Revisions submitted for the purpose of mitigating a Contractor-caused project delay (Recovery Schedule).

1.14 WEEKLY SCHEDULE

A. Submit to Engineer, at every weekly progress meeting, a 4-Week Look-Ahead Schedule showing the activities completed during the previous week and the Contractor's schedule of activities for the next 3 weeks.

B. Use the logic and conform to the status of the current progress schedule when producing a Weekly Schedule in CPM schedule or a bar chart format.
    1. In the event that the Weekly Schedule no longer conforms to the current schedule Contractor may be required to revise the schedule as specified in this Section.

C. The activity designations used in the Weekly Schedule must be consistent with those used in the Baseline Schedule and the monthly Schedule Updates.

D. Contractor and Engineer must agree on the format of the Weekly Schedule.

1.15 ADJUSTMENT OF CONTRACT TIMES

A. Contract Time will be adjusted only for causes specified in Contract Documents.
    1. Non-excusable delay: Non-excusable delays include actions or inactions of the Contractor, or events for which the Contractor has assumed contractual responsibility (including actions or inactions of subcontractors, suppliers, or material manufacturers at any tier) that would independently delay the completion of the Work beyond the current Contract completion date). No time extensions will be granted for non-excusable delays.
    2. Excusable delay: Events which are unforeseeable, outside the control of, and without the fault or negligence of either the Owner or the Contractor (or any party for whom either is responsible), which would independently delay the completion of the Work beyond the current Contract completion date. The Contractor is entitled to a time extension only. No other damages will be approved.
    3. Compensable delay: Actions or inactions of the Owner, or events for which the Owner has assumed contractual responsibility, which would independently delay the completion of the Work beyond the current Contract completion date. The Contractor is entitled to a time extension and delay damages.
    4. Concurrent delay: Concurrent delay is any combination of the above 3 types of delay occurring on the same calendar date.
        a. Exception to concurrent delay: Cases where the combination consists of 2 or more instances of the same type of delay occurring on the same calendar date. When one cause of delay is Owner-caused or caused by an event which is beyond the control and without the fault or negligence of either the Owner or the Contractor and the other Contractor-caused, the Contractor is entitled only to a time extension and no delay damages.

B. If the Contractor believes that the Owner has impacted its work, such that the project completion date will be delayed, the Contractor must submit proof

demonstrating the delay to the critical path. This proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of contract time.

C. Time Impact Analysis:
   1. Use the accepted schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other Owner-caused delay). Represent the delay event in the schedule by:
      a. Inserting new activities associated with the delay event into the schedule.
      b. Revising activity logic.
      c. Revising activity durations.
   2. If the project schedule's critical path and completion date are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact may be warranted.
   3. The Time Impact Analysis submittal must include the following information:
      a. A fragment of the portion of the schedule affected by the delay event.
      b. A narrative explanation of the delay issue and how it impacted the schedule.
      c. A CD containing the schedule file used to perform the Time Impact Analysis.

D. When a delay to the project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.

E. Indicate clearly that the Contractor has used, in full, all project float available for the work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date. Utilize the latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.

F. Adjustment of the Contract Times will be granted only when the Contract Float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the Contract completion date. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.

G. Actual delays in activities which do not affect the critical path work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the Contract Time.

H. If completion of the project occurs within the specified Contract Time, the Contractor is not entitled to job-site or home office overhead beyond the Contractor's originally planned occupancy of the site.

I. Notify Engineer of a request for Contract Time adjustment. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.

J. The Engineer will, within 30 calendar days after receipt of a Contract Time adjustment, request any supporting evidence, review the facts and advise the Contractor in writing.
    1. Include the new Progress Schedule data, if accepted by the Owner, in the next monthly Schedule Update.

1.16 SUMMARY SCHEDULE

A. Provide Summary Schedule, which consolidates groups of activities associated with Major Items of Work shown on Baseline Schedule. Summary Schedule is intended to give an overall indication of the project schedule without a large amount of detail.

B. Submit updated Summary Schedule at weekly progress meetings and after each Schedule Update or Schedule Revision.

1.17 SCHEDULE OF SUBMITTALS

A. Schedule of Submittals shall include submittals required in the Contract Documents but not limited to Commissioning and Process Start-up Plans, Training Plans, test procedures, operation and maintenance manuals, shop drawings, samples, record documents, and specifically required certificates, warranties, and service agreements.

B. Preliminary Schedule of Submittals:
    1. Due date: After Preliminary Schedule has been submitted and accepted by Owner.
    2. Format:
        a. Include submittals anticipated in the first 90 calendar days after Notice to Proceed using early start dates.
        b. Indicate week and month anticipated for each submittal.
        c. Indicate “Priority” submittals where review time can impact Contractor’s schedule.
            1) “Priority” indication will not alter review times specified in Section 01330 - Submittal Procedures.
            2) Engineer will endeavor to provide early review of “Priority” submittals where possible.
    3. Submittal of Preliminary Schedule of Submittals shall be a condition precedent to Owner making progress payments during the first 90 calendar days after Notice to Proceed.

C. Final Schedule of Submittals:
    1. Due date: After Baseline Schedule has been submitted and accepted by Owner.
    2. Format:
        a. Include submittals using early start dates.
        b. Include all submittals, including those required in the preliminary schedule of shop drawings and sample submittals.
        c. Indicate week and month anticipated for each submittal.
        d. Indicate “Priority” submittals where review time can impact Contractor’s schedule.
            1) “Priority” indication will not alter review times specified in Section 01330 - Submittal Procedures.

2) Engineer will endeavor to provide early review of “Priority” submittals where possible.

3. Submittal of Final Schedule of Submittals shall be a condition precedent to Owner making progress payments after the first 90 calendar days after Notice to Proceed.

D. Provide updated Schedule of Submittals with updated schedules if schedule revisions change listing and timing of submittals.

1.18 MANPOWER SCHEDULES

A. Due date: After Baseline Schedule has been submitted and accepted by Owner.

B. Format:
1. Schedule histogram depicting total craft manpower and craft manpower for Contractor’s own labor forces and those of each subcontractor.
2. Submit electronically on a computer disk in Excel format, with 1 paper copy.

C. Progress payments after the first 90 calendar days after Notice to Proceed will not be made until manpower schedule is provided.

1.19 EQUIPMENT SCHEDULE

A. Due date: After Baseline Schedule has been submitted and accepted by Owner.

B. Format:
1. Tabular report listing each major piece of construction equipment to be used in performing the Work.
2. Include major equipment for Contractor and each subcontractor.
3. Submit electronically on a computer disk in Excel format with 1 paper copy.

C. Progress payments after the first 90 calendar days after Notice to Proceed will not be made until equipment schedule is provided.

1.20 COMMISSIONING AND PROCESS START-UP SCHEDULE SUBMITTAL

A. Proposed Commissioning and Process Start-up Schedule:
1. Due date: As specified in Section 01756 - Commissioning.
2. Schedule requirements: As specified in Section 01756 - Commissioning.
3. Engineer response due within 20 calendar days of receipt.
4. Contractor responsible for updating schedule and resubmitting within 10 calendar days of receipt of Engineer and Owner comments.

B. The Commissioning and Process Start-up Schedule may not be combined with the Detailed Schedule until Engineer acceptance of the Proposed Commissioning and Process Start-up Schedule.

C. Commissioning and Process Start-up Schedule monthly update requirements:
1. Highlight percentages of completion, actual start and finish dates, and remaining durations, as applicable.
2. Include activities not previously included in the previously accepted detail work plan Commissioning and Process Start-up Schedule.
3. Change Order required for any change to contractual dates.

4. Reviews of these submittals by Engineer will not be construed to constitute acceptance within the time frames, durations, or sequence of work for each added activity.

1.21 FINAL SCHEDULE SUBMITTAL

A. The final Schedule Update becomes the As-Built Schedule.
   1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.
   2. Contractor's Project Manager and scheduler sign and certify the As-Built Schedule as being an accurate record of the way the project was actually constructed.

B. Retainage will not be released until final Schedule Update is provided.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01329

SAFETY PLAN

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Development and maintenance of a Construction Safety Plan.

1.02 REFERENCES

A. National Fire Protection Association (NFPA):
   1. 70E - Standard for Electrical Safety in the Workplace.

B. Occupational Safety and Health Administration (OSHA).

1.03 CONSTRUCTION SAFETY PLAN

A. Detail the Methods and Procedures to comply with NFPA 70E, Federal, and Local Health and Safety Laws, Rules and Requirements for the duration of the Contract Times. Methods and procedures must also comply with the Owner's Safety Plan. Include the following:
   1. Identification of the Certified or Licensed Safety Consultant who will prepare, initiate, maintain and supervise safety programs, and procedures.
   2. Procedures for providing workers with an awareness of safety and health hazards expected to be encountered in the course of construction.
   3. Safety equipment appropriate to the safety and health hazards expected to be encountered during construction. Include warning devices, barricades, safety equipment in public right-of-way and protected areas, safety equipment used in multi-level structures, personal protective equipment (PPE) as required by NFPA 70E.
   4. Methods for minimizing employees' exposure to safety and health hazards expected during construction.
   5. Procedures for reporting safety or health hazards.
   6. Procedures to follow to correct a recognized safety and health hazard.
   7. Procedures for investigation of accidents, injuries, illnesses, and unusual events that have occurred at the construction site.
   8. Periodic and scheduled inspections of general work areas and specific workstations.
   9. Training for employees and workers at the jobsite.
   10. Methods of communication of safe working conditions, work practices and required personal protection equipment.
   11. Provision of a site specific emergency action and evaluation plan.
   12. Verify safety plan includes reference to and compliance with latest Owner safety policies.

B. Assume sole responsibility for every aspect of Health and Safety on the jobsite, including the health and safety of subcontractors, suppliers, and other persons on the jobsite:

1. Forward available information and reports to the Safety Consultant who shall make the necessary recommendations concerning worker health and safety at the jobsite.
2. Employ additional health and safety measures specified by the Safety Consultant, as necessary, for workers in accordance with OSHA guidelines.

C. Transmit to Owner and Engineer copies of reports and other documents related to accidents or injuries encountered during construction.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements and procedures for submittals.

1.02 REFERENCES

A. NSF International:
   1. NSF 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

A. Certificates: Describe certificates that document affirmations by the Contractor or other entity that the work is in accordance with the Contract Documents.

B. Extra stock materials: Describe extra stock materials to be provided for the Owner's use in facility operation and maintenance.

C. Maintenance material submittals: Use this article to categorize maintenance materials submittals requiring no Engineer action other than confirmation of receipt under an explanatory heading.

D. Manufacturer's instructions: Instructions, stipulations, directions, and recommendations issued in printed form by the manufacturer of a product addressing handling, installation, erection, and application of the product; manufacturer's instructions are not prepared especially for the Work.

E. Product data: Product data usually consists of manufacturers' printed data sheets or catalog pages illustrating the products to be incorporated into the project.

F. Samples: Samples are full-size actual products intended to illustrate the products to be incorporated into the project. Sample submittals are often necessary for such characteristics as colors, textures, and other appearance issues.

G. Spare parts: Describe spare parts necessary for the Owner's use in facility operation and maintenance; identify the type and quantity here, but include the actual characteristics of the spare parts in Product as part of the specification of the product.

H. Shop drawings: Shop drawings are prepared specifically for the project to illustrate details, dimensions, and other data necessary for satisfactory fabrication or construction that are not shown in the contract documents. Shop drawings could include graphic line-type drawings, single-line diagrams, or schedules and lists of products and their application.

I. Submittals: Submittals are samples, product data, shop drawings, and others that demonstrate how Contractor intends to conform with the Contract Documents.

J. Tools: Tools are generally defined as items such as special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the Owner's tool kit.

1.04 GENERAL INSTRUCTIONS

A. Certification: Contractor is responsible to determine and verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and check and coordinate each item with other applicable approved shop drawings and all Contract requirements.

B. Provide submittals that are specified or reasonably required for construction, operation, and maintenance of the Work.

C. Where multiple submittals are required, provide a separate submittal for each specification section.
   1. In order to expedite construction, the Contractor may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:
      a. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section.
      b. For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit breakers, even though they are covered in a different specification section.

D. Edit all submittals so that the submittal specifically applies to only the equipment furnished. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.

E. Prepare submittals in the English language. Do not include information in other languages.

F. Present measurements in customary American units (feet, inches, pounds, etc.).

G. Must be clear and legible, and of sufficient size for presentation of information.

H. Minimum page size will be 8 1/2 inches by 11 inches:
   1. Maximum page size will be 11 inches by 17 inches.

I. If submittal is more than 80 pages, additionally provide hardcopy.

J. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.

K. Provide submittal information from only 1 manufacturer for a specified product. Submittals with multiple manufacturers for 1 product will be rejected without review.

L. Indicate project designated equipment tag numbers from P&IDs for submittal of devices, equipment, and assemblies.

1.05 SUBMITTAL ORGANIZATION

A. Fully indexed with bookmarks for every section.

B. Sequentially number pages within the tabbed sections:
   1. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.

C. Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.

D. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is used.

E. Attachments:
   1. Specification section: Include with each submittal a copy of the relevant specification section.
      a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
      b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
   2. Drawings: Include with each submittal a copy of the relevant Drawing, including relevant addendum updates.
      a. Indicate either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
      b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
      c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.

F. Contractor: Prepare submittal information in sufficient detail to show compliance with specified requirements.
   1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.
   2. Coordinate submittal with other submittals and with the requirements of the Contract Documents.
   3. Check, verify, and revise submittals as necessary to bring them into conformance with Contract Documents and actual field conditions.

1.06 SUBMITTAL METHOD AND FORMAT

A. As specified in Section 01322 - Web Based Construction Document Management.

B. Submittals in electronic media format:
   1. General: Provide all information in PC-compatible format using Windows® operating system as utilized by the Owner and Engineer.

2. Text: Provide text documents and manufacturer's literature in Portable Document Format (PDF).
3. Graphics: Provide graphic submittals (drawings, diagrams, figures, etc.) utilizing Portable Document Format (PDF).

C. Contractor: Send electronic copy of submittals to Engineer and Owner:
1. Utilize EADOC system for all submittals including:
   a. Submittals.
   b. O&M's.
   c. RFI's.

1.07 SUBMITTAL PROCEDURE

A. Engineer: Review submittal and provide response:
1. Review description:
   a. Engineer will be entitled to rely upon the accuracy or completeness of designs, calculations, or certifications made by licensed professionals accompanying a particular submittal whether or not a stamp or seal is required by Contract Documents or Laws and Regulations.
   b. Engineer's review of submittals shall not release Contractor from Contractor's responsibility for performance of requirements of Contract Documents. Neither shall Engineer's review release Contractor from fulfilling purpose of installation nor from Contractor's liability to replace defective work.
   c. Engineer's review of shop drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in Contract Documents.
   d. Engineer's review does not extend to:
      1) Accuracy of dimensions, quantities, or performance of equipment and systems designed by Contractor.
      2) Contractor's means, methods, techniques, sequences, or procedures except when specified, indicated on the Drawings, or required by Contract Documents.
      3) Safety precautions or programs related to safety which shall remain the sole responsibility of the Contractor.
   e. Engineer can Approve or Not Approve any exception at their sole discretion.
2. Review timeframe:
   a. Except as may be provided in technical specifications, a submittal will be returned within 30 days.
   b. When a submittal cannot be returned within the specified period, Engineer will, within a reasonable time after receipt of the submittal, give notice of the date by which that submittal will be returned.
   c. Engineer's acceptance of progress schedule containing submittal review times less than those specified or agreed to in writing by Engineer will not constitute Engineer's acceptance of review times.
   d. Critical submittals:
      1) Contractor will notify Engineer in writing that timely review of a submittal is critical to the progress of Work.
3. Schedule delays:
   a. No adjustment of Contract Times or Contract Price will be allowed due to Engineer's review of submittals, unless all of the following criteria are met:

1) Engineer has failed to review and return first submission within the agreed upon time frame.
2) Contractor demonstrates that delay in progress of Work is directly attributable to Engineer's failure to return submittal within time indicated and accepted by Engineer.

4. Review response will be returned to Contractor with one of the following dispositions:
   a. Approved:
      1) No Exceptions:
         a) There are no notations or comments on the submittal and the Contractor may release the equipment for production.
      2) Make Corrections Noted - See Comments:
         a) The Contractor may proceed with the work, however, all notations and comments must be incorporated into the final product.
         b) Resubmittal not required.
      3) Make Corrections Noted - Confirm:
         a) The Contractor may proceed with the work, however, all notations and comments must be incorporated into the final product.
         b) Submit confirmation specifically addressing each notation or comment to the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.
   b. Not approved:
      1) Correct and resubmit:
         a) Contractor may not proceed with the work described in the submittal.
         b) Contractor assumes responsibility for proceeding without approval.
         c) Resubmittal of complete submittal package is required within 30 calendar days of the date of the Engineer's submittal review response.
      2) Rejected - See Remarks:
         a) Contractor may not proceed with the work described in the submittal.
         b) The submittal does not meet the intent of the Contract Documents. Resubmittal of complete submittal package is required with materials, equipment, methods, etc. that meet the requirements of the Contract Documents.
   c. Receipt acknowledged - Filed for record:
      1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc.
   d. Receipt acknowledged with comments - Resubmit:
      1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc. Feedback regarding missing information, conflicting information, or other information that makes it incomplete can be made with comments.

B. Contractor: Prepare resubmittal, if applicable:

1. Clearly identify each correction or change made.
2. Include a response in writing to each of the Engineer's comments or questions for submittal packages that are resubmitted in the order that the comments or questions were presented throughout the submittal and numbered consistent with the Engineer's numbering.
    a. Acceptable responses to Engineer's comments are listed below:
        1) "Incorporated" Engineer's comment or change is accepted and appropriate changes are made.
        2) "Response" Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.
    b. Reviews and resubmittals:
        1) Contractor shall provide resubmittals which include responses to all submittal review comments separately and at a level of detail commensurate with each comment.
        2) Contractor responses shall indicate how the Contractor resolved the issue pertaining to each review comment. Responses such as "acknowledged" or "noted" are not acceptable.
        3) Resubmittals which do not comply with this requirement may be rejected and returned without review.
        4) Contractor shall be allowed no extensions of any kind to any part of their contract due to the rejection of non-compliant submittals.
        5) Submittal review comments not addressed by the Contractor in resubmittals shall continue to apply whether restated or not in subsequent reviews until adequately addressed by the Contractor to the satisfaction of the reviewing and approving authority.
    c. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for Revision and Resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.
3. Resubmittal timeframe:
    a. Contractor shall provide resubmittal within 15 days.
    b. When a resubmittal cannot be returned within the specified period, Contractor shall notify Engineer in writing.
4. Review costs:
    a. Costs incurred by Owner as a result of additional reviews of a particular submittal after the second time it has been reviewed shall be borne by Contractor.
    b. Reimbursement to Owner will be made by deducting such costs from Contractor's subsequent progress payments.

1.08 SHOP DRAWINGS

A. Contractor to field verify elevation, coordinates, and pipe material for pipe tie-in to pipeline or structure prior to the preparation of shop drawings.

B. Details:
1. Fabrication drawings: Drawn to scale and dimensioned.
2. Front, side, and, rear elevations, and top and bottom views, showing all dimensions.
3. Locations of conduit entrances and access plates.

4. Component layout and identification.
5. Weight.
6. Finish.
7. Temperature limitations, as applicable.
8. Nameplate information.

C. Minor or incidental products and equipment schedules:
   1. Details:
      a. Shop Drawings of minor or incidental fabricated products will not be required, unless requested.
      b. Submit tabulated lists of minor or incidental products showing the names of the manufacturers and catalog numbers, with Product Data and Samples as required to determine acceptability.

1.09 PRODUCT DATA

A. Details:
   1. Supplier name and address.
   2. Subcontractor name and address.

B. Include:
   1. Catalog cuts.
   2. Bulletins.
   3. Brochures.
   4. Manufacturer's Certificate of Compliance: Signed by product manufacturer along with supporting reference data, affidavits, and tests, as appropriate.
   5. Manufacturer's printed recommendations for installation of equipment.
   6. Quality photocopies of applicable pages from manufacturer's documents.

C. Motor Data Sheet:
   1. Provide completed Motor Data Sheet as specified in Section 16222 - Low Voltage Motors Up to 500 Horsepower, for every motor furnished as part of the associated equipment submittal.

D. Test reports including the following information:
   1. Test description.
   2. List of equipment used.
   3. Name of the person conducting the test.
   4. Date and time the test was conducted.
   5. Ambient temperature and weather conditions.
   6. All raw data collected.
   7. Calculated results.
   8. Clear statement if the test passed or failed the requirements stated in Contract Documents.
   9. Signature of the person responsible for the test.

E. Certificates:
   1. As specified in technical sections.
   2. For products that will be in contact with potable water, submit evidence from a nationally recognized laboratory that the products comply with the requirements of the NSF 61 standard.

1.10 SAMPLES

A. Details:
   1. Submit labeled samples.
   2. Samples will not be returned.
   3. Provide samples from manufacturer's standard colors, materials, products, or equipment lines.
      a. Clearly label samples to indicate any that represent non-standard colors, materials, products, or equipment lines and that if selected, will require an increase in Contract Time or Contract Price.
   4. Provide number of sample submittals as below:
      a. Total: 3 minimum.
         1) Owner: 1.
         2) Engineer: 2.
         3) Contractor: None.

B. Field samples:
   1. As specified in technical sections.

1.11 DESIGN CALCULATIONS

A. Defined in technical sections:
   1. Calculations must bear the original seal and signature of a Professional Engineer licensed in the state where the project is located and who provided responsible charge for the design.

1.12 SCHEDULES

A. Progress schedules: As specified in 01324C - Progress Schedules and Reports - Small Projects:
   1. Each schedule submittal specified in these Contract Documents shall be submitted as a native backed-up file (.xer) of the scheduling program as specified in Section 01324C - Progress Schedules and Reports - Small Projects.
   2. The schedule and all required reports shall also be submitted as a PDF file.

A. Progress reports and quantity charts:
   1. As specified in Section 01324C - Progress Schedules and Reports - Small Projects.

1.13 REQUESTS FOR SUBSTITUTIONS (RFS)

A. As specified in Section 01600 - Product Requirements.

1.14 REQUESTS FOR INFORMATION (RFI)

A. As specified in Section 01260 - Contract Modification Procedures.

1.15 CONTRACTOR'S PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

A. Submit a completed Contractor's P.E. Certification Form, provided in this Section, to comply with technical sections requirement for a professional engineer's certification from an engineer licensed in the state the project is located.

1.16 CLOSEOUT SUBMITTALS

A. Provide closeout submittals as specified in Section 01770 - Closeout Procedures.

B. Operation and Maintenance Manuals: final documents shall be submitted as specified in Section 01782 - Operation and Maintenance Data.

C. Extra materials, spare parts, etc.: Submittal forms shall indicate when actual materials are submitted.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

APPENDIX A

CONTRACTOR'S P.E. CERTIFICATION FORM

DOCUMENT 01330
CONTRACTOR'S P.E. CERTIFICATION FORM

Owner:	Click here to enter text.	**Date:**	MM/DD/YYYY.
Contractor:	Click here to enter text.	**Registration State:**	Click here to enter text.
Project Name:	Click here to enter text.	**Project No.:**	00000.00.
Responsibilities:	Click here to enter text.		
Spec Section:	Click here to enter text.		

Statement of Certification

The undersigned hereby certifies that he/she is a professional engineer registered in the State of and that he/she has been employed by

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state, and federal codes, rules, and regulations; and, that his/her signature and P.E. stamp have been affixed to all calculation and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to:

Click here to enter text.

(Name of Owner, or Owner's representative within 7 days of receiving a written request by the Owner.)

Prof. Engineer Signature: _____ **Date:** _____

Printed Name: _____ **Company Name:** _____

Contractor's Signature: _____ **Date:** _____

Printed Name: _____

APPENDIX B

CONTRACTOR SUBMITTAL TRANSMITTAL FORM

DOCUMENT 01330
CONTRACTOR SUBMITTAL TRANSMITTAL FORM

Owner:	Click here to enter text.	**Date:**	MM/DD/YYYY
Contractor:	Click here to enter text.	**Project No.:**	XXXXX.XX
Project Name:	Click here to enter text.	**Submittal Number:**	000
Submittal Title:	Click here to enter text.		
To:	Click here to enter text.		
From:	Click here to enter text.	Click here to enter text.	
	Click here to enter text.	Click here to enter text.	

Specification No. and Subject of Submittal / Equipment Supplier			
Spec ##:	Spec ##.	**Subject:**	Click here to enter text.
Authored By:	Click here to enter text.	**Date Submitted:**	XX/XX/XXXX

Submittal Certification
Check Either (A) or (B): ☐ (A) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions. ☐ (B) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the deviations listed.
Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.
General Contractor's Reviewer's Signature:
Printed Name:
In the event, Contractor believes the Submittal response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.
Firm: Click here to enter text. **Signature:** **Date Returned:** XX/XX/XXXX

PM/CM Office Use	
Date Received GC to PM/CM:	
Date Received PM/CM to Reviewer:	
Date Received Reviewer to PM/CM:	
Date Sent PM/CM to GC:	

SECTION 01450

QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Quality control and control of installation.
   2. Tolerances.
   3. References.
   4. Mock-up requirements.
   5. Authority and duties of Owner’s representative or inspector.
   6. Sampling and testing.
   7. Testing and inspection services.
   8. Contractor’s responsibilities.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

H. When specified, products will be tested and inspected either at point of origin or at Work site:
   1. Notify Engineer in writing well in advance of when products will be ready for testing and inspection at point of origin.
   2. Do not construe that satisfactory tests and inspections at point of origin is final acceptance of products. Satisfactory tests or inspections at point of origin do not preclude retesting or re-inspection at Work site.

I. Do not ship products which require testing and inspection at point of origin prior to testing and inspection.

1.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When Manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM): E 329 - Standard for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

B. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

C. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

D. Obtain copies of standards where required by product specification sections.

E. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

1.05 MOCK-UP REQUIREMENTS

A. Tests will be performed under provisions identified in this Section and identified in respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work.

D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Engineer.

1.06 AUTHORITY AND DUTIES OF OWNER'S REPRESENTATIVE OR INSPECTOR

A. Owner’s Project Representative employed or retained by Owner is authorized to inspect the Work.

B. Inspections may extend to entire or part of the Work and to preparation, fabrication, and manufacture of products for the Work.

C. Deficiencies or defects in the Work which have been observed will be called to Contractor’s attention.

D. Inspector will not:
   1. Alter or waive provisions of Contract Documents.
   2. Inspect Contractor's means, methods, techniques, sequences, or procedures for construction.
   3. Accept portions of the Work, issue instructions contrary to intent of Contract Documents, or act as foreman for Contractor. Supervise, control, or direct Contractor's safety precautions or programs; or inspect for safety conditions on Work site, or of persons thereon, whether Contractor's employees or others.

E. Inspector will:
   1. Conduct on-site observations of the Work in progress to assist Engineer in determining when the Work is, in general, proceeding in accordance with Contract Documents.
   2. Report to Engineer whenever Inspector believes that Work is faulty, defective, does not conform to Contract Documents, or has been damaged; or whenever there is defective material or equipment; or whenever Inspector believes the Work should be uncovered for observation or requires special procedures.

1.07 SAMPLING AND TESTING

A. General:
   1. Prior to delivery and incorporation in the Work, submit listing of sources of materials, when specified in sections where materials are specified.
   2. When specified in sections where products are specified:
      a. Submit sufficient quantities of representative samples of character and quality required of materials to be used in the Work for testing or examination.
      b. Test materials in accordance with standards of national technical organizations.

B. Sampling:
   1. Furnish specimens of materials when requested.
   2. Do not use materials which are required to be tested until testing indicates satisfactory compliance with specified requirements.
   3. Specimens of materials will be taken for testing whenever necessary to determine quality of material.
   4. Assist Engineer in preparation of test specimens at site of work, such as soil samples and concrete test cylinders.

1.08 TESTING AND INSPECTION SERVICES

A. Contractor will employ and pay for specified services of an independent firm to perform Contractor quality control testing as required in the technical specifications for various work and materials.

B. Owner will employ and pay for specified services of an "Owner's independent testing firm" certified to perform testing and inspection as required in the technical specifications for various work and materials.

C. The Owner's independent testing firm will perform tests, inspections and other services specified in individual specification sections and as required by Owner and requested by the Engineer.

D. The qualifications of laboratory that will perform the testing, contracted by the Owner or by the Contractor, shall be as follows:
   1. Has authorization to operate in the state where the project is located.
   2. Meets “Recommended Requirements for Independent Laboratory Qualification,” published by American Council of Independent Laboratories.
   3. Meets requirements of ASTM E329.
   4. Laboratory Staff: Maintain full time specialist on staff to review services.
   5. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to National Bureau of Standards (NBS) or accepted values of natural physical constants.
   6. Will submit copy of report of inspection of facilities made by Materials Reference Laboratory of NBS during most recent tour of inspection, with memorandum of remedies of deficiencies reported by inspection.

E. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing inspections and source quality control as required by Engineer or Owner.

F. Contractor shall cooperate with Owner’s independent testing firm, furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Engineer and Owner’s independent testing firm 48 hours prior to expected time for operations requiring testing.
   2. Make arrangements with Owner’s independent testing firm and pay for additional samples and tests required for Contractor’s use.

G. Limitations of authority of testing Laboratory: Owner’s independent testing firm or Laboratory is not authorized to:
   1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency or laboratory may not approve or accept any portion of the Work.
   3. Agency or laboratory may not assume duties of Contractor.
   4. Agency or laboratory has no authority to stop the Work.

H. Testing and employment of an Owner’s independent testing firm or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

I. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same Owner’s independent testing firm on instructions by Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

J. The Owner’s independent testing firm responsibilities will include:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.

5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
6. Perform additional tests required by Engineer.
7. Attend preconstruction meetings and progress meetings.

K. Owner's independent testing firm individual test reports: After each test, Owner's independent testing firm will promptly submit electronically and 3 hard copies of report to Engineer and to Contractor. Include the following:
1. Date issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and specifications section.
6. Location in Project.
7. Type of inspection or test.
8. Date of test.
9. Certified test results stamped and signed by a registered Engineer in the State of Florida.
10. Summary of conformance with Contract Documents.
11. When requested by Engineer, the Owner's independent testing firm will provide interpretation of test results.

L. Owner's independent testing firm will provide monthly report of certification to identify all work performed for special inspections and other contract requirements on this project. The following certified monthly report at a minimum will include but not limited to:
1. Results of testing.
2. Testing logs.
3. Outstanding deficiencies.
4. Various statistical data.
5. Testing curves (up to 4 types) as required by the Engineer.

1.09 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with Owner's independent testing firm or laboratory personnel and provide access to construction and manufacturing operations.

B. Secure and deliver to Owner's independent testing firm or laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.

C. Provide to Owner's independent testing firm or laboratory and Engineer preliminary mix design proposed to be used for concrete, and other materials mixes which require control by testing laboratory.

D. Furnish electronically and 5 hard copies of product test reports.

E. Furnish incidental labor and facilities:
1. To provide access to construction to be tested.
2. To obtain and handle samples at Work site or at source of product to be tested.
3. To facilitate inspections and tests.
4. For storage and curing of test samples.

F. Notify Owner's independent testing firm or laboratory 48 hours in advance of when observations, inspections and testing is needed for laboratory to schedule and perform in accordance with their notice of response time.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01460

CONTRACTOR QUALITY CONTROL PLAN

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Contractor Quality Control Plan.

1.02 SUBMITTALS

A. Qualifications of the Contractor's Quality Control (CQC) Plan Manager must include all qualifying registrations and show that the candidate has had experience (minimum 10 years) on projects of similar type and size.

B. Contractor's Daily Quality Control Report: Submit to Engineer within 1 day of completion of each inspection.

C. Daily Inspection Report: Submit to Engineer at the end of each working day or no later than prior to the beginning of the next working day.

1.03 CONTRACTOR'S INSPECTION OF THE WORK

A. Work performed by Contractor shall be inspected by the Contractor's CQC Plan Manager. Non-conforming Work and any safety hazards in the Work area shall be noted and promptly corrected.

B. No materials or equipment shall be used in Work without inspection and acceptance by Contractor's CQC Plan Manager.

1.04 QUALIFICATIONS

A. Contractor's CQC Plan Manager: Demonstrate having performed similar CQC functions on similar type projects. Submit records of personnel experience, training, and qualifications.

1.05 COVERING WORK

A. Whenever Contractor intends to backfill, bury, cast in concrete, or otherwise cover any Work, notify Engineer not less than 24 hours in advance to request inspection before beginning any such Work of covering. Failure of Contractor to notify Engineer in accordance with this requirement shall be resolved according to Article 14 of the General Conditions.

1.06 REJECTED WORK

A. Failure to promptly remove and replace rejected Work will be considered a breach of this Contract, and Owner may proceed under provisions of the General Conditions.

1.07 CONTRACTOR'S QUALITY CONTROL PROGRAM

A. General: Establish and execute a Quality Control (CQC) Plan for Work. The plan shall establish adequate measures for verification and conformance to defined requirements by Contractor personnel and lower-tier Subcontractors (including Fabricators, Suppliers, and Subcontractors). This program shall be described in a Plan responsive to this Section.

B. CQC personnel:
   1. Contractor's CQC Plan Manager shall report to a Senior Project Manager of the Contractor and shall have no supervisory or managerial responsibility over the workforce.
   2. The Contractor CQC Plan Manager shall be on-site as often as necessary, but not less than the daily working hours specified in the Contract Documents to remedy and demonstrate that Work is being performed properly and to make multiple observations of Work in progress.
   3. The Contractor is to furnish personnel with assigned CQC functions reporting to the CQC Manager. Persons performing CQC functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions.

C. CQC Plan:
   1. Contractor's CQC Plan shall include a statement by the Senior Project Manager designating the CQC Plan Manager and specifying the authority delegated to the CQC Plan Manager to direct cessation or removal and replacement of defective Work.
   2. Describe the CQC program and include procedures, work instructions, and records. Describe methods relating to areas that require special testing and procedures as required by the specifications.
   3. Include specific instructions defining procedures for observing Work in process and comparing this Work with the Contract requirements (organized by specifications section).
   4. Describe procedures to ensure that equipment or materials that have been accepted at the Site are properly stored, identified, installed and tested.
   5. Include procedures to verify that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to lower-tier Suppliers and/or Subcontractors.
   6. Startup and testing quality control: Include procedures to verify that the startup and testing requirements of the Contract Documents are integrated into the Contractor's CQC Plan and conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to the Contractor and the lower-tier Suppliers and/or Subcontractors.
   7. Include instructions for recording inspections and requirements for demonstrating through the Daily Inspection Reports that Work inspected was in compliance or a deficiency was noted and action to be taken.
   8. Procedures to preclude the covering of deficient or rejected Work.
   9. Procedures for halting or rejecting Work.
   10. Procedures for resolution of differences between the CQC Plan Manager and the production personnel.
   11. Identify contractual hold/inspection points as well as any Contractor-imposed hold/inspection points.

D. Daily Inspection Report: Include, at a minimum:
   1. Inspection of specific work.
   2. Quality characteristics in compliance.
   3. Quality characteristics not in compliance.
   4. Corrective/remedial actions taken.
   5. Statement of certification.
   6. CQC Manager's signature.
   7. Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents.

E. Deficient and Non-conforming Work and Corrective Action: Include procedures for handling deficiencies and non-conforming Work. Deficiencies and non-conforming Work are defined as documentation, drawings, material, equipment, or Work not conforming to the indicated requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent reoccurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documents and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:
   1. Personnel responsible for identifying deficient and non-complying items within Work.
   2. How and by whom deficient and non-compliant items are documented "in the field."
   3. The personnel and process utilized for logging deficient and non-compliant Work at the end of each day onto a deficiency log.
   4. Tracking processes and tracking documentation for deficient and non-conforming Work.
   5. Personnel responsible for achieving resolution of outstanding deficiencies.
   6. Include detailed procedures for the performance and control of special process (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).

F. Audits: The CQC program shall provide for regularly scheduled documented audits to verify that CQC procedures are being fully implemented by Contractor and its Subcontractors. Audit records shall be made available to Engineer upon request.

G. Documented control/quality records:
   1. Establish methods for control of Contract Documents that describe how Drawings and Specifications are received and distributed to ensure the correct issue of the document being used. Describe how record document/drawing data are documented and furnished to Engineer.
   2. Maintain evidence of activities affecting quality. Including operating logs, records of inspection, audit reports, personnel qualification and certification records, procedures, and document review records.
   3. Maintain quality records in a manner that provides for timely retrieval and traceability. Protect quality records from deterioration, damage and destruction.
   4. Develop a list of specific records as required by the Contract Documents that will be furnished to Engineer at the completion of activities.

H. Acceptance of CQC Plan: Engineer's acceptance of the CQC Plan shall not relieve Contractor from any of its obligations for performance of Work. Contractor's CQC staffing is subject to Engineer's review and continued acceptance. Owner, at its sole option, and without cause, may direct Contractor to remove and replace the CQC Plan Manager.
   1. Acceptance of the CQC Plan by the Engineer is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction.
   2. After acceptance of the CQC Plan, notify the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01756

COMMISSIONING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for each Commissioning phase of, the Project equipment/system and/or facility.

1.02 DEFINITIONS

A. Clean Water Facility Testing - Testing of complete facility utilizing clean water for purposes of confirming extended equipment/system operation prior to Process Start-up Phase.

B. Commissioning - The process of planning, testing, and process start-up of the installation for compliance with contract requirements and demonstrating, through documented verification, that the project has successfully met the Contractual requirements. It includes training the Owner's staff to operate the facility.

C. Commissioning Phases - The work activities of facility commissioning are grouped into the phases defined in the table below.

Commissioning		
Planning Phase	**Testing and Training Phase**	**Process Start-Up Phase**
Owner Training Plan and Schedule	Source Testing	Process Start-up
Commissioning Schedule	Owner Training	Process Operational Period
Subsystem Testing Plan	Installation Testing	Instrumentation and Controls Fine-Tuning

D. Component - A basic building block of equipment, subsystems, and systems that requires installation or functional testing but does not have an electrical connection or internal electronics. (Examples: filter effluent piping and manual isolation valves).

E. Device - A basic building block of equipment, subsystems, and systems that requires installation or functional testing and does have an electrical connection or internal electronics. (Examples: filter level transmitter or water pump pressure transmitter).

F. Equipment - An assembly of component(s) and devices(s) that requires installation or functional testing. (Examples: Pump, motor, VFD, Ozone Generator, UV Disinfection System, etc.).

G. Facility - A grouping of process areas, systems, subsystems, equipment, components, and devices (Examples: treatment plant, pump station, etc.).

H. Functional Testing - Testing performed on a completed subsystem to demonstrate that equipment/system meets manufacturers' calibration and adjustment requirements and other requirements as specified. Functional testing includes operating equipment/system manually in local, manually in remote (or remote manual), and automatically in remote (in remote auto).

I. Installation Testing - Testing to demonstrate that subsystem component (piping, power, networks, devices, etc.) is ready and meets the project requirements in advance of functional testing. Installation testing also includes manufacturers' certification of installation and other requirements as specified to prepare equipment/system for Functional Testing. Also referred to as Field Acceptance Testing.

J. Manufacturer's Certificate of Source Testing - When applicable, the form is used during Source Testing for the manufacturer to confirm that the applicable source tests have been performed and results conform to the Contract Documents. The form is provided at the end of this Section.

K. Manufacturer's Certificate of Installation and Functionality Compliance - The form is used during Installation Testing and Functional Testing. It is submitted at the end of Functional Testing to confirm that the equipment/system is installed in conformance with the Contract Documents and that it meets the Functional Testing requirements defined in the Contract Documents. The form is provided at the end of this Section.

L. Process Area - A grouping of systems, subsystems, equipment, components, and devices that divide a facility into functional areas. (Examples: Filter Process Area or Chemical Area).

M. Process Operational Period - A period of time after completion of the process start-up set aside for final Operational Testing to verify facility performance meets the Contract Document requirements. This period may specifically limit other construction activities.

N. Process Start-up Phase - Operating the facility to verify performance meets the Contract Document requirements.

O. Process Start-Up - Activities conducted after the testing and training phase that are necessary to place systems or process areas into operational service.

P. Product - A system, subsystem or component.

Q. Subsystem - A building block of systems made up from a grouping of components, devices, and equipment that perform a definable function. (Examples: Filter No. 1 Backwash Subsystem, Sedimentation Basin No. 1 Hoseless Sludge Removal Subsystem).

R. System - A grouping of subsystems, equipment, components, and devices that perform a definable function. (Examples: Filter No. 1, Sedimentation Basin).

1.03 SERVICES OF MANUFACTURER'S REPRESENTATIVES

A. Qualification of manufacturer's representative as specified in the Contract Documents technical sections include the following:
   1. Authorized representative of the manufacturer, factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
   2. Competent, experienced technical representative of equipment/system manufacturer for assembly, installation, testing guidance, and training.
   3. Additional qualifications may be specified in the individual sections.
   4. Submit qualifications of the manufacturer's representative no later than 30 days in advance of required observations.
   5. Representative subject to approval by Owner and Engineer.
   6. No substitute representatives will be allowed until written approval by Owner and Engineer has been obtained.

B. Completion of manufacturer on-site services: Engineer approval required.

C. Manufacturer is responsible for determining the time required to perform the specified services.
   1. Minimum times specified in the Contract Documents are estimates.
   2. No additional costs associated with performing the required services will be approved.
   3. Manufacturer required to schedule services in accordance with the Contractor's project schedule up to and including making multiple trips to project site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.

D. Manufacturer's on-site services as specified in the Contract Documents include the following:
   1. Assistance during Commissioning Phase and Process Start-Up Phase.
   2. Provide copies of manufacturer's representatives field notes and data to Engineer.
   3. Other requirements as specified in the Contract Documents.

1.04 PLANNING PHASE

A. Overview of Planning Phase:
   1. Define approach and timing for Commissioning.

B. Owner training plan and schedule:
   1. Training outcomes:
      a. Owner's operations, maintenance, and engineering staff have the information needed to safely operate, maintain, and repair the equipment/systems provided in the Contract Documents.
   2. Training objectives:
      a. To instruct personnel in the operation and maintenance of the equipment/system. Instruction shall include step-by-step troubleshooting procedures with all necessary test equipment/system.
      b. To instruct personnel in the removal, inspection, and cleaning of equipment/system as needed.

c. Training tailored to the skills and job classifications of the staff attending the classes (e.g., plant superintendent, treatment plant operator, maintenance technician, electrician, etc.).
d. Provide supporting documentation, such as vendor operation and maintenance manuals.

3. Training schedule:
   a. Schedule Owner's staff training within the constraints of their workloads. Those who will participate in this training have existing full-time work assignments, and training is an additional assigned work task, therefore, scheduling is imperative. Owner staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.
4. Training plan:
   a. Coordinate and arrange for manufacturer's representatives to provide both classroom-based learning and field (hands-on) training, based on training module content and stated learning objectives.
   b. Conduct classroom training at location designated by Owner.
   c. Scope and sequence:
      1) Plan and schedule training in the correct sequence to provide prerequisite knowledge and skills to trainees.
         a) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
5. Training scheduling coordination:
   a. CC is responsible for the following:
      1) Coordinate schedule for training periods with the Owner's personnel and manufacturer's representatives (instructors).
   b. Complete Owner training no sooner than 15 calendar days prior to start of process start-up of each system.
6. Meetings:
   a. CC is responsible for setting commissioning coordination meeting dates and times, as well as preparing the agendas and meeting minutes.
   b. CC shall meet with Engineer and Owner's designated training coordinator to develop list of personnel to be trained and to establish expected training outcomes and objectives at least 60 calendar days prior to commissioning of equipment/system.
   c. CC shall conduct commissioning progress meetings throughout construction, to plan, scope, coordinate, and schedule future activities, resolve problems, etc.
      1) Frequency: Monthly minimum. Increase frequency as needed based on complexity and quantity of commissioning activities.
7. Submittals:
   a. Submit Training Plan Schedule 60 calendar days before the first scheduled training session, including but not limited to lesson plans, participant materials, instructor's resumes, and training delivery schedules.
   b. Submit training documentation including the following:
      1) Training plan:
         a) Training modules.
         b) Scope and sequence statement.
         c) Contact information for manufacturer's instructors including name, phone, and e-mail address.
         d) Instructor qualifications.
      2) Training program schedule:

a) Format: Bar chart:
(1) Additionally include in the Project Progress Schedule.
b) Contents:
(1) Training modules and classes.

8. Training sessions:
   a. Provide training sessions for equipment/system as specified in the individual equipment/system section.

C. Commissioning Schedule:
   1. Commissioning overview:
      a. Comply with Commissioning Roles and Responsibilities Matrix specified at the end of this Section.
   2. Submittal due date:
      a. Submit Commissioning Schedule not less than 60 calendar days prior to planned initial commissioning of each subsystem or system.
   3. Schedule requirements:
      a. Schedule durations and float for commissioning activities to ensure Work does not fall behind schedule due to complications or delays during commissioning.
      b. Time-scaled network diagram detailing the work to take place in the period between 210 calendar days prior to planned initial commissioning of equipment and systems, and prior to the date of Substantial Completion, together with supporting narrative.
      c. Provide detailed schedule of commissioning activities including durations and sequencing requirements.
         1) Identify the following activities:
            a) Testing and Training Phase:
               (1) Source Testing.
               (2) Owner Training.
               (3) Installation Testing.
               (4) Functional Testing.
               (5) Clean Water Facility Testing.
               (6) Closeout Documentation.
            b) Process Start-Up Phase:
               (1) Process Start-Up.
               (2) Process Operational Period.
               (3) Instrumentation and Controls Fine-Tuning.
      d. Schedule manufacturer's services to avoid conflict with other on-site testing or other manufacturers' on-site services.
      e. Verify that conditions necessary to allow successful testing have been met before scheduling services.

D. Subsystem testing plans:
   1. Provide separate testing plans for each individual subsystem and system that include the following:
      a. Approach to testing including procedures, schedule, and recirculation requirements.
      b. Test objective: Demonstrate subsystem meets the design requirements as specified in the technical sections.
      c. Test descriptions, forms, temporary systems (pumps, piping, etc.), shutdown requirements for existing systems, test forms, test logs, witness

forms, and checklists to be used to control and document the required tests.

d. Test forms: Include, but not limited to, the following information:
    1) Tag and name of equipment/system to be tested.
    2) Test date.
    3) Names of persons conducting the test.
    4) Names of persons witnessing the test, where applicable.
    5) Test data.
    6) Applicable project requirements.
    7) Check offs for each completed test or test step.
    8) Place for signature of person conducting tests and for the witnessing person, as applicable.
e. Define start-up sequencing of unit processes:
    1) Include testing of alarms, interlocks, permissives, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
    2) Provide detailed test procedures setting forth step-by-step descriptions of the procedures for systematic testing of equipment/system.
    3) Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration.
        a) Perform initial checks in the presence of and with the assistance of the manufacturer's representative.
    4) Demonstrate proper operation of each control loop function including mechanical, electrical, alarms, local and remote controls, instrumentation, and other equipment/system functions.
        a) Generate signals with test equipment/system to simulate operating conditions in each control mode.

2. Engineer approval of test plan is required prior to performing test.
    a. Revise and update test plans based on review comments, actual progress, or to accommodate changes in the sequence of activities.
    b. Submit test reports for each phase of testing for each equipment/system.
    c. Engineer approval of preceding test reports is required prior to start of next test.
    d. Tests will be rescheduled if test plan is not approved by the required deadline.
        1) Contractor is responsible for any resulting delay.
3. Contractor is responsible to reproduce and distribute final test procedures.
    a. Provide 3 copies for Engineer.
4. Tests may commence only after Engineer has received approved test plan copies.
5. Submittals:
    a. Submit test plans not less than 30 calendar days prior to planned installation testing of subsystem or system.
    b. Completed Manufacturer's Certificate of Installation and Functionality Compliance.
    c. Test procedures and forms: Provide signed-off copy of test forms and test reports upon completion of the test.
    d. Test reports:
        1) Submit preliminary copies within 1 day after testing completion.
        2) Submit final copies and report within 14 days after testing completion.

1.05 TESTING AND TRAINING PHASE

A. Overview of Testing and Training Phase:
   1. General:
      a. Include specified Source Testing, Owner Training, Installation Testing, Functional Testing, Clean Water Facility Testing, and Closeout Documentation required by this Section and the technical sections.
   2. Contractor responsibilities:
      a. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
      b. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.
      c. Acceptable tests: Demonstrate the equipment/system performance meets the requirements stated in the Contract Documents.
         1) When the equipment/system fails to meet the specified requirements, perform additional, more detailed, testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.

B. Source testing:
   1. Also referred to as factory testing or factory acceptance testing (FAT).
   2. Test components, devices, and equipment/system for proper performance at point of manufacture or assembly as specified in the technical sections.
   3. Notify the Engineer in writing when the equipment/system is ready for source inspection and testing.
   4. Source Test Plan:
      a. As specified in this Section and other technical sections.
      b. Source testing requirements as specified in technical sections.
         1) Non-witnessed: Provide Manufacturer’s Certificate of Source Testing.
         2) Witnessed: 1 Owner's representative and 1 Engineer’s representative present during testing, unless otherwise specified, and provide Manufacturer’s Certificate of Source Testing.
      c. Prepared by Contractor as a result of discussions and planning emerging from regularly conducted commissioning meetings for source tests as specified in the Contract Documents.
      d. Provide the following items for each Source Test:
         1) Purpose and goals of the test.
         2) Identification of each item of equipment/system, including system designation, location, tag number, control loop identifier, etc.
         3) Description of the pass/fail criteria that will be used.
         4) Listing of pertinent reference documents (Contract Documents and industry standards or sections applicable to the testing).
         5) Complete description, including drawings or photographs, of test stands and/or test apparatus.
         6) Credentials of test personnel.
         7) Descriptions of test equipment to be used, product information, and all appropriate calibration records for the test equipment.
         8) Test set-up procedures.
         9) Detailed step-by-step test procedures.
            a) The level of detail shall be sufficient for any witness with a rudimentary technical aptitude to be able to follow the steps and

develop confidence that the tests were being performed as planned.
b) All steps are significant, and all steps shall be included in the procedures.
10) Sample data logs and data recording forms.
11) Sample computations or analyses with the results in the same format as the final report to demonstrate how data collected will be used to generate final results.
a) Complete disclosure of the calculation methodologies.
b) Include a sample for each type of computation required for the test and analysis of the results.
12) Detailed outline of the Source Test report.
13) Sample test reports.
e. Submit Source Test Plan and forms as specified in the technical sections.
1) Submit a copy of the Source Test Plan at least 21 days before any scheduled test date.
2) Engineer approval of Source Test Plan required prior to beginning source testing.
3) Schedule the testing after approval of the test procedures submittal.
f. Indicate the desired dates for source inspection and testing.
1) Notify the Engineer of the scheduled tests a minimum of 15 days before the date of the test.
5. Test results:
a. Prepare and submit test results with collected data attached.
6. Contractor is responsible for costs associated with Owner's representatives and Engineer's representative witnessing Source Tests.
a. Include costs for at least the following:
1) Transportation:
a) Travel 1 day on commercial airline to site including air flight costs and $1,600 allowance per person per day.
b) Travel 1 day on commercial airline from site including air flight costs and $1,600 allowance per person per day.
c) Rental car from hotel to and from the test site.
2) Hotel costs at a facility with an American Automobile Association 4 star rating or equivalent for single occupancy room per person per day.
3) Meal allowance of $60 per person per day.
4) On-site time: 1 day at the site, unless specified otherwise, including $1,600 allowance per person per day.
b. If Source Test is not ready when the witnesses arrive or if the Source Test fails, the witnesses will return home with Contractor responsible for costs associated with the trip including costs described above. Contractor is responsible for rescheduling the Source Test and witnesses' costs associated with the second trip including costs described above.
c. Contractor is responsible for witnesses' costs associated with retests including costs described above.
7. Contractor is responsible for providing fuel, chemicals, and other consumables needed for Source Testing.

C. Owner training:
1. Training instruction format:

a. The training for operations and maintenance personnel shall be provided as one entity.
b. The training for operations personnel shall be provided separately from the maintenance personnel.
    1) The training for maintenance personnel shall be further subdivided into 2 trade groups:
        a) Electrical maintenance.
        b) Instrumentation and controls maintenance.
c. Instructors shall apply adult education best practices, emphasizing learner participation and activity.
d. Training delivery may include problem solving, question/answer, hands-on instruction, practice, evaluation/feedback tools, and lecture.
e. Visual aids and hands-on practice sessions must support training objectives.
f. Lecturing should be less than 30 percent of class time.
g. Conduct hands-on instruction according to the following descriptions:
    1) Present hands-on demonstrations of at least the following tasks:
        a) Proper start-up, shutdown, and normal and alternative operating strategies.
        b) Common corrective maintenance repairs for each group.
        c) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
    2) Use tools and equipment provided by manufacturer to conduct the demonstrations.
        a) Submit requests for supplemental assistance and facilities with the Contractor's proposed lesson plans.
    3) Contractor remains responsible for equipment disassembly or assembly during hands-on training situations involving equipment disassembly or assembly by Owner's personnel.
        a) Provide written certification of proper equipment/system operation to Engineer after completion of hands-on training.

2. Class agenda:
    a. Include the following information in the agenda:
        1) Instructor name.
        2) Listing of subjects to be discussed.
        3) Time estimated for each subject.
        4) Allocation of time for Owner staff to ask questions and discuss the subject matter.
        5) List of documentation to be used or provided to support training.
    b. Owner may request that particular subjects be emphasized and the agenda be adjusted to accommodate these requests.
    c. Distribute copies of the agenda to each student at the beginning of each training class.
3. Number of students:
    a. Estimated maximum class size: 10 persons.
        1) Owner will determine the actual number of students.
        2) Engineer will provide an estimated headcount 1 week prior to the class, so that the instructor can provide the correct number of training aids for students.
4. Instructor qualifications:
    a. Provide instructors completely knowledgeable in the equipment/system for which they are training.

b. Provide instructors experienced in conducting classes.
c. Provide instructor's technical preparation and instructional technology skills and experience.
d. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.
e. If, in the opinion of the Owner, an appropriately knowledgeable person did not provide the scheduled training, such training shall be rescheduled and repeated with a suitable instructor.

5. Training aids:
   a. Instructors are encouraged to use audio-visual devices, P&IDs, models, charts, etc. to increase the transfer of knowledge.
   b. Instructors shall provide such equipment (televisions, video recorder/player, computer, projectors, screens, easels, etc.), models, charts, etc. for each class.
   c. Instructor is responsible for confirming with Engineer and Owner in advance of each class that the classroom will be appropriate for the types of audiovisual equipment to be employed.
6. Classroom documentation:
   a. Trainees will keep training materials and documentation after the session.
   b. Operations and maintenance manuals, as specified in technical sections:
      1) Provide a minimum of 2 copies of final Engineer-approved operations and maintenance manuals as specified in Section 01782 - Operation and Maintenance Data for use during the classroom instruction.
      2) Owner reserves the right to delay training for a particular equipment item if the operations and maintenance manuals for that equipment are incomplete, inaccurate, or otherwise unsuitable for use by the Owner's staff.
      3) No contract extensions or extra costs will be allowed for training delays due to operations and maintenance manual submittal delays.
   c. Provide supplemental documentation handouts to support instruction.
   d. Digitally record audio and video of each training session.
      1) Include classroom and field instruction with question and answering periods.
      2) Engineer approval required for producer of video materials from one of the following options:
         a) Qualified, professional video production company.
         b) Contractor demonstrates satisfactory skill.
      3) Record in digital format and recording shall become property of the Owner.
         a) Provide audio quality that is not degraded during the recording of the field sessions due to background noise, space, distance or other factors.
      4) Video files shall be file format and delivery medium as directed and approved by Owner.
      5) Provide 2 complete sets of video materials fully indexed and cataloged with printed labels stating session content and dates recorded.
      6) The Contractor shall provide a written release from all claims to the recorded training material produced, if required.
   e. Training modules:
      1) Provide a training module for each equipment category.

2) Divide each training module's instructional content into discrete lesson plans.

f. Lesson plans:
   1) Provide performance-based learning objectives.
   2) State learning objectives in terms of what the trainees will be able to do at the end of the lesson.
   3) Define student conditions of performance and criteria for evaluating instructional success.
   4) Instruction lesson plan outlines for each trade.
      a) Provide specific components and procedures.
   5) Minimum requirements:
      a) Hands-on demonstrations planned for the instructions.
      b) Cross-reference training aids.
      c) Planned training strategies such as whiteboard work, instructor questions, and discussion points or other planned classroom or field strategies.
      d) Attach handouts cross-referenced by section or topic in the lesson plan.
      e) Indicate duration of outlined training segments.
   6) Provide maintenance instruction lesson plans including mechanical, HVAC, instrumentation, and electrical aspects:
      a) Equipment operation:
         (1) Describe equipment's operating (process) function and system theory.
         (2) Describe equipment's fundamental operating principles and dynamics.
         (3) Identify equipment's mechanical, electrical, and electronic components and features.
         (4) Identify support equipment associated with the operation of subject equipment.
         (5) Detail the relationship of each piece of equipment or component to the subsystems, systems, and process.
         (6) Cite hazards associated with the operations, exposure to chemicals associated with the component, or the waste stream handled by the component.
         (7) Specify appropriate safety precautions, equipment, and procedures to eliminate, reduce, or overcome hazards.
      b) Detailed component description:
         (1) Define Preventative Maintenance (PM) inspection procedures required on equipment in operation, spot potential trouble symptoms (anticipate breakdowns), and forecast maintenance requirements (predictive maintenance).
            (a) Review preventive maintenance frequency and task analysis table.
         (2) Identify each component function and describe in detail.
         (3) Where applicable, group relative components into subsystems.
         (4) Identify and describe in detail equipment safety features, permissive and controls interlocks.
   7) Provide the following information in equipment troubleshooting lesson plans:

a) Define recommended systematic troubleshooting procedures as they relate to specific craft problems.
b) Provide component specific troubleshooting checklists as they relate to specific craft problems.

8) Provide the following information in equipment Corrective Maintenance (CM) troubleshooting lesson:
a) Describe recommended equipment preparation requirements as they relate to specific craft problems.
b) Identify and describe the use of any special tools required for maintenance of the equipment as they relate to specific craft problems.
c) Describe component removal/installation and disassembly/assembly procedures for specific craft repairs.
d) Perform at least 2 hands-on demonstrations of common corrective maintenance repairs.
(1) Additional demonstrations may be required by the Owner.
e) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.

7. Class logistics:
a. Delivery time minimum: 2 hours.
b. Delivery time maximum: 4 hours.
1) Longer time requires Engineer approval.
c. Class agenda:
1) Refreshment break: One 10-minute break.
2) Meal break: One 45-minute break, unless otherwise specified.
3) Schedule refreshment breaks and meal breaks to meet the class needs and Owner work rules.
d. Schedule specific sessions:
1) Minimum of 30 days in advance to allow Owner staffing arrangements to take place.
2) At the times requested by the Owner, within the period 7 a.m. to 7 p.m. Monday through Friday.
a) Times scheduled will be at Owner's discretion.
3) Owner approval and confirmation required for session schedules.
4) Provide minimum of 2 sessions for each class unless otherwise noted.
a) The purpose of having multiple sessions on each class is to accommodate the attendance of as many Owner personnel working different shifts as possible.
b) A maximum of 1 session per day for each class.

8. Distribute Training Evaluation Form following each training session.
a. Training Evaluation Form is included in this Section.
b. Return completed Training Evaluation Forms to Owner's designated training coordinator immediately after session is completed.
c. Revise training sessions judged "Unsatisfactory" by a majority of attendees.
1) Conduct training sessions again until a satisfactory rating is achieved at no additional cost to Owner.

9. Submittals:
a. Prior to the training session:

1) Instructor qualifications: Due 30 calendar days prior to initial training session.
2) Training course materials: Due 14 calendar days prior to initial training session.
a) Training agenda, lesson plan, presentation, and handouts.
b) Other audio-visual aids utilized during each training course.
c) Format: 2 electronic copies and 3 hard copies organized in notebooks.

b. Post training session:
1) Training course materials: Due 14 calendar days after class completion.
a) Video recordings.
b) Class attendance sheet.
c) Training agenda, final lesson plan, presentation, and handouts.
d) Other audio-visual aids utilized during each training course.
e) Provide materials for all sessions of the class in a single transmittal.
f) Format: 2 electronic copies and 3 hard copies organized in notebooks.

D. Installation Testing:
1. Perform subsystem testing according to approved Subsystem Testing Plans.
2. Initiate the Manufacturer's Certificate of Installation and Functionality Compliance for all equipment.
a. Manufacturer's Certificate of Installation and Functionality Compliance form is included in this Section.
b. Manufacturer's Certificate of Installation and Functionality Compliance certifies the equipment meets the following requirements:
1) Has been properly installed, adjusted, aligned, and lubricated.
2) Is free of any stresses imposed by connecting piping or anchor bolts.
3) Is able to be operated as necessary for Functional Testing.
c. Form shall be submitted after completion of Functional Testing, as specified in this Section.
3. Coordinate Installation Testing with restrictions and requirements as specified in Section 01140 - Work Restrictions.
4. Perform coating holiday testing as specified in Section 09960 - High-Performance Coatings.
5. Perform pressure and leakage testing as specified in individual component Sections and Section 15956 - Piping Systems Testing.
6. Instrumentation devices and subsystems Installation Testing: As specified below, in Section 17950 - Testing, Calibration, and Commissioning, and technical sections.

E. Functional Testing:
1. Perform subsystem testing according to approved Subsystem Testing Plan.
2. Notify the Engineer 5 days prior to when the Work is ready for Functional Testing.
a. Perform testing in the presence of the Engineer.
3. Determine Functional Testing durations with Owner's input.
a. Durations will vary depending on the availability of water for testing.
b. Target minimum Functional Test duration: 8 hours.

1) Identify equipment/system that cannot be tested for a minimum of 8 hours as specified in technical sections.

4. Perform Functional Testing as specified in technical sections.
   a. Perform Functional Testing in addition to the other tests specified in the technical sections.
   b. Perform Functional Testing to demonstrate that the component equipment functions as an entire system in accordance with the design requirements.
   c. Perform Functional Testing to demonstrate that the unit process has operated in a manner necessary to demonstrate equipment/system functions manually in local, manually in remote (or remote manual), and automatically in remote (in remote auto).
   d. Perform testing with Contractor-provided water.
   e. Repair or replace parts that operate improperly and retest.
   f. Submit testing results as specified in the technical sections to the Owner and Engineer for approval of Functional Testing results.
5. Provide completed Manufacturer's Certificate of Installation and Functionality Compliance forms for all equipment.
   a. Manufacturer's Certificate of Installation and Functionality Compliance form is included in this Section.
   b. Manufacturer's Certificate of Installation and Functionality Compliance certifies the equipment/system meets the following requirements:
      1) Is suitable for satisfactory full-time operation under full-load conditions.
      2) Operates within the allowable limits for vibration and noise.
      3) Electrical and instrumentation requirements:
         a) Electrical equipment, instrumentation, and control panels are properly installed, calibrated, and functioning.
         b) Electrical Installation Testing is complete, and test results have been approved by the Engineer.
            (1) Noted deficiencies have been corrected.
            (2) Relays, circuit breakers, and other protective devices are set.
         c) Control logic for start-up, shutdown, sequencing, interlocks, control, and emergency shutdown has been tested and is properly functioning.
         d) Motor control is calibrated and tested.

F. Closeout documentation:
   1. Submittals:
      a. Provide records generated during Commissioning Phase of Project.
         1) Required documents include but are not limited to:
            a) Training documentation.
            b) Manufacturer's Certificate of Source Testing.
            c) Manufacturer's Certificate of Installation and Functionality Compliance.
            d) Daily logs of equipment/system testing identifying tests conducted and outcome.
            e) Test forms and documentation.
            f) Functional Testing results.
            g) Logs of time spent by manufacturer's representatives performing services on the job site.
            h) Equipment lubrication records.

i) Electrical phase, voltage, and amperage measurements.
j) Insulation resistance measurements.
k) Bearing temperature measurements.

2) Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints. Format: 2 electronic copies and 3 hard copies organized in notebooks.
3) Due date: Within 14 calendar days of Substantial Completion.

1.06 PROCESS START-UP PHASE

A. Overview of Process Start-Up Phase:
1. Operating the facility to verify performance meets the Contract Document requirements.

B. Process Start-Up:
1. Perform process start-up in the presence of the Engineer.
2. Pre-start-up activities:
a. Commissioning Documentation and Data Review.
b. Start-Up Go/No-Go Decision Criteria.
c. Building and Fire Inspection Compliance Check.
d. Process Start-Up Sequence Review.
1) Submit a Process Start-Up plan for review by Engineer not less than 60 calendar days prior to planned commencement of process start-up activities.
2) Include the following:
a) Pre-start-up activities.
b) Process Start-Up.
c) Process Operational Period.
e. Description of Temporary Testing Arrangement, if applicable.
f. Final Process Start-Up Forms and Documentations.
g. Final Operational Testing Plan.
3. Control loop tuning.
a. Perform control loop tuning during system testing with water to the extent possible.
4. Process area start-ups.
a. Process start-up individual process areas comprised of multiple interdependent systems where possible and beneficial to reduce complexity and risk of complete facility testing.
b. Process area test flows may be limited by upstream and downstream process constraints (i.e., tank and basin volumes) and/or localized recirculation capabilities.
5. Facility-wide process start-up.
a. Upon approved completion of pre-start-up activities, perform entire facility process start-up.
1) Complete control loop tuning during this phase of process start-up.
2) Continue process start-up operations until facility meets or exceeds the Contract requirements.
b. Process control systems testing:
1) Test complete system instrumentation, controls and PLC, HMI, and LOI programming for the facility.
c. HVAC systems start-up and testing:
1) Test complete HVAC system for the facility.

d. Ancillary systems start-up and testing:
    1) Test complete security system, phone system, fire alarm system, etc. for the facility.
e. Remaining equipment/system tests:
    1) Conduct remaining specified equipment/system performance tests that could not be performed during the Testing and Training Phase due to inter-system and/or treatment process dependencies.

C. Process Operational Period:
1. Prior to beginning the Process Operational Period:
    a. Conformance with treatment standards is required prior to Operational Testing, if applicable.
        1) Biological processes require time to build up the necessary population of organisms to meet treatment standards, as specified in Section 01140 - Work Restrictions.
    b. Correct any outstanding punch list items prior to the Operational Testing.
2. Duration: 30 calendar days.
3. Engineer will be present for process operational period unless such presence is expressly waived in writing.
4. Prove facility conformance with Contract Document requirements.
5. Contractor to provide:
    a. Specified start-up materials and operating supplies.
    b. Necessary craft of labor assistance, in the event of an emergency equipment failure requiring immediate attention (emergency is defined as a failure of function which precludes the further operation of a critical segment of or the whole of the Work) with a response time of not more than 4 hours from the time of notification.
    c. Manufacturer's authorized representative to supervise placing equipment/systems in operation and provide guidance during Operational Testing per applicable section.
    d. Necessary manufacturer's representatives and operating supplies for retesting systems that fail to pass the initial Operational Testing due to deficiencies in products of workmanship at no additional cost to the Owner.
    e. List of 24-hour "on-call" representative supervisory persons who will monitor the Operational Testing and serve as liaison for the Engineer and Owner.
6. Owner will provide:
    a. Operations personnel for duration of test.
7. Prior to date of Substantial Completion of Installation, the Contractor's CC shall oversee Process Operational Period.
    a. Owner staff will operate the completed Project construction.
    b. Entire system shall continuously meet performance requirements and shall operate without fault, failure, or defect for a continuous period.
    c. Individual equipment/system failures that are corrected within 24 hours and do not prevent the entire project from continuously satisfying the established operational requirements shall not require the consecutive day test to be restarted unless the failure recurs.
    d. Restart the consecutive test period for any of the following conditions:
        1) Any failure of the complete Project construction to meet operational requirements.

2) When malfunctions or deficiencies cause shutdown or partial operation of the facility, or results in failure of the complete Project construction to meet operational requirements.
3) Any individual equipment/system failure that meets any of the following conditions:
   a) Requires more than 24 hours to correct, unless otherwise specified in Section 17950 - Testing, Calibration, and Commissioning.
   b) Recurs within the 24-hour correction period requiring further correction.
4) Immediately correct defects in material, workmanship, or equipment/system which became evident during Operational Testing.

1.07 INSTRUMENTATION AND CONTROLS FINE-TUNING:

A. After the Process Operational Period, test PCIS system for additional 60 days as specified in Section 17950 - Testing, Calibration, and Commissioning to identify issues and make corrections, as needed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

Comments: _____

_____

_____

_____

_____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract Documents, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____, 20____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

_____
(Authorized Signature)

If applicable, Witness Name *(print)*: _____

_____
(Witness Signature)

MANUFACTURER'S CERTIFICATE OF
INSTALLATION AND FUNCTIONALITY COMPLIANCE

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify that the above-referenced equipment/system has been: (Check Applicable)

- ☐ Installed in accordance with manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical/instrumentation and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functionally tested.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements.

NOTES:
Attach test results with collected data and test report.

Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

_____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20 ____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

COMMISSIONING

TRAINING EVALUATION FORM

EQUIPMENT/SYSTEM ITEM: _____

VENDOR/MANUFACTURER: _____

DATE: _____ NAME OF REPRESENTATIVE: _____

1.	Was representative prepared?	Acceptable	Unacceptable	or	N/A
2.	Was an overview description presented?	Acceptable	Unacceptable	or	N/A
3.	Were specific details presented for system components?	Acceptable	Unacceptable	or	N/A
4.	Were alarm and shutdown conditions clearly presented?	Acceptable	Unacceptable	or	N/A
5.	Were step-by-step procedures for starting, stopping, and troubleshooting presented?	Acceptable	Unacceptable	or	N/A
6.	Were routine/preventative maintenance items clearly identified?	Acceptable	Unacceptable	or	N/A
7.	Was the lubrication schedule (if any) discussed?	Acceptable	Unacceptable	or	N/A
8.	Was the representative able to answer all questions?	Acceptable	Unacceptable	or	N/A
9.	Did the representative agree to research and answer unanswered questions?	Acceptable	Unacceptable	or	N/A

10. Comments: _____

_____

_____

_____

11. Overall Rating: Satisfactory Unsatisfactory

Note:

Sessions judged “Unsatisfactory” by a majority of attendees shall be revised and conducted again until a satisfactory rating is achieved.

COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
Source Testing				
1	Source Testing	Witness, Review Support	Lead	Witness, Review
Installation Testing				
2	Electrical Conductor Testing	No Action	Lead	Witness
3	Electrical Field Acceptance Tests	No Action	Lead	Witness
4	Instrument Field Calibration	No Action	Lead	Witness
5	Network Installation Testing	Witness, Review Support	Lead	Witness
6	Loop Testing	Witness, Review Support	Lead	Witness
7	Pressure Testing	No Action	Lead	Witness
8	Leak Testing	No Action	Lead	Witness
9	Holiday Testing	No Action	Lead	Witness
10	HVAC Testing	No Action	Lead	Witness
11	Motor Electrical Testing	No Action	Lead	Witness
Functional Testing				
12	Network Operational Testing	Witness, Review Support	Lead	Review
13	Preliminary Run Testing Local/Manual Control	Witness, Review Support	Lead	Review
14	PCIS Functional Demonstration Testing - Local/Auto Control Testing - Remote/Manual Contact Testing - Alarm Testing - Control Loop Testing	Witness, Review Support	Lead	Review
15	Subsystem Start-Up and Testing	Witness, Review Support	Lead	Review
16	Equipment/System Start-Up and Testing	Witness, Review Support	Lead	Review
17	HVAC Start-Up and Testing	Witness, Review Support	Lead	Review
18	Corrosion Control Start-Up and Testing	Witness, Review Support	Lead	Review

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
19	Wide Area Network Communications Testing	Witness, Review Support	Lead	Witness
20	Manufacturer's Certificate of Installation and Functionality Compliance	No Action	Lead	Witness, Review
Clean Water Facility Testing				
21	Test Water Management Plan Finalization	Witness, Review Support	Lead	Review
22	Clean Water Facility Testing	Witness, Review Support	Lead	Witness, Review
Process Start-Up Phase				
Process Start-Up				
23	Commissioning Documentation and Data Review	Witness, Review Support	Support	Lead
24	Start-Up Go/No-Go Decision Criteria	Lead	Support	Review
25	Building and Fire Inspection Compliance Check	No Action	Lead	Witness
26	HVAC Functionality Check	No Action	Lead	Witness
27	Start-Up Sequence Review	Witness, Review Support	Lead	Review
28	Temporary Testing Arrangement Finalization	Witness, Review Support	Lead	Support
29	Start-Up Forms Finalization	Witness, Review Support	Lead	Support
30	Operation Testing Plan Finalization	Witness, Review Support	Support	Lead
31	Test Water Management Plan Finalization	Witness, Review Support	Lead	Review
32	System Testing	Witness, Review Support	Lead	Witness
33	Control Loop Tuning	Witness, Review Support	Lead	Witness
34	Process Area Start-Ups	Witness, Review Support	Lead	Witness
35	Facility-Wide Start-Up	Witness, Review Support	Lead	Witness

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
36	Process Control Systems Testing	Witness, Review Support	Lead	Witness
38	HVAC Final Testing, Adjust, and Balancing	Witness, Review Support	Lead	Witness, Review
Process Operational Period				
39	Operational Testing	Witness, Review Support	Lead	Witness, Review
40	Final Testing Reports	Witness, Review Support	Lead	Review
41	Water Quality Testing and Documentation	Witness, Review Support	Lead	Review
Instrumentation and Controls Reliability Phase				
Instrumentation and Controls Reliability Period				
42	As specified in Section 17950 - Testing, Calibration, and Commissioning	Witness, Review Support	Lead	Review

Legend:
Lead: Primarily responsible for organization, coordination, and execution of task work product or result.
Support: Assist the lead with organization, coordination, and execution of task work product or result.
Witness: Observe and document completion of task work product or result.
Review: As necessary to accept task work product result.
No Action: Limited or no involvement.

SECTION 01770

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Contract closeout requirements including:
   1. Final cleaning.
   2. Waste disposal.
   3. Touch-up and repair.
   4. Disinfection of systems.
   5. Preparation and submittal of closeout documents.
   6. Certificate of Substantial Completion.

1.02 REFERENCES

A. American Water Works Association (AWWA).

1.03 FINAL CLEANING

A. Perform final cleaning prior to inspections for Substantial Completion.

B. Employ skilled workers who are experienced in cleaning operations.

C. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.

D. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.

E. Clean roofs, gutters, downspouts, and drainage systems.

F. Broom clean exterior paved surfaces and rake clean other surfaces of site work:
   1. Police yards and grounds to keep clean.

G. Remove dust, cobwebs, and traces of insects and dirt.

H. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.

I. Remove non-permanent protection and labels.

J. Polish waxed woodwork and finish hardware.

K. Wash tile.

L. Wax and buff hard floors, as applicable.

M. Wash and polish glass, inside and outside.

N. Wash and shine mirrors.

O. Polish glossy surfaces to clear shine.

P. Vacuum carpeted and soft surfaces.

Q. Clean permanent filters and replace disposable filters when heating, ventilation, and air conditioning units were operated during construction.

R. Clean ducts, blowers, and coils when units were operated without filters during construction.

S. Clean light fixtures and replace burned-out or dim lamps.

T. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.04 WASTE DISPOSAL

A. Arrange for and dispose of surplus materials, waste products, and debris off-site:
   1. Prior to making disposal on private property, obtain written permission from Owner of such property.

B. Do not fill ditches, washes, or drainage ways which may create drainage problems.

C. Do not create unsightly or unsanitary nuisances during disposal operations.

D. Maintain disposal site in safe condition and good appearance.

E. Complete leveling and cleanup prior to Final Completion of the Work.

1.05 TOUCH-UP AND REPAIR

A. Touch-up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for Substantial Completion.

B. Refinish or replace entire surfaces which cannot be touched-up or repaired satisfactorily.

1.06 CLOSEOUT DOCUMENTS

A. Submit following Closeout Submittals before Substantial Completion:
   1. Punch list of items to be completed or corrected with the request for issuance of Substantial Completion.
   2. Evidence of Compliance with Requirements of Governing Authorities.
   3. Project Record Documents.
   4. Approved Operation and Maintenance Manuals.
   5. Approved Warranties and Bonds.
   6. Keys and Keying Schedule.
   7. Completed contract requirements for commissioning and process start-up.

B. Submit following Closeout Submittals before final completion of the Work and at least 7 days prior to submitting Application for Final Payment:

1. Punch list of items have been completed and Engineer and Owner are satisfied that all deficiencies are corrected.
2. Evidence of Payment and Release of Liens or Stop Payment Notices as outlined in Conditions of the Contract.
3. Release of claims as outlined in Conditions of the Contract.
4. Submit certification of insurance for products and completed operations, as specified in the General Conditions.
5. Final statement of accounting.

1.07 EVIDENCE OF COMPLIANCE WITH REQUIREMENTS OF GOVERNING AUTHORITIES

A. Submit the following:
   1. Certificates of Inspection:
      a. Electrical.

1.08 PROJECT RECORD DOCUMENTS

A. Maintain at Project site, available to Owner and Engineer, 1 copy of the Contract Documents, shop drawings, and other submittals in good order:
   1. Mark and record field changes and detailed information contained in submittals and change orders.
   2. Record actual depths, horizontal and vertical location of underground pipes, duct banks, and other buried utilities. Reference dimensions to permanent surface features.
   3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.
   4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits and filled conduits.
   5. Provide schedules, lists, layout drawings, and wiring diagrams.
   6. Make annotations in electronic format. Hard copy format with erasable colored pencil conforming to the following color code:

Additions:	**Red**
Deletions:	**Green**
Comments	**Blue**
Dimensions:	**Graphite**

B. Maintain documents separate from those used for construction:
   1. Label documents "RECORD DOCUMENTS."

C. Keep documents current:
   1. Record required information at the time the material and equipment is installed and before permanently concealing.
   2. Engineer will review Record Documents weekly to ascertain that changes have been recorded.

D. Affix civil engineer's or professional land surveyor's signature and registration number to Record Drawings to certify accuracy of information shown.

E. Deliver Record Documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

F. Record Documents will be reviewed monthly to determine the percent complete for the monthly pay application.

G. Updated Record Documents are a condition for Engineer’s recommendation for progress payment.

H. Final Schedule Submittal as specified in Section 01324C - Progress Schedules and Reports - Small Projects.

1.09 MAINTENANCE SERVICE

A. Maintenance service as specified in technical specifications.

1.10 SUBSTANTIAL COMPLETION

A. Obtain Certificate of Substantial Completion.

1.11 FINAL COMPLETION

A. When Contractor considers the Work is complete, submit written certification that:
   1. Work has been completed in accordance with the Contract Document:
   2. Punch list items have been completed or corrected.
   3. Work is ready for final inspection.

B. Engineer will make an inspection to verify the status of completion with reasonable promptness.

C. Should the Engineer consider that the Work is incomplete or defective:
   1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
   2. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to the Engineer that the Work is complete.
   3. Engineer shall re-inspect the Work.

1.12 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit a final statement of accounting to the Engineer at least 7 days prior to final Application for Payment.

B. Statement shall reflect all adjustments to the Contract amount.
   1. The original Contract amount.

2. Additions and deductions resulting from:
    a. Change Orders.
    b. Units installed and unit prices.
    c. Set-offs for uncorrected or incomplete Work.
    d. Set-offs for liquidated damages.
    e. Set-offs for reinspection payments.
    f. Extended engineering and/or inspection services and inspection overtime.
    g. Excessive shop drawings review cost by the Engineer.
    h. Other adjustments.
3. Total Contract amount, as adjusted.
4. Previous payments.
5. Remaining payment due.

C. Engineer will prepare a final Change Order reflecting approved adjustments to the Contract amount which were not previously made by Change Orders.

1.13 FINAL APPLICATION FOR PAYMENT

A. Contractor shall submit the final Application for Payment reflecting the agreed upon information provided in the final statement of accounting.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01782

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preparation and submittal of Operation and Maintenance Manuals.

1.02 GENERAL

A. Submit Operation and Maintenance Manuals as specified in technical sections.

B. Make approved manuals available at project site for use by construction personnel and Owner.

1.03 SUBMITTALS

A. Draft Operation and Maintenance Manuals:
   1. Submit prior to shipment of equipment or system to site.
   2. Shipment will be considered incomplete without the draft Operation and Maintenance Manuals.
   3. Quantity:
      a. Hard copy: 4 sets.
      b. Electronic: 2 CD-ROM VD, or electronic media acceptable to the owner.

B. Final Operation and Maintenance Manuals:
   1. Make additions and revisions in accordance with Owner's and Engineer's review comments on draft manuals.
   2. Submit approved Operation and Maintenance Manuals at least 30 days prior to Functional Testing and at least 60 days prior to Owner Training.
   3. Quantity:
      a. Hard copy: 4 sets.
      b. Electronic: 2 CD-ROM or DVD, or electronic media acceptable to the owner.

1.04 PREPARATION

A. General requirements:
   1. Provide dimensions in US units.
   2. Assemble material, where possible, in the same order within each volume.
   3. Reduce drawings and diagrams to 8 1/2 by 11-inch size, if possible unless otherwise specified.
   4. Complete forms on computer, handwriting not acceptable.
   5. Delete items or options not provided in the supplied equipment or system.
   6. Provide package control system annotated ladder logic for PLC, if applicable.

B. Hard copy requirements:
   1. Binders: 3-ring with rigid covers.

a. Break into separate binders as needed to accommodate large size.
2. Utilize numbered tab sheets to organize information.
3. Provide original and clear text on reproducible non-colored paper, 8 1/2 by 11-inch size, 24 pound paper.
4. Drawings larger than 8 1/2 by 11 inch:
   a. Fold drawings separately and place in envelope bound into the manual.
   b. Label each drawing envelope on the outside regarding contents.

C. Electronic requirements:
1. File format:
   a. Entire manual in PDF format.
      1) Include text and drawing information.
      2) Provide a single PDF file even if the hard copy version is broken into separate binders due to being large.
      3) Create PDF from the native format of the document (Microsoft Word, graphics programs, drawing programs, etc.).
         a) If material is not available in native format and only available in paper format, remove smudges, fingerprints, and other extraneous marks before scanning to PDF format.
         b) Hard copy record drawing requirements:
            (1) Provide a single multipage PDF file of each set of the scanned drawings.
            (2) Page 1 shall be the cover of the drawing set.
         c) At file opening, display the entire cover.
            (1) Scan drawings at 200 to 300 dots per inch (DPI), black and white, Group IV Compression, unless otherwise specified.
            (2) Scan drawings with photos in the background at 400 dots per inch (DPI), black and white, Group IV Compression.
      4) Pagination and appearance to match hard copy.
      5) Searchable.
      6) Scanned images are not acceptable.
      7) Bookmarks:
         a) Bookmarks shall match the table of contents.
         b) Bookmark each section (tab) and heading.
         c) Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
         d) At file opening, display all levels of bookmarks as expanded.
      8) Thumbnails optimized for fast web viewing.
   b. Drawing requirements:
      1) Provide additional copy of drawings in most current version of AutoCAD format.
      2) Drawings shall have a white background.
      3) Drawing shapes shall not degrade when closely zoomed.
      4) Screening effects intended to de-emphasize detail in a drawing must be preserved.
      5) Delete items or options not provided in the supplied equipment or system.
      6) Provide one (1) hardcopy of final drawings including schematics in each RTU/PLC control panel.
2. Media:
   a. CD-ROM or DVD-ROM compatible with Microsoft Windows.
   b. Flash drive.

c. Secure Electronic File Transfer (SEFT).

3. Label media with the following information:
   a. Operation and Maintenance Manual.
   b. Equipment name.
   c. Specification Section Number
   d. Equipment tag number.
   e. Owner's name.
   f. Project number and name.
   g. Date.
4. If multiple submittals are made together, each submittal must have its own subdirectory that is named and numbered based on the submittal number.

1.05 CONTENTS

A. Label the spines:
   1. Equipment name.
   2. Tag number.
   3. Project name.
   4. Owner name.

B. Cover page:
   1. Operation and Maintenance Manual.
   2. Equipment name.
   3. Specification Section Number.
   4. Equipment tag number.
   5. Owner's name.
   6. Project number and name.
   7. Date.

C. Table of Contents: General description of information provided within each tab section.

D. Equipment Summary Form: Completed form as specified in Appendix A of this Section.

E. Equipment Maintenance Summary Form: Completed form as specified in Appendix B of this Section.

F. Electric Motor Technical Data Form: Completed form as specified in Appendix C of this Section.

G. Description of equipment function, normal operating characteristics, and limiting conditions.

H. Manufacturer's product data sheets:
   1. Where printed material covers more than 1 specific model, indicate the model number, calibrated range, and other special features.

I. Assembly, installation, alignment, adjustment, and checking instructions.

J. Storage instructions: Control diagrams:
   1. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections

between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.
2. Complete set of 11-inch by 17-inch drawings of the control system.
3. Complete set of control schematics.

K. Programming: Copies of Contractor furnished programming.

L. Start-up procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.

M. Operating procedures:
1. Step-by-step instructions including but not limited to the following:
   a. Safety precautions.
   b. Guidelines.
   c. Manual keyboard entries.
   d. Entry codes.
   e. System responses.
   f. Other information as needed for safe system operation and maintenance.
2. Modes:
   a. Startup.
   b. Routine and normal operation.
   c. Regulation and control.
   d. Shutdown under specified modes of operation.
   e. Emergency operating shutdown.

N. Preventative maintenance procedures:
1. Recommended steps and schedules for maintaining equipment.
2. Troubleshooting.

O. Lubrication information: Required lubricants and lubrication schedules.

P. Overhaul instructions: Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.

Q. Parts list:
1. Complete parts list for equipment including but not limited to the following information:
2. Catalog data: Generic title and identification number of each component part of equipment.
3. Include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
4. Availability.
5. Service locations.

R. Spare parts list: Recommended number of parts to be stored at the site and special storage precautions.

S. Engineering data:
1. Drawings: Complete set of 11-inch by 17-inch equipment drawings.
2. Exploded view or plan and section views with detailed callouts.
3. Outline, cross-section, and assembly drawings.

4. System drawings: Provide interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.
5. Packaged equipment system drawings: Provide instrumentation loop drawing, control schematic diagrams, interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.
6. System drawings and data sheets: Include drawings and data furnished by the Engineer and the Supplier; provide "as installed" version.
7. Provide electrical and instrumentation schematic record drawings.

T. Test data and performance curves, when applicable.

U. Manufacturer's technical reference manuals.

V. Source (factory) Test results: Provide copies of Source Tests reports as specified in technical sections.

W. Functional Test results: After Functional Tests are completed, insert Functional Test reports as specified in technical sections.

1.06 ARCHIVAL DOCUMENTATION

A. Typically does not require updating to remain valid and should be stored in a format that preserves the document and limits one's ability to make changes.

B. Types of archival documents include the following:
1. Record drawings.
2. Reports.
3. Specifications.
4. Shop drawings.
5. Vendor Equipment O & M Manuals.
6. Photos.
7. Demonstration and training videos.
8. Other.

1.07 LIVING DOCUMENTATION

A. Requires periodic updates to remain valid and should be stored in formats that are easy to update.

B. Types of living documents include the following:
1. Facility O&M Manuals.
2. Standard Operating Procedures.
3. Other.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

APPENDIX A
EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT IDENTIFICATION NUMBER(S) _____
(maps equipment number)

4. LOCATION OF EQUIPMENT _____

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

_____

_____

_____

NAMEPLATE DATA -
- Horsepower _____
- Amperage _____
- Voltage _____
- Service Factor (S.F.) _____
- Speed _____
- ENC Type _____
- Capacity _____
- Other _____

7. MANUFACTURER'S LOCAL REPRESENTATIVE

Name _____

Address _____

Telephone Number _____

8. MAINTENANCE REQUIREMENTS _____

_____

_____

9. LUBRICANT LIST _____

_____

10. SPARE PARTS (recommendations) _____

_____

11. COMMENTS _____

APPENDIX B

EQUIPMENT MAINTENANCE SUMMARY

1. Equipment Item: _____
2. Manufacturer: _____
3. Serial No. (if applicable): _____
4. Manufacturer's Order No. (if applicable): _____
5. Nameplate Data (horsepower, voltage, speed, etc.): _____

   _____
6. Manufacturer's Local Representative:

   Name: _____

   Address: _____

   Telephone: _____
7. Maintenance Requirements:

Maintenance Operation	Frequency	Lubricant (if applicable)	Comments
(List each operation required. Refer to specific information in Manufacturer's Manual, if applicable)	(List required frequency of each maintenance operation)	(Refer by symbol to lubricant list as required)	

8. Lubricant List:

Reference Symbol	Conoco Phillips	Exxon/Mobil	BP/Amoco	Other (List)
(Symbols used in Item 7 above)	(List equivalent lubricants, as distributed by each manufacturer for the specific use recommended)			

9. Spare Parts: (Include recommendation on what spare parts should be kept on the job):

_____

_____

APPENDIX C

ELECTRIC MOTOR TECHNICAL DATA

Technical Data for Each Motor:

Application: _____

Manufacturer: _____

Frame No.: _____ Type: _____

Code Letter: _____ Design Letter: _____

Rating:

Horsepower: _____Voltage: _____ Phase: _____

Cycles: _____Full Load rpm: _____

(wound rotor secondary)

Volts: _____ Amperes: _____

Full Load Current: _____ amperes

Locked Rotor Current: _____ amperes

Locked Rotor or Starting Torque (percent of full load): _____ percent

Full Load Torque: _____ ft-lb

Breakdown Torque: _____ percent

Efficiency:		Power Factor:	
Full Load:	_____ percent	Full Load	_____ percent
3/4 Load:	_____ percent	3/4 Load:	_____ percent
1/2 Load:	_____ percent	1/2 Load:	_____ percent

Insulation:

Type: _____

Class: _____

Temperature Rise: _____ Above Ambient: _____

Enclosure: _____

Net Weight: _____ lbs

Wk^2: _____ lbs/sq ft

Type of Bearings: _____

Service Factor: _____

Noise Level in Decibels: _____

Heaters: _____ kW, _____ Phase, _____ volts

Altitude: _____

SECTION 01783

WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Warranty and bonds requirements.

1.02 SUBMITTALS

A. For each item of material or equipment furnished under the Contract:
   1. Submit form of manufacturer's warranty prior to fabrication and shipment of the item from the manufacturer's facility.
   2. Submit form of manufacturer's special warranty when specified.

B. Provide consolidated warranties and bonds within 15 calendar days of Substantial Completion.
   1. Contents:
      a. Organize warranty and bond documents:
         1) Include Table of Contents organized by specification section number and the name of the product or work item.
      b. Include each required warranty and bond in proper form, with full information, are certified manufacturer as required, and are properly executed by Contractor, or subcontractor, supplier, or manufacturer.
      c. Provide name, address, phone number, and point of contact of manufacturer, supplier, and installer, as applicable.
   2. Hardcopy format:
      a. Submit 2 copies.
      b. Assemble in 3 D-side ring binders with durable cover.
      c. Identify each binder on the front and spine with typed or printed title "Warranties and Bonds"; Project Name or Title, and the Name Address and Telephone Number of the Contractor.
   3. Electronic copy in PDF format:
      a. Submit 1 copy.

1.03 OWNER'S RIGHTS

A. Owner reserves the right to reject warranties.

B. Owner reserves the right to refuse to accept Work for the project if the required warranties have not been provided.

1.04 RELATIONSHIP TO GENERAL WARRANTY AND CORRECTION PERIOD

A. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, both Contractor's general warranty and the correction period requirements.

B. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty, nor does such affect or limit Contractor's performance obligations under the correction period.

1.05 MANUFACTURER'S WARRANTY MINIMUM REQUIREMENTS

A. Written warranty issued by item's manufacturer.

B. Project-specific information, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Owner.

C. Covers all costs associated with the correction of the defect, including but not limited to removal of defective parts, new parts, labor, and shipping.
   1. When correcting warranted Work that has failed, remove and replace other Work that had been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

D. Provides a timely response to correct the defect.
   1. Manufacturer shall provide, in a timely fashion, temporary equipment as necessary to replace warranted items requiring repair or replacement, when warranted items are in use and are critical to the treatment process, as defined by Owner.
   2. In the case that Owner has to provide temporary equipment to replace function of warranted item requiring repair or replacement, manufacturer shall reimburse Owner for such costs associated with the temporary equipment.

E. Warranty commence running on the date of substantial completion.
   1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of warranty period.

F. Duration of Warranty: 3 years upon notice of substantial completion.

1.06 MANUFACTURER'S SPECIAL WARRANTY

A. Manufacturer's special warranty is a written warranty published by the manufacturer which includes the requirements specified in the section where the item is specified.
   1. Includes Project-specific information and requirements, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Owner. Technical sections indicate Project-specific requirements that differ from the minimum warranty requirements for that item.
      a. Examples include extending the duration of manufacturer's warranty or to provide increased rights to Owner.
   2. Manufacturer's warranties commence on the date that the associated item is certified by Engineer as substantially complete**.**

1.07 WARRANTY WORK

A. Contractor's responsibilities:
   1. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the product, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

B. Replacement cost:
    1. Upon determination that work covered by warranty has failed, replace or rebuild the work to an acceptable condition complying with requirement of the Contract Documents.
        a. Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether Owner has benefited from the use of the work through a portion of its anticipated useful service life.

C. Related damages and losses:
    1. When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

D. Owner's recourse:
    1. Written warranties are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitation on time in which Owner can enforce such other duties, obligations, rights, or remedies.

E. Reinstatement of warranty:
    1. When work covered by a warranty has failed and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement.
        a. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

1.08 IMPLIED WARRANTIES

A. Warranty of title and intellectual rights:
    1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
    2. Provisions on intellectual rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.

B. Implied warranties: Duration in accordance with Laws and Regulations.

1.09 BONDS

A. Bond requirements as specified in the technical sections.

B. Bonds commence running on the date of substantial completion.
    1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of bond period.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02050

SOILS AND AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Aggregate base course.
   2. Native material.
   3. Sand.
   4. Select material.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C117 - Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
   2. C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   3. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   4. D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
   5. D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   6. D4829 - Standard Test Method for Expansion Index of Soils.

1.03 SUBMITTALS

A. Product data:
   1. Material source.
   2. Gradation.
   3. Testing data.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:
   1. Provide material having maximum particle size not exceeding 4 inches and that is free of trash, lumber, debris, leaves, grass, roots, stumps, and other organic matter.

2. Materials derived from processing demolished or removed asphalt concrete are not acceptable.

B. Aggregate base course:
   1. Consists of hard, durable particles or fragments of stone or gravel; crushed to required size and grading; and free from vegetable matter, lumps or balls of clay, alkali, adobe, or other deleterious matter.
   2. When sampled and tested in accordance with specified test methods, material shall comply with following requirements:
      a. Durability: Percentage of wear not greater than 40 percent when tested in accordance with ASTM C131.
      b. Plasticity index: Shall not be more than 5 when tested in accordance with ASTM D4318.
      c. Liquid limit: Shall not be more than 25 percent when tested in accordance with ASTM D4318.
   3. Aggregate base course for structures:
      a. Consists of crushed or fragmented particles.
   4. Conforms to size and grade within the following limits when tested in accordance with ASTM C117 and ASTM C136:

C. Native material:
   1. Sound, earthen material passing 1-inch sieve.
   2. Percent of material by weight passing Number 200 sieve shall not exceed 30 when tested in accordance with ASTM C136.
   3. Expansion index less than 35 when tested in accordance with ASTM D4829.

D. Sand:
   1. Clean, coarse, natural sand.
   2. Non-plastic when tested in accordance with ASTM D4318.
   3. 100 percent shall pass a 1/2-inch screen.
   4. No more than 20 percent shall pass a Number 200 sieve.

E. Select material:
   1. Sound earthen material for which the sum of plasticity index when tested in accordance with ASTM D4318 and the percent of material by weight passing a Number 200 sieve shall not exceed 23 when tested in accordance with ASTM C136.
   2. Organic content shall not be greater than 3 percent by volume.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02260

EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for designing, providing, maintaining, and removing excavation support and protection.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. Guidelines of Engineering Practice for Braced and Tied-Back Excavations.

B. Department of the Navy Naval Facilities Engineering Command (NAVFAC):
   1. Design Manual 7.2 - Foundations and Earth Structures.
   2. Design Manual 7.3 - Soil Dynamics and Special Design Aspects.

C. United States Steel Corporation (USS):
   1. Steel Sheet Piling Design Manual.

1.03 DEFINITIONS

A. General Engineering Design Practice: General engineering design practice in area of the Project, performed in accordance with recent engineering literature on subject of shoring and stability of excavations.

B. Shoring: A temporary structural system designed to support vertical faces, or nearly vertical faces, of soil or rock for purposes of excavation. Shoring includes cantilevered sheet piling, internally braced sheet piling, slurry walls, soldier piles and lagging, and other similar shoring systems. Sloping of the soil is not shoring.

C. Support levels: Level of tiebacks, wales, rackers, bottom of excavation, and other types of support.

1.04 SYSTEM DESCRIPTION

A. Where General Engineering Design Practice is specified, provide drawings and calculations that are performed and signed by civil or structural engineer registered in State where Project is located:
   1. Clearly disclose assumptions made, criteria followed, and stress values used for materials being used in design calculations.
   2. Submit list of references acceptable to Engineer that substantiating appropriateness of design assumptions, criteria, and stress values.

B. Design requirements:
   1. General:
      a. For trench excavations 5 feet or more in depth and for trenches less than 5 feet in depth when there is potential for cave-in.
         1) Perform design pursuant to general engineering design practice.
      b. Dewatering:
         1) Dewater soil inside shoring as specified in Section 02240 - Dewatering for Structures.
         2) Do not lower groundwater outside of shoring more than 1 foot.
         3) Recharge groundwater outside shoring to limit groundwater draw down outside of shoring to amount specified above.
      c. When electing to design with material stresses for temporary construction higher than allowable stresses prescribed in building code as specified in Section 01410 - Regulatory Requirements, increase in such stresses shall not exceed 10 percent of value of prescribed stresses.
      d. Minimum safety factor used for design shall not be less than 1.5.
      e. The calculated minimum depth of penetration of shoring below bottom of excavation shall be increased not less than 30 percent if full value of allowable passive pressure is used in design.
      f. Maximum height of cantilever shoring above bottom of excavation shall not exceed 15 feet. Use braced shoring when height of shoring above bottom of excavation exceeds 15 feet.
      g. The location of point of fixity for shoring shall not be less than half calculated minimum embedment depth below bottom of excavation.
      h. Generally acceptable references for design of shoring and excavations are as follows:
         1) ASCE Guidelines of Engineering Practice for Braced and Tied-Back Excavations.
         2) NAVFAC Design Manual 7.2.
         3) NAVFAC Design Manual 7.3.
         4) USS Steel Sheet Piling Design Manual.
      i. Maximum total deflection of shoring at any point on shoring shall not be more than 1/4 inch.
   2. Soldier piles and lagging:
      a. Provide lagging over full face of excavation. Joints between pieces of lagging shall be tight to prevent loss of soil.
      b. Provide full face lagging all around penetrations through lagging.
      c. Assumed effective width for passive soil resistance:
         1) Effective width of driven soldier piles shall not exceed 2 times width of pile.
         2) Effective width of CLSM encased soldier piles in drilled holes shall not exceed 2 times width of pile.
         3) Effective width of concrete encased soldier piles shall not exceed 2 times width of concrete encasement.
      d. Fill voids behind lagging with gravel or other material acceptable to Engineer.
      e. Apply loads from tie back soil, rock, or deadman anchors concentrically to soldier piles or wales spanning between soldier piles:
         1) Wales shall be back-to-back double channels or other members acceptable to Engineer.
         2) Do not eccentrically load structural section of soldier piles or wales.

f. Design soldier piles for downward loads including vertical loads from tieback anchors.

3. Soil anchors, rock anchors, and deadman anchors:
   a. Design tieback anchors for a safety factor of not less than 2 times calculated load from shoring.
   b. Proof load all production anchors to 150 percent of calculated load from shoring.
   c. Lock off production anchors at calculated load from shoring.
   d. Length of soil anchors used to calculate resistance to load from shoring shall not include any length within potential active pressure soil failure zone behind face of shoring.
   e. Design tie rods for tieback anchors for 130 percent of calculated load from shoring.
   f. Design tie rods for tieback anchors for 150 percent of the calculated load from shoring when tie rod couplers are used and for other conditions where stress concentrations can develop.
4. Set inside face of shoring back from structure not less than greater of following:
   a. 5 feet from face of wall.
   b. 2 foot 6 inches from edge of foundation.
   c. Depth of excavation below bottom of foundation.

C. Performance requirements:
1. General:
   a. Support faces of excavations and protect structures and improvements in vicinity of excavations from damage and loss of function due to settlement or movement of soils, alterations in ground water level caused by such excavations, and related operations.
   b. Specified provisions:
      1) Complement, but do not substitute or diminish, obligations of Contractor for furnishing of safe place of work pursuant to provisions of the Occupational Safety and Health Act of 1970 and its subsequent amendments and regulations and for protection of Work, structures, and other improvements.
      2) Represent minimum requirement for:
         a) Number and types of means needed to maintain soil stability.
         b) Strength of such required means.
         c) Methods and frequency of maintenance and observation of means used for maintaining soil stability.
2. Provide safe and stable excavations by means of sheeting, shoring, bracing, sloping, and other means and procedures, such as draining and recharging groundwater and routing and disposing of surface runoff, required to maintain stability of soils and rock.
3. Provide support for trench excavations for protection of workers from hazard of caving ground.
4. Provide shoring:
   a. Where, as result of excavation work and analysis performed pursuant to general engineering design practice, as defined in this Section:
      1) Excavated face or surrounding soil mass may be subject to slides, caving, or other types of failures.

2) Stability and integrity of structures and other improvements may be compromised by settlement or movement of soils, or changes in soil load on structures and other improvements.

b. For trenches 5 feet and deeper.
c. For trenches less than 5 feet in depth, when there is potential for cave-in.
d. Where indicated on the Drawings.

5. For safe and stable excavations, use appropriate design, construction, and maintenance procedures to minimize settlement of supported ground and to prevent damage to structures and other improvements, including:
   a. Using stiff shoring systems.
   b. Following appropriate construction sequence.
   c. Using shoring system that is tight enough to prevent soil loss through the shoring.
   d. Using shoring system that extends far enough below bottom of excavation to prevent piping, heave, or flow of soil under shoring.
   e. Design for safety factor of not less than 1.50.
   f. Providing surface runoff routing and discharge away from excavations.
   g. Where dewatering inside shoring is necessary, recharge groundwater outside shoring as necessary to prevent settlement in area surrounding shored excavation.
   h. Where sheet piling is used, use interlocking type sheets:
      1) Sheet piles shall be continuous and driven in interlock.
      2) If bottom of the excavation is located below the water table, use “ball and socket” or "thumb and finger" type interlock.
   i. Not applying shoring loads to existing structures and other improvements.
   j. Not changing existing soil loading on existing structures and other improvements.
   k. Provide welded steel packing between soil retaining members such as sheet piles and wales and similar members when gap exceeds 1/4 inch before wales are loaded.

1.05 SUBMITTALS

A. Shop drawings and calculations:
   1. Calculations for different load, support, and other conditions that occur during the sequence of installation of shoring, construction of facilities protected by shoring, and sequence of removal of shoring.
   2. Sketches showing the condition at various stages of installation and removal of shoring.
   3. Show on plan shoring, structures, pipelines, and other improvements located near shoring.
   4. When utilities penetrate shoring, show location of penetrations on elevation of all sides of shoring.
   5. Show details for ground support and sealing around utility penetrations.
   6. Indicate method used for installing driven shoring.

B. Control points and schedule of measurements:
   1. Submit location and details of control points and method and schedule of measurements.
   2. Survey data.

C. Detailed sequence of installation and removal of shoring:

1. Consider effects of ground settlement in sequence of installation and removal of shoring.
2. Provide sketches showing conditions at various stages in sequence of installation and removal of shoring.

D. Submit submittals for excavation support and protection as complete package and include all items required in this Section:
1. Incomplete submittals will not be reviewed and will be returned for resubmittal as complete package.

E. Submit dewatering submittals as specified in Section 02240 - Dewatering for Structures with submittals for excavation support and protection.

1.06 SEQUENCING

A. Do not begin construction of any shoring or excavation operations until:
1. Submittals for shoring and dewatering have been accepted.
2. Control points as specified in this Section and on existing structures and other improvements as indicated on the Drawings have been established and surveyed to document initial elevations and locations.
3. Materials necessary for installation are on site.

B. Submit submittals minimum of 30 days prior to scheduled date to begin excavation work.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. Installation of shoring:
1. Install means for providing safe and stable excavations as indicated in submittals.

B. Removal of shoring:
1. Except for concrete encased soldier piles, slurry walls, and similar shoring systems, remove shoring by completion of Work.
2. Select shoring system and method of removal, which will minimize soil that sticks to shoring from creating voids and causing settlement.
3. To prevent settlement caused by pulling shoring, fill voids with pressure injected grout:
   a. Inject grout starting at bottom of void and progressively fill void to grade.
   b. Minimize length of shoring removed ahead of grouting operation and limit time void is left ungrouted to prevent void from closing up before being grouted.
4. Pressure preservative treated wood lagging may be left in place if acceptable to Engineer.

C. Control points:
    1. Establish control points on shoring and on structures and other improvements in vicinity of excavation for measurement of horizontal and vertical movement:
        a. Set control points on shoring support system:
            1) Set points at distances not exceeding 25 feet at each support level.
    2. Promptly upon completion of construction of control points survey control points. Submit copy of field notes with measurement.
    3. Perform horizontal and vertical survey and measurement of control points at least once every week.
        a. Field notes shall show current measurement and change in measurement from first measurement taken.
    4. Set control points on corners of existing structures and on curbs, manholes, and other improvements at the locations indicated on the Drawings.
    5. Provide plumb bobs with horizontal targets indicating original position of plumb bobs in relation to shoring at control points.

D. Maintenance:
    1. Where loss of soil occurs, plug gap in shoring and replace lost soil with fill material acceptable to Engineer.
    2. Where measurements and observations indicate possibility of failure or excessive movement of excavation support, determined in accordance with general engineering design practice, take appropriate action immediately.

END OF SECTION

SECTION 02318

TRENCHING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Trench excavation, fine grading, backfilling, and compaction for the following, including requirements for ditch crossings:
   1. Direct buried electrical and control conduits.
   2. Electrical and control duct banks.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
   2. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   3. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS

A. Lab certification.

B. Confirmation test reports.

1.04 QUALITY ASSURANCE

A. Initial compaction demonstration:
   1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
      a. 200 linear feet of trench backfill.
   2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
   3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

PART 2 PRODUCTS

2.01 MATERIALS

A. Soil and rock materials:
   1. Aggregate base course material: As specified in Section 02050 - Soils and Aggregates for Earthwork.

2. Gravel: As specified in Section 02050 - Soils and Aggregates for Earthwork.
3. Native material: As specified in Section 02050 - Soils and Aggregates for Earthwork.
4. Sand: As specified in Section 02050 - Soils and Aggregates for Earthwork.
5. Select material: As specified in Section 02050 - Soils and Aggregates for Earthwork.

PART 3 EXECUTION

3.01 PREPARATION

A. General:
   1. Embankment condition:
      a. Exists where width of trench exceeds limits specified in this Section.

B. Protection: Stabilize trench excavations as specified in Section 02260 - Excavation Support and Protection.

3.02 INSTALLATION

A. Trench excavation:
   1. General requirements:
      a. Excavate bottom of trench to depth indicated on the Drawings. The bottom of the trench excavation shall be firm and dry.
   2. The trench may be excavated by machinery to the grade indicated on the Drawings provided that the soil material remaining in the bottom of the trench is no more than slightly disturbed.
   3. Rock:
      a. Direct buried electrical and control conduits: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of conduit bedding material. Backfill overcut with aggregate base course material up to bottom of conduit bedding material.
      b. Electrical and control duct banks: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of concrete duct bank. Backfill overcut with aggregate base course material up to bottom of concrete duct bank.
   4. Overcut of trench bottom: Where the bottom of the trench is excavated below the depth indicated on the Drawings, restore trench bottom to proper grade by back filling with aggregate base course material compacted to 95 percent of maximum density, at no additional cost to Owner.
   5. Soft or unstable material:
      a. If bottom of excavation is found to consist of soft or unstable material which is incapable of providing proper support, remove such material to a depth and for the length required, as determined by the Engineer. Backfill trench to bottom of fine grading material with aggregate base course material compacted to 90 percent of maximum density.
   6. For manholes, valves, or other accessories:

a. Provide excavations sufficient to leave at least 12 inches clear between their outer surfaces and sides of trench or shoring.
b. Backfilling of manhole excavation: Conform to backfilling requirements as specified for trenches in this Section.
c. Backfill under manholes, vaults, tanks, or valves with aggregate base course material. Do not backfill with soil.
d. Fill any unauthorized excess excavation below elevation indicated on the Drawings for foundation of any structure with aggregate base course material at no additional cost to Owner.

B. Trench backfill above electrical and control conduit bedding, and electrical and control duct banks:
1. Under structures:
a. Backfill trench up to underside of structure with aggregate base course material as specified in Section 02050 - Soils and Aggregates for Earthwork compacted to 95 percent of maximum density.
2. Cuts across roadways and paved streets:
a. Backfill trench to underside of pavement with aggregate base course material as specified in Section 02050 - Soils and Aggregates for Earthwork compacted to 95 percent of maximum density.
3. Under and parallel to roadways, paved areas, or storage areas:
a. Backfill trench up to within 2 feet of finish grade with native material compacted to 95 percent of maximum density.
b. Then backfill from 2 feet below finish grade to finish grade, or underside of aggregate base course or pavement as indicated on the Drawings with aggregate base course material as specified in Section 02050 - Soils and Aggregates for Earthwork, compacted to 95 percent of maximum density.
4. In areas outside the improved section of roadways or in open country:
a. Backfill to finish grade with native material as specified in Section 02050 - Soils and Aggregates for Earthwork compacted to 90 percent of maximum density.
5. Through earth slopes adjacent to, or supporting structures:
a. Backfill to finish grade with aggregate base course material or select material compacted to 95 percent of maximum density.

C. Compaction:
1. In-place density of compacted trench backfill, and bedding determined in accordance with ASTM D1556, or with ASTM D6938.
2. Maximum density obtained in laboratory when tested in accordance with ASTM D1557.
3. Consolidation:
a. Do not use water settling methods such as flooding, poling, or jetting.

D. Excess material:
1. Remove excess excavated material from the Project site as specified in Section 02300 - Earthwork and dispose of legally off site.

3.03 FIELD QUALITY CONTROL

A. Tests:
1. Confirmation tests:
a. Contractor's responsibilities:

1) Accomplish specified compaction of trench backfill.
2) Control operations by confirmation tests to verify and confirm that compaction work complies, and is complying at all times, with requirements specified in this Section concerning compaction, control, and testing.
3) Cost of confirmation tests: Paid for by the Contractor.
4) Qualifications of Contractor's testing laboratory: Acceptable to Engineer. Provide lab certification.
5) Copies of confirmation test reports: Submit promptly to the Engineer.

b. Frequency of confirmation testing:
1) Perform testing not less than as follows:
a) For trenches: At each test location include tests for each type or class of backfill from bedding to finish grade.
b) In open fields: 2 every 1,000 linear feet.
c) Along dirt or gravel road or off traveled right-of-way: 2 every 500 linear feet.
d) Crossing paved roads: 2 locations along each crossing.
e) Under pavement cuts or within 2 feet of pavement edges: 1 location every 400 linear feet.

2. Compliance tests:
a. Frequency of testing: Periodic compliance tests will be made by the Engineer to verify that compaction is meeting requirements previously specified.
b. If compaction fails to meet specified requirements: Perform remedial work by one of the following methods:
1) Remove and replace backfill at proper density.
2) Bring density up to specified level by other means acceptable to the Engineer.

3. Retesting:
a. Costs of retesting: Contractor is responsible for the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
b. Contractor's confirmation tests during performance of remedial work:
1) Performance: Perform tests in manner acceptable to the Engineer.
2) Frequency: Double amount specified for initial confirmation tests.

3.04 SCHEDULES

A. Bedding materials:
1. Direct buried electrical and control conduits: Sand.

END OF SECTION

SECTION 02742

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Asphalt concrete pavement on prepared subgrade or aggregate base course, and on existing pavement, to lines, grades, compacted thicknesses, and cross sections indicated on the Drawings.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Transportation Materials and Methods of Sampling and Testing:
      a. MP1: Specification for Performance Graded Asphalt Binder.

B. ASTM International (ASTM):
   1. C117 - Standard Test Method for Material Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
   2. C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   3. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   4. D977 - Standard Specification for Emulsified Asphalt.
   5. D2041 - Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
   6. D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.03 DEFINITIONS

A. Bituminous prime coat: Consist of application of hot bituminous material on previously prepared base course.

1.04 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Compact the asphalt concrete to at least 95 percent of the density of the theoretical maximum density in accordance with ASTM D2041.

1.05 SUBMITTALS

A. Proposed mix design and gradation of materials.

B. Quality control submittals:
   1. Certificate of Compliance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Asphalt concrete delivery:
   1. Transport the mixture from the mixing plant to the point of use in vehicles having tight bodies previously cleaned of all foreign materials.
   2. Treat bodies as necessary to prevent material from sticking to the bodies.
   3. Cover each load with canvas or other suitable material of sufficient size and thickness to protect the asphalt mixture from the weather.

1.07 PROJECT CONDITIONS

A. Environmental requirements:
   1. Asphalt concrete:
      a. Place asphalt concrete only when surface is dry, and when atmospheric temperature in the shade is 40 degrees Fahrenheit and rising, or above 50 degrees Fahrenheit if falling.
      b. Do not place asphalt concrete when weather is foggy or rainy or when base on which material is to be placed is in wet or frozen condition.
   2. Prime coat:
      a. Do not apply prime coat when atmospheric temperature is below 60 degrees Fahrenheit.
      b. Apply prime coat only when base course is dry or contains moisture not in excess of that which will permit uniform distribution and desired penetration.

1.08 SEQUENCING AND SCHEDULING

A. Prime coat:
   1. Prior to requesting Engineer's acceptance for application, inspect area to be coated to determine its fitness to receive bituminous priming material.
   2. Do not begin application before area to be coated has been accepted for application by the Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Prime coat: Use bituminous material for prime coat conforming to requirements for SC-70 and apply at temperature of 105 to 175 degrees Fahrenheit at rate of 0.3 to 0.6 gallons per square yard by use of bituminous distributor.

B. Sand: Acceptable to the Engineer.

C. Tack coat: Grade SS-1h anionic emulsion in accordance with ASTM D977.

D. Asphalt concrete materials:
   1. Asphalt cement: Conform to requirements for asphalt cement, PG 64-10 AASHTO MP1.
   2. Mineral aggregate:
      a. Consist of coarse aggregate of crushed stone or gravel composed of hard, durable particles, sand, and filler as follows:

1) Coarse aggregate: Portion of material retained on Number 8 sieve. Fine aggregate: That portion passing Number 8 sieve.

b. Provide composite material that is uniformly graded from coarse to fine and that complies with requirements of one of following gradings when tested in accordance with ASTM C136.

c. Asphalt concrete: 2-course plant mix for asphalt concrete having an overall thickness of 2 1/2 inches or more if not indicated. If less than 2-1/2 inches of asphalt concrete, use single-course plant mix.

Plant Mix, Two Course				**Plant Mix, Single Course**	
Seal, 3/4 inch Thick Minimum		**Base, 1-3/4 inch Thick Minimum**		**1-1/2 inch Thick Minimum**	
Sieve Size	**Percent Passing**	**Sieve Size**	**Percent Passing**	**Sieve Size**	**Percent Passing**
1/2"	100	1-1/4"	100	3/4"	100
3/8"	95 - 100	1"	87 - 100	1/2"	75 - 95
No. 4	50 - 70	3/4"	75 - 90	3/8"	65 - 85
No. 8	35 - 55	3/8"	55 - 72	No. 4	50 - 65
No. 30	15 - 30	No. 4	40 - 60	No. 8	35 - 50
No. 100	5 - 15	No. 8	30 - 50	No. 30	15 - 30
No. 200	3 - 8	No. 30	15 - 30	No. 100	5 - 15
		No. 100	5 - 15	No. 200	3 - 8
		No. 200	3 - 8		

3. Coarse aggregate:

a. Consist of at least 70 percent by weight of each size aggregate and consist of particles that have at least 1 rough, angular surface produced by crushing:

1) Have percentage of wear of not more than 50 at 500 revolutions, in accordance with ASTM C131.

b. Aggregate plasticity index: Not more than 2 in accordance with ASTM D4318.

c. Sand may be added to crusher or pit-run product to supply any deficiency in Number 8 sieve and filler may be added to supply any deficiency in Number 200 sieve material. If aggregate contains an excess of sand, wasting will be required.

d. Filler:

1) Use finely powdered limestone, portland cement, or other artificially or naturally powdered mineral dust acceptable to the Engineer.

2) Weigh filler and add separately to each batch at time of proportioning.

3) Use filler that is free from deleterious matter of any kind.

4) Fineness that meet the following requirements:

a) Passing Number 50 sieve: 100 percent.

b) Passing Number 200 sieve: At least 75 percent.

5) Determine amount of material passing the Number 200 sieve in accordance with ASTM C117.

e. Provide composite aggregate that is free from vegetable matter, lumps or balls of clay, adherent films of clay, or other matter which would prevent thorough coating of asphalt cement.
f. Materials derived from processing demolished, or removed asphalt concrete, are not acceptable.

E. Fog sealing: Asphalt emulsion, Grade SS-1h.

2.02 EQUIPMENT

A. Bituminous distributor: Designed and equipped so as to distribute bituminous material uniformly at even heat on variable widths of surface at readily determined and controlled rate with pressure range of 25 to 75 pounds per square inch.

B. Liquid asphalt distributor:
1. Designed and operated to distribute asphaltic material in uniform spray without atomization.
2. Equipped with bitumeter having dial registering feet of travel per minute.
   a. Locate dial so that it is visible to truck driver so that he can maintain constant speed required for application at specified rate.
3. Equip pump with tachometer having dial registering gallons per minute passing through nozzles.
   a. Locate dial so that it is readily visible to operator.
4. Provide means for accurately indicating temperature of asphaltic material in distributor at all times.
   a. Locate thermometer well so that it is not in contact with, or close to, heating tube.
5. Have spray bar having normal width of application of not less than 12 feet and capable of providing for application of lesser width when necessary.
6. Provided with hose and spray nozzle attachment for applying asphaltic material to patches and areas inaccessible to spray bar.
7. Equipped with heating attachments and capable of circulating asphaltic material through spray bar during entire heating process.

C. Asphalt concrete mixing plants:
1. Equipment:
   a. Use screen and storage bins at plant of sufficient capacity to furnish the necessary amount of all aggregates, when operating at the maximum capacity of the plant, with no periods of undue waiting for material.
      1) Use bins consisting of at least 2 compartments, so proportioned as to ensure adequate storage of appropriate fractions of the aggregate.
      2) Provide each compartment with an overflow pipe of such size and at such location as to prevent any backing up of material into other compartments.
   b. Dryer:
      1) Designed to heat and dry the aggregate to Specification requirements and to agitate it continuously during the heating.
      2) Capable of preparing aggregates at a rate equal to the full-rated capacity of the plant.

c. Dust collector:
    1) So constructed as to waste or return uniformly to the hot elevator all or any part of the material collected.
d. Mixer:
    1) Adequate capacity, with twin shafts.
e. Thermometers:
    1) Furnished for determining the temperature of the mix.
f. Weighing and measuring equipment:
    1) Weighing or volumetric measuring equipment of sufficient capacity.
    2) Devices to permit easy readjustment of any working part needing readjustment, so that the equipment will function properly and accurately.
    3) Attach scales for weighing to the bucket.
    4) Test and seal all weighing equipment by a representative of the Inspector of Weights and Measures having jurisdiction, as often as the Engineer may deem necessary to ensure accuracy.
g. Tanks for storage of bituminous material:
    1) Capable of heating the material under effective and positive control at all times to temperatures within the range stipulated.

2. Asphalt concrete plant operation:
a. Mineral aggregate:
    1) Dry and heat mineral and then screen into at least 2 fractions and conveyed into separate compartments ready for proportioning and mixing.
    2) When combined with asphalt cement:
b. Aggregate:
    1) Contain not more than 2 percent moisture by weight.
    2) Be at a temperature within the range of that specified for the asphalt cement but not more than 25 degrees Fahrenheit above the temperature of the asphalt cement.
c. Combine dry aggregate in the plant in the proportionate amounts of each fraction of aggregate required to meet the specified grading.
    1) Introduce the asphalt cement into the mixer in the amount and at the temperature for the particular material being used.
    2) Continue mixing for at least 30 seconds, and for such longer period as may be necessary to coat all the particles.
d. When a continuous mixer is used, determine the mixing time by weight method using the following formula:
    1) Mixing time in seconds = Pugmill dead capacity in pounds.
    2) Pugmill output in pounds per second.

D. Asphalt-concrete-placing equipment:
1. Use equipment for placing, spreading, shaping, and finishing asphalt concrete consisting of a self-contained power machine operating in such manner that no supplemental spreading, shaping, or finishing is required to provide surface that complies with requirements for smoothness contained in this Section.
    a. In areas inaccessible to the machine, hand spreading may be permitted.
2. Furnish 1 self-propelled, pneumatic-tired roller, and one 8-ton (minimum), smooth-wheel tandem roller.
    a. When spreading is in excess of 100 tons per hour, furnish 1 additional roller of either type for each additional 100 tons, or fraction thereof, spread per hour.

2.03 MIXES

A. Asphalt cement:
   1. Do not mix at temperatures lower than 275 degrees Fahrenheit or higher than 325 degrees Fahrenheit.
   2. Usual amount of asphalt cement, by weight, to be added to aggregate be 5.4 to 5.8 percent of weight of mixture.

B. Asphalt concrete:
   1. Before being delivered to the site, mix aggregate with asphalt cement at the central mixing plant.
   2. Use mixing plants that are in good working order with no excessively worn parts and so equipped that:
      a. Temperatures of aggregates leaving dryer, of asphalt cement entering mixer, and of mix leaving mixer can be readily determined and positively controlled within Specification limits at all times.
      b. Weights of different sizes of aggregates and of asphalt cement as set by the Engineer can be consistently introduced into the mixer.
      c. Asphalt cement can be uniformly distributed throughout the mixture with aggregate completely coated.
      d. Mixing time can be positively controlled to minimum specified.
      e. Bin samples of aggregate can be readily obtained.
      f. Provide means of calibrating weighing devices.

PART 3 EXECUTION

3.01 PREPARATION

A. Protection
   1. Prime-coated surfaces:
      a. Maintain surfaces until succeeding layer of pavement has been placed.
      b. During this interval, protect primed surfaces against damage and repair any broken spots.

B. Surface preparation:
   1. Prime coat:
      a. Where portions of base course prepared for immediate treatment are excessively dry, sprinkle such portions lightly with water immediately in advance of prime coat application.
      b. Immediately following preparation of base course, apply bituminous material by means of bituminous distributor at the temperature previously specified.
      c. Apply priming material in manner that results in uniform distribution being obtained at all points of surface to be primed.
      d. Following the application of prime material, allow the surface to dry for a period of not less than 48 hours without being disturbed, or for such additional period of time as may be necessary to obtain penetration into the base course and drying out or evaporation of the volatiles from prime material.
      e. Spread sufficient sand on areas that show an excess of bituminous material to effectively blot up and cure the excess.

2. Base courses:
    a. Thoroughly clean base and apply prime coat before placing asphalt concrete.
    b. Thoroughly clean any existing base, surfacing, or pavement prior to placing plant-mixed surfacing.
    c. Where existing pavement is being widened or extended, cut to straight vertical face and treat with asphalt paint binder prior to paving operations.
    d. When asphalt concrete is to be applied over existing pavement and local irregularities in existing surface would result in course of more than specified thickness, bring surface of existing pavement to uniform contour by patching with asphalt concrete thoroughly tamped or rolled until it conforms with surrounding surface, and then apply tack coat.

3.02 APPLICATION

A. At existing asphalt to be paved over: Apply tack coat at minimum rate of 0.10 gallons per square yard.

B. Placing and compacting asphalt concrete:
    1. Placing and compacting asphalt mixture: Progress in sections generally not more than 750 linear feet in length.
    2. Spreading of mixture:
        a. Spread, shape, and finish by specified equipment.
        b. Spread each successive strip adjacent to previously spread strip.
        c. Do not compact minimum 6-inch width of each strip adjacent to new strip until after new strip has been placed.
        d. Spread as nearly continuous as possible.
        e. Laying against vertical surfaces such as gutters: Roughen and clean face of vertical surfaces as required for proper bonding and then paint with light coating of asphalt cement or emulsified asphalt.
        f. At terminations of new surface courses: Feather asphalt mixture into existing surface over such distance as may be required to produce smooth riding transition.
        g. Base-course and single-course construction: Joined by vertical butt joints, finished and rolled to smooth surface.
        h. Rolling:
            1) Perform initial or "breakdown" rolling with tandem power roller and follow spreading operation when mixture has reached temperature where it does not "pick up" on rolls.
            2) Keep rolls properly moistened but do not use surplus of water.
            3) Follow initial rolling with pneumatic roller when mixture is in proper condition and when rolling does not cause undue displacement, cracking, or shoving.
            4) Begin rolling at sides and progress gradually to center, lapping each preceding track until entire surface has been rolled.
            5) Terminate alternate trips of roller in stops at least 3 feet distance from any preceding stop.
            6) At any place not accessible to roller, thoroughly compact mixture with tampers and finish, if necessary, with hot iron to provide uniform layer over entire width being paved.
    3. Provide finish surface having uniform texture.

C. Fog sealing:
    1. Fog seal asphalt pavement after compaction with fog sealing material applied at rate of 0.05 gallons per square yard at the following locations:
        a. All asphalt pavement.

D. Full-depth asphalt pavement:
    1. Contractor's option:
        a. Install either asphalt and aggregate base material or full-depth asphalt pavement in areas where paving is required or specified to be 2 inches of asphalt concrete over aggregate base course.
        b. If option is selected to install full-depth asphalt pavement, prepare subgrade as previously specified in this Section.
        c. Substitute asphalt concrete for aggregate base at ratio of 1 inch of asphalt concrete to 2-1/2 inches of aggregate base material. Use full-depth asphalt pavement not less than 4 inches in thickness after compaction.
        d. Place asphalt concrete in courses of not more than 4 inches.
        e. Use compaction equipment in accordance with following course thicknesses:
            1) 1- to 2-inch thickness: Minimum 8-ton roller.
            2) 2- to 3-inch thickness: Minimum 10-ton roller.
            3) 3- to 4-inch thickness: Minimum 12-ton roller.
    2. Pneumatic rollers used for initial or secondary rolling: Use 12 to 15 tons with tires capable of 90-pounds-per-square-inch inflation pressure.
    3. Asphalt concrete for full-depth asphalt pavement:
        a. Asphalt concrete as previously specified in this Section.
        b. Apply bituminous prime coats where full-depth asphalt pavement is installed.
        c. Contractor's option: If Contractor elects to use full-depth asphalt pavement, at road shoulders reduce aggregate base course to minimum aggregate thickness of 4 inches.
    4. Except for asphalt thickness, aggregate base course thickness, and prime coating, full-depth asphalt pavement shall comply with requirements of this Section.

3.03 FIELD QUALITY CONTROL

A. Placement:
    1. Place the mixture on the roads, pavements, or walks at a temperature not less than 225 degrees Fahrenheit.

B. Tests:
    1. Provide sampling and control testing for the asphalt concrete.
        a. Type and size of the samples: Suitable to determine conformance with stability, density, thickness, compaction, and other specified requirements.
        b. Use an approved power saw or core drill for cutting samples.
        c. Furnish all tools, labor, and materials for cutting samples, testing, and replacing the pavement where samples were removed.
        d. Take a minimum of 1 sample per 200 tons of asphalt concrete placed.

C. Inspection:
    1. Asphalt concrete:
        a. Test with a 10-foot straightedge laid on the surface parallel with the centerline of the road. Variation of the surface from the testing edge of the straightedge not to exceed 1/4 inch.

END OF SECTION

SECTION 02952

PAVEMENT RESTORATION AND REHABILITATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Resurfacing roads and paved surfaces in which surface is removed or damaged by installation of new work.

1.02 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Limiting dimensions:
      a. Determine the exact lengths and dimensions of such roads, pavements, parking areas, and walks that will require removal and replacement for new work.
      b. Join existing surfaces to terminals of new surfacing in smooth juncture.

1.03 SUBMITTALS

A. Mix designs:
   1. Prior to placement of asphalt concrete, submit full details, including design and calculations for the asphalt concrete mix proposed.
   2. Submit gradation of aggregate base.
   3. Submit proposed mix design of portland cement concrete.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate base course: As specified in Section 02050 – Soil and for Earthwork.

B. Asphalt pavement: As specified in Section 02742 - Asphaltic Concrete Paving.

C. Portland cement concrete replacement material: Class A concrete as specified in Section 03300 - Cast-in-Place Concrete.

2.02 EQUIPMENT

A. Roads, pavements, parking areas, and walks:
   1. Equipment requirements: Good condition, capable of performing work intended in satisfactory manner.

2.03 ACCESSORIES

A. Material for painting asphalt concrete pavement: Tack coat as specified in Section 02742 - Asphaltic Concrete Paving.

PART 3 EXECUTION

3.01 INSTALLATION

A. Aggregate surface removal replacement:
   1. When trench cut is in aggregate surfaced areas, replace aggregate base course material with material matching existing material compacted to 95 percent of its maximum density.

B. Pavement removal and temporary asphalt replacement:
   1. Install temporary asphalt pavement or first course of permanent pavement replacement immediately following backfilling and compaction of trenches that have been cut through existing pavement.
   2. Except as otherwise provided, maintain this temporary pavement in safe and reasonably smooth condition until required permanent pavement is installed.
   3. Remove and dispose of temporary paving from project site.
   4. Where longitudinal trench is partly in pavement, replace pavement to original pavement edge, on a straight line, parallel to centerline of roadway.
   5. Where no part of longitudinal trench is in pavement, surfacing replacement shall only be required where existing surfacing materials have been removed.

C. Asphalt pavement replacement:
   1. Replace asphalt pavement to same thickness as adjacent pavement and match as nearly as possible adjacent pavement in texture.
   2. Cut existing asphalt pavements to be removed for trenches or other underground construction by wheel cutter, clay spade, or other device capable of making neat, reasonably straight and smooth cut without damaging adjacent pavement. Cutting device operation shall be subject to acceptance of Engineer.
   3. Cut and trim existing pavement after placement of required aggregate base course and just prior to placement of asphalt concrete for pavement replacement, and paint trimmed edges with material for painting asphalt concrete pavement immediately prior to constructing new abutting asphalt pavements. No extra payment will be made for these items, and all costs incurred in performing this work shall be incidental to pipe laying or pavement replacement.
   4. Conform replacement of asphalt pavement to contour of original pavement.

D. Portland cement concrete pavement replacement:
   1. Where trenches lie within portland cement concrete section of streets, alleys, sidewalks, and similar concrete construction, saw cut such concrete (to a depth of not less than 1-1/2 inches) to neat, vertical, true lines in such manner adjoining surfaces are not damaged.
   2. Replace portland cement concrete replacement material to same thickness as adjacent concrete.
   3. Provide expansion joints that match existing.
   4. Before placing replacement concrete, thoroughly clean edges of existing pavement and wash with neat cement and water.
   5. Surface finish: Wood float finish.

E. Curb, gutter, and sidewalk replacement:

1. Where any concrete curb, gutter, or sidewalk has been removed or displaced, replace to nearest construction joints with new Class A curb, gutter, or sidewalk to same dimensions and finish as original construction that was removed:
    a. Provide expansion joints of same spacing and thickness as original construction.

F. Asphalt pavements:
1. Trim existing asphalt pavements which are to be matched by pavement widening or pavement extension to neat true line with straight vertical edges free from irregularities with saw specifically designed for this purpose. Minimum allowable depth of cut shall be 1-1/2 inches.
2. Cut and trim existing pavement after placement of required aggregate base course and just prior to placement of asphalt concrete for pavement widening or extension, and paint trimmed edges with material for painting asphalt concrete pavement immediately prior to constructing new abutting asphalt concrete pavements.
3. No extra payment will be made for these items and all costs incurred in performing this work shall be incidental to widening or pavement extension.

3.02 FIELD QUALITY CONTROL

A. Tests:
1. Asphalt concrete as specified in Section 02742 - Asphaltic Concrete Paving.
2. Concrete as specified in Section 03300 - Cast-in-Place Concrete.

B. Inspection:
1. Asphalt concrete:
    a. Lay 10-foot straightedge parallel to centerline of trench when the trenches run parallel to street, and across pavement replacement when trench crosses street at angle.
    b. Remove and correct any deviation in cut pavement replacement greater than 1/4 inch in 10 feet.
2. Portland cement concrete replacement pavement:
    a. Lay 10-foot straightedge either across pavement replacement or longitudinal with centerline of gutter or ditch.
    b. Remove and correct any deviation in cut pavement replacement greater than 1/4 inch in 10 feet.

END OF SECTION

SECTION 03200

CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Reinforcing bars.
      a. Carbon steel.
   2. Thread bars.
   3. Bar supports.
   4. Tie wires.
   5. Welded wire fabric.
   6. Mechanical reinforcing bar couplers.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.
   2. SP-66 - ACI Detailing Manual.

B. American Iron and Steel Institute (AISI).

C. American Welding Society (AWS):
   1. D1.4 - Structural Welding Code - Reinforcing Steel.

D. ASTM International (ASTM):
   1. A493 - Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
   2. A615 - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
   3. A1064 - Standard Specification of Carbon-Steel wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

E. Concrete Reinforcing Steel Institute (CRSI):
   1. Manual of Standard Practice.

F. ICC Evaluation Service (ICC-ES):
   1. AC133 - Acceptance Criteria for Mechanical Connector Systems for Steel Reinforcing Bars.

1.03 DEFINITIONS

A. Architectural concrete: Concrete surfaces that will be exposed to view in the finished work. For purposes of this Section, architectural concrete includes the following:
   1. Concrete surfaces specified to receive paints or coatings.

2. Exposed concrete in open basins, channels, and similar liquid containing structures, that is located above a line 2 feet below the normal operating water surface elevation in that structure.

B. Bars: Reinforcement or reinforcing bars as specified in this Section.

C. Evaluation Report: Report prepared by ICC-ES , or by other testing agency acceptable to the Engineer and to the Building Official, that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES Acceptance Criteria, and its acceptance for use under the Building Code. .

D. Give away bars: Reinforcing bars that are not required by the Contract Documents, but are installed by the Contractor to provide support for the required reinforcing bars.

E. Wire supports: Metal reinforcing supports constructed of steel wire as specified. Includes individual high chairs, continuous high chairs, bolsters and other similar configurations and shapes.

1.04 SYSTEM DESCRIPTION

A. The drawings contain notes describing the size and spacing of reinforcement and its placement, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete, and other related information.

1.05 SUBMITTALS

A. General:
   1. Submit in accordance with 01330 - Submittal Procedures.
   2. Changes to reinforcement in Contract Documents:
      a. Indicate in a separate letter submitted with shop drawings any changes to reinforcement indicated on the Drawings or specified.
      b. Such changes will not be acceptable unless Engineer has accepted them in writing.

B. Product data:
   1. Bar supports:
      a. Wire bar supports:
         1) Schedule of support materials to be provided and locations of use.
   2. Mechanical reinforcing bar couplers. For each type and/or series to be provided:
      a. Evaluation Report documenting compliance with the requirements of ICC-ES AC133.
      b. Details, properties, and dimensions of couplers. Include type or size identification, and bar size(s) and grade(s) for which the coupler is suitable.
      c. Manufacturer’s installation and testing instructions.
      d. Manufacturer's statement that products installed in accordance with manufacturer's recommended procedures will develop strengths and limit slip as specified in this Section.

C. Shop drawings:
   1. Reinforcement shop drawings:

a. Submit drawings showing bending and placement of reinforcement required by the Contract Documents.
b. Clearly indicate structures or portions of structures covered by each submittal.
c. Shop drawings shall conform to the recommendations of the CRSI Manual of Standard Practice and ACI SP-66.
d. Use the same bar identification marks on bending detail drawings, placement drawings, and shipping tags.
e. Submittals consisting solely of reinforcing bar schedules, without accompanying placement drawings, will not be accepted unless accepted under prior written agreement with Engineer.

2. Reinforcement placement drawings:
   a. Clearly show placement of each bar listed in the bill of materials, including additional reinforcement at corners and openings, and other reinforcement required by details in the Contract Documents.
   b. Clearly identify locations of reinforcement with coatings (e.g., galvanized or epoxy) and with yield strength other than ASTM A615, Grade 60.
   c. Show splice locations.
   d. Indicate locations of mechanical reinforcing couplers if used.
3. Reinforcement fabrication drawings:
   a. If bend types or nomenclature differs from that recommended in the CRSI Manual of Standard Practice, provide details showing bend types and dimensional designations.
      Clearly identify reinforcement with coatings and with yield strength other than ASTM A615, Grade 60.

D. Samples (when requested by Engineer):
1. Bar supports/wire reinforcement supports: Samples of each type of chair and bolster proposed for use. Submit with letter stating where each type will be used.
2. Precast concrete bar supports: Samples of each type of precast support proposed for use. Submit with letter stating where each will be used.

E. Test reports:
1. Certified copy of mill test for each steel used. Show physical properties and chemical analysis.
   a. Mill test reports may be submitted as record documents at the time the reinforcement from that heat of steel is shipped to the site.
   b. In such cases, submit certificates under the shop drawing submittal number with the letter "R" (for record date) appended to the end (e.g., of the reinforcement was submitted as 03320-002-1, deliver the associated mill certificate as submittal 03320-002-1R).
2. Mechanical reinforcing bar couplers:
   a. Current Evaluation Report confirming that couplers provide specified tension and compression strength and conform to specified limits on total slip within the coupler.
   b. Certified copy of mill tests for heat(s) of steel incorporated into the reinforcing bar couplers shipped.
   c. For threaded sleeve type couplers, heat treatment lot numbers for each shipment.

F. Manufacturer's instructions:

1. Mechanical reinforcing bar couplers:
    a. Manufacturer's installation instructions.
    b. Manufacturer's instructions for confirmation testing of couplers after reinforcing bars have been inserted into the couplers.

G. Special procedures:
1. Welding procedures conforming to AWS D1.4 for reinforcement to be field welded.
    a. Procedures qualification record.

H. Qualifications statements:
1. Welder qualifications.

I. Closeout documents:
1. Field quality control and inspection reports.
2. Field quality assurance special inspection and testing reports.

1.06 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 with letter containing manufacturer's guarantee of grade.

1.07 SEQUENCING AND SCHEDULING

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

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing bars:
1. Provide reinforcement of the grades and quality specified, fabricated from new stock, free from excessive rust or scale, and free from unintended bends or other defects affecting its usefulness.
2. Reinforcing bars:
    a. ASTM A615 Grade 60 deformed bars, including the following requirements,
        1) Actual yield strength based on mil tests of reinforcement provided shall not exceed the minimum yield strength specified in this Section by more than 18,000 pounds per square inch.
        2) Ratio of actual ultimate tensile strength to actual tensile yield strength shall not be less than 1.25.

B. Bar supports:
1. Wire supports:
    a. All stainless steel bar supports:

1) Conforming to CRSI Manual of Standard Practice recommendations for types and details, but custom fabricated entirely from stainless steel wire conforming to ASTM A493, AISI Type 316.

b. Stainless steel protected bar supports:
1) Conforming to CRSI Manual of Standard Practice Class 2, Type B, and consisting of bright basic wire support fabricated from cold-drawn carbon steel wire with stainless steel ends attached at the bottom of each leg.
2) Stainless steel wire ends shall conform to ASTM A493, AISI Type 316 and shall extend at least 3/4 inch inward from the formed surface of the concrete.

c. Bright basic wire bar supports.
1) Conforming to CRSI Manual if Standard Practice, Class 3.

2. Plastic supports:
a. Manufacturers: The following or equal:
1) Aztec Concrete Accessories.

3. Deformed steel reinforcing bar supports:
a. Fabricated of materials and to CRSI details recommended for typical reinforcement embedded in concrete and bent to dimensions required to provide specified clearances and concrete cover.

4. Stainless steel wire supports on stainless steel plates:
a. Type 304 stainless steel wire bar support chairs or bolsters supported on Type 304 stainless steel plates resting on the ground surface.
1) Weld plates to at least 2 legs of wire support chairs.

C. Tie wires:
1. General use: Black annealed steel wire, 16-gauge or heavier.

D. Welded wire fabric reinforcement:
1. Material:
a. Carbon steel conforming to ASTM A1064.

2. Provide welded wire reinforcement in flat sheet form. Rolled wire fabric is not permitted.

E. Mechanical reinforcing bar couplers:
1. General:
a. Only products conforming to the requirements of ACI 318 for mechanical splices, and holding a current Evaluation Report that documents the following performance characteristics, will be considered for use.
b. Strength of coupler: Capable of developing tension and compression strength not lower than the lesser of the following:
1) ACI 318 "Type 2" units: In static tension and compression:
a) Minimum 125 percent of the ASTM-specified minimum yield strength of the reinforcement being spliced.
b) Minimum 100 percent of the ASTM-specified minimum ultimate strength of the reinforcement being spliced.

c. Slip of reinforcing bars within coupler: Total slip of the reinforcing bars within the splice sleeve limited as follows:
1) For bar sizes #14 and smaller, elongation between gauge points measured clear of the splice sleeve not exceeding 0.010 inches after coupler has been loaded to a tension of 30,000 pounds per square inch and load relaxed to a tension of 3,000 pounds per square inch.

d. Fabrication:
    1) Threaded joints:
        a) Provide threaded ends designed so that cross-threading of bars will not occur during assembly.
        b) Fabricate male ends for female couplers using coupler manufacturer's bar threading equipment to ensure proper taper and thread engagement.
    2) Mark each sleeve with heat treatment lot number.
2. Couplers: Threaded - Reinforcing bar splice at construction joints.
    a. Steel sleeve butt splice with tapered internal threads in forged or swaged head, and nailing flange for attaching to forms. Provide with matching, tapered male-threaded dowels for insertion and tightening into threaded sleeve after form removal.
        1) Provide sleeve with factory-installed plugs to prevent concrete mortar from entering internally threaded coupler.
        2) Provide optional clipped nailing flanges as required to maintain minimum specified concrete cover over all surfaces of coupler.
    b. Holding current Evaluation Report demonstrating acceptance under ICC ES AC133.
    c. Manufacturers: One of the following or equal:
        1) Dayton Superior, DBDI Splice System.
        2) ERICO-Pentair, Lenton Form Saver.
3. Couplers: Threaded - reinforcing bar splice:
    a. Steel sleeve butt splice with tapered internal threads at each end for joining to matching tapered male threads on reinforcing bars.
    b. Holding current Evaluation Report demonstrating acceptance under ICC ES AC133.
    c. Manufacturers: One of the following, or equal:
        1) Dayton Superior: Taper-Lock System.
        2) ERICO-Pentair: Lenton Taper Threaded Splicing System.

2.02 FABRICATION

A. Shop fabrication and assembly:
    1. Cut and bend bars in accordance with provisions of ACI 318 and the CRSI Manual of Standard Practice.
    2. Bend bars cold. Use bending collars to develop the recommended bend radius.
    3. Circumferential and radiused reinforcement: Roll to the radius required for its location in the structure before installation.
    4. Bars to be fitted with mechanical couplers:
        a. Fabricate threaded ends for connections in shop using manufacturer's recommended tools. Field fabrication is not allowed.
        b. Cut ends square.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
    1. Reinforcing bars and welded wire reinforcement:

a. Verify that reinforcement is new stock, free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings that will adversely affect bonding capacity when placed in the Work.

2. Welded wire fabric:
   a. Verify that sheets are not curled or kinked before or after installation.

3.02 PREPARATION

A. Surface preparation:
   1. Reinforcing bars - uncoated:
      a. Clean reinforcement of concrete, dirt, oil and other coatings that will adversely affect bond before embedding bars in subsequent concrete placements.
      b. Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean bars having rust scale, loose mill scale, or thick rust coat.
      c. Partially embedded reinforcement: Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placements.

3.03 INSTALLATION

A. Reinforcing bars: General:
   1. Field-cutting of reinforcing bars is not permitted.
   2. Field-bending of reinforcing bars, including straightening and rebending, is not permitted.

B. Placing reinforcing bars:
   1. Accurately place bars to meet position and cover requirements specified. Secure bars in position.
   2. Tolerances for placement and minimum concrete cover: As listed in Table 1.

Table 1 - Reinforcement Placing Tolerances

Member	Tolerance on Reinforcement Location (1)	Tolerance on Minimum Concrete Cover (1,2)
Slabs, beams, walls and columns except as noted below:		
10 inches thick and less	± 3/8 inch	- 3/8 inch
More than 10 inches thick	± 1/2 inch	- 1/2 inch
Formed soffits:	As noted above	- 1/4 inch
Longitudinal location of bends and ends of reinforcement:		
Conditions not listed below:	± 2 inches	- 1/2 inch
At discontinuous ends of brackets and corbels	± 1/2 inch	- 1/4 inch

Table 1 - Reinforcement Placing Tolerances		
Member	**Tolerance on Reinforcement Location (1)**	**Tolerance on Minimum Concrete Cover (1,2)**
At discontinuous ends of other members:	± 1 inch	- 1/2 inch
Notes: (1) ± indicates "plus or minus;" - indicates "minus;" + indicates "plus."		

3. Spacing between bars:
   a. Minimum clear spacing between bars in a layer:
      1) Not less than the larger of 1.5 times the bar diameter or 1-1/2 inches.
   b. Minimum clear spacing between bars in 2 or more parallel layers:
      1) Place bars in upper layers directly above bars in lower layers.
      2) Minimum spacing between layers: Not less than the larger of 1.5 times the bar diameter or 1-1/2 inches.
   c. Limits on minimum clear spacing between bars also applies to the clear spacing between a lap splice and the adjacent bars and/or lap splices.
4. Lap splices for bars:
   a. Where lap lengths are not indicated, provide in accordance with ACI 318.
   b. Install bars at lap splices in contact with each other and fasten together with tie wire.
   c. Where bars are to be lap spliced at concrete joints, ensure that bars project from the first concrete placement a length equal to or greater than minimum lap splice length.

C. Reinforcing supports:
1. Provide supports of sufficient numbers, sizes, and locations to maintain concrete cover, to prevent sagging and shifting, and to support loads during construction without displacement and without gouging or indentation into forming surfaces.
   a. Quantities and locations of supports shall not be less than those indicated in ACI SP-66 and the CRSI Manual of Standard Practice.
2. Do not use brick, concrete masonry units, concrete spalls, rocks, wood, or similar materials for supporting reinforcement.
3. Do not use "give away bars" that have less cover than that required by the Contract Documents. Do not adjust the location of reinforcement required by the Contract Documents to provide cover for give away bars.
4. Provide bar supports of height required to maintain the clear concrete cover.
5. Provide bar supports at formed vertical faces to maintain the clear concrete cover.
6. Schedule of reinforcement support materials: Provide bar supports as indicated in Table 2.

Table 2 - Reinforcement Support Materials		
Case	**Location**	**Material**
a.	Concrete placed over earth and concrete seal slabs ("mud mats"):	Stainless steel wire supports on stainless steel plates.
b.	Concrete placed against forms and exposed to water or wastewater process liquids (whether or not such concrete received additional linings or coatings):	All stainless steel bar supports.
c.	Concrete placed against forms and exposed to earth, weather, frequent washdown, or groundwater in the finished work	All stainless steel bar supports.
d.	Concrete placed against forms and exposed to interior equipment/piping areas in the finished work	All stainless steel bar supports.
e.	Between mats of reinforcement, and fully embedded within a concrete member	Bright basic wire bars supports, or deformed steel reinforcing bars.

D. Tying of reinforcing:
   1. Fasten reinforcement securely in place with wire ties.
   2. Tie reinforcement at spacings sufficient to prevent shifting.
      a. Provide 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).
   3. Tie slab bars at every intersection around perimeter of slab.
   4. Tie wall bars and slab bar intersections other than around perimeter at not less than every fourth intersection, but at not more than the spacing indicated in Table 3:

Table 3 - Maximum Spacing of Tie Wires for Reinforcement		
Bar Size	**Slab Bar Spacing (Inches)**	**Wall Bar 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

   5. After tying:
      a. Bend ends of wires inward towards the center of the concrete section. Minimum concrete cover for tie wires shall be the same as cover requirements for reinforcement.
      b. Remove tie wire clippings from inside forms before placing concrete.

E. Welded wire fabric reinforcement:
   1. Install only where accepted in advance by Engineer.
   2. Install necessary tie wires, spacing chairs, and supports to keep welded wire fabric at its designated position in the concrete section while concrete is being placed.
   3. Straighten welded wire fabric to make sheets flat in the Work.

4. Do not allow wire fabric to drape between supports.
    a. If fabric is displaced during placement of concrete, make provisions to restore it to the designated location using methods acceptable to Engineer.
5. Bend welded wire fabric as required to fit Work.
6. Lap splice welded wire fabric.
    a. If lap splice length is not indicated, splice in accordance with ACI 318, but not less than 1 1/2 courses of fabric or 8 inches minimum. Tie laps at ends and at not more than 12 inches on center.

F. Reinforcing bar mechanical couplers:
1. Install only at locations where prior approval has been obtained from Engineer.
2. Install in accordance with manufacturer's instructions and requirements of Evaluation Report.
    a. Make splices using manufacturer's standard equipment, jigs, clamps, and other required accessories.
    b. After assembly of the splice, tighten using torque load not less than that recommended by the manufacturer.
3. Provide clear cover from surface of concrete to outside face of couplers that is not less than the minimum concrete cover specified for typical reinforcement.
    a. If cover is less than required, contact Engineer for evaluation of conditions before modifying locations of bars or placing concrete.
    b. Modifications to maintain or provide required concrete cover, such as addition of concrete ; re-positioning of stirrups, ties, etc., may be completed only after approval by Engineer.

3.04 FIELD QUALITY CONTROL

A. Provide quality control for the Work of this Section as specified in Section 01450 - Quality Control.

B. Field inspections and testing:
1. Submit records of inspections and testing to Engineer in electronic format within 24 hours after completion.

3.05 FIELD QUALITY ASSURANCE

A. Provide quality assurance as specified in Section 01450 - Quality Control.

B. Special inspections and tests:
1. Provide as specified in Section 01455 - Special Tests and Inspections.
2. Frequency of inspections:
    a. Provide periodic special inspection as required by the Building Code specified in Section 01410 - Regulatory Requirements.
3. Preparation:
    a. Review Drawings and Specification for the Work to be observed.
    b. Review approved submittal sand shop drawings.
4. Inspections: Special inspection shall include, but is not limited to, the following items.
    a. Reinforcement: General:
        1) Type (material) and location of reinforcement supports.
        2) Bar material/steel grade and bar size.
        3) Location, placement, and spacing of bars.

4) Clear concrete cover over reinforcement.
5) Lap splice: Location and lap length. Bars within tolerances for contact
6) Bar hooks and development lengths embedded within concrete sections.
7) Reinforcement tired in position and tie wire legs turned inward toward the center of the concrete section.

5. Mechanical reinforcing bar couplers:
   a. Special inspection shall include, but is not limited to, the following items:
      1) Coupler model and identification.
      2) Couplers are installed in accordance with the requirements of the Engineering Report for each product.
      3) Confirmation of the following:
         a) Grade and size of reinforcing bars.
         b) Positon of couplers.
         c) Insertion length of reinforcement.
         d) Tightening of bars in the couplers.
6. Records of inspections:
   a. Provide a written record of each inspection using forms acceptable to the Engineer and to the Building Official.
   b. Submit electronic copies of inspection reports to Engineer within 24 hours after completion of inspections.

3.06 NON-CONFORMING WORK

A. Before placing concrete, adjust or remove and re-install reinforcement to conform to the requirements of the Contract Documents.

END OF SECTION

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. 305 - Hot Weather Concreting Standard.
   2. 306 - Cold Weather Concreting Standard.
   3. 318 - Building Code Requirements for Structural Concrete and Commentary.
   4. 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
   5. Manual of Concrete Practice.

B. ASTM International (ASTM):
   1. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   2. C33 - Standard Specification for Concrete Aggregates.
   3. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   4. C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
   5. C42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   6. C88 - Standard Test Method of Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
   7. C94 - Standard Specification for Ready-Mixed Concrete.
   8. C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement.
   9. C117 - Standard Test Method for Materials Finer that 75-m (No. 200) Sieve in Mineral Aggregates by Washing.
   10. C123 - Standard Test Method for Lightweight Particles in Aggregate.
   11. C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   12. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   13. C142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregate.
   14. C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
   15. C150 - Standard Specification for Portland Cement.
   16. C156 - Standard Test Method for Water Loss Through Liquid Membrane-Forming Curing Compounds for Concrete.
   17. C171 - Standard Specifications for Sheet Materials for Curing Concrete.
   18. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
   19. C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

20. C227 - Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
21. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
22. C295 - Standard Guide to Petrographic Examination of Aggregates for Concrete.
23. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
24. C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
25. C494 - Standard Specification for Chemical Admixtures for Concrete.
26. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
27. C856 - Standard Practice for Petrographic Examination of Hardened Concrete.
28. C1260 - Standard Test Method of Potential Alkali Reactivity of Aggregates (Mortar Bar Method).
29. C1293 - Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
30. D75 - Standard Practice for Sampling Aggregates.
31. D2103 - Standard Specification for Polyethylene Film and Sheeting.

1.03 DEFINITIONS

A. Alkali: Sum of sodium oxide and potassium oxide calculated as sodium oxide.

B. Cementitious materials: Portland cement and fly ash.

C. Cold weather: A period when for more than 3 consecutive days, the average daily outdoor temperature drops below 40 degrees Fahrenheit. The average daily temperature is the average of the highest and lowest temperatures during the period from midnight to midnight. When temperatures above 50 degrees Fahrenheit occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.

D. Cold weather concreting: Operations for placing, finishing, curing, and protection of concrete during cold weather.

E. Green concrete: Concrete with less than 100 percent of the specified strength.

F. Hairline crack: Crack with a crack width of less than 4 thousandths of an inch.

G. Hot weather: A period when project conditions such as low humidity, high temperature, solar radiation, and high winds, promote rapid drying of freshly placed concrete.

H. Hot weather concreting: Operations for placing, finishing, curing, and protection of concrete during hot weather.

1.04 SYSTEM DESCRIPTION

A. Performance requirements:
   1. General:
      a. Except as otherwise specified, provide concrete composed of portland cement, fly ash, fine aggregate, coarse aggregate, admixtures 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-cementitious materials ratio that is consistent with good workability, plastic and cohesive mixture, and a mixture that is within specified slump range.
    c. Proportion fine and coarse aggregates in manner such as not to produce harshness in placing or honeycombing.
2. It is the intent of this Section to secure for every part of the Work concrete with homogeneous mixture, which 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.
3. Workmanship and methods: Provide concrete work, including detailing of reinforcing, conforming with best standard practices and as set forth in ACI 318, ACI 350, Manual of Concrete Practices, and recommended practices.

1.05 SUBMITTALS

A. Cement mill tests:
1. Include alkali content representative of each shipment of cement for verification of compliance with specified requirements.
2. Provide mill test reports dated not more than 90 days before the date of submittal.

B. Concrete mixes: 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. Source quality test records with mix design submittal:
    a. Include calculations for required compressive strength (f'_{cr}) based on source quality test records.

C. Concrete aggregate tests: Certified copies in triplicate of commercial laboratory tests not more than 90 days old of all samples of concrete aggregates:
1. Coarse aggregate:
    a. Abrasion loss.
    b. Clay lumps and friable particles.
    c. Coal and lignite.
    d. Materials finer than 200 sieve.
    e. Reactivity.
    f. Shale and chert.
    g. Soundness.
2. Fine aggregate:
    a. Clay lumps.
    b. Color.
    c. Decantation.
    d. Reactivity.
    e. Shale and chert.
    f. Soundness.

D. Drying shrinkage test data.

E. Fine or coarse aggregate batched from more than 1 bin: Analyses for each bin, and composite analysis made up from these, using proportions of materials to be used in mix.

F. Fly ash Certificate of Compliance: Identify source of fly ash and certify compliance in accordance with ASTM C618.

G. For conditions that promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind: Corrective measures for use prior to placing concrete.

H. Hot weather concreting: Procedures for production, placement, finishing, curing, protection, and temperature monitoring for concrete during hot weather and appropriate corrective measures.

I. Heating equipment for cold weather concreting: Information on type of equipment used for heating materials and new concrete in process of curing during excessively cold weather.

J. Information on mixing equipment.

K. Product data: Submit data completely describing products.

L. Sequence of concrete placing: Submit proposed sequence of placing concrete showing proposed beginning and ending of individual placements.

M. Sieve analysis: Submit sieve analyses of fine and coarse aggregates being used in triplicate at least every 3 weeks and at any time there is significant change in grading of materials.

N. Trial batch test data:
   1. Submit data for each test cylinder.
   2. Submit data that identifies mix and slump for each test cylinder.

O. Weather monitoring: Records of:
   1. Relative humidity.
   2. Site ambient temperature.
   3. Wind speed.

P. Temperature of freshly placed concrete.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
   1. Deliver, store, and handle concrete materials in manner that prevents 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. Monitoring weather conditions:
      a. Install an outdoor weather station capable of measuring and recording ambient temperature, wind speed, and humidity. Furnish instruments accurate to within 2 degrees Fahrenheit, 5 percent relative humidity, and 1 mile per hour wind speed.
      b. Measure and record temperature of fresh concrete. Furnish and use sufficient number of maximum and minimum self-recording thermometers to adequately measure temperature of concrete.
      c. Monitor and keep records of the weather forecast starting at least 48 hours prior to placing concrete in order to allow enough time for taking appropriate measures pertaining to Hot or Cold weather concreting.
   2. Hot weather concreting:
      a. Initiate evaporation control measures when concrete and air temperatures, relative humidity of the air, and the wind velocity have the capacity to evaporate water from a free surface at a rate that is equal to or greater than 0.2 pounds per square feet per hour. Determine evaporation rate using the Menzel Formula and monograph in ACI 305 3.1.3.
      b. When ambient air temperature is above 85 degrees Fahrenheit: Prior to placing concrete, cool forms and reinforcing steel by water cooling to below 90 degrees Fahrenheit.
      c. Monitor weather conditions at the site including air temperature, humidity, and wind speed, to assess the need for evaporation control measures begin monitoring site conditions no later than 1 hour before the start of concrete placement. Continue to monitor site conditions at intervals of 30 minutes until concrete curing has begun.
      d. Temperature of concrete mix at time of placement: Keep temperature below 90 degrees Fahrenheit by methods which do not impair quality of concrete.
      e. 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:
      f. 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, or expansion joint.

PART 2 PRODUCTS

2.01 MATERIALS

A. Admixtures:
   1. General:

a. Do not use admixtures of any type, except as specified, unless written acceptance has been obtained from the Engineer.
b. Admixtures shall be compatible with concrete and other admixtures. Admixtures other than pozzolans shall be the products of a single manufacture to ensure compatibility.
c. Do not use admixtures containing chlorides calculated as chloride ion in excess of 0.5 percent by weight of cement.
d. Use in accordance with manufacturer's recommendations. Add each admixture to concrete mix separately.

2. Air entraining admixture:
   a. Provide concrete with 5 percent, within 1 percent, entrained air of evenly dispersed air bubbles at time of placement.
   b. In accordance with ASTM C260.
3. Water reducing admixture:
   a. May be used at the Contractor's option.
   b. In accordance with ASTM C494, Type A or Type D.
   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.
4. Super-plasticizers: Are not to be used without acceptance by Engineer.

B. Aggregate:
1. General:
   a. Provide concrete aggregates that are sound, uniformly graded, and free of deleterious material in excess of allowable amounts specified.
   b. Grade aggregate in accordance with ASTM C136 and D75.
   c. Provide unit weight of fine and coarse aggregate that produces in place concrete with weight of not less than 140 pounds per cubic foot.
   d. Do not use aggregate made from recycled materials such as crushed and screened hydraulic-cement concrete, brick, and other construction materials.
2. Fine aggregate:
   a. Provide fine aggregate for concrete or mortar consisting of clean, natural sand or of sand prepared from crushed stone or crushed gravel.
   b. Do not provide aggregate having deleterious substances in excess of following percentages by weight of contaminating substances.
      1) In no case shall total exceed percent listed.

Item	**Test Method**	**Percent**
Removed by decantation (dirt, silt, etc.)	ASTM C117	3
Shale or Chert	ASTM C123 ASTM C295*	1 1
Clay Lumps	ASTM C142	1
* Test Method C123 is used to identify particles in the sample lighter than 2.40 Specific Gravity. Test Method C295 is used to identify which of the lightweight particles are shale or chert. If the results of Test Method C123 are less than 1 percent, Test Method C295 is not required.		

c. Except as otherwise specified, grade fine aggregate from coarse to fine in accordance with ASTM C33.

3. Coarse aggregate:
   a. Provide coarse aggregate consisting of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances.
   b. Not exceeding 15 percent by weight, of thin or elongated pieces having length greater than 5 times average thickness.
   c. 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 C123 ASTM C295*	1.25 1
Coal and lignite	ASTM C123	1/4
Clay lumps and friable particles	ASTM C142	1/4
Materials finer than Number 200 sieve	ASTM C117	1/2**

* Test Method C123 is used to identify particles in the sample lighter than 2.40 Specific Gravity. Test Method C295 is used to identify which of the lightweight particles are shale, chert, coal, or lignite. If the results of Test Method C123 are less than 1.25 percent (the minimum combined percentage of shale, chert, coal and lignite), Test Method C295 is not required.

** Except when material finer than Number 200 sieve consists of crusher dust, maximum amount shall be 1 percent.

   d. Grading:
      1) Aggregate for Class A, B, C, and D concrete: In accordance with ASTM C33, Size Number 57, except as otherwise specified or authorized in writing by the Engineer.
      2) Aggregate for Class CE concrete for encasement of electrical conduits:
         a) Graded in accordance with ASTM C33, Size Number 8.

C. Concrete sealer:
   1. Manufacturers: One of the following or equal:
      a. Euclid Chemical Co., Diamond Hard.
      b. L&M Construction Chemicals, SealHard.

D. Conduit encasement coloring agent:
   1. Color: Red color concrete used for encasement of electrical ducts, conduits, and similar type items.
   2. Manufacturers: One of the following or equal:
      a. Davis Co., #160 Brick Red.
      b. Euclid Chemical Co., Increte Division, “Colorcrete Brick Red.”
   3. Conduit encasement concrete: Mix into each cubic yard of concrete 10 pounds of coloring agent.

E. Evaporation retardant:
   1. Manufacturers: One of the following or equal:
      a. BASF, MasterKure ER 50.
      b. Euclid Chemical Co., Eucobar.

F. Fly ash:
   1. Fly ash in accordance with ASTM C618, Class F, may be used in concrete made with Type II portland cement.
   2. Maximum of 15 percent by weight of fly ash to total weight of cementitious materials.
      a. The total weight of cementitious materials shall not be less than minimum cementitious materials listed in Table A.
   3. Do not use in concrete made with portland-pozzolan cement.
   4. Loss on ignition: Not exceed 4 percent.

G. Keyway material: Steel, plastic, or lumber.

H. Nonslip abrasive:
   1. Aluminum oxide abrasive size 8/16, having structure of hard aggregate that is, homogenous, nonglazing, rustproof, and unaffected by freezing, moisture, or cleaning compounds.
   2. Manufacturers: One of the following or equal:
      a. Abrasive Materials, Inc.
      b. Euclid Chemical Co., Flexolith Summer Grade.

I. Portland cement:
   1. Conform to specifications and tests in accordance with ASTM C150, Types II or III, low alkali, except as specified otherwise.
   2. 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 or repairs: Provide cement from same source and of same type as concrete to be finished or repaired.

J. Sheet membrane for curing:
   1. Polyethylene film:
      a. In accordance with ASTM C171.
      b. Color: White.
      c. Thickness: Nominal thickness of polyethylene film shall not be less than 0.0040 inches when measured in accordance with ASTM D2103. Thickness of polyethylene film at any point shall not be less than 0.0030 inches.
      d. Loss of moisture: Not exceed 0.055 grams per square centimeter of surface when tested in accordance with ASTM C156.

K. Sprayed membrane curing compound: Clear type with fugitive dye in accordance with ASTM C309, Type 1D.

L. Surface sealant system:
   1. Manufacturers: One of the following or equal:
      a. Euclid Chemical Co., Vandex Super.
      b. Kryton International, Inc., Krystol T1.
      c. Xypex Chemical Corp., Xypex Concentrate.

M. 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 containing not more than 1,000 milligrams per liter of chlorides calculated as chloride ion, nor more than 1,000 milligrams per liter of sulfates calculated as sulfate ion.
   b. Water for prestressed or post-tensioned concrete: Use water containing not more than 650 milligrams per liter of chlorides calculated as chloride ion, or more than 800 milligrams per liter of sulfates calculated as sulfate ion.

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, cementitious materials, and water within specified time into thoroughly mixed and uniform mass and 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 cementitious materials 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 cementitious materials are used, weigh them on separate visible scale which will accurately register scale load at any stage of weighing operation from zero to full capacity.
3. Prevent cementitious materials 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 cementitious materials 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 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 C94.
   2. Total elapsed time between addition of water at batch plant and discharging completed mix:
      a. Not to exceed 90 minutes.
      b. Elapsed time at project site shall not exceed 30 minutes.
   3. Under conditions contributing to quick setting, total elapsed time permitted may be reduced by the Engineer.
   4. Equip each truck mixer with device interlocked to prevent discharge of concrete from drum before required number of turns and furnish 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 add 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 1 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 cementitious materials 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 1 percent of desired amount of that material.
   4. Measuring or weighing devices: Subject to review by the Engineer. Shall bear valid seal of the Sealer of Weights and Measures having jurisdiction.
   5. Weighing cementitious materials:
      a. Weigh cementitious materials separately.
      b. Cement in unbroken standard packages (sacks): Need not be weighed.
      c. Weigh bulk cementitious materials and fractional packages.
   6. Measure mixing water by volume or by weight.

B. Concrete proportions and consistency:

1. 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.
2. Prevent unnecessary or haphazard changes in consistency of concrete.
3. Ratio of coarse aggregate to fine aggregate: Not less than 1.0 or more than 2.0 for all concrete Classes, with exception of Class CE.
4. Aggregate:
    a. Obtain aggregate from source that is capable of providing uniform quality, moisture content, and grading during any single day's operation.
5. Maximum concrete mix water to cementitious materials ratio, minimum cementitious materials content, and slump range: Conform to values specified in Table A in this Section.
6. Concrete batch weights: Control and adjust to secure maximum yield. At all times, maintain proportions of concrete mix within specified limits.
7. Mix modification: If required, by the Engineer, modify mixture within limits set forth in this Section.

C. Concrete mixes:
1. Proportioning of concrete mix: Proportion mixes based on required compressive strength f'_{cr}.
2. Mixes:
    a. Adjusting of water: After acceptance, do not change mixes without acceptance by Engineer, except that at all times adjust batching of water to compensate for free moisture content of fine aggregate.
    b. Total water content of each concrete class: Not exceed those specified in Table A in this Section.
    c. Checking moisture content of fine aggregate: Furnish satisfactory means at batching plant for checking moisture content of fine aggregate.
3. Change in mixes: Submit new mix design and perform new trial batch and test program as specified in this Section.

D. Classes of concrete:
1. Provide concrete consisting of 5 classes: Classes A, B, C, D, and CE. Use where specified.
2. Weight of concrete classes: Provide classes of concrete having minimum weight of 140 pounds per cubic foot.
3. Class B concrete: 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: Class C concrete may be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, and for bedding of pipe.
5. Class D concrete: Use Class D for precast concrete items.
6. Class CE concrete: Use Class CE for electrical conduit encasements.
7. All other concrete, unless specified or otherwise indicated on the Drawings: Use Class A concrete.

TABLE A2: CONCRETE				
Class	**Minimum Specified Compressive Strength f'_c at 28 Days (Pounds per Square Inch)**	**Water-to-Cementitious Materials Ratio**	**Cementitious Materials per Cubic Yard of Concrete by Weight (Pounds)**	**Slump Range (Inches)**
A	4,000	0.40 to 0.53	564 to 658	2 to 4
B (Type III cement)	4,000	0.40 to 0.53	564 to 658	2 to 4
C	2,500	Maximum 0.62	Minimum 423	3 to 6
CE	2,500	Maximum 0.62	Minimum 423	3 to 6
D	5,000	0.40 to 0.45	564 to 658	2 to 4

8. Pumped concrete: Provide pumped concrete that complies with all requirements of this Section.
9. Do not place concrete with slump outside limits indicated in Table A.
10. Classes:
    a. Classes A, C, D, and CE concrete: Make with Type II low alkali portland cement.
    b. Class B concrete: Make with Type III low alkali portland cement.
    c. Admixtures: Provide admixtures as specified in this Section.

E. Air entraining admixture:
1. Add agent to batch in portion of mixing water.
2. Batch solution by means of mechanical batcher capable of accurate measurement.

2.04 SOURCE QUALITY CONTROL

A. Tests:
1. Trial batches:
    a. After concrete mix designs 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.
    b. Prepare trial batches using cementitious materials and aggregates proposed to be used for the Work.
    c. Prepare trial batches with sufficient quantity to determine slump, workability, consistency, and finishing characteristics, and to provide sufficient test cylinders.
    d. Test cylinders: Provide cylinders having 6-inch diameter by 12-inch length and that are prepared in accordance with ASTM C31 for tests specified in this Section.
    e. Determine slump in accordance with ASTM C143.
    f. Test cylinders from trial batch:
        1) Test 8 cylinders for compressive strength in accordance with ASTM C39:
            a) Test 4 cylinders at 7 days and 4 at 28 days.
            b) Establish ratio between 7 day and 28 day strength for mix. 7-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: Equal to or greater than required average compressive strength (f'_{cr}) on which concrete mix design is based.

g. 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.
   1) Perform additional trial batches and tests until an acceptable trial batch is produced that meets requirements of this Section.

h. Perform test batches and tests required to establish trial batches and acceptability of materials without change in Contract Price.

i. Do not place concrete until the concrete mix design and trial batch have been accepted by Engineer.

2. Required average compressive strength:
   a. Determine required average compressive strength (f'_{cr}) for selection of concrete proportions for mix design, for each class of concrete, using calculated standard deviation for its corresponding specified compressive strength (f'_c,) in accordance with ACI 318 and ACI 350.
   b. 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 in accordance with ACI 318 and ACI 350 and as modified in this Section.
   c. 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 in preparation of concrete for the Work.
   d. Provide test records with materials and proportions that are more restricted than those for the Work.
   e. Specified compressive strength (f'_c) of concrete used in test records: Within 1,000 pounds per square inch of that specified for the Work.
   f. When lacking adequate test records for calculation of standard deviation meeting requirements, determine required average compressive strength f'_{cr} from following Table B.

TABLE B
REQUIRED AVERAGE COMPRESSION STRENGTH

Specified Compressive Strength f'_c (pounds per square inch)	**Required Average Compressive Strength f'_{cr} (pounds per square inch)**
Less than 3,000	f'_c + 1,000
3,000 to 5,000	f'_c + 1,200
Over 5,000	1.10f'_c + 700

3. Aggregate:
   a. Testing of concrete aggregate is at Contractor's expense.
   b. Provide test reports representing samples of materials taken and tested at the following times:
      1) Not more than 60 days prior to the date on the proposed materials for concrete mixes.
      2) Not more than 60 days prior to any change in the source of aggregates, including suppliers and/or quarries.

3) Whenever there is a significant change in aggregate quality or gradation from a previously submitted and accepted source.

c. Sample aggregate in accordance with ASTM D75.

d. Fine and coarse aggregates:
   1) Gradation: Test in accordance with ASTM C136. Use sieves with square openings for testing grading of aggregates.
   2) Alkali-silica reactivity:
      a) Provide fine and coarse aggregate with expansion not greater than 0.10 percent at 14 days when tested in accordance with ASTM C1260, unless the aggregate has been determined to be not deleteriously reactive based on testing in accordance with one of the following:
         (1) ASTM C227: Expansion not greater than 0.05 percent and 3 months, and not greater than 0.10 percent at 6 months.
         (2) ASTM C1293: Expansion not greater than 0.04 percent at 1 year.

e. Fine aggregate:
   1) Provide fine aggregate that does not contain strong alkali nor organic matter which gives color darker than standard color when tested in accordance with ASTM C40.
   2) Provide aggregate having soundness in accordance with ASTM C33 when tested in accordance with ASTM C88.

f. Coarse aggregate:
   1) Soundness when tested in accordance with ASTM C88: 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 C131.

g. Fly ash:
   1) Sampling and testing: Sample and test fly ash in accordance with ASTM C311.

h. Portland cement:
   1) Determination of alkali content: In accordance with ASTM C114.

PART 3 EXECUTION

3.01 INSTALLATION

A. Liquid evaporation retardant:
   1. 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.
   2. Apply the evaporation retardant again after each work operation as necessary to prevent drying shrinkage cracks.
   3. Conditions which result in rapid evaporation of moisture may include one or more of the following:
      a. Low humidity.
      b. Windy conditions.
      c. High temperature.

B. Surface sealant system:
   1. Apply as recommended by manufacturer published instructions.

2. Where concrete continues to sweat or leak, apply additional coats of surface sealant until the sweating or leaks stop.

C. Joints and bonding:
   1. As far as practicable construct concrete work as monolith.
   2. Locations of construction, expansion, and other joints are as specified in this Section.
   3. Time between placement of adjacent concrete separated by joints:
      a. Provide not less than 3 days (72 hours) between placement of adjacent sections for the following:
         1) Slabs.
         2) Walls.
      b. Provide not less than 7 days (168 hours) between placement of upper and lower pours for the following:
         1) Walls over slabs.
         2) Slabs over walls.
         3) Slabs keyed into the sides of walls.
   4. Construction joints:
      a. Where construction joints are not indicated on the Drawings, provide construction joints in slabs and walls at intervals not greater than 35 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.
      d. Cleaning of construction joints:
         1) Wash construction joints free of sawdust, chips, and other debris after forms are built and immediately before concrete or grout placement.
         2) 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.
         3) Provide cleanout hole at base of each wall and column for inspection and cleaning.
      e. At horizontal joints: As initial placement over cold joints, thoroughly spread bed of cement grout - Grouting with a thickness of not less than 1/2 inch nor more than 1 inch.
   5. Take special care to ensure that concrete is well consolidated around and against waterstops and waterstops are secured in proper position.
   6. 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.

D. 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 equipment for chuting, pumping, and conveying concrete of such size and design as to ensure practically continuous flow of concrete at delivery end without segregation 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 day's placement.

E. Placing concrete:
1. Place no concrete without prior authorization of the Engineer.
2. Do not place concrete until:
    a. Reinforcement is secure and properly fastened in its correct position and loose form ties at construction joints have been retightened.
    b. Dowels, bucks, sleeves, hangers, pipes, conduits, anchor 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. Do not place concrete in which initial set has occurred, or that has been retempered.
4. Do not place 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, reinforcement, 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, starting 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 concrete placement begins, continue concrete placement without significant interruption. Plan and implement precautions to prevent any delay, between layers being placed, from exceeding 20 minutes.
12. If concrete is to be placed over previously placed concrete and more than 20 minutes has elapsed, spread layer of cement 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 1 hour for shrinkage.

F. 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. Do not place 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 to leave no voids.
6. Take every precaution to make concrete solid, compact, and smooth. If for any reason surfaces or interiors have voids or are in any way defective, repair such concrete in manner acceptable to the Engineer.

G. 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 or more than 20 hours in advance of placing concrete.
3. If subgrade becomes dry prior to concrete placement, sprinkle again, without forming pools of water.
4. Do not place concrete if subgrade is muddy or soft.

H. Loading concrete:
1. Green concrete:
a. No heavy loading of green concrete will be permitted.
2. No backfill shall be placed against concrete walls, connecting slabs, or beams until the concrete has 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.

I. Curing concrete:
1. General:
a. Cure concrete by methods specified in this Section.
b. Keep concrete continuously moist and at a temperature of at least 50 degrees Fahrenheit for minimum of 7 days after placement.
c. Cure concrete to be painted with water or sheet membrane.
d. Do not use sprayed membrane curing or sealing compounds on concrete surfaces that are to receive paint or upon which any material is to be bonded.
e. Water cure or sheet membrane cure concrete slabs that are specified to be sealed by concrete sealer.

f. Cure other concrete by water curing or sprayed membrane curing compound at the Contractor's option.
g. Floor slabs may be cured using sheet membrane curing.

2. Water curing:
   a. Keep surfaces of concrete being water cured constantly and visibly moist day and night for period of not less than 7 days.
   b. Each day forms remain in place 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. Flood top of walls with water at least 3 times per day, and keep concrete surfaces moist at all times during 7 day curing period.
3. Sprayed membrane curing compound:
   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 curing compound, but use water curing for full curing period.
   c. If surface requires repairing or painting, water cure such concrete surfaces.
   d. Do not remove curing compound from concrete in less than 7 days.
   e. Curing compound may be removed only upon written request by Contractor and acceptance by Engineer, stating what measures are to be performed to adequately cure concrete.
   f. Take care to apply curing compound to construction joints. Apply to all surfaces along full profile of joints.
   g. After curing period is complete, remove curing compound placed within construction joint profile by heavy sandblasting prior to placing any new concrete.
   h. Contractor's Option: Instead of using curing compound for curing of construction joints, such joints may be water cured.
   i. Apply curing compound by mechanical, power operated sprayer and mechanical agitator that will uniformly mix all pigment and compound.
   j. Apply curing compound in at least 2 coats.
   k. Apply each coat in direction 90 degrees to preceding coat.
   l. Apply curing compound in sufficient quantity so that concrete has uniform appearance and that natural color is effectively and completely concealed at time of spraying.
   m. Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
   n. Thickness and coverage of curing compound: Provide curing compound having film thickness that can be scraped from surfaces at any and all points after drying for at least 24 hours.
   o. The Contractor is cautioned that method of applying curing compound specified in this Section may require more curing compound than normally suggested by manufacturer of curing compound and also more than is customary in the trade.
   p. Apply amounts specified in this Section, regardless of manufacturer's recommendations or customary practice.
   q. If the Contractor desires to use curing compound other than specified curing compound, coat sample areas of concrete wall with proposed

curing compound and also similar adjacent area with specified compound in specified manner for comparison:
1) If proposed sample is not equal or better, in opinion of the Engineer, in all features, proposed substitution will not be allowed.

r. 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. Sheet membrane curing:
   a. Install sheet membrane as soon as concrete is finished and can be walked on without damage.
   b. Seal joints and edges with small sand berm.
   c. Keep concrete moist under sheet membrane.

3.02 CONCRETE FINISHING

A. Provide concrete finishes to match existing.

B. Edges of joints:
   1. 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 of concrete:
   1. During progress of construction, the Owner will have tests made to determine whether the concrete, as being produced, complies with requirements specified.
   2. Tests will be performed in accordance with ASTM C31, ASTM C39, and ASTM C172.
   3. Contractor shall hire a Certified Independent Laboratory that will make and deliver test cylinders to the laboratory and testing expense will be borne by the Owner.
   4. Furnish test equipment.
   5. Make provisions for and furnish concrete for test specimens, and provide manual assistance to the Engineer in preparing said specimens.
   6. Assume responsibility for care of and providing of curing conditions for test specimens in accordance with ASTM C31.
   7. Sampling frequency:
      a. 1 set of test cylinders for each 150 cubic yards of each class of concrete.
      b. Minimum of 1 set of test cylinders for each class of concrete placed.
      c. Not less than 1 set of test cylinders for each half-day's placement.
      d. At least 2 sets of test cylinders for each structure.

B. Compressive strength tests:
   1. Set of 3 cylinder specimens, 6-inch diameter by 12 inch long.
   2. Information: Test 1 cylinder at 7 days.
   3. Acceptance: Test 2 cylinders at 28 days.

C. Slump tests:
   1. Test slump of concrete using slump cone in accordance with ASTM C143.
   2. Do not use concrete that does not meet specification requirements in regards to slump:

a. Remove such concrete from project site.
b. 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.

D. Air entrainment tests:
1. Test percent of entrained air in concrete at beginning of each placement, as often as necessary to keep entrained air within specified range, and when requested to do so by the Engineer.
2. Do not use concrete that does not meet Specification requirements for air entrainment:
   a. Remove such concrete from project site.
3. Test air entrainment in concrete in accordance with ASTM C173.
4. The Engineer may at any time test percent of entrained air in concrete received on project site.

E. Enforcement of strength requirement:
1. Concrete is expected to reach a compressive strength (f'_c) equal to or greater than that the minimum specified in Table A.
2. Strength level of concrete will be considered acceptable if following conditions are satisfied:
   a. Averages of all sets of 3 consecutive strength test results is greater or equal to specified compressive strength(f'_c).
   b. No individual strength test (average of 2 cylinders) falls below specified compressive strength (f'_c) by more than 500 pounds per square inch.
3. Non-compliant strength tests:
   a. Mark non-compliant strength test reports to highlight that they contain non-complying results and immediately forward copies of test reports to all parties on the test report distribution list.
   b. Provide treatment of non-compliant concrete at no additional cost to Owner and with no additional time added to project schedule:
   c. Initial treatment may consist of additional curing and testing of the affected concrete.
      1) Provide additional curing of concrete using means and duration acceptable to the Engineer.
      2) Upon completion of the additional curing, provide additional testing designated by the Engineer.
         a) Obtain and test core samples for compression strength in accordance with ASTM C42, ACI 318, and ACI 350.
         b) Provide not less than 3 cores for each affected area. Obtain Engineer's acceptance of proposed coring locations before proceeding with that work.
         c) Submit report of compression strength testing for Engineer's review.
         d) If required by the Engineer, provide additional cores and obtain petrographic examination in accordance with ASTM C856. Submit report of petrographic analysis for Engineer's review.
      3) If additional curing does not bring average of 3 cores taken in affected area to at least the minimum specified compressive strength (f'_c), designate such concrete in affected area as defective.

3.04 ADJUSTING

A. Provide repair of defective concrete at no additional cost to Owner and with no additional time added to the project schedule:

B. Make repairs using approach and means acceptable to the Engineer:
   1. Provide repairs having strength equal to or greater than specified concrete for areas involved.
   2. Do not patch, repair, or cover defective work without inspection by the Engineer.
   3. Acceptable means may include, but are not limited to strengthening, repair, or removal and replacement.

C. Strengthening of defective concrete:
   1. By addition of concrete.
   2. By addition of reinforcing.
   3. By addition of both concrete and reinforcing.

D. Repairs:
   1. Methods of repair:
      a. Dry pack method:
         1) Use for holes having depth nearly equal to or greater than least surface dimension of hole, for cone-bolt holes, and for narrow slots cut for repair.
         2) Smooth holes: Clean and roughen by heavy sandblasting before repair.
      b. Mortar replacement method:
         1) Use for holes too wide to dry pack and too shallow for concrete replacement.
         2) Comparatively shallow depressions, large or small, which extend no deeper than nearest surface reinforcement.
      c. Concrete replacement method:
         1) 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.
   2. Preparation of concrete for repair:
      a. Chip out and key imperfections in the work and make them ready for repair.
      b. Obtain Engineer’s acceptance of surface preparation methods and of prepared surfaces prior to repair.
      c. Surfaces of set concrete to be repaired: First coat with epoxy bonding agent.

E. Remove and replace defective concrete.

END OF SECTION

SECTION 16050

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. General requirements applicable to all Electrical Work.
   2. General requirements for electrical submittals.

B. Interfaces to equipment, instruments, and other components:
   1. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.
   2. Provide all material and labor needed to install the actual equipment furnished, and include all costs to add any additional conduit, wiring, terminals, or other electrical hardware to the Work, which may be necessary to make a complete, functional installation based on the actual equipment furnished:
      a. Make all changes necessary to meet the manufacturer's wiring requirements.
   3. Submit all such changes and additions to the Engineer for acceptance as specified in Section 01260 - Contract Modifications Procedures.
   4. Review the complete set of Drawings and Specifications in order to ensure that all items related to the electrical power and control systems are completely accounted for. Include any such items that appear on the Drawings or in the Specifications from another discipline in the scope of Work:
      a. If a conflict between Drawings and Specifications is discovered, refer conflict to the Engineer as soon as possible for resolution.

C. All electrical equipment and systems for the entire Project must comply with the requirements of the Electrical Specifications, whether referenced in the individual Equipment Specifications or not:
   1. The requirements of the Electrical Specifications apply to all Electrical Work specified in other sections.
   2. Inform all vendors supplying electrical equipment or systems of the requirements of the Electrical Specifications.
   3. Owner is not responsible for any additional costs due to the failure of Contractor to notify all subcontractors and suppliers of the Electrical Specifications requirements.

D. Contract Documents:
   1. General:
      a. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work.

2. Specifications:
    a. The General and Supplementary Conditions of the Contract Documents govern the Work.
    b. These requirements are in addition to all General Requirements.
3. Contract Drawings:
    a. The Electrical Drawings show desired locations, arrangements, and components of the Electrical Work in a diagrammatic manner.
    b. Locations of equipment, control devices, instruments, boxes, panels, etc. are approximate only; exercise professional judgment in executing the Work to ensure the best possible installation:
        1) The equipment locations and dimensions indicated on the Drawings are approximate. Use the shop drawings to determine the proper layout, foundation, and pad requirements, etc. for final installation. Coordinate with all subcontractors to ensure that all electrical equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.
        2) The Contractor has the freedom to select any of the named manufacturers identified in the individual specification sections; however, the Engineer has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the Contractor's responsibility to ensure that the equipment being furnished fits within the defined space.
    c. Installation details:
        1) The Contract Drawings include typical installation details the Contractor is to use to complete the Electrical Work. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work, and submit these details for review by the Engineer.
        2) Not all typical installation details are referenced within the Drawing set. Apply and use typical details where appropriate.
    d. Schematic diagrams:
        1) All controls are shown de-energized.
        2) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.
        3) Add slave relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.
        4) Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.
        5) Schematic diagrams are to be used in conjunction with the descriptive operating sequences in the Contract Documents. Combine all information and furnish a coordinated and fully functional control system.

E. Alternates/Alternatives:
    1. Coordinate with Manatee County Front end document. IFBC No. 01260 for substitute item provisions.

F. Changes and change orders:
    1. As specified in Manatee County Front end document. IFBC No. 01260.

1.02 REFERENCES

A. Code compliance:
    1. The publications are referred to in the text by the basic designation only. The latest edition accepted by the Authority Having Jurisdiction of referenced publications in effect at the time of the bid governs.
    2. The standards listed are hereby incorporated into this Section and all specifications for this project.
        a. American National Standards Institute (ANSI).
        b. American Society of Civil Engineers (ASCE):
            1) ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
        c. ASTM International (ASTM).
        d. Illuminating Engineering Society (IES).
        e. Institute of Electrical and Electronics Engineers (IEEE).
        f. Insulated Cable Engineers Association (ICEA).
        g. International Code Council (ICC):
            1) International Code Council Evaluation Service (ICC-ES).
                a) AC 156 - Acceptance Criteria for Seismic Certification by Shake Table Testing of Non-Structural Components (ICC-ES AC 156).
        h. International Society of Automation (ISA).
        i. National Electrical Manufacturers Association (NEMA):
            1) 250 - Enclosures for Electrical Equipment (1000 V Maximum).
        j. National Fire Protection Association (NFPA):
            1) 70 - National Electrical Code (NEC).
            2) 70E - Standard for Electrical Safety in the Workplace
            3) 79 - Industrial Machinery Handbook
        k. National Institute of Standards and Technology (NIST).
        l. Underwriters' Laboratories, Inc. (UL).
            1) 508A - Standard for Industrial Control Equipment

B. Compliance with laws and regulations:
    1. As specified in Division 01 - General Requirements.

1.03 DEFINITIONS

A. Definitions of terms and other electrical and instrumentation considerations as set forth by:
    1. IEEE.
    2. NETA.
    3. IES.
    4. ISA.
    5. NEC.
    6. NEMA.
    7. NFPA.
    8. NIST.

B. Specific definitions:
    1. FAT: Factory acceptance test.
    2. ICSC: Instrumentation and controls subcontractor.

3. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.
4. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.
5. PCIS: Process control and instrumentation system.
6. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.
7. Space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device but is capable of accepting a device with no modifications to the equipment, i.e., provide all standoffs, bus, and hardware, as part of the space.
8. Spare: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that physically contains a device with no load connections to be made.
9. VCP: Vendor control panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, OIT, HMI, etc.
10. Unequipped space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device, standoff, bus, hardware, or other equipment.

1.04 SYSTEM DESCRIPTION

A. General requirements:
   1. The Work includes everything necessary for and incidental to executing and completing the Electrical Work indicated on the Drawings and specified in the Specifications and reasonably inferable there from:
      a. The Electrical Drawings are schematic in nature; use the Structural, Architectural, Mechanical, and Civil Drawings for all dimensions and scaling purposes.
   2. It is the intent of these Specifications that the entire electrical power, instrumentation, and control system be complete and operable. Provide all necessary material and labor for the complete system from source of power to final utilization equipment, including all connections, testing, calibration of equipment furnished by others as well as equipment furnished by the Contractor, whether or not specifically mentioned but which are necessary for successful operation.
   3. Provide all Electrical Work, including conduit, field wiring, and connections by the electrical subcontractor under the provisions of the Electrical Specifications for all aspects of the Work.
   4. Coordinate all aspects of the Work with the electrical subcontractor and other subcontractors before bidding in order to ensure that all costs associated with a complete installation are included. The Owner is not responsible for any change orders due to lack of coordination of the Work between the Contractor, the electrical subcontractor, the other subcontractors or suppliers.
   5. Demolition:
      a. Where demolition is specified or indicated on the Drawings, disconnect all associated electrical equipment and render the equipment safe.

b. Remove and dispose of all conduit, wire, electrical equipment, controls, etc. associated with the items and/or areas to be demolished as indicated on the Drawings unless otherwise indicated.
c. For each piece of equipment to be removed, remove all ancillary components (e.g. instruments, solenoid valves, disconnect switches, etc.).
d. Conduit:
1) Where conduit removal, other than associated with equipment to be removed, is indicated on the Drawings:
a) Remove exposed conduit to the point of encasement or burial.
b) Cut conduit flush and plug or cap encased or buried conduit.
2) Where conduits are to remain in place and removal is not indicated on the Drawings:
a) Cap conduit open ends.
b) Re-label empty conduits as spare.
e. Remove all wire back to the source for all conduits to be removed or abandoned in place.
f. Provide new nameplates for modified electrical distribution equipment, motor control centers etc. to identify equipment and circuits that are no longer used as spares.
g. Provide new typewritten schedules for all modified panelboards.

6. Portions of this Project involve installation in existing facilities and interfaces to existing circuits, power systems, controls, and equipment:
a. Perform and document comprehensive and detailed field investigations of existing conditions (circuits, power systems, controls, equipment, etc.) before starting any Work. Determine all information necessary to document, interface with, modify, upgrade, or replace existing circuits, power systems, controls, and equipment.
b. Provide and document interface with, modifications to, upgrades, or replacement of existing circuits, power systems, controls, and equipment.
7. Provide all trenching, forming, rebar, concrete, back filling, hard surface removal and replacement, for all items associated with the Electrical Work and installation:
a. As specified in the Contract Documents.
8. Defective work:
a. As specified in Division 01 - General Requirements.

B. Operating facility:
1. As specified in Section 01140 - Work Restrictions.
2. The Manatee County - Lake Manatee WTP is an operating facility. Portions of this facility must remain fully functional throughout the entire construction period. In consideration of this requirement, comply with the following guidelines:
a. All outages must be of minimal duration and fully coordinated and agreed to by the Owner. Adjust the construction schedule to meet the requirements of the Owner. All changes in schedule and any needs to reschedule are included in the Work.
b. As weather and water demand conditions dictate, re-adjust the construction schedule to meet the demands placed upon Owner by its users.
c. Coordinate the construction and power renovation, bear all costs, so that all existing facilities can continue operation throughout construction.

3. According to individual circumstances and in compliance with the Drawings, extend or replace conduit and cable connections from existing locations.
4. The standards of documentation, instrument tagging, cable and conductor ferruling, terminal identification and labeling that apply to the new installation apply equally to the existing installation which forms part of the modified system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures and this Section.

B. General:
1. Instruct all equipment suppliers of submittals and operation and maintenance manuals of the requirements in this Section.
2. Furnish the submittals required by each section in the Electrical Specifications.
3. Adhere to the wiring numbering scheme specified in Section 16075 - Identification for Electrical Systems throughout the Project:
   a. Uniquely number each wire.
   b. Wire numbers must appear on all Equipment Drawings.
4. Use equipment and instrument tags, as indicated on the Drawings, for all submittals.

C. Operation and maintenance manuals:
1. As specified in Section 01782 - Operation and Maintenance Data.
2. Furnish the Engineer with a complete set of written operation and maintenance manuals 8 weeks before Functional Acceptance Testing.

D. Material and equipment schedules:
1. Furnish a complete schedule and/or matrix of all materials, equipment, apparatus, and luminaries that are proposed for use:
   a. Include sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

E. Schedule of values:
1. In addition to completing all items referred to in the schedule of values per, submit per unit material and labor costs used in developing the final bid for the electrical system, for the express purpose of pricing and cost justification for any proposed change orders. In addition to the items shown on the schedule of values, provide per unit material and labor costs for conduit and wire installation for specific types, sizes, and locations as indicated on the Drawings and Conduit Schedule. It is the responsibility of the electrical subcontractor to prove to the Engineer’s satisfaction that said per unit costs were used in the development of the final Bid amount.

F. Roof penetrations:
1. Submit details of all portions of the electrical installation that penetrate the roof. Include details showing support of the penetrating component, and the sealing means to be utilized.

G. Record Documents:
1. Furnish as specified in Section 01770 - Closeout Procedures.

H. Test reports:
   1. As specified in Section 01330 - Submittal Procedures.
   2. Additional requirements for field acceptance test reports are specified in Sections 01756 - Commissioning.

I. Calculations:
   1. Where required by specific Electrical Specifications:
      a. Because these calculations are being provided by a registered professional engineer, they will be reviewed for form, format, and content but will not be reviewed for accuracy and calculation means.

1.06 QUALITY ASSURANCE

A. Furnish all equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. Site conditions:
   1. Provide an electrical, instrumentation and control system, including all equipment, raceways, and any other components required for a complete installation that meets the environmental conditions for the Site as specified in the General Requirements and below.
   2. Wind load resistance:
      a. Provide electrical equipment with construction and anchorage to supporting structures designed to resist site wind loads per current Florida Building Code.
   3. Altitude, temperature and humidity:
      a. Provide all electrical components and equipment fully rated for continuous operation at this altitude, with no additional derating factors applied.
      b. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures, with a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature, as determined by the equipment manufacturer's guidelines:
         1) Provide all power conduits wiring for these devices (e.g. heaters, fans, etc.) whether indicated on the Drawings or not.
   4. Site security:
      a. Abide by all security and safety rules concerning the Work on the Site, as specified in Sections 01329 - Safety Plan.
   5. Outdoor installations:
      a. Provide electrical, instrumentation and control equipment suitable for operation in the ambient conditions where the equipment is located.
      b. Provide heating, cooling, and dehumidifying devices incorporated into and included with electrical equipment, instrumentation and control panels to maintain the enclosures within the rated environmental operating ranges as specified in this Section for the equipment:
         1) Provide all wiring necessary to power these devices.

B. Provide enclosures for electrical, instrumentation and control equipment, regardless of supplier or subcontractor furnishing the equipment, that meet the requirements outlined in NEMA Standard 250 for the following types of enclosures:
   1. NEMA Type 1: Intended for indoor use, primarily to provide a degree of protection from accidental contact with energized parts or equipment.
   2. NEMA Type 4: Intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation and freezing.
   3. NEMA Type 4X: Made from corrosion resistant materials and are intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation and freezing, and corrosion. Provide specific materials as specified or indicated on the Drawings.
   4. NEMA Type 12: Intended for indoor use, primarily to provide a degree of protection from dust, falling dirt and dripping non-corrosive liquids.
   5. NEMA Type 6: Rated for submergence.
   6. NEMA Type 6P: Rated for prolonged submergence.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING

A. General:
   1. As specified in Sections 01312 - Project Meetings and 01756 - Commissioning.
   2. Testing requirements are specified in Section 01756 - Commissioning.
   3. General scheduling requirements are specified in Section 01324C - Progress Schedules and Reports - Small Projects.
   4. Work restrictions and other scheduling requirements are specified in Section 01140 - Work Restrictions.
   5. Commissioning requirements as specified in Section 01756 - Commissioning.

B. Pre-submittal conference:
   1. Before producing any submittals, schedule a pre-submittal conference for the purposes of reviewing the entire Project, equipment, control philosophy, schedules, and submittal requirements.
   2. Contractor, electrical subcontractor, all suppliers, and individual equipment manufacturers furnishing major pieces of equipment must attend.

1.11 WARRANTY

A. Warrant the Electrical Work as specified in Document 00783 - Warranties and Bonds:
   1. Provide additional warranty as specified in the individual Electrical Specifications.

1.12 SYSTEM START-UP

A. Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:

1. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the Engineer.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE

A. Before Substantial Completion, perform all maintenance activities required by any sections of the Specifications including any calibrations, final adjustments, component replacements or other routine service required before placing equipment or systems in service.

B. Furnish all spare parts as required by other sections of the Specifications.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide similar items of same manufacturer throughout the electrical and instrumentation portion of the Project.

B. Allowable manufacturers are specified in individual Electrical Specifications.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Furnish all materials under this Contract that are new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products and that bear all approvals and labels as required by the Specifications.

B. Provide materials complying with the applicable industrial standard as specified in Division 01 - General Requirements.

C. Stainless steel:
   1. Where stainless steel is indicated or used for any portion of the Electrical Work, provide a non-magnetic, corrosion-resistant alloy, ANSI Type 316, satin finish.
   2. Provide exposed screws of the same alloys.
   3. Provide finished material free of any burrs or sharp edges.
   4. Use only stainless steel hardware, when chemically compatible, in all areas that are or could be in contact with corrosive chemicals.
   5. Use stainless steel hardware, when chemically compatible, in all chemical areas or areas requiring NEMA Type 4X construction.
   6. Do not use stainless steel in any area containing chlorine, gas or solution, chlorine products or ferric chloride.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Provide all equipment that is new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products.

PART 3 EXECUTION

3.01 EXAMINATION

A. The electrical subcontractor is encouraged to visit the site to examine the premises completely before bidding.

B. It is the electrical subcontractor's responsibility to be fully familiar with the existing conditions and local requirements and regulations.

C. Review the site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Equipment locations shown on Electrical Drawings may change due to variations in equipment size or minor changes made by others during construction:
   1. Verify all dimensions indicated on the Drawings:
      a. Actual field conditions govern all final installed locations, distances, and levels.
   2. Review all Contract Documents and approved equipment shop drawings and coordinate Work as necessary to adjust to all conditions that arise due to such changes.
   3. Make minor changes in location of equipment before rough in, as directed by the Owner or Engineer.
   4. Provide a complete electrical system:
      a. Install all extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical system.

B. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

C. Cutting and patching:

1. Perform all cutting, patching, channeling, core drilling, and fitting required for the Electrical Work, except as otherwise directed:
    a. Secure the permission of the Engineer before performing any operation likely to affect the strength of a structural member such as drilling, cutting or piercing:
        1) Before cutting, channeling, or core drilling any surface, ensure that no penetration of any other systems will be made:
            a) Verify that area is clear and free of conduits, cables, piping, ductwork, post-tensioning cables, etc.
            b) Use tone-locate system or X-ray to ensure that area is clear of obstructions.
    b. Review the complete Drawing set to ensure that there are no conflicts or coordination problems before cutting, channeling, or core drilling any surface.
2. Perform all patching to the same quality and appearance as the original work. Employ the proper tradesmen to secure the desired results. Seal around all conduits, wires, and cables penetrating walls, ceilings, and floors in all locations with a fire stop material, typically:
    a. 3M: CP 25WB+: Caulk.
    b. 3M: Fire Barrier: Putty.
3. Use the installation details indicated on the Drawings as a guide for acceptable sealing methods.

D. Install all conduits and equipment in such a manner as to avoid all obstructions and to preserve headroom and keep openings and passageways clear:
    1. Install all conduits and equipment in accordance with working space requirements in accordance with the NEC.
        a. This includes any panel, disconnect switch or other equipment that can be energized while open exposing live parts regardless of whether it is likely to require examination or has serviceable parts.
    2. Where the Drawings do not show dimensions for locating equipment, install equipment in the approximate locations indicated on the Drawings.
        a. Adjust equipment locations as necessary to avoid any obstruction or interferences.
    3. Where an obstruction interferes with equipment operation or safe access, relocate the equipment.
    4. Where the Drawings do not indicate the exact mounting and/or supporting method to be used, use materials and methods similar to the mounting details indicated on the Drawings.

E. Earthwork and concrete:
    1. Install all trenching, shoring, concrete, backfilling, grading and resurfacing associated with the Electrical Work:
        a. Requirements as specified in the Contract Documents.

F. Roof penetrations:
    1. Seal conduit penetrations in accordance with roofing manufacturer’s instructions.

G. Terminations:
    1. Provide and terminate all conductors required to interconnect power, controls, instruments, panels, and all other equipment.

H. Miscellaneous installation requirements:
   1. In case of interference between electrical equipment indicated on the Drawings and the other equipment, notify the Engineer as specified in Division 01 - General Requirements.
   2. Location of manholes and pullboxes indicated on the Drawings are approximate. Coordinate exact location of manholes and pullboxes with Mechanical and Civil Work.
   3. Provide additional manholes or pullboxes to those shown where they are required to make a workable installation.

I. Labeling:
   1. Provide all nameplates and labels as specified in Sections 16075 - Identification for Electrical Systems.

J. Equipment tie-downs:
   1. Anchor all instruments, control panels, and equipment by methods that comply with wind bracing criteria, which apply to the Site.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Owner training:
   1. As specified in Section 01756 - Commissioning and in this Section.

3.08 FIELD QUALITY CONTROL

A. Inspection:
   1. Allow for inspection of electrical system installation as specified in Section 01450 - Quality Control.
   2. Provide any assistance necessary to support inspection activities.
   3. Engineer inspections may include, but are not limited to, the following:
      a. Inspect equipment and materials for physical damage.
      b. Inspect installation for compliance with the Drawings and Specifications.
      c. Inspect installation for obstructions and adequate clearances around equipment.
      d. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.
      e. Inspect equipment nameplate data to verify compliance with design requirements.
      f. Inspect raceway installation for quality workmanship and adequate support.
      g. Inspect cable terminations.

B. Field acceptance testing (Functional Testing):
   1. Notify the Engineer when the Electrical Work is ready for field acceptance testing.

2. Record results of the required tests along with the date of test:
    a. Use conduit identification numbers to indicate portion of circuit tested.

C. Workmanship:
    1. Leave wiring in panels, manholes, boxes, and other locations neat, clean, and organized:
        a. Neatly coil and label spare wiring lengths.
        b. Shorten, re-terminate, and re-label excessive used as well as spare wire and cable lengths, as determined by the Engineer.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 01770 - Closeout Procedures.

B. Remove all foreign material and restore all damaged finishes to the satisfaction of the Engineer and Owner.

C. Clean and vacuum all enclosures to remove all metal filings, surplus insulation and any visible dirt, dust or other matter before energization of the equipment or system start-up:
    1. Use of compressors or air blowers for cleaning is not acceptable.

D. Clean and re-lamp all new and existing luminaries that were used in the areas affected by the construction, and return all used lamps to the Owner.

E. As specified in other sections of the Contract Documents.

3.11 PROTECTION

A. Protect all Work from damage or degradation until Substantial Completion.

B. Maintain all surfaces to be painted in a clean and smooth condition.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16060

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Grounding materials and requirements.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. B3 - Standard Specification for Soft or Annealed Copper Wire.
   2. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

D. Underwriters Laboratories, Inc. (UL):
   1. 467 - Ground and Bonding Equipment.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Ground equipment and raceway systems so that the completed installation conforms to all applicable code requirements.

B. Provide a complete electrical grounding system as indicated on the Drawings and as specified including but not limited to:
   1. Grounding electrodes.
   2. Bonding jumpers.
   3. Ground connections.

C. Provide bonding jumpers and wire, grounding bushings, clamps and appurtenances required for complete grounding system to bond equipment and raceways to equipment grounding conductors.

D. The ground system resistance (electrode to ground) of the completed installation, shall be:
   1. 5 ohms or less for industrial systems.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
   1. Catalog cut sheets.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050 - Common Work Results for Electrical.

B. All grounding components and materials shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050 - Common Work Results for Electrical.

1.08 PROJECT/SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 16050 - Common Work Results for Electrical.

1.12 SYSTEM START-UP

A. As specified in Section 16050 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exothermic connectors: One of the following or equal:
   1. Erico.
   2. Harger.
   3. Burndy Weld.

B. Ground rods: One of the following or equal:
   1. Erico.
   2. Harger.
   3. Conex.

C. Ground cable: One of the following or equal:
   1. Nehring.

2. Harger.
3. Southwire.

D. Precast ground well boxes: One of the following or equal:
1. Brooks Products, 3-RT Valve Box.
2. Christy Concrete Products, G12 Valve Box.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Ground rod:
1. Minimum: 5/8-inch diameter, 20 feet long.
2. Uniform 10 mil covering of electrolytic copper metallically bonded to a rigid steel core:
   a. The copper-to-steel bond shall be corrosion resistant.
3. In accordance with UL 467.
4. Sectional type joined by threaded copper alloy couplings.
5. Fit the top of the rod with a threaded coupling and steel-driving stud.

B. Ground cable:
1. Requirements:
   a. Soft drawn (annealed).
   b. Concentric lay, coarse stranded in accordance with ASTM B8.
   c. Bare copper in accordance with ASTM B3.
2. Size is as indicated on the Drawings, but not less than required by the NEC.

C. Exothermic welds:
1. Current carrying capacity equal to that of the conductor.
2. Permanent molecular bond that cannot loosen or corrode over time.
3. Will not deteriorate with age.

D. Equipment grounding conductors:
1. Conductors shall be the same type and insulation as the load circuit conductors:
   a. Use 600-volt insulation for the equipment grounding conductors for medium voltage systems.
2. Minimum size in accordance with the NEC.

E. Grounding electrode conductors:
1. Minimum size in accordance with the NEC.

F. Main bonding jumpers and bonding jumpers:
1. Minimum size in accordance with the NEC.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Precast ground well boxes:
   1. Minimum 10 inch interior diameter.
   2. Traffic-rated cast iron cover.
   3. Permanent “GROUND” marking on cover.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Provide a separate, green insulated, grounding conductor in each raceway independent of raceway material:
   1. Multi-conductor power and control cables shall include an integral green insulated grounding conductor.
   2. Provide a separate grounding conductor in each individual raceway for parallel feeders.

C. Provide a separate grounding conductor for each motor and connect at motor terminal box. Do not use bolts securing motor box to frame or cover for grounding connectors:
   1. When grounding motors driven by variable frequency drives (VFD) comply with the requirements of the VFD manufacturer.

D. Provide a grounding type bushing with lug for connection of grounding conductor for conduits that originate from each motor control center section, switchboard, or panelboard:
   1. Individually bond these raceways to the ground bus in the equipment.

E. Provide grounding type bushings with lugs for connection of grounding conductor at both ends of metallic conduit runs. Bond ground bushings to the grounding system.

F. Provide a green insulated wire-grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

G. Interconnect the secondary switchgear, switchboard, or panelboard neutral bus to the ground bus in the secondary switchgear, switchboard, or panelboard compartment, only at service entrance point or after a transformer.

H. Duct bank ground system:
   1. Provide a bare copper grounding conductor the entire length of each duct bank, embedded in the concrete of the duct bank as indicated on the Drawings and specified in the Specifications.
   2. Bond duct bank ground conductors together where duct banks join, merge, intersect, or split.

I. Grounding at service (600 V or Less):
   1. Connect the neutral to ground only at one point within the enclosure of the first disconnecting means on the load side of the service transformer.

J. Ground connections:
   1. All connections to the ground grid system, the duct bank grounding system, equipment, ground rods, etc., shall be made using exothermic welds as indicated on the Drawings, UL listed, and labeled for the application.
   2. Make ground connections in accordance with the manufacturer's instructions.
   3. Do not conceal or cover any ground connections until the Engineer or authorized representative has established and provided written confirmation that every grounding connection is as indicated on the Drawings and specified in the Specifications.

K. Grounding electrode system:
   1. Ground ring:
      a. Provide all trenching and materials necessary to install the ground ring as indicated on the Drawings.
      b. Ground ring conductor shall be in direct contact with the earth, or where embedded, concrete, of the size as indicated on the Drawings.
      c. Minimum burial depth 36 inches or as indicated on the Drawings.
      d. Re-compact disturbed soils to original density in 6-inch lifts.
   2. Ground rods:
      a. Locations as indicated on the Drawings.
      b. Length of rods forming an individual ground array shall be equal in length.
      c. Drive ground rods and install grounding conductors before construction of concrete slabs and duct banks.
   3. Metal underground water pipe:
      a. Bond metal underground domestic water pipe to grounding electrode system.
   4. Metal frame of building or structure:
      a. Bond metal frame of building or structure to grounding electrode system.
   5. Extend grounding conductors through concrete to accessible points for grounding equipment and electrical enclosures.
   6. Where grounding conductors are not concrete-encased or direct buried, install in Schedule 40 PVC conduit for protection.
   7. Install grounding system at each structure where switchgear, motor control centers, switchboards, panelboards, panels, or other electrical equipment are installed.

L. Shield grounding:
   1. Shielded instrumentation cable shall have its shield grounded at one end only unless shop drawings indicate otherwise:
      a. The grounding point shall be at the control panel or at the power source end of the signal carried by the cable.
   2. Terminate the shield drain wire on a dedicated terminal block.
   3. Use manufacturer’s terminal block jumpers to interconnect ground terminals.
   4. Connection to the panel main ground bus shall be via a green No. 12 conductor to the main ground bus for the panel.

M. Antenna ground:
   1. Install individual ground rod or ground system for communication system antenna:
      a. Install a dedicated grounding electrode conductor from the antenna ground to the grounding electrode system.
      b. Do not connect any other grounds to the antenna grounding electrode conductor.
   2. Install ground rod or ground system in accordance with the radio manufacturer's requirements.

N. Where indicated on the Drawings, install ground rods in precast ground wells.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Measure grounding electrode system resistance to ground in accordance with IEEE 81.

3.09 ADJUSTING

A. Under the direction of the Engineer, add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurement meets the specified resistance requirements:
   1. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in Section 16050 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16070

HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Mounting and supporting electrical equipment and components.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Design requirements:
   1. Conform to the requirements of the current Florida Building Code.
   2. Demonstrate the following using generally accepted engineering methods:
      a. That the anchors to the structure are adequate to resist the loads generated in accordance with the Building Code and equipment requirements.
      b. That the required load capacity of the anchors can be fully developed in the structural materials to which they are attached.
   3. Design loading and anchoring requirements:
      a. As indicated in the Building Code unless otherwise specified.
      b. Seismic loading requirements:
         1) Freestanding, suspended or wall-hung equipment shall be anchored in place by methods that will satisfy the requirements for the seismic design specified in Section 16050 - Common Work Results for Electrical.
      c. Wind loading requirements:
         1) All exterior equipment shall be anchored in place by methods that will satisfy the requirements for wind design specified in Section 16050 - Common Work Results for Electrical.
      d. Minimum safety factor against overturning: 1.5.

e. The foundation and structures to which hangers and supports are attached shall be capable of withstanding all anchor loads.

B. Performance requirements:
1. Hangers and supports individually and as a system shall resist all weights and code-required forces without deflections and deformations that would damage the supporting elements, the equipment supported, or the surrounding construction.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
1. Supports:
a. Materials.
b. Geometry.
c. Manufacturer.
2. Hardware:
a. Materials.
b. Manufacturer.

C. Shop drawings:
1. Complete dimensioned and scalable shop drawings of all supporting structures, trapezes, wall supports, etc.
2. Complete anchoring details for equipment, lighting and raceway, supporting structures, trapezes, wall supports for all equipment in excess of 200 pounds, and all freestanding supports:
a. Stamped by a professional engineer licensed in the state where the Project is being constructed.
b. Said submittals, by virtue of the fact that they bear the stamp of a registered engineer, will be reviewed for general consistency with the requirements specified in the Contract Documents, but not for context, accuracy, or method of calculation.
3. Include data on attachment hardware and construction methods that will satisfy the design loading and anchoring criteria.

D. Installation instructions:
1. Furnish anchorage instructions and requirements based on the seismic and wind conditions of the Site:
a. Stamped by a professional engineer licensed in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050 - Common Work Results for Electrical.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050 - Common Work Results for Electrical.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 16050 - Common Work Results for Electrical.

1.12 SYSTEM STARTUP

A. As specified in Section 16050 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Thomas & Betts.
   2. Power-Strut.
   3. Unistrut.
   4. Cooper B-Line.
   5. Robroy.
   6. Aickinstrut.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Use materials appropriate for the area as specified in Section 16050 - Common Work Results for Electrical.

B. Stainless steel:
   1. Supports:
      a. In accordance with ASTM A240.
      b. ANSI Type 316 material.
   2. Hardware:
      a. ANSI Type 316 material.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Mount all raceways, cabinets, boxes, fixtures, instruments, and devices on Contractor-fabricated racks unless otherwise indicated on the Drawings.
   1. Provide the necessary sway bracing to keep trapeze type structures from swaying under seismic events or wind loading.

C. Brace and anchor freestanding equipment supports using methods that provide structural support based on the seismic loads and wind loads:
   1. Lateral deflection at top of supports not to exceed support height divided by 240 unless otherwise approved by the Engineer.

D. Provide fabricated steel support pedestals for wall mounted panels that weigh more than 200 pounds:
   1. Fabricate pedestals out of welded angle, tube sections, or preformed channel.
   2. If the supported equipment is a panel or cabinet, match the supported equipment in physical appearance and dimensions.
   3. Provide auxiliary floor supports for transformers hung from stud walls and weighing more than 200 pounds.
   4. Mount all equipment, cabinets, boxes, instruments, and devices in damp or wet locations on minimum of 7/8-inch preformed mounting channel.
      a. Mount channel vertically along the length of the device so that water or moisture may run freely behind the device.

E. Corrosion protection:
   1. Isolate dissimilar metals, except where required for electrical continuity.
      a. Use neoprene washers, 9-mil polyethylene tape, or gaskets for isolation.

F. Raceway:
   1. Furnish all racks and trapeze structures needed to support the raceway from the structure.
      a. Group raceway and position on racks to minimize crossovers.

b. Provide the necessary bracing to keep trapeze type structures from swaying under loads from cable installation, seismic forces, or wind forces.

G. Anchoring methods:
   1. Solid concrete: Anchor bolts, anchor rods or post-installed anchors
   2. Metal surfaces: Machine screws or bolts.
   3. Hollow masonry units: Post-installed anchors.

H. Recoat or seal all drilled holes, cut or scratched surfaces or with products recommended by the manufacturer.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in Section 16050 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16075

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Identification of electrical equipment, devices and components.
   2. Material, manufacturing and installation requirements for identification devices.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Nameplates:
   1. Provide a nameplate for each piece of electrical equipment and devices, control panel and control panel components.
   2. Provide all nameplates of identical style, color, and material throughout the facility.
   3. Device nameplates information:
      a. Designations as indicated on the Drawings and identified on the Process and Instrumentation Drawings.

B. Wire numbers:
   1. Coordinate the wire numbering system with all vendors of equipment so that every field wire has a unique number associated with it for the entire system:
      a. Wire numbers shall correspond to the wire numbers on the control drawings or the 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.
      d. Multi-conductor cables shall be assigned a cable number that shall be attached to the cable at intermediate pull boxes and stub-up locations beneath freestanding equipment. All multi-conductor and instrumentation cables shall be identified at pull points as described above:
         1) Label armored multi-conductor cable using the conduit number as indicated on the Drawings, following the requirements for conduit markers in Section 16130 - Conduits.
   2. Provide the following wiring numbering schemes throughout the project for field wires between process control module, (PCM), RTU'S, vendor control

panels, (VCP), motor control centers, (MCC), field starters, field instruments, etc. Provide 2 lines on wire label. Top line is the termination location. Bottom line is the destination.

OR

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 PLC

All existing conductors shall be re-labelled as specified above. This includes terminals, field and equipment side of wiring.

I/O address at destination panel:

a. Identify equipment and field instruments 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 (e.g. T1, T2, T3, etc.).
f. Terminal designations at PCMs where the field conductor connects to field terminal blocks for 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) Discrete Point: W:X:Y/Z.
       Analog Point: W:X:Y.Z.
       Where:
       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 or a word number for an analog point (1, 2, 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 (e.g.

C0010). For common power after a fuse or neutrals after a switch, the subsequent points shall have and capital letter suffix starting with “A” (e.g. 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 (VCP#)
   B = Terminal number within VCP (manufacturer’s or vendor’s standard terminal number)
   C = Process control module number without hyphen (PCM#)
   D = Either the 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: VCP#-10/PCM#-I:1:01/01
   VCP#-10/PCM#-O:1:10/07
   VCP#-10/PCM#-C0100

4. **Case 2**: Field instrument to process control module (PCM):
   Field wire number/label: E-F/C-D
   C = Process control module number without hyphen (PCM#)
   D = Either the 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 (EDV#)
   F = Manufacturer’s standard terminal number within instrument. Use both terminal numbers for analog points separated by a comma

   Examples: TIT#-2,3/PCM#-I:1:01.1
   TSH#-1/PCM#-I:2:01/00

5. **Case 3**: Motor control center (MCC) to process control module (PCM):
   Field wire number/label: G-B/C-D
   B = Terminal number within Motor Control Center (manufacturer’s or vendor’s standard terminal number)
   C = Process control module without hyphen (PCM#)
   D = Either the 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 = Actual starter designation in the motor control center without hyphen (MMS#)

   Examples: MMS#-10/PCM#-I:1:01/01
   MMS#-10/PCM#-O:1:10/07
   MMS#-10/PCM#-C0100

6. **Case 4**: Motor control center (MCC) to vendor control panel (VCP):
   Field wire number/label: G-B/A-B
   A = Vendor control panel number without hyphen (VCP#)
   B = Terminal number within motor control center or vendor control panel (manufacturer’s or vendors standard terminal number)

G = Actual starter designation in the motor control center without hyphen (MMS#)

Example: MMS#-X2/VCP#-10

7. **Case 5**: Motor leads to a motor control center (MCC):
   Field wire number/label: H-I/G-B
   B = Terminal number within motor control center (manufacturer's standard terminal number)
   G = Actual starter designation in the motor control center without hyphen (MMS#)
   H = Equipment tag and loop number without hyphen (PMP#)
   I = Motor manufacturer's standard motor lead identification (e.g. T1, T2, T3, etc.)

   Example: PMP-#-T3/MMS#-T3

8. **Case 6**: Remote or separately mounted starter or variable frequency drive (VFD) to process control module (PCM):
   Field wire number/label: J-B/C-D
   B = Terminal number within starter or variable frequency drive (manufacturer's standard terminal number)
   C = Process control module number without hyphen (VCP#)
   D = Either the 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 = Starter or variable frequency drive tag and loop number without hyphen (MMS#)

   Examples: MMS#-10/PCM#-I:1:01/01
   MMS#-10/PCM#-O:2:10/07
   MMS#-10/PCM#-C0010

9. **Case 7**: Field bus trunk segment:
   Field cable number/label: C/K-L/M; C/K-L/H; C/K-L/J
   C = Process control module without hyphen (PCM#).
   K = Field bus cable type.
   L = Field bus segment number.
   M = Field Bus field network component without hyphen (PTB1) or
   H = Equipment tag and loop number without hyphen (EMV#) or
   J = Starter or variable frequency drive tag and loop number without hyphen (VFD60.0112)

   Examples: PCM#/PA-1A/PTB1PTB1/PA-1B/PTB2
   PCM#/DN-1A/VFD#
   PCM#/DP-2A/ EMV#

10. **Case 8**: Field bus spur (drop):
    Field cable number/label: E/K-L/M
    E = Field mounted instrument tag and loop numbers without hyphen (FIT#)
    K = Field bus cable type.
    L = Field bus segment number

M = Field bus field network component without hyphen (PTB1), identify ports on the device.

Examples: FIT#/PA-1C/PTB1-1
FIT#/PA-1D/PTB1-2

11. Identify all spare conductors as required for other field wires with an “S” prefix:

Example: S MMS#-10/PCM#-C011

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
   1. Nameplates:
      a. Color.
      b. Size:
         1) Outside dimensions.
         2) Lettering.
      c. Material.
      d. Mounting means.
   2. Nameplate schedule:
      a. Show exact wording for each nameplate.
      b. Include nameplate and letter sizes.
   3. Wire numbers:
      a. Manufacturer’s catalog data for wire labels and label printer.

C. Record documents:
   1. Update the conduit schedule to reflect the exact quantity of wire numbers including spares and destination points for all wires.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050 - Common Work Results for Electrical.

1.08 PROJECT SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 16050 - Common Work Results for Electrical.

1.12 SYSTEM START-UP

A. As specified in Section 16050 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nameplates and signs:
   1. One of the following or equal:
      a. Brady.
      b. Seton.

B. Conductor and cable markers:
   1. Heat-shrinkable tubing:
      a. One of the following or equal:
         1) Raychem.
         2) Brady.
         3) Thomas & Betts.
         4) Kroy.

C. Conduit and raceway markers:
   1. Stainless steel, one of the following or equal:
      a. Panduit: Pan Steel.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Nameplates:
   1. Colors:
      a. Warning nameplates: White-center, red face.
      b. Other nameplates: Black-center, white face.
   2. Laminated plastic engraving stock:
      a. 3/32-inch thick material.
      b. 2-ply.
      c. With chamfered edges.
   3. Block style engraved characters of adequate size to be read easily from a distance of 6 feet:
      a. No characters smaller than 1/8-inch in height.

B. Signs:
   1. Automatic equipment and high voltage signs:
      a. Suitable for exterior use.
      b. In accordance with OSHA regulations.

C. Conductor and cable markers:
   1. Machine printed black characters on white tubing.
   2. 10 point type or larger.

D. Conduit and raceway markers:
   1. Stainless steel:

a. Type 304 or 316.
b. 3/16-inch character height.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Nameplates:
1. Provide all nameplates for control panel operator devices (e.g. pushbuttons, selector switches, pilot lights, etc.):
a. Same material and same color and appearance as the device nameplates, in order to achieve an aesthetically consistent and coordinated system.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Nameplates:
1. Attach nameplates to equipment with rivets, bolts or sheet metal screws, approved waterproof epoxy-based cement or install in metal holders welded to the equipment.
2. On NEMA Type 4, NEMA Type 4X, or NEMA Type 7 enclosures, use epoxy-based cement to attach nameplates.
3. Nameplates shall be aligned and level or plumb to within 1/64 inch over the entire length:
a. Misaligned or crooked nameplates shall be remounted, or provide new enclosures at the discretion of the Engineer.

C. Conductor and cable markers:
1. Apply all conductor and cable markers before termination.
2. Heat-shrinkable tubing:
a. Tubing shall be shrunk using a heat gun that produces low temperature heated air.

b. Tubing shall be tight on the wire after it has been heated.
c. Characters shall face the open panel and shall read from left to right or top to bottom.
d. Marker shall start within 1/32 inch of the end of the stripped insulation point.

D. Conduit markers:
1. Furnish and install conduit markers for every conduit in the electrical system that is identified in the conduit schedule or part of the process system:
a. Conduit markings shall match the conduit schedule.
2. Mark conduits at the following locations:
a. Each end of conduits that are greater than 10 feet in length.
b. The middle of conduits that are 10 feet or less in length.
c. Where the conduit penetrates a wall or structure.
d. Where the conduit emerges from the ground, slab, etc.
3. Mark conduits after the conduits have been fully painted.
4. Position conduit markers so that they are easily read from the floor.
5. Attach stainless steel tags with stainless steel cable ties.

E. Signs and labeling:
1. Furnish and install permanent warning signs at mechanical equipment that may be started automatically or from remote locations:
a. Fasten warning signs with round head stainless steel screws or bolts.
b. Locate and mount in a manner to be clearly legible to operations personnel.
2. Furnish and install permanent and conspicuous warning signs on equipment (front and back), doorways to equipment rooms, pull boxes, manholes, etc. where the voltage exceeds 600 volts.
3. Furnish and install warning signs on equipment that has more than one source of power.
a. Warning signs to identify every panel and circuit number of the disconnecting means of all external power sources.
4. Place warning signs on equipment that has 120 VAC control voltage source used for interlocking.
a. Identify panel and circuit number or conductor tag for control voltage source disconnecting means.
5. Place Arc Flash and Shock hazards label for all panels indicating Nominal System Voltage, Arc Flash boundary and Arc Flash PPE Category.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. Replace any nameplates, signs, conductor markers, cable markers or raceway labels that in the sole opinion of the Engineer do not meet the Engineer's aesthetic requirements.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

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 or less wire and cable.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. B3 - Standard Specification for Soft or Annealed Copper Wire.
   2. B8 - Standard Specification for Concentric-Lay–Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. CSA International (CSA).

D. Insulated Cable Engineers Association (ICEA):
   1. NEMA WC 70/ICEA S-95-658-1999 - Standard for Non-shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
   2. NEMA WC 57/ICEA S-73-532 - Standard for Control, Thermocouple Extension, and Instrumentation Cables.

E. National Fire Protection Association (NFPA):
   1. 70 - National Electrical Code (NEC).
   2. 72 - National Fire Alarm and Signaling Code.
   3. 101 - Life Safety Code.

F. Telecommunications Industry Association/Electronics Industry Association (TIA/EIA):
   1. 568-C.2 - Balanced Twisted-Pair Telecommunication Cabling and Components Standard.

G. Underwriter's Laboratories Inc., (UL):
   1. 44 - Thermoset-Insulated Wires and Cables.
   2. 1277 - Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
   3. 1424 - Standard for Cables for Power-Limited Fire-Alarm Circuits.
   4. 1569 - Standard for Metal-Clad Cables.
   5. 2196 - Standard for Tests for Fire Resistive Cables.
   6. 2225 - Standard for Cables and Cable-Fittings For Use in Hazardous (Classified) Locations.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Definitions of terms and other electrical considerations as set forth in the:
   1. ASTM.
   2. ICEA.

1.04 SYSTEM DESCRIPTION

A. Furnish and install the complete wire and cable system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
   1. Manufacturer of wire and cable.
   2. Insulation:
      a. Type.
      b. Voltage class.
   3. American wire gauge (AWG) size.
   4. Conductor material.
   5. Pulling compounds.

C. Shop drawings:
   1. Show splice locations.
      a. For each proposed splice location provide written justification describing why the splice is necessary.

D. Test reports:
   1. Submit test reports for meg-ohm tests.

E. Calculations:
   1. Submit cable pulling calculations to the Engineer for review and comment for all cables that will be installed using mechanical pulling equipment. Show that the maximum cable tension and sidewall pressure will not exceed manufacturer recommended values:
      a. Provide a table showing the manufacturer’s recommended maximum cable tension and sidewall pressure for each cable type and size included in the calculations.
      b. Submit the calculations to the Engineer a minimum of 2 weeks before conduit installation.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050 - Common Work Results for Electrical.

B. All wires and cables shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050 - Common Work Results for Electrical.

1.08 WARRANTY

A. As specified in Section 16050 - Common Work Results for Electrical.

1.09 SYSTEM START-UP

A. As specified in Section 16050 - Common Work Results for Electrical.

1.10 MANUFACTURERS

A. One of the following or equal:
   1. 600 volt class wire and cable:
      a. General Cable.
      b. Okonite Company.
      c. Southwire Company.
   2. 600 volt VFD cable:
      a. General Cable.
      b. Southwire Company.
   3. Instrumentation class wire and cable:
      a. Alpha Wire Company.
      b. Belden CDT.
      c. General Cable BICC Brand.
      d. Okonite Company.
      e. Rockbestos Surprenant Cable Corporation.
   4. Network cables:
      a. Belden CDT.
      b. General Cable.
      c. CommScope.
   5. Fire alarm wire and cable:
      a. West Penn Wire.
      b. Olympic Wire and Cable.
      c. Rockbestos Surprenant Cable Corporation.
      d. Draka Lifeline.
   6. Telephone wire and cable:
      a. American Telephone and Telegraph.
      b. West Penn Wire.
      c. Olympic Wire and Cable.
      d. Superior Essex Inc.
      e. Draka Comteq.
      f. General Cable.
   7. Tray cables:
      a. General Cable, BICC Brand.
      b. Southwire Company.
      c. Okonite.
   8. Armored cables.
      a. Okonite Company.
      b. Rockbestos Surprenant Cable Corporation.
      c. Southwire Company.

1.11 MATERIALS

A. Conductors:
   1. Copper in accordance with ASTM B3.

1.12 MANUFACTURED UNITS

A. General:
   1. Provide new wires and cables manufactured within 1 year of the date of delivery to the Site.
   2. Permanently mark each wire and cable with the following at 24-inch intervals:
      a. AWG size.
      b. Voltage rating.
      c. Insulation type.
      d. UL symbol.
      e. Month and year of manufacture.
      f. Manufacturer's name.
   3. Identify and mark wire and cable as specified in Section 16075 - Identification for Electrical Systems:
      a. Use integral color insulation for Number 2 AWG and smaller wire.
      b. Wrap colored tape around cable larger than Number 2 AWG.

B. 600 volt class wire and cable:
   1. Provide AWG or kcmil sizes as indicated on the Drawings or in the Conduit Circuit Wiring Schedules:
      a. When not indicated on the Drawings, size wire as follows:
         1) In accordance with the NEC:
            a) Use 75 degree Celsius ampacity ratings.
            b) Ampacity rating after all derating factors, equal to or greater than rating of the overcurrent device.
         2) Provide Number 12 AWG minimum for power conductors.
         3) Provide Number 14 AWG minimum for control conductors.
   2. Provide Class B stranding in accordance with ASTM B8:
      a. Provide Class C stranding where extra flexibility is required.
   3. Insulation:
      a. THHN-2.
      b. 90 degrees Celsius rating.
   4. Multiconductor cables:
      a. Number and size of conductors as indicated on the Drawings or in the Conduit Circuit Wiring Schedules.
      b. Individual conductors with XHHW-2 insulation.
      c. Overall PVC jacket.
      d. Tray cable rated.
      e. Color-coding for control wire in accordance with ICEA Method 1, E-2 in accordance with NEMA WC 57/ICEA S-73-532.
      f. Ground conductor: Bare Insulated, green:
         1) Sized in accordance with NEC.

C. 600 volt VFD cables:
   1. Conductor:
      a. Provide Class B stranding in accordance with ASTM B8.
   2. Insulation:
      a. Cross-linked Polyethylene.
      b. 90 degrees Celsius rating.
      c. UL 44 Type RHH/RHW-2.
   3. Ground:
      a. Provide Class B stranding in accordance with ASTM B8.

b. 3 symmetrically placed bare copper conductors in direct contact with shield.

4. Metallic shield:
   a. Overall 5 mil bare copper tape shield with 50 percent overlap.
5. Outer jacket:
   a. UL 1277 Type Polyvinyl Chloride (PVC).
6. Cable tray rated.

D. Instrumentation class cable:
1. Type TC.
2. Suitable for use in wet locations.
3. Voltage rating: 600 volts.
4. Temperature rating:
   a. 90 degrees Celsius rating in dry locations.
   b. 75 degrees Celsius rating in wet locations.
5. Conductors:
   a. Insulation:
      1) Flame-retardant PVC, 15 mils nominal thickness, with nylon jacket 4 mils nominal thickness.
   b. Number 16 AWG stranded and tinned.
   c. Color code:
      1) Pair: Black and white.
      2) Triad: Black, white and red.
      3) Multiple pairs or triads:
         a) Color-coded and numbered.
6. Drain wire:
   a. 18 AWG.
   b. Stranded, tinned.
7. Jacket:
   a. Flame retardant, moisture and sunlight resistant PVC.
   b. Ripcord laid longitudinally under jacket to facilitate removal.
8. Shielding:
   a. Individual pair/triad:
      1) Minimum 1.35-mil double-faced aluminum foil/polyester tape overlapped to provide 100 percent coverage.
   b. Multiple pair or triad shielding:
      1) Group shield: Minimum 1.35-mil double-faced aluminum foil/polyester tape overlapped to provide 100 percent coverage.
      2) Completely isolate group shields from each other.
      3) Cable shield: 2.35 mils double-faced aluminum and synthetic polymer backed tape overlapped to provide 100 percent coverage.
   c. All shielding to be in contact with the drain wire.

E. Network cables:
1. Category 6:
   a. General:
      1) Provide all Cat 6 cables meeting the standards set by TIA/EIA-568-C.2.
   b. Conductors:
      1) 24 AWG solid bare copper conductors.
   c. Insulation:
      1) Polyolefin.

2) 4 non-bonded twisted pair cables formed into a cable core.

d. Color code:
   1) Pair 1: White/blue stripe and blue.
   2) Pair 2: White/orange stripe and orange.
   3) Pair 3: White/green stripe and green.
   4) Pair 4: White/brown stripe and brown.

e. Outer jacket:
   1) PVC with ripcord.

f. Electrical characteristics:
   1) Frequency range: 0.772-100 MHz.
   2) Attenuation: 32.1 dB/100 m.
   3) Near-end crosstalk (NEXT): 39.3 dB.
   4) Power sum NEXT: 37.3 dB.
   5) Attenuation to crosstalk ratio (ACR): 7.2 dB.
   6) Power sum attenuation to crosstalk ratio (PSACR): 5.3 dB/100 m.
   7) Equal level far-end crosstalk (ELFEXT): 22.8 dB.
   8) Power sum ELFEXT: 19.8 dB/100 m.
   9) Return loss: 17.3 dB.
   10) Propagation delay: 537 ns/100 m.
   11) Delay skew: 45 ns/100 m.
   12) Propagation delay (skew), max: 2.5 ns/100 m.

2. DeviceNet cable:

a. Provide DeviceNet cables in the following cable types as indicated on the Drawings and in the Specifications:
   1) Thick.
   2) Thin.
   3) Flat.

b. General:
   1) NEC/UL Type TC or TC-ER.
   2) Compliant with all ODVA specifications, and shall pass the ODVA established conformance test.
   3) Approved to bear the ODVA Conformance Tested Service Mark.

c. Thick cable types shall consist of 2 shielded pairs for data and power:
   1) Shielded data pair:
      a) Tinned, copper conductors minimum with 19 by 30 stranding (minimum).
      b) Flame retardant polypropylene insulated.
      c) Aluminum foil-polyester tape.
      d) One pair AWG #18 for signal (minimum).
      e) Color: Blue and white.
   2) Shielded DC power pair:
      a) Tinned, copper conductors with 19 by 28 stranding (minimum).
      b) Polyvinyl chloride insulated.
      c) Aluminum foil-polyester tape.
      d) One pair AWG #16 for power (minimum).
      e) Color: Black and red.
   3) 100 percent coverage each pair foil shielded with overall 65 percent coverage tinned copper braid.
   4) Outer shield tinned copper drain wire.
   5) Sunlight/oil resistant polyvinyl chloride outer jacket.
   6) 600-volt insulation level.
   7) Nominal OD 0.48 inch (minimum).

8) [Use CPE insulated cable for direct burial.]

d. Thin cable types shall consist of 2 shielded pairs for data and power:
   1) Shielded data pair:
      a) Tinned, copper conductors with 19 by 32 stranding (minimum).
      b) Foam polyethylene (FPE).
      c) Aluminum foil-polyester tape.
      d) One pair AWG #20 for signal (minimum).
      e) Color: Blue and white.
   2) Shielded DC power pair:
      a) Tinned, copper conductors with 19 by 30 stranding (minimum).
      b) Polyvinyl chloride insulated.
      c) Aluminum-foil polyester tape.
      d) One pair AWG #18 for power.
      e) Color: Black and red.
   3) 100 percent coverage each pair foil shielded with overall 65 percent tinned copper braid.
   4) Outer shield tinned copper drain wire.
   5) Sunlight/oil resistant polyvinyl chloride outer jacket.
   6) 300-volt insulation level.
   7) Nominal OD 0.378 inch.

e. Flat cable types shall consist of 4 conductors:
   1) Two data conductors:
      a) Tinned, copper conductors with 19 by 29 stranding (minimum).
      b) Polyvinyl chloride insulated.
      c) Two - AWG #16 for signal.
      d) Color: Blue and white.
   2) DC power pair:
      a) Tinned, copper conductors minimum with 19 by 29 stranding.
      b) Polyvinyl chloride insulated.
      c) Two - AWG #16 for power.
      d) Color: Black and red.
   3) Sunlight resistant PVC jacket.
   4) 600-volt insulation level.
   5) Nominal dimensions: 0.760 inch by 0.210 inch.
   6) Not available with insulation rated for direct burial.

3. Profibus cable:
   a. Provide Profibus cables in the following cable types as indicated on the Drawings and in the Specifications:
      1) Profibus PA.
      2) Profibus DP.
   b. Profibus PA 1 pair:
      1) Tinned, copper conductors with 7 by 26 stranding (minimum).
      2) Polyolefin insulation.
      3) Aluminum foil-polyester shield.
      4) One hundred percent coverage of outer shield.
      5) One pair AWG #18.
      6) Tinned copper drain wire.
      7) Chlorinated polyethylene (CPE) outer jacket.
      8) 300-volt insulation level.
      9) Nominal OD 0.253 inch (minimum).
   c. Profibus DP 1 pair:
      1) Tinned, copper conductors with 7 by 30 stranding (minimum).

2) Polyolefin insulation.
3) Aluminum foil-polyester shield.
4) 100 percent coverage of outer shield.
5) One pair AWG #22.
6) Tinned copper drain wire.
7) CPE outer jacket.
8) 300-volt insulation level.
9) Nominal OD 0.335 inch.

d. Meet NEC/UL specification for direct burial or wet locations.
e. Meet all Profibus specifications.
f. Be certified by Profibus when applicable.

4. Foundation Fieldbus cable:
   a. Tin, copper conductors with 7 by 26 standing (minimum).
   b. Polyolefin insulation.
   c. Aluminum foil-polyester shield.
   d. 100 percent coverage of outer shield.
   e. One pair AWG #18.
   f. Tinned copper drain wire.
   g. Chlorinated polyethylene (CPE) outer jacket.
   h. 300-volt insulation level.
   i. Nominal OD 0.253 inch.
5. ControlNet cable:
   a. Meets NEC/UL listed for wet locations.
   b. Conductor:
      1) RG-6 coaxial cable.
      2) AWG #18.
      3) Solid stranding.
      4) Bare copper-covered steel (BCCS).
   c. Insulation:
      1) PFE - Foam polyethylene.
      2) OD 0.18 inch.
      3) 300-volt rated.
   d. Inner jacket:
      1) Polyvinyl chloride.
   e. Outer shield:
      1) Quad shielded - tape/braid/tape/braid.
      2) 100 percent coverage.
   f. Outer jacket:
      1) PVC: Polyvinyl chloride.
      2) Sunlight resistant.
   g. Armoring/outer jacket:
      1) Interlocking.
      2) Armor material: Aluminum.
   h. Overall nominal OD 0.60 inch.
   i. Minimum bending radius: 7.3 inches.
   j. UL/CSA flame tested.
6. RS-485 cable:
   a. Two-wire:
      1) Shielded twisted pair.
      2) Tinned, copper conductors minimum with 7 by 30 stranding.
      3) AWG #22.

4) Insulation:
   a) FHDPE: Foam high-density polyethylene.
   b) 300-volt insulation level.
5) Outer shield:
   a) 100 percent coverage.
   b) Tape/braid.
   c) Aluminum foil-polyester tape.
   d) Tinned copper braid.
6) Outer shield drain wire:
   a) Tinned, copper conductor minimum with 7 by 30 stranding.
   b) AWG #22.
7) Outer jacket PVC:
   a) Sunlight resistant.
8) UL/CSA flame tested.
9) Minimum bending radius 2.5 inches.
10) Nominal OD 0.284 inch.

b. Four-wire:
1) Shielded twisted 2 pair.
2) Tinned, copper conductors minimum with 7 by 30 stranding.
3) AWG #22.
4) Insulation:
   a) FHDPE: Foam high-density polyethylene.
   b) 300-volt insulation level.
5) Outer shield:
   a) 100 percent coverage.
   b) Tape/braid.
   c) Aluminum foil-polyester tape.
   d) Tinned copper braid.
6) Outer shield drain wire:
   a) Tinned, copper conductor minimum with 7 by 30 stranding.
   b) AWG #22.
7) Outer jacket PVC: Polyvinyl Chloride.
   a) Sunlight resistant.
8) UL/CSA flame tested.
9) Minimum bending radius 3.6 inches.
10) Nominal OD 0.356 inch.

F. Tray cable:
1. Provide minimum size Number 1/0 AWG for single wires:
   a. Listed and identified on its surface as suitable for cable tray use, Type TC cable in accordance with the NEC.
2. Provide multi-conductor cable listed and identified on its surface as suitable for cable tray use, Type TC cable in accordance with the NEC.
   a. Provide with an integral white insulated conductor where a neutral is required.
3. Ambient temperature adjustment in accordance with the NEC.

G. Fire alarm cable:
1. Number of pairs: As indicated on the Drawings or as necessary for the application.
2. Voltage rating: 300 V minimum.
3. Two-hour fire rating in accordance with UL 2196.

4. Provide fire alarm cable in accordance with the requirements of UL 1424.
5. Provide Type FPLP (power-limited plenum rated) for all cabling within ducts, plenums, and all spaces used for air handling:
    a. Cable must meet NEC standards, and must have adequate fire-resistant and low smoke-producing characteristics.
6. Provide Type FPLR (power-limited riser rated) for all vertical runs that pass from floor to floor:
    a. FPLR cable must meet NEC standards, and must have fire-resistant characteristics capable of preventing the carrying of fire from floor to floor.
7. FPL (power-limited general purpose) is only suitable for general-purpose fire alarm use and shall not be used for risers, ducts, plenums, and in air-handling spaces:
    a. FPL cable must meet NEC standards, and must be listed as resistant to the spread of fire.
8. Cable substitutions are not permitted unless approved by Engineer.
9. Meets code requirements of NFPA 72 and NFPA 101.
10. Conductor insulation:
    a. Low smoke PVC.
    b. Minimum 105 degrees Celsius rating.
11. Conductor jacket:
    a. Low smoke PVC.
    b. Ripcord and surface-printed with year of manufacture and cable description at maximum 24-inch intervals.
    c. Minimum 105 degrees Celsius rating.

H. Telephone cable:
1. Number of twisted pairs: As indicated on the Drawings.
2. Voltage rating: 300 volts.
3. Insulation: Thermoplastic, color coded in accordance with telephone industry standards Section 16075 - Identification for Electrical Systems.
4. Insulation:
    a. Non-plenum: High molecular weight polyethylene.
    b. Plenum-rated: FEP.
5. Jacket:
    a. Non-plenum: PVC.
    b. Plenum-rated: Low smoke PVC.
    c. Surface-printed with year of manufacture and cable description at maximum 24-inch intervals.
6. 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.
7. Conductors: ASTM B3, solid, soft, bare copper.
8. Use minimum Number 24 AWG conductors, unless otherwise indicated on the Drawings.
9. Twist insulated conductors into pairs with varying lengths of lay.
10. Apply non-hygroscopic core tape over cable core as a dielectric and heat barrier.
11. Provide plenum-rated cable for wiring within ducts, plenums, and all spaces used for air handling.

I. Armored cable:
   1. Tight-fitting, continuously welded, corrugated impervious aluminum armor sheath applied over the cable core in accordance with UL 1569.
   2. PVC outer jacket.
   3. Comply with UL-2225 if within hazardous classification area.
   4. For multi-conductor cable, include a separate ground conductor in the cable:
      a. An internal ground conductor may be used, if it is no smaller than indicated on the Drawings, and meets NEC requirements for equipment ground conductor size.
      b. The cable armor is not acceptable as a ground conductor.
   5. Rated for 90 degrees Celsius in wet or dry locations.
   6. Color-coding for control wire in accordance with ICEA Method 1, E-2.
   7. Color-coding for power cables as specified above.
   8. Individual conductors in accordance with this Specification:
      a. Provide the number and size of conductors as indicated on the Drawings.

1.13 ACCESSORIES

A. Wire ties:
   1. One of the following or equal:
      a. T&B "Ty-Rap" cable ties.
      b. Panduit cable ties.

B. Wire markers:
   1. As specified in Section 16075 - Identification for Electrical Systems.

1.14 SOURCE QUALITY CONTROL

A. Assembly and testing of cable shall comply with the applicable requirements of ICEA S-95-658-1999.

B. Test Type XHHW-2 in accordance with the requirements of UL 44.

1.15 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Color-coding:
   1. Color-coding shall be consistent throughout the facility.
   2. The following color code shall be followed for all 240/120 volt and 208/120 volt systems:
      a. Phase A - Black.
      b. Phase B - Red.
      c. Phase C - Blue.
      d. Single phase system - Black for one hot leg, red for the other.
      e. Neutral - White.
      f. High phase or wild leg - Orange.
      g. Equipment ground - Green.
   3. The following color code shall be followed for all 480/277 volt systems:
      a. Phase A - Brown.
      b. Phase B - Orange.
      c. Phase C - Yellow.
      d. Neutral - Gray.

e. Equipment ground - Green.

4. The following color code shall be followed for all 120 VAC control wiring:
   a. Power - Red.
   b. Neutral - White.
5. The following color code shall be followed for all general purpose DC control circuits:
   a. Grounded conductors - White with blue stripe.
   b. Ungrounded conductors - Blue.
6. Switch legs shall be violet. Three-way switch runners shall be pink.
7. Wires in intrinsically safe circuits shall be light blue.
8. Wire colors shall be implemented in the following methods:
   a. Wires manufactured of the desired color.
   b. Continuously spiral wrap the first 6 inches of the wire from the termination point with colored tape:
      1) Colored tape shall be wrapped to overlap 1/2 of the width of the tape.

C. Install conductors only after the conduit installation is complete, and all enclosures have been vacuumed clean, and the affected conduits have been swabbed clean and dry:
   1. Install wires only in approved raceways.
   2. Do not install wire:
      a. In incomplete conduit runs.
      b. Until after the concrete work and plastering is completed.

D. Properly coat wires and cables with pulling compound before pulling into conduits:
   1. For all Number 4 AWG and larger, use an approved wire-pulling lubricant while cable is being installed in conduit:
      a. Ideal Products.
      b. Polywater Products.
      c. 3M Products.
      d. Greenlee Products.
      e. Or equal as recommended by cable manufacturer.
      f. Do not use oil, grease, or similar substances.

E. Cable pulling:
   1. Prevent mechanical damage to conductors during installation.
   2. For cables Number 1 AWG and smaller, install cables by hand.
   3. For cables larger than Number 1 AWG, power pulling winches may be used if they have cable tension monitoring equipment.
   4. Provide documentation that maximum cable pulling tension was no more than 75 percent of the maximum recommended level as published by the cable manufacturer. If exceeded, the Engineer may, at his discretion, require replacement of the cable.
   5. Ensure cable pulling crews have all calculations and cable pulling limitations while pulling cable.
   6. Make splices or add a junction box or pullbox where required to prevent cable pulling tension or sidewall pressure from exceeding 75 percent of manufacturer’s recommendation for the specified cable size:
      a. Make splices in manholes or pull boxes only.
      b. Leave sufficient slack to make proper connections.

F. Use smooth-rolling sheaves and rollers when pulling cable into cable tray to keep pulling tension and bending radius within manufacturer’s recommendations.

G. Install and terminate all wire in accordance with manufacturer's recommendations.

H. Neatly arrange and lace conductors in all switchboards, panelboards, pull boxes, and terminal cabinets by means of wire ties:
   1. Do not lace wires in gutter or panel channel.
   2. Install all wire ties with a flush cutting wire tie installation tool:
      a. Use a tool with an adjustable tension setting.
   3. Do not leave sharp edges on wire ties.

I. Terminate stranded conductors on equipment box lugs such that all conductor strands are confined within the lug:
   1. Use ring type lugs if box lugs are not available on the equipment.

J. Lighting circuits:
   1. Each circuit shall have a dedicated neutral.

K. Splices:
   1. Provide continuous circuits from origin to termination whenever possible:
      a. Obtain Engineer’s approval prior to making any splices.
   2. Lighting and receptacle circuit conductors may be spliced without prior approval from the Engineer.
   3. Where splices are necessary because of extremely long wire or cable lengths that exceed standard manufactured lengths:
      a. Splice box NEMA rating requirements as specified in Section 16050 - Common Work Results for Electrical.
      b. Make splices in labeled junction boxes for power conductors.
      c. Make splices for control and instrument conductors in terminal boxes:
         1) Provide terminal boards with setscrew pressure connectors, with spade or ring lug connectors.
   4. Power and control conductors routed in common raceways may be spliced in common junction boxes.
   5. Clearly label junction and terminal boxes containing splices with the word "SPLICE LOCATED WITHIN”.
   6. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.
   7. Install splices with compression type butt splices and insulate using a heat-shrink sleeve:
      a. In NEMA Type 4 or NEMA Type 4X areas, provide heat-shrink sleeves that are listed for submersible applications.
   8. Splices in below grade pull boxes, in any box subject to flooding, and in wet areas shall be made waterproof using:
      a. A heat shrink insulating system listed for submersible applications.
      b. Or an epoxy resin splicing kit.

L. Apply wire markers to all wires at each end after being installed in the conduit and before meg-ohm testing and termination.

M. Instrumentation class cable:
   1. Install instrumentation class cables in separate raceway systems from power cables:

a. Install instrument cable in metallic conduit within non-dedicated manholes or pull boxes.
b. Install cable without splices between instruments or between field devices and instrument enclosures or panels.

2. Do not make intermediate terminations, except in designated terminal boxes as indicated on the Drawings.
3. Shield grounding requirements as specified in Section 16060 - Grounding and Bonding.

N. Multi-conductor cable:
1. Where cable is not routed in conduit with a separate ground conductor, use one conductor in the cable as a ground conductor:
a) Use an internal ground conductor, if it is no smaller than as indicated on the Drawings and in accordance with NEC requirements for equipment ground conductor size.
b) Where 2 parallel cables are used, and the internal ground conductor in each cable does not meet NEC requirements for the combined circuit, use 4-conductor cable, with one of the full-sized conductors serving as ground.

O. Armored cable:
1. Where 2 parallel cables are used, and the internal ground conductor in each cable does not meet NEC requirements for the combined circuit, use 4-conductor cable, with 1 of the full-sized conductors serving as ground.
2. The cable armor is not acceptable as a ground conductor.
3. Where armored cable terminates at a device, switchboard, panel, etc., use armored cable connector.
4. Where armored cable run continues in conduit, strip jacket and armor for portions in conduit, and terminate cable and jacket with an armored cable connector threaded into a coupling or conduit box.

P. Telephone cable:
1. Install telephone cables in dedicated metallic raceways, including raceways in duct banks, manholes, and pull boxes.

Q. Fire alarm cable:
1. Install fire alarm cable in dedicated metallic raceways as indicated on the Drawings.

R. Signal cable:
1. Separate and isolate electrical signal cables from sources of electrical noise and power cables by minimum 12 inches.

S. Submersible cable in wet wells:
1. Provide Kellem’s grip or stainless steel wire mesh to support cable weight and avoid stress on insulation.

T. Wiring allowances:
1. Equipment locations may vary slightly from the drawings. Include an allowance for necessary conductors and terminations for motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of locations indicated on the Drawings.

2. Locations for pull boxes, manholes, and duct banks may vary slightly from the drawings. Include an allowance for necessary conductors and related materials to provide conductors to all pull boxes, manholes and duct banks within 20 linear feet of locations indicated on the Drawings.

1.16 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

1.17 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Grounding:
   1. As specified in Section 16060 - Grounding and Bonding.

1.18 PROTECTION

A. As specified in Section 16050 - Common Work Results for Electrical.

END OF SECTION

SECTION 16125

FIBER OPTIC CABLE AND APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fiber optic cable.
   2. Fiber splices and terminations.
   3. Accessories.

B. Furnish a complete fiber optic network as indicated on the Drawings.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Bellcore Standards:
   1. GR-409, “Generic Requirements for Intrabuilding Fiber.”

C. Electronic Industry Association (EIA) 455B "Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components":
   1. FOTP-25 - Repeated Impact testing of Fiber Optic Cables and Cable Assemblies.
   2. FOTP-33 - Fiber Optic Cable Tensile Loading and Bending Test.
   3. FOTP-41 - Compressive Loading Resistance of Fiber Optic Cables.
   4. FOTP-81 - Compound Flow (Drip) Test for Filled Fiber Optic Cable.
   5. FOTP-104 - Fiber Optic Cable Cyclic Flexing Test.
   6. FOTP-181 - Lightning Damage Susceptibility Test for Fiber Optic Cables with Metallic Components.

D. Insulated Cable Engineer’s Association (ICEA):
   1. S-83-596, “Optic Fiber Premises Distribution Cables.”
   2. S-87-640, “Optic Fiber Outside Plant Communications Cable.”
   3. S-104-696, “Fiber Optic Premises Distribution Cables.”

E. TIA/EIA Standards:
   1. 598, “Color Coding of Fiber Optic Cables.”

F. Underwriters Laboratories, Inc. (UL):
   1. 1666 - Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.
   2. 1685 - Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.

1.03 DEFINITIONS

A. As specified in Sections 16050 - Common Work Results for Electrical and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definition:
   1. N/Cm: Newtons per centimeter.

1.04 SYSTEM DESCRIPTION

A. This facility currently contains an existing fiber optic cable system. This SCADA upgrade project is going to attempt to reuse the existing fiber cable system within the facility. Therefore the purpose of this specification is to provide the contractor with the requirements for testing the existing fiber optic cable system and if the fiber is not acceptable per the testing, the requirements for new cabling.

B. The contractor shall test all existing fiber optic cables and systems in accordance with section 16125-3.08 and provide the Owner with a submittal per 16125-1.05 F.

C. Any fiber optic cable not acceptable per the above reference testing shall be replaced by the contractor per these specifications.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
   1. Complete manufacturer's brochures that identify materials and options.
   2. Completed data sheets, including catalog number and source for determining catalog number.
   3. Manufacturer's installation instructions.
   4. Include the following:
      a. Manufacturer's data on testing equipment used on this project.
      b. Manufacturer's specifications and data sheets for all fiber types.
      c. Manufacturer's specifications and data sheets for all connectors, bulkheads, splicing kits, breakout devices, and appurtenances used connecting and terminating the fiber spans.
   5. Catalog data on all testing devices proposed for use plus certifications of accuracy, calibration, and traceability to standards of the NIST.
   6. Manufacturer's test procedures and quality assurance procedures:
      a. After review, the Engineer may require that additional tests be performed before installation.

C. Shop drawings:
   1. Interconnection cabling diagrams for the complete system including every fiber in each cable.
   2. Drawings indicating the locations of all pull boxes including pull box identifiers and lengths.
   3. Submit optical power budget calculations for all fiber segments. Include the following:
      a. Minimum transmit power of active devices.
      b. Minimum receive sensitivity.

c. Available power, in dBm.
d. Loss for each segment in dBm, including cable attenuation and connector losses. Use manufacturer's data for cable attenuation, at the wavelength to be used. Assume 0.5 dB per connector.
e. Demonstrate that remaining power budget at each receiver is equal to or greater than 3.0 dBm.

D. Installation instructions:
1. Submit a cable pulling and splicing work plan a minimum of 45 days before the planned initiation of cable pulling. The cable pulling and splicing work plan must be approved a minimum of 15 days before pulling cable. Include the following:
a. Pull tension calculations.
b. Detailed description of pull operation methods for all conduit runs.
c. Tools and equipment to be used for cable installation and testing.
d. Physical location of equipment setup and type.
e. Exact locations of splice points.
f. Safety and manual assist cable-pulling operations.
g. Detailed schedule for pulling and testing cables.
h. The name and qualifications of the supervisory personnel directly responsible for the installation of the conduit system.
i. Sample fiber optic cable test sheets.
j. All signed test sheet results.

E. Operation and maintenance manuals:
1. Compile completed test reports, instruction manuals, and manufacturer's information into the operating manuals and submitted in accordance with Section 01782 - Operation and Maintenance Data.

F. Test reports:
1. Submit the results of all specified tests to the Engineer.
2. Submit 3 copies of all test reports showing the results of all tests specified herein:
a. Test forms shall include the following information at a minimum:
1) Test type.
2) Test location.
3) Test date.
4) Wavelength.
5) Index of refraction.
6) Cable identification.
7) Fiber type.
8) Fiber number.
9) Fiber color.
10) Result of the value of the tested parameter.
3. Furnish hard copy and electronic copy for all OTDR traces.
4. Submit certification that the fiber optic cable has passed each testing stage:
a. Submit separate documentation for each testing stage result.

G. Record documents:
1. Furnish updated electrical drawings, network diagrams, and fiber cable block diagrams at the end of construction and submit as Record Drawings.

H. Calculations:
    1. Cable pulling calculations for all conduit runs:
        a. Indicate on the submittal any additional pull boxes that are required, including pull box identifiers and a written description of the location.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Furnish all cable and appurtenances manufactured within 1 year of installation.

C. Proof test all optical fibers by the fiber manufacturer at a minimum load of 50 kpsi.

D. Provide 100 percent attenuation testing for all optical fibers:
    1. Include with each cable reel the attenuation of each fiber.

E. Provide information on at least 5 successful fiber optic cable installations of comparable size and complexity in the past 3 years with name, address, and telephone number of facility owner, name of project with completion date, and type of conduit system and length of cable pulled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Package the cable for shipment on wooden reels:
    1. Seal both ends of the cable to prevent the ingress of moisture.
    2. Place fiber cable assemblies on reels such that both cable ends are available for testing.
    3. Weatherproof cable reel markings shall include the following:
        a. Manufacturer.
        b. Date of manufacture.
        c. Shipping date.
        d. Cable identification.
        e. Cable configuration/fiber count.
        f. Cable length.
        g. Gross weight.
        h. Cable test date.
        i. Handling instructions.
        j. Direction to unreel.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.09 SEQUENCING

A. Testing:
    1. Perform testing of each fiber in each cable as follows:
        a. At the factory before shipment.
        b. At the project site upon delivery.
        c. After installation, before breakout and terminations.
        d. After installation is complete.

2. Submit test reports following each set of tests as specified in this Section.

B. Notify the Engineer and Owner a minimum of 15 days before post-installation testing.

1.10 SCHEDULING

A. As specified in Section 16050 - Common Work Results for Electrical.

1.11 WARRANTY

A. As specified in Section 16050 - Common Work Results for Electrical.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers are indicated with each component type as listed in the remainder of this specification.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. General fiber cable requirements:
   1. Suitable for the installed environment.
   2. Color-coded fibers according to EIA/TIA-598.
   3. Color-coded buffer tubes according to EIA/TIA-598.
   4. Furnish buffer tubes of a single layer nylon construction or of a material with similar mechanical performance.
   5. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.
   6. Utilize a glass reinforced plastic rod as the central anti-buckling member.
   7. Apply binders with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes:
      a. Provide binders that are:
         1) Non-hygroscopic.
         2) Non-wicking (or rendered so by the flooding compound).
         3) Dielectric with low shrinkage.
   8. Provide a minimum of 1 ripcord under the cable sheath.
   9. Provide the high tensile strength Aramid yarns, Kevlar, and/or fiberglass helically stranded evenly around the cable core:
      a. No metallic elements whatsoever are allowed in non-armored cable.
   10. The jacket or sheath shall be free of holes, splits, and blisters.

11. Mark the jacket or sheath with:
    a. Manufacturer's name.
    b. The words "Optical Cable”.
    c. Year of manufacture.
    d. Sequential meter marks.
    e. Repeat markings every 1-meter.
    f. The actual length of the cable to be within 1 percent of the length marking.
    g. The marking must be in a contrasting color to the cable jacket.
    h. The height of the marking:
        1) Approximately 2.5 millimeters.
12. The shipping, storage, and operating temperature range of the cable shall be -40 degrees Celsius to +70 degrees Celsius.
13. General performance characteristics:
    a. The rated tensile load of the cables:
        1) 2,670 N (600 lbf) for armored cables, 1,334 N (300 lbf) for non-armored cables.
        2) Maximum fiber strain within a cable no greater than 60 percent of the fiber proof test level.
    b. Non-armored fiber optic cables: Compressive load withstand of 220 N/cm applied uniformly over the length of the cable.
    c. Armored fiber optic cables: Compressive load withstand of 440 N/cm applied uniformly over the length of the cable.
    d. The average increase in attenuation for the fibers: Less than or equal to 0.10 dB at 1,550 nm for a cable subjected to this load:
        1) With no measurable increase in attenuation after load removal.
    e. Test in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cable,” except that the load must be applied at the rate of 3 millimeters to 20 millimeters per minute and maintained for 10 minutes.
    f. Capable of withstanding 25 cycles of mechanical flexing at a rate of 30 within 1 cycles/minute.
    g. The average increase in attenuation for the fibers: Less than or equal to 0.10 dB at 1,550 nm at the completion of the test.
    h. For armored cables, any visible cracks causing separation of the armor and propagating more than 5 millimeters constitutes failure.
    i. Outer cable jacket cracking or splitting observed under 10X times magnification, constitutes failure.

B. Outside plant cable:
1. General:
    a. Application: Outside of structures.
2. Cable construction:
    a. Cable type: Outdoor only:
        1) Completely preventing the entrance of water.
    b. Fiber count: 12 strand.
    c. Fiber type: Multimode.
    d. Buffer tube: Loose tube.
    e. Armoring: None
    f. Strength member: Central nonmetallic strength member with a coefficient of thermal expansion similar to the fibers.
    g. Design and test criteria: In accordance with ICEA S-87-640.

3. Where required, fill each buffer tube with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel, that is free from dirt and foreign matter:
    a. The gel to be readily removable with conventional non-toxic solvents.
4. Armored cables constructed with an inner sheath of low or medium density polyethylene:
    a. Minimum inner sheath jacket thickness of 0.5 millimeters.
    b. Armor constructed of a corrugated stainless steel tape, plastic-coated on both sides for corrosion resistance, and applied with an overlapping seam with the corrugations in register.
    c. Recoat all armor splices with plastic to further enhance the armor's corrosion resistance.
    d. Outer jacket:
        1) Apply over the corrugated steel tape armor.
        2) Low or medium density polyethylene with a minimum nominal jacket thickness of 1.25 millimeters.
        3) Provide the polyethylene containing carbon black to provide ultraviolet light protection and that does not promote the growth of fungus.
5. Loose-tube cables shall exhibit no flow (drip or leak) at 80 degrees Celsius:
    a. Weight of any compound that drips from the sample: Less than 0.05 grams (0.002 ounce).
    b. Test a representative sample of cable in accordance with FOTP-81:
        1) Prepare the test sample in accordance with method A.
6. Manufacturers: One of the following or equal:
    a. ADC/KRONE, loose tube outside plant cable.
    b. Berk-Tek.
    c. Corning Cable Systems.
    d. Pirelli.

C. Indoor cable:
1. General:
    a. Application: The interior of structures where exposure to moisture can be minimized.
2. Cable construction:
    a. General:
        1) Cable type: Indoor - Flame retardant, low smoke, zero halogen.
        2) Fiber count: 12 strand.
        3) Fiber type: Multimode.
        4) Buffer tube: Loose tube.
        5) Armoring: None.
        6) Strength member: Central nonmetallic strength member with a coefficient of thermal expansion similar to the fibers.
        7) Approvals and Listings: NEC OFN approved for general purpose indoor applications.
        8) Design and test criteria: In accordance with ICEA S-83-596.
    b. Testing:
        1) All fibers in the cable: proof test of 100 kpsi.
        2) Each optical fiber: Bellcore GR-409 strip force testing.
        3) No gaps are allowed between the coating material and the buffer material, visible under a 50-power microscope.
    c. Outer jacket material:

1) Linear low-density polyethylene.
2) Color: Black.
3) Meet all requirements of the NEC for use in all indoor areas (excluding plenums) without being enclosed in conduit.
4) Flame retardant riser rated conforming to UL 1666.
5) Printed with all necessary UL marks and manufacturer identification.
6) With sequential printing of footage in 2-foot increments.
7) With a ripcord incorporated under the cable jacket.

D. Indoor/outdoor cable:
1. General:
a. Application: Interior and exterior of buildings.
2. Cable construction:
a. General:
1) Cable type: Indoor/Outdoor - Flame retardant, low smoke, zero halogen, UV resistant.
2) Fiber count: 12 strand.
3) Fiber type: Multimode.
4) Buffer tube: Loose tube.
5) Armoring: None.
6) Waterproofing: Water blocking layer.
7) Strength member: Central nonmetallic strength member with a coefficient of thermal expansion similar to the fibers.
8) Approvals and listings: UL 1666 and UL 1685.
9) Design and test criteria: In accordance with ICEA S-104-696.
b. Testing:
1) All fibers in the cable:
a) Proof test of 100 kpsi.
b) Each optical fiber: Bellcore GR-409 strip force testing.
c) No gaps are allowed between the coating material and the buffer material visible under a 50-power microscope.
c. Outer jacket material:
1) Linear low-density polyethylene.
2) Color: black.
3) Meet all requirements of the NEC for use in all indoor/outdoor areas (excluding plenums) without being enclosed in conduit.
4) Flame retardant OFNR riser rated conforming to UL 1666.
5) Printed with all necessary UL marks and manufacturer identification.
6) Sequential printing of footage in 2-foot increments.
7) With a ripcord incorporated under the cable jacket.
d. Manufacturers: One of the following or equal:
1) Corning Cable Systems, Freedm® LST (OFNR Loose-Tube).
2) Krone, LSZH Indoor/Outdoor (OFNR) distribution cables.

E. Single mode fibers:
1. All fibers in the cable must be usable fibers and meet required specifications.
2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.
3. Single mode fiber characteristics:
a. Fiber type: Single mode.
b. Core diameter: 8.2 within 2.5 µm.
c. Clad diameter: 125 within 0.7µm.

d. Cladding non-circularity: Less than .7 percent.
e. Numerical aperture: 14 within 0.015.
f. Maximum attenuation: .4 dB/km at 1,310 nm, .3 dB/km at 1,550 nm.
g. Gigabit Ethernet distance: 5,000 m at 1,310 nm.
h. Coating diameter: 245 within 5 µm.
i. Cabled cutoff wavelength: Less than 1,260.
j. Mode-field diameter: 9.2 within 0.4 µm at 1,310 nm, 10.4 within 0.5 µm at 1,550 nm.
k. Zero dispersion wavelength: 1,313 nm.
l. Dispersion slope: 0.086 ps/(nm^2*km).

4. Manufacturers: One of the following or equal:
   a. ADC/KRONE Group.
   b. Berk-Tek.
   c. Corning Cable Systems.

F. Multimode fibers:
1. All fibers in the cable must be usable fibers and meet required specifications.
2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.
3. Multimode fiber characteristics:
   a. Fiber type: Multimode.
   b. Core diameter: 62.5 within 2.5 µm.
   c. Clad diameter: 125 within 2.0 µm.
   d. Core-to-cladding offset: 3.0 µm.
   e. Cladding non-circularity: Less than 1 percent.
   f. Numerical aperture: 0.275 within 0.015.
   g. Maximum attenuation: 3.5 dB/km at 850 nm, 1 dB/km at 1,300 nm.
   h. Minimum bandwidth: 200 MHz*Km at 850 nm, 500 MHz*Km at 1,300 nm.
   i. Coating diameter: 245 within 5 µm.
   j. Cabled cutoff wavelength: N/A.
   k. Mode-field diameter: N/A.
   l. Zero dispersion wavelength: N/A.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Patch cords:
1. General:
   a. Connector types to match supplied equipment and the patch panel terminations.
   b. Maximum length of patch cords: 25 feet.
   c. Provide 2 spare patch cords (or 1 duplex patch cord) of each type used at each PLC or network cabinet.
   d. Factory assembled and optically tested.
2. Manufacturers: One of the following or equal:
   a. Krone.
   b. Corning Cable Systems.

B. Fiber connectors:
   1. As specified in Section 17733 - Control Systems: Network Materials and Equipment.

C. Fiber optic identification/warning tags:
   1. Black letters on orange or yellow background.
   2. UV resistant polyethylene or other suitable material.
      a. Manufacturers: The following or equal.
         1) Almetek.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify the condition of the conduit system before installation of the fiber optic cable or inner duct.

B. Pass a test mandrel through all fiber optic conduits prior to pulling fiber or installing inner duct.
   1. Run the mandrel in both directions.

C. Examine all materials and equipment before installation and verify they are free from physical damage and defects.

3.02 PREPARATION

A. Before fiber splicing terminating or testing activities, verify sufficient workspace is available to perform the activity without interferences from other trades.

B. Pre-installation test:
   1. Conduct pre-installation tests on all fiber optic cable.
   2. Upon arrival at the site:
      a. Inspect the cable and reel for damage.
      b. Test all fibers with an optical time domain reflectometer (OTDR) for fiber integrity.
      c. Verify that the fiber lengths are consistent with the cable manufacture.
      d. Verify that all traces yield no point discontinuities.
   3. Complete test sequence and obtain approval from the Engineer of submitted test results before cable installation:
      a. Replace any cable failing to meet the requirements of the required tests and test before installation.
   4. Submit copies of the test results to the Engineer within 5 days after the delivery to the site.

3.03 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Install fiber optic patch cords in open network trays or in dedicated conduits no longer than 25 feet in length.

C. Install all fiber optic system components in accordance with the recommendations of the manufacturer.

D. Install fiber optic cable in continuous lengths without intermediate splices, except where approved by the Engineer.

E. Installation:
   1. Utilize personnel certified by the manufacturer with specific knowledge of the cable manufacturer's recommended procedures:
      a. Schedule Engineer, 5 days before installation, to witness all cable installations.
   2. Properly attach the fiber optic cable's strength elements to a 600-pound breakaway swivel containing tension or shear pins using Kellums pulling grips that are a minimum of 18 inches long.
   3. Certify that cable tensile limits do not exceed cable pull tension and bend limits using tension monitoring devices.
   4. Leave an extra loop of fiber optic cable in each pull box.
   5. Conform with the cable manufacturer's specifications, practices, and the following requirements:
      a. When power equipment is used to install fiber optic cables, use low speeds and do not exceed a rate of 30 meters per minute.
      b. Do not exceed the tensile and bending limitation for fiber optic cables under any circumstances.
      c. Use large diameter wheels, pulling sheaves, and cable guides to maintain the specified bending radius.
      d. Use commercial dynamometers or load cells to monitor pulling tension.
      e. A nonfreezing type of swivel inserted between the pulling line and cable pulling grip to prevent twisting under strain.
      f. All cable to be installed using a breakaway swivel.
   6. Apply to all conduits a lubricant at each conduit ingress and egress location during the pull operation:
      a. Pour or pump lubricant into the end of the conduit at the feed location at a nominal application rate of 3 gallons per 1,000 feet of cable.
      b. If the conduit is open at intermediate locations, then apply the appropriate proportion of lubricant at each opening.
      c. Continuously lubricate the cable as it is being pulled by pouring or pumping the lubricant into the conduit at the feed location and at each intermediate location.
      d. Station workers at each intermediate location as required.
      e. Remove all excess lubricant that has collected.
      f. Remove and clean the surrounding area after cable installation.
   7. Install using a hydraulic capstan or winch equipped with a recording running line dynamometer graph which measures and records pulling tensions:
      a. Use pulling equipment with "slip-load" capability to allow the winch to maintain a constant pulling force without taking up the winch line.

b. Use pulling equipment equipped with a hydraulic bypass set so that a maximum tension of 600 pounds is not exceeded.
c. Use only equipment designed to prevent a preset pulling tension from being exceeded.
d. Fiber optic cable manufacturer to provide the pulling tension setpoint.
e. If during the pulling operation excessive tension is detected, cease all operations and notify the Engineer.

8. Position the cable reel at the feed point in alignment with the raceway and in such a position that the cable can be passed from the top of the reel in a long, smooth bend into the raceway system:
   a. The use of a cable feeder is required, unless the cable is hand-pulled.
9. Supply all bull wheels, blocks, split wheels, cable feeders, and necessary equipment required to provide a clean and safe operation:
   a. The cable shall not be allowed to travel over any wheel or block that has a radius less than the minimum radius allowed by the cable manufacturer.
10. Minimize the use of snatch blocks and rollers to guide the cable into the conduit at the feed point:
    a. Slack feed by hand the cable into the feed point and raceway without the use of rollers.
11. Tend the cable reel at all times and turn by hand to provide the required cable slack:
    a. Under no circumstances shall the cable tension be allowed to turn the cable reel.
12. Use a rim roller, with a wheel radius greater than the minimum cable bending radius placed at the manhole or vault opening to prevent the cable from dragging on the manhole rim or steps.
13. Perform a continuous thorough visual inspection for flaws, breaks, and abrasions in the cable sheath as the cable leaves the reel, and maintain a slow pulling speed to permit this inspection.
14. Damage to the sheath or finish of the cable is cause for rejecting the cable:
    a. Replace any cable damaged in any way during installation.
15. If the cable becomes damaged during installation, stop operations and notify the Engineer immediately:
    a. Engineer to determine whether to replace the entire reel of cable or to install a termination panel to eliminate the damaged section.
16. Document all pulls by a graph which is annotated with the following information:
    a. Reel number.
    b. Pull point ID.
    c. Date and time.
    d. Explanations for abnormalities in readings or interruptions.
    e. Sign-off by Contractor and Engineer.
17. Under no conditions shall the fiber optic cable be left exposed or unattended.

F. After the cables are installed and spliced:
   1. Rack the cables.
      a. Loosely secure in racked position with wire ties.
      b. Attach imprinted plastic coated cloth identification/warning tags to each cable in at least 2 locations in each handhole/manhole.

G. Armored fiber optic cables containing metallic members shall be grounded in accordance with NEC.

H. Splices:
1. Submit all splice locations to the Engineer for approval before installation of the fiber cables.
2. Provide field splices in a splice tray located in a waterproof splice enclosure:
a. Manufacturers: The following or equal:
1) Tyco/Raychem, FOSC style splice enclosure.
3. Loop the individual fibers a minimum of 1 full turn within the splice tray to avoid macro/micro bending.
4. After completion of cable terminations, neatly dress all cables.
5. Protect all splices with a thermal shrink sleeve.
6. Provide fusion type fiber optic cable splicing meeting the following requirements:
a. Joins multimode or single mode fibers.
b. Establishes a permanent fusion splice.
c. Waterproof.
d. Re-enterable, rearrangable, and reusable.
e. Splice loss less than 0.10 dB.
f. Protected by a splice enclosure.
7. Requirement for outdoor fiber splice enclosures:
a. Seal.
b. Bond.
c. Anchor.
d. Protect fiber optic cable splices.
e. Stand-alone unit that does not require an outer enclosure.
f. Provide for a maximum of 6 cable entries in a butt-end configuration.
g. Used in aerial, underground, and direct buried applications.
8. Requirement for indoor fiber splice enclosures:
a. Anchor.
b. Protect fiber optic cable splices.
c. Stand-alone unit that does not require an outer enclosure.
d. Suitable for the minimum number of splices at that location plus additional capacity for reconfigurations.
9. Re-splice any splice that has a loss greater than 0.10 dB.
10. Leave a minimum of 20 feet of fiber optic cable at each end of splice.

I. Terminations:
1. Terminate all fiber inside a patch panel.
a. Direct landing to a switch, router hub, or PLC will not be allowed.
2. Terminate outdoor cables using a breakout kit that seals the cable and provides physical protection for the fiber strands.
3. Terminate indoor cables using breakout kits with field installed terminators.
4. Labeling:
a. Permanently label all cable terminations. Use labels produced by a wire printer using pressure sensitive polyester labels. Label patch panels as specified in Section 16075 - Identification for Electrical Systems.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Factory test:
   1. Before shipment and while on the shipping reel, test 100 percent of all fibers for attenuation:
      a. Copies of the results shall be:
         1) Maintained on file.
         2) Attached to the cable reel in a waterproof pouch.
         3) Submitted before the delivery of the cable to the job site to Engineer for approval.
   2. Conduct the flex test in accordance with FOTP-104 test condition I and III with a maximum sheave diameter of 20 times the cable OD.
   3. Verify that the cable withstands 25 impact cycles with:
      a. The average increase in attenuation for the fibers less than 0.20 dB at 1,550 nm.
      b. No evidence of cracking or splitting.
      c. Conduct the test in accordance with FOTP-25.
   4. Certify that the cable withstands a tensile load of 2,700 N (600 pounds):
      a. Without exhibiting an average increase in attenuation of greater than 0.10 dB.
      b. Test in accordance with FOTP-33 using a maximum mandrel and sheave diameter of 560 millimeters.
      c. Apply the load for 1 hour in Test Condition II.
   5. Certify that the cable withstands a simulated lightning strike:
      a. Peak value of the current pulse greater than 105kA.
      b. Use a test current with a damped oscillatory maximum time-to-peak value of 15 µs (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz.
      c. The time to half-value of the waveform envelope 40 to 70 µs.
      d. Conduct the test in accordance with the FOTP-181.
      e. In addition to the analysis criterion set forth in FOTP-181, the integrity of the buffer tubes (or analogous loose tube, i.e. core tube) and strength members must be intact after removal of the cable specimens from the test box.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

B. General:
   1. All test results shall meet or exceed manufacturer specifications:
      a. Test each fiber of each cable for breaks, abnormalities, and overall attenuation characteristics.
      b. Replace any fiber that does not meet or exceed manufacturer specifications.
   2. Pre-installation tests and post-installation tests to be witnessed and signed off by Engineer and Owner.
   3. Perform attenuation tests with an optical loss test set capable and calibrated to show anomalies of 0.1 dB as a minimum:
      a. Test multimode fibers at 850 nm and 1,300 nm.

b. Test single mode fibers at 1,310 and 1,550 nm.

4. Perform OTDR tests on fiber cables less than 100 meters with the aid of a launch cable:
   a. Adjust OTDR pulse width settings to a maximum setting of 1/1000th of the cable length or 10 nanoseconds.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. Clean all fiber optic connectors after termination and before testing. After cleaning, cover all un-terminated connectors with a protective boot.

B. At the completion of construction, touch up the finish on all fiber patch panels and enclosures.

3.11 PROTECTION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Protect the fiber system from physical damage and the encroachment of dust, before, during, and after installation.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16130

CONDUITS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Metallic conduits.
   2. Nonmetallic conduits.
   3. Conduit bodies.
   4. Conduit fittings and accessories.
   5. Conduit installation.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. American National Standards Institute (ANSI):
   1. C80.1 - Electrical Rigid Steel Conduit.
   2. C80.3 - Steel Electrical Metallic Tubing.
   3. C80.5 - Electrical Rigid Aluminum Conduit.
   4. C80.6 - Electrical Intermediate Metal Conduit.

C. National Electrical Manufacturer's Association (NEMA):
   1. RN-1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Steel Conduit.
   2. TC2 - Electrical Polyvinyl Chloride (PVC) Conduit.
   3. TC3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   4. TC7 - Smooth-Wall Coilable Electrical Polyethylene Conduit.
   5. TC13 - Electrical Nonmetallic Tubing.
   6. TC14 - Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

D. Underwriters Laboratories (UL):
   1. 1 - Standard for Flexible Metal Conduit.
   2. 6 - Standard for Electrical Rigid Metal Conduit - Steel.
   3. 6A - Standard for Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel.
   4. 360 - Standard for Liquidtight Flexible Steel Conduit.
   5. 651 - Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
   6. 651B - Standard for Continuous Length HDPE Conduit.
   7. 797 - Standard for Electrical Metallic Tubing - Steel.
   8. 1242 - Standard for Electrical Intermediate Metal Conduit - Steel.
   9. 1653 - Standard for Electrical Nonmetallic Tubing.
   10. 1660 - Standard for Liquidtight Flexible Nonmetallic Conduit.
   11. 1684 - Standard for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions and abbreviations:
   1. Conduit bodies: A separate portion of a conduit system that provides access through a removable cover to the interior of the system at a junction of 2 or more conduit sections. Includes, but not limited to, Shapes C, E, LB, T, X, etc.
   2. Conduit fitting: An accessory that primarily serves a mechanical purpose. Includes, but not limited to, bushings, locknuts, hubs, couplings, reducers, etc.
   3. PVC: Polyvinyl chloride rigid nonmetallic conduit.
   4. RAC: Rigid aluminum conduit.
   5. NPT: National pipe thread.

1.04 SYSTEM DESCRIPTION

A. Provide conduits, conduit bodies, fittings, junction boxes, and all necessary components, whether or not indicated on the Drawings, as required, to install a complete electrical raceway system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
   1. Furnish complete manufacturer’s catalog sheets for every type and size of conduit, fitting, conduit body, and accessories to be used on the Project.
   2. Furnish complete manufacturer’s recommended special tools to be used for installation if required.

C. Shop drawings:
   1. Furnish conduit routing plans for all conduits before the installation of any conduit.
   2. Detail the intended routing of each conduit, conduit material and include supporting methods.

D. Record Documents:
   1. Incorporate all changes in conduit routing on electrical plan drawings.
   2. Dimension underground and concealed conduits from building lines.
   3. Furnish hard copy drawings.

E. Installation drawings: Installation drawings, including individual conduit numbers, routing, sizes, cable sizes, and circuit numbers for each conduit.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050 - Common Work Results for Electrical.

B. All conduits, conduit bodies, and fittings shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Do not expose non-metallic conduit to direct sunlight.

C. Do not store conduit in direct contact with the ground.

D. Do not store aluminum conduit in contact with concrete.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.09 SEQUENCING

A. Before installing any conduit or locating any device box:
   1. Examine the complete set of Drawings and Specifications, and all applicable shop drawings.
   2. Verify all dimensions and space requirements and make any minor adjustments to the conduit system as required to avoid conflicts with the building structure, other equipment, or the work of other trades.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 16050 - Common Work Results for Electrical.

1.12 SYSTEM START-UP

A. As specified in Section 16050 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Rigid aluminum conduit:
   1. One of the following or equal:
      a. Allied Tube and Conduit.
      b. Patriot Aluminum Products.
      c. Republic Conduit.
      d. Wheatland Tube Co.

B. Sealtight-liquidtight flexible conduit:
   1. One of the following or equal:
      a. Southwire.
      b. AFC Cable Systems.

c. Electri-Flex Co.
d. Anaconda.

C. Rigid nonmetallic PVC conduit:
1. One of the following or equal:
a. Carlon.
b. Cantex.
c. Triangle Conduit and Cable.

D. Conduit bodies:
1. One of the following or equal:
a. Crouse-Hinds.
b. Appleton.
c. O-Z/Gedney.
d. Ocal, Inc.
e. Robroy Ind.
f. Calbond.
g. Carlon.

E. Joint compound:
1. The following or equal:
a. Thomas and Betts.

F. Conduit sleeve:
1. One of the following or equal:
a. Crouse-Hinds.
b. Appleton.
c. O-Z/Gedney.

G. Conduit hangers and supports:
1. As specified in Section 16070 - Hangers and Supports.

H. Conduit through wall and floor seals:
1. The following or equal:
a. O-Z/Gedney:
1) Type "WSK."
2) Type “CSM.”

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS

A. RAC:
1. Material:
a. Extruded from 6063 Alloy in Temper Designation T-1.
b. Maximum 1/10-percent copper content.
c. Containing lubricating inside liners.

2. NPT standard threads with a 3/4-inch taper per foot:
    a. Running conduit threads are not acceptable.
3. Provide aluminum fittings and conduit bodies.

B. PVC:
1. Extruded from virgin PVC compound:
    a. Schedule 40 unless otherwise specified.
    b. Schedule 80 extra-heavy wall where specified.
2. Rated for 90 degrees Celsius conductors or cable.
3. Rated for use in direct sunlight.

C. Conduit bodies:
1. Material consistent with conduit type:
    a. Cast aluminum bodies and covers when used with Type RAC.
    b. PVC bodies and covers when used with Type PVC.
2. Conduit bodies to conform to Form 8, Mark 9, or Mogul design:
    a. Mogul design conforming to NEC requirements for bending space for large conductors for conduit trade sizes of 1 inch and larger with conductors #4 AWG and larger, or where required for wire-bending space.
3. Gasketed covers attached to bodies with stainless steel screws secured to threaded holes in conduit body.

2.07 ACCESSORIES

A. Connectors and fittings:
1. Manufactured with compatible materials to the corresponding conduit.

B. Insulated throat metallic bushings:
1. Construction:
    a. Aluminum when used with aluminum conduit.
    b. Positive metallic conduit end stop.
    c. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
    d. Use fully insulated bushings on nonmetallic conduit system made of high-impact 150 degrees Celsius rated non-combustible thermosetting phenolic.

C. Insulated grounding bushings:
1. Construction:
    a. Malleable iron or steel, zinc-plated, with a positive metallic end stop.
    b. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
    c. Tin-plated copper grounding saddle for use with copper or aluminum conductors.

D. Electrical unions (Erickson Couplings):
1. Construction:
    a. Aluminum for use with aluminum conduit.
    b. Concrete tight, 3-piece construction.
    c. Rated for Class I Division 1 Group D in hazardous areas.

E. Hubs for threaded attachment of steel conduit to sheet metal enclosures:
1. Construction:

a. Insulated throat.
b. PVC-coated when used in corrosive areas.
c. Bonding locknut.
d. Recessed neoprene o-ring to ensure watertight and dusttight connector.
e. 1/2-inch through 1-1/4-inch steel zinc electroplated.
f. 1-1/2-inch through 6-inch malleable iron zinc plated.
g. Aluminum with aluminum conduit.

2. Usage:
   a. All conduits in damp, wet, outdoor, and corrosive areas shall use threaded hubs for connections to sheet metal enclosures.

F. PVC fittings:
1. Shall include the following:
   a. Couplings.
   b. Terminal adapters.
   c. Female adapters.
   d. Caps.
   e. Reducer bushings.
   f. Duct couplings.
   g. End bells.
   h. Expansion couplings.
   i. Duct couplings: 5 degree.
   j. C-Type pull fittings.
   k. E-Type pull fittings.
   l. LB-Type pull fittings.
   m. LL-Type pull fittings.
   n. LR-Type pull fittings.
   o. T-Type pull fittings.
   p. X-Type pull fittings.
   q. Service entrance caps.
2. Materials:
   a. All devices shall be made of PVC, using the same materials as used for Type PVC conduit.
   b. All metal hardware shall be stainless steel.

G. Expansion/deflection couplings:
1. Use to compensate for movement in any directions between 2 conduit ends where they connect.
2. Shall allow movement of 3/4 inch from the normal in all directions.
3. Shall allow angular movement for a deflection of 30 degrees from normal in any direction.
4. Constructed to maintain electrical continuity of the conduit system.
5. Materials:
   a. End couplings: Bronze or galvanized ductile iron.
   b. Sleeve: Neoprene.
   c. Bands: Stainless steel.
   d. Bonding jumper: Tinned copper braid.

H. Expansion couplings:
1. Shall allow for expansion and contraction of conduit:
   a. Permitting 8-inch movement, 4 inches in either direction.
2. Constructed to maintain electrical continuity of the conduit system.

3. Materials:
    a. Head: Malleable or ductile iron.
    b. Sleeve: Steel.
    c. Insulating bushing: Phenolic.
    d. Finish: Hot-dip galvanized.
    e. Aluminum when used with Type RAC.

I. Conduit markers:
    1. As specified in Section 16075 - Identification for Electrical Systems.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. General:
    1. Conduit routing:
        a. The electrical drawings are diagrammatic in nature:
            1) Install conduit runs as specified with schematic representation indicated on the Drawings and as specified.
            2) Modify conduit runs to suit field conditions, as accepted by the Engineer:
                a) Make changes in conduit locations that are consistent with the design intent but are dimensionally different, or routing to bypass obstructions.
                b) Make changes in conduit routing due to the relocation of equipment.
            3) The electrical drawings do not indicate all required junction boxes and pull boxes:
                a) Provide junction boxes and pull boxes to facilitate wire pulling as required:
                    (1) To meet cable manufacturer’s pulling tension requirements.
                    (2) To limit total conduit bends between pull locations.
                b) Install junction boxes and pull boxes at locations acceptable to the Engineer.

b. The Contractor is responsible for any deviations in general location, conduit size, routing, or changes to the conduit schedule without the express written approval or direction by the Engineer:
    1) The Engineer is the sole source in determining whether the change is constituted as a deviation:
    2) Perform any changes resulting in additional conduits, or extra work from such deviations.
    3) Incorporate any deviations on the Record Documents.

2. Use only tools recommended by the conduit manufacturer for assembling the conduit system.
3. Provide adequate clearances from high-temperature surfaces for all conduit runs. Provide minimum clearances as follows:
    a. Clearance of 6 inches from surfaces 113 degrees Fahrenheit to 149 degrees Fahrenheit.
    b. Clearance of 12 inches from surfaces greater than 149 degrees Fahrenheit.
    c. Keep conduits at least 6 inches from the coverings on hot water and steam pipes, 18 inches from the coverings on flues and breechings, and 12 inches from fuel lines and gas lines.
    d. Where it is necessary to route conduits close to high-temperature surfaces, provide a high-reflectance thermal barrier between the conduit and the surface.
4. Support conduit runs on water-bearing walls a minimum of 7/8-inch away from wall on an accepted preformed channel:
    a. Do not run conduits within water-bearing walls unless otherwise indicated on the Drawings.
5. Do not install 1-inch or larger conduits in or through structural members unless approved by the Engineer.
6. Run conduits exposed to view parallel with or at right angles to structural members, walls, or lines of the building:
    a. Install straight and true conduit runs with uniform and symmetrical elbows, offsets, and bends.
    b. Make changes in direction with long radius bends or with conduit bodies.
7. Install conduits with total conduit bends between pull locations less than or equal to 270 degrees.
8. Route all exposed conduits to preserve headroom, access space and work space, and to prevent tripping hazards and clearance problems:
    a. Install conduit runs so that runs do not interfere with proper and safe operation of equipment and do not block or interfere with ingress or egress, including equipment-removal hatches.
    b. Route conduits to avoid drains or other gravity lines. Where conflicts occur, relocate the conduit as required.
9. When installing conduits through existing slabs or walls, make provisions for locating any possible conflicting items where the conduit is to penetrate. Use tone signal or X-ray methods to make certain that no penetrations will be made into the existing conduits, piping, cables, post-tensioning cables, etc.
10. Plug conduits brought into pull boxes, manholes, handholes, and other openings until used to prevent entrance of moisture.
11. Install conduits through wall and floor seals where indicated on the Drawings.
12. For existing and new 2-inch and larger conduit runs, snake conduits with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of the conduit:

a. Remove and replace conduits through which mandrel will not pass.

13. Provide all sleeves and openings required for the passage of electrical raceways or cables even when these openings or sleeves are not specifically indicated on the Drawings.
14. Install complete conduit systems before conductors are installed.
15. Provide metallic conduits terminating in transformer, switchgear, motor control center, or other equipment conduit windows with grounding bushings and ground with a minimum No. 6 AWG ground wire.
16. Underground conduits:
    a. Install underground conduits, including conduit runs below slabs-on-grade in concrete-reinforced duct bank construction:
        1) As specified in Section 16133 - Duct Banks.
    b. Make underground conduit size transitions at handholes and manholes.
    c. 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 handholes.
    d. Seal around conduit penetrations of below grade walls with a mechanical seal.

C. Lighting and receptacle conduits:
    1. Provide conduit runs for lighting and receptacle circuits, whether or not indicated on the Drawings:
    2. Install conduits in accordance with the requirements of this Section unless otherwise indicated.
    3. Minimum conduit size:
        a. 3/4-inch for exposed conduits.
        b. 1-inch for underground or in-slab conduits.
    4. Provide conduit materials for the installed location as specified in Section 16050 - Common Work Results for Electrical.

D. Conduit usage:
    1. Exposed conduits:
        a. Rigid conduit:
            1) Install the rigid conduit type for each location as specified in Section 16050 - Common Work Results for Electrical.
            2) Minimum size: 3/4-inch.
        b. Flexible conduit:
            1) Use flexible conduit for final connections between rigid conduit and motors, vibrating equipment, instruments, control equipment, or where required for equipment servicing:
                a) Use Type SLT with rigid metallic conduit.
                b) Use Type NFC with PVC conduit.
            2) Minimum size: 3/4-inch:
                a) 1/2 when required for connection to instruments.

3) Maximum length:
a) Fixed equipment:

Conduit Trade Size	Flexible Conduit Length (inch)
3/4	18
1	18
1-1/4	18
1-1/2	18
2	36
2-1/2	36
3	36
3-1/2	38
4	40

b) Removable instruments or hinged equipment:
(1) As required to allow complete removal or full movement without disconnecting or stressing the conduit.

2. Concrete-encased and embedded conduits:
a. Type PVC Schedule 40 and PVC-coated rigid metallic conduit as specified below:
1) Use Type PCS in underground and embedded installation as follows:
a) Stub-up and risers to grade floor or equipment from nonmetallic conduits.
b) Entering and exiting underground or embedded conduit runs a minimum 12 inches above and below grade of finished floor.
c) For any and all bends where the total deflection is greater than 45 degrees.
b. Minimum size:
1) 2-inch in duct banks unless otherwise indicated on the Drawings.
2) 1-inch for in-slab conduits unless otherwise indicated on the Drawings.
3. PVC:
a. Conduit terminations shall be via threaded adapters into threaded hubs on the junction boxes or conduit bodies.
b. Conduit terminations into boxes without threaded hubs shall utilize a threaded adapter and a flat neoprene washer on the outside of the box.
1) Use a locknut on the inside of the box to tighten the adapter to the box.
c. Route conduit to afford it the maximum physical protection.
1) If necessary, cover conduit to afford additional protection when it cannot be shielded by the structure or machinery frames.
a) Use Schedule 80 where exposed runs may be subject to physical damage.
4. RAC:
a. Do not use aluminum conduit below grade, cast in concrete, or on concrete or masonry in contact with earth.

b. When installing RAC on concrete surfaces, mount the RAC on the nonmetallic channel so that only the nonmetallic channel is in contact with the concrete.
c. When penetrating concrete walls and/or floors, use O-Z/Gedney rubber-gasketed through wall and floor seals so that the aluminum conduit is completely isolated from the concrete by the rubber seal material.

E. Conduit joints and bends:
1. General:
a. Where conduit is underground, under slabs on grade, exposed to the weather, or in NEMA Type 4 or NEMA Type 4X locations, make joints liquidtight.
b. Keep bends and offsets in conduit runs to an absolute minimum.
c. All bends shall be symmetrical.
d. The following conduit systems shall use large-radius sweep elbows:
1) Underground conduits.
2) Conduits containing fiber optic cables.
e. Provide large-radius factory-made bends for 1-1/4-inch trade size or larger.
f. Make field bends with a radius of not less than the requirements found in the NEC:
1) The minimum bending radius of the cable must be less than the radius of the conduit bend.
2) Make all field bends with power bending equipment or manual benders specifically intended for the purpose:
a) Make bends so that the conduit is not damaged and the internal diameter is not effectively reduced.
b) For the serving utilities, make bends to meet their requirements.
g. Replace all deformed, flattened, or kinked conduit.
2. Threaded conduit:
a. Cut threads on rigid metallic conduit with a standard conduit-cutting die that provides a 3/4-inch per foot taper and to a length such that all bare metal exposed by the threading operation is completely covered by the couplings or fittings used. In addition, cut the lengths of the thread such that all joints become secure and wrench-tight just preceding the point where the conduit ends would butt together in couplings or where conduit ends would butt into the ends or shoulders of other fittings.
b. Thoroughly ream conduit after threads have been cut to remove burrs.
c. Use bushings or conduit fittings at conduit terminations.
d. On exposed conduits, repair scratches and other defects with galvanizing repair stick, Enterprise Galvanizing “Galvabar™,” or CRC “Zinc It.”
e. Coat conduit threads with an approved electrically conductive sealant and corrosion inhibitor that is not harmful to the conductor insulation:
1) Apply to the male threads and tighten joints securely.
2) Clean excess sealant from exposed threads after assembly.
f. Securely tighten all threaded connections.
g. Any exposed threaded surfaces must be cleaned and coated with a galvanizing solution so that all exposed surfaces have a galvanized protective coating.
3. PVC:
a. Use approved solvent-weld cement specifically manufactured for the purpose. Spray-type cement is not allowed.

b. Apply heat for bends so that conduit does not distort or discolor. Use a spring mandrel as required to ensure full inside diameter at all bends:
    1) Utilize a heater specifically for PVC conduit as recommended by the conduit manufacturer.

F. Conduit sealing and drainage:
1. Conduit drainage and sealing other than required for hazardous and classified areas:
    a. Provide sealing and drainage in vertical drops of long (in excess of 20 feet), exterior, above-grade conduit runs at the points at which the conduit enters buildings, switchgear, control panels, lighting panelboards, and other similar enclosures.
    b. Provide seal fittings with drains in vertical drops directly above grade for exterior and above-grade conduit runs that are extended below grade.
    c. Provide conduit seals with drains in areas of high humidity and rapidly changing temperatures:
        1) Where portions of an interior raceway pass through walls, ceilings, or floors that separate adjacent areas having widely different temperatures.
    d. Provide conduit seals similar to O-Z/Gedney (Type CSM) on all conduits between corrosive and non-corrosive areas.
    e. Seal one end only of all underground conduits at highest point with O-Z/Gedney sealing (non-hazardous) filling, or equal.
2. Install seals with drains at any location along conduit runs where moisture may condense or accumulate. This requirement includes, but is not limited to, the following locations: control panels, junction boxes, pullboxes, or low points of the conduit.

G. Conduit supports:
1. General:
    a. Provide appropriate hangers, supports, fasteners, and seismic restraints to suit applications:
        1) As specified in Section 16070 - Hangers and Supports.
        2) Provide support materials consistent with the type of conduit being installed as specified in Section 16050 - Common Work Results for Electrical.
    b. Support conduit at the intervals required by the NEC.
    c. Perforated strap and plumbers tape are not acceptable for conduit supports.
2. Conduit on concrete or masonry:
    a. Use 1-hole malleable iron straps with metallic or plastic expansion anchors and screws or support from preset inserts.
    b. Use preset inserts in concrete when possible.
    c. Use pipe spacers (clamp backs) in wet locations.
3. Suspended conduit:
    a. Use malleable-iron factory-made split-hinged pipe rings with threaded suspension rods sized for the weight to be carried (minimum 3/8-inch diameter), Kindorf, or equal.
    b. For grouped conduits, construct racks with threaded rods and tiered angle iron or preformed channel cross members. Clamp each conduit individually to a cross member. Where rods are more than 2-feet long, provide rigid sway bracing.

4. Supports at structural steel members:
    a. Use beam clamps.
    b. Drilling or welding may be used only as specified or with approval of the Engineer.
5. PVC conduit supports:
    a. Mount all conduits with hangers specifically designed for use with PVC to minimize the problems of bowing resulting from the expansion and contraction of conduits caused by varying temperatures:
        1) Hangers to be constructed of PVC incorporating serrated teeth to grip the conduit securely and yet allow for conduit movement due to thermal considerations:
        2) Manufacturers: The following or equal:
            a) Carlon; Models E978D, E, F, G, H, and J.

H. Expansion or expansion/deflection fittings:
1. General:
    a. Align expansion coupling with the conduit run to prevent binding.
    b. Follow manufacturer's instructions to set the piston opening.
    c. Install expansion fittings across concrete expansion joints and at other locations where necessary to compensate for thermal or mechanical expansion and contraction.
    d. Furnish fittings of the same material as the conduit system.
2. For metallic conduit, provide expansion or expansion/deflection couplings, as appropriate, where:
    a. Install expansion fittings a minimum of every 200 feet in straight conduit runs.
3. For PVC, provide expansion or expansion/deflection couplings, as appropriate, where length change due to temperature variation exceeds 2 inches:
    a. Rigidly fix the outer barrel of the expansion coupling so it cannot move.
    b. Mount the conduit connected to the piston loosely enough to allow the conduit to move as the temperature changes.

I. Empty conduits:
1. Provide a polyethylene rope rated at 250 pounds tensile strength in each empty conduit more than 10 feet in length.
2. Seal ends of all conduits with approved, manufactured conduit seals, caps, or plugs immediately after installation:
    a. Keep ends sealed until immediately before pulling conductors.

J. Miscellaneous:
1. Seal roof penetrations for raceways and other items that penetrate the roof in accordance with roofing manufacturer's instructions and as indicated on the Drawings.
2. Provide electrical unions at all points of union between ends of rigid conduit systems that cannot otherwise be coupled:
    a. Running threads and threadless couplings are not allowed.
3. Replace any conduits installed that the Engineer determines do not meet the requirements of this Specification.
4. Provide conduit housekeeping curb around all embedded or below-grade conduits exiting or entering the slab, per the Typical Details.

3.04 ERECTION, INSTALLATION, APPLICATIONS, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in Section 16050 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16133

DUCT BANKS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Electrical underground duct banks.
   2. Duct bank installation requirements.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Provide trenching, forming, rebar, spacers, conduit, concrete, backfill, and compaction necessary for the complete installation of the duct banks.

B. Provide reinforced concrete duct banks for all conduits installed below grade, on the site, below structures, or in contact with the earth, unless otherwise indicated on the Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
   1. PVC conduit spacers.
   2. Detectable underground marking tape.
   3. Pull line.

C. Provide applicable submittal documents as specified in:
   1. Section 02050 - Soils and Aggregates for Earthwork.
   2. Section 02260 - Excavation Support and Protection
   3. Section 02318 - Trenching.

D. Shop drawings:
   1. Submit site plan drawings of duct banks including underground profiles indicating all underground utilities.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050 - Common Work Results for Electrical.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050 - Common Work Results for Electrical.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Field conditions and related requirements:
   1. Underground water table may be near or above the location of new duct banks.
   2. Include cost for necessary dewatering, and cleaning equipment to perform work in underground duct banks, pullboxes and manholes, before installation.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 16050 - Common Work Results for Electrical.

1.12 SYSTEM START-UP

A. As specified in Section 16050 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Conduit spacers:
   1. One of the following or equal:
      a. Carlon Snap-Loc.
      b. Cantex.
      c. Osburn Associates, Inc.

B. Detectable underground marking tape:
   1. One of the following or equal:
      a. Blackburn Manufacturing Co.
      b. Pro-Line Safety Products.
      c. Panduit.

C. Pull line:
   1. One of the following or equal:
      a. Arnco.
      b. Greenlee.
      c. Osburn Associates, Inc.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Provide conduit as specified in Section 16130 - Conduits:
   1. Use duct suitable for use with 90-degree Celsius rated conductors.

B. Provide reinforcing steel as specified in Section 03200 - Concrete Reinforcing:
   1. Provide minimum Number 4 reinforcing steel.

2.04 MANUFACTURED UNITS

A. Conduit spacers:
   1. Provide conduit spacers recommended by the conduit manufacturer or specified above.
   2. Saddle type.
   3. Non-metallic, non-corrosive, non-conductive.
   4. Interlocking type:
      a. Vertical interlocking.
      b. Horizontal interlocking.
   5. Suitable for concrete encasement.
   6. Molded-in rebar holder.
   7. Accommodates 2-inch through 6-inch conduit sizes.
   8. Relieves the conduit from both horizontal and vertical stresses.

B. Pull line:
   1. Minimum 1/4-inch wide, flat design.
   2. Polyester.
   3. Minimum pulling strength 1,200 pounds.

C. Detectable marking tape:
   1. Provide a detectable tape, locatable by a cable or metal detector from above the undisturbed grade.
   2. Aluminum core laminated between polyethylene film.
   3. 6-inch wide red tape imprinted with black lettering "CAUTION - BURIED ELECTRIC UTILITIES."

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES

A. Concrete mix requirements as specified in Section 03300 - Cast-In-Place Concrete.

B. Provide a red-oxide conduit encasement coloring agent as specified in Section 03300 - Cast-In-Place Concrete.

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Duct banks:
   1. Install duct banks encased in concrete at least 24 inches below finish grade, unless otherwise indicated on the Drawings.
   2. Damage minimization:
      a. Conduit should not be left exposed in an open trench longer than is necessary.
      b. Protect all underground duct banks against damage during pouring of concrete or backfilling.
   3. All plastic conduit fittings to be joined should be exposed to the same temperature conditions for a reasonable length of time before assembly.
   4. Provide No. 4/0 American Wire Gauge bare copper ground wire the entire length of duct bank and bond to the grounding system at each end of the duct bank and every 20 feet to steel reinforcing bar.
   5. Install underground ducts to be self-draining:
      a. Slope duct banks away from buildings to manholes, handholes, or pullboxes.
      b. Slope duct banks uniformly from manholes, handholes, or pullboxes to manholes, handholes, or pullboxes or both ways from high points between manholes, handholes, or pullboxes.
      c. Slope a minimum of 1/4 inch per 10 feet.
   6. Where new duct banks join to existing manholes, handholes, or pulboxes, make the proper fittings and fabricate the concrete envelopes to ensure smooth durable transitions, as indicated on the Drawings.
   7. Install pull line in spare conduits:
      a. Provide adequate pull line at both ends of conduits to facilitate conductor pulling.
      b. Cap above ground spare conduit risers at each end with screw-on conduit caps.

C. Trenching:
   1. Perform trenching as specified in Section 02318 - Trenching.
   2. Trench must be uniformly graded with the bottom, rock free and covered with select material.
   3. Whenever possible, use the walls of the trench as forms for concrete encasement:
      a. Forms are required where the soil is not self-supporting.
   4. Avoid damaging existing ducts, conduits, cables, and other utilities.

D. Duct spacing:
    1. Separate conduits with manufactured plastic spacers using a minimum space between the outside surfaces of adjacent conduits of 2 inches, unless otherwise indicated on the Drawings:
        a. Separate medium voltage ducts a minimum of 7.5 inches on center.
    2. Install spacers to maintain uniform spacing of duct assembly a minimum of 4 inches above the bottom of the trench during concrete pour. Install spacers on 8-foot maximum intervals:
        a. Due to some distortion of conduit from heat, and other means, it may be necessary to install extra spacers within the duct bank:
            1) Install the intermediate set of spacers within normal required spacing to maintain the proper horizontal clearance:
                a) Clearance is required to allow the proper amount of concrete to infiltrate vertically among the duct to ensure proper protection.
    3. Spacers shall not be located at the center of a bend:
        a. Locate spacer in the tangent, free of the coupling on fabricated bends.
        b. Locate spacers midway between the tangent and the center bend on trench formed sweeps.

E. Terminating:
    1. Use bell ends in duct at entrances into cable vaults.
    2. Make conduit entrances into cable vaults tangential to walls of cable vault.
    3. Form trapezoidal transitions between duct bank and cable vaults as needed in order to ensure adequate cable bending radius for the duct bank-to-vault transition.
    4. New manhole or handhole applications, provide a single opening or “window” per duct bank, sized to accommodate the duct bank envelope.

F. Concrete:
    1. Install concrete as specified in Section 03300 - Cast-In-Place Concrete.
    2. Provide nonferrous tie wires to prevent displacement of the conduits during pouring of concrete:
        a. Tie wire shall not act as a substitute for spacers.
    3. Install minimum 3-inch cover around conduit and rebar.
    4. Consolidation of encasement concrete around duct banks shall be by hand puddling, with no mechanical vibration.
    5. Conduit is subject to temperature rise. As concrete cures, allow the free end to expand by pouring the concrete from the center of the run or from one tie in point.

G. Marking tape:
    1. Install a detectable marking tape 12 inches above the duct bank the entire length of the duct bank.

H. For conduit installations beneath building slabs:
    1. Duct banks shall be continued under building slabs to the final destination of the conduits.
        a. Construct separate duct banks as required.
        b. Concrete for encasement under building slabs need not be colored red.
        c. For duct banks crossing under building footers or foundations, install the top of the duct bank a minimum of 12 inches below the footer.

d. Where duct banks enter through building walls, foundation walls, stem walls, etc. make connections as indicated on the Drawings.
e. Where duct banks terminate with conduit risers entering building walls, install an expansion/deflection fitting or a flat-wise elbow (elbow parallel to building wall) in order to accommodate differential movement between the conduits and structure.

I. Restore all surfaces to their original condition as specified in Section 02952 - Pavement Restoration and Rehabilitation, unless otherwise specified.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. Clean conduits of dirt and debris by use of an appropriately sized steel mandrel no less than 1/2 inch smaller than the inside diameter of the conduit.

3.11 PROTECTION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Provide shoring and pumping to protect the excavation and safety of workers.

C. Protect excavations with barricades as required by applicable safety regulations.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16134

BOXES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Device boxes.
   2. Raceway system boxes.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. A47 - Standard Specification for Ferritic Malleable Iron Castings.
   2. D149 - Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
   3. D495 - Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation.
   4. D570 - Standard Test Method for Water Absorption of Plastics.
   5. D648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
   6. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
   7. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

C. Joint Industry Conference (JIC).

D. Underwriters Laboratories, Inc. (UL):
   1. 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions:
   1. Arcing parts: Circuit breakers, motor controllers, switches, fuses, or any device intended to interrupt current during its operation.
   2. Raceway system boxes: Boxes that are used for wire and cable pullboxes, conduit junction boxes, or terminal boxes.

1.04 SYSTEM DESCRIPTION

A. Provide outlet boxes for devices such as switches, receptacles, telephone and computer jacks, security systems, junction, and pullboxes for use in the raceway systems, etc.

B. Provide boxes as indicated on the Drawings or as needed to complete the raceway installation.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
   1. Manufacturer.
   2. Materials.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
      d. Weight.
      e. NEMA rating.
   4. Conduit entry locations.
   5. Catalog cut sheets.
   6. Installation instructions.

C. Shop drawings:
   1. Include identification and sizes of pullboxes.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Regulatory requirements:
   1. Outlet boxes shall comply with all applicable standards of:
      a. JIC.
      b. NEC.
      c. NEMA.
      d. UL.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050 - Common Work Results for Electrical.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.09 SEQUENCING

A. As specified in Section 16050 - Common Work Results for Electrical.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 16050 - Common Work Results for Electrical.

1.12 SYSTEM START-UP

A. As specified in Section 16050 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Pressed steel boxes and concrete boxes:
      a. Steel City.
      b. Appleton.
      c. Crouse - Hinds.
      d. Thomas & Betts.
   2. Formed steel enclosures:
      a. Hoffman.
      b. Thomas and Betts.
      c. Stahlin.
      d. Rittal.
   3. Stainless steel enclosures:
      a. Hoffman.
      b. Stahlin.
      c. Rittal.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Concrete boxes:
   1. For outlets and pullboxes in concrete construction.
   2. Pressed steel or cast construction, concrete tight.
   3. Knockout sizes range from 1/2 inch to 1 inch.
   4. Depth as needed.
   5. Types:
      a. Four-inch octagon.
      b. Four-inch octagon ceiling boxes with hanging bars.
      c. Gangable masonry boxes:
         1) 3-1/2-inch deep, 3-3/4-inch high, length as required:
            a) 2-1/2-inch deep boxes may be used where wall thickness precludes the use of the deeper boxes.

2) With partitions as needed.

B. Formed steel enclosures:
1. Steel:
a. NEMA Type 12.
b. Fabricated from 14-gauge steel, minimum.
c. All seams continuously welded ground smooth.
d. Door:
1) Rolled lip around 3 sides.
2) Attached to enclosure by means of a continuous stainless steel hinge and pin.
e. Neoprene door gasket to provide a watertight, dusttight, oiltight seal:
1) Attached with an adhesive.
2) Retained by a retaining strip.
f. Fabricate all external removable hardware for clamping the door to the enclosure body from zinc-plated heavy gauge steel:
1) With a hasp and staple for padlocking.
g. Provide large enclosures with door and body stiffeners for extra rigidity.
h. No holes or knockouts.
i. Finish:
1) ANSI-61 gray electrostatically applied polyester powder inside and out over cleaned and primed surfaces.
2) White electrostatically applied polyester powder mounting plate.
j. Heavy gauge steel external mounting brackets when surface mounted.
2. Stainless steel:
a. NEMA Type 4X:
1) Boxes in locations subject to flooding or temporary submersion:
a) NEMA Type 6.
b. Fabricated from 14-gauge Type 316 stainless steel.
c. All seams continuously welded.
d. Door:
1) Rolled lip around 3 sides.
2) Attached to enclosure by means of a continuous stainless steel hinge and pin.
e. Neoprene door gasket to provide a watertight seal:
1) Attached with an adhesive.
2) Retained by a retaining strip.
f. Fabricate all external removable hardware for clamping the door to the enclosure body from heavy gauge stainless steel:
1) With a hasp and staple for padlocking.
g. Provide large enclosures with door and body stiffeners for extra rigidity.
h. No holes or knockouts.
i. Finish:
1) Brushed.
j. Stainless steel external mounting brackets when surface mounted.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Fasteners:
   1. Electroplated or stainless steel in boxes with wiring devices.
   2. Screws, nuts, bolts, and other threaded fasteners:
      a. Stainless steel.

B. Provide breather and drain fittings where appropriate.

C. Internal panels:
   1. Provide internal panels where required for mounting of terminal strips or other equipment.
   2. With plated steel shoulder studs.
   3. Steel with white polyester powder finish.

D. Floor stand kit when shown:
   1. Fabricated from 12-gauge steel.
   2. Bottom plate 11-gauge.
   3. Heights:
      a. 12 inches.
   4. Do not provide external mounting brackets, when a floor stand kit is used.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. General:
   1. Provide materials and construction suitable for environmental conditions at the location of the box as specified in Section 16050 - Common Work Results for Electrical.
   2. Provide outlet box materials to match the conduit system:
      a. RAC - Aluminum (copper free) boxes.
      b. PVC - PVC boxes.
   3. Solid type gang boxes:
      a. For more than 2 devices.
      b. For barriered outlets.

4. Support all wall mounted NEMA Type 4 or NEMA Type 4X boxes to maintain a minimum of 7/8-inch free air space between the back of the enclosure and the wall:
    a. Use machined spacers to maintain air space; built-up washers are not acceptable.
    b. Use stainless steel or nylon materials for spacers.
5. Use cast malleable iron boxes when box must support other devices.
6. Boxes serving luminaires or devices:
    a. Use as pullboxes wherever possible.
7. Fit all cast boxes and pressed steel boxes for flush mounting in concrete with cast, malleable box covers and gaskets.
8. In terminal boxes, furnish terminals as indicated on the Drawings, with a minimum of 50 percent spare terminals:
    a. Furnish wireways for discrete and analog/DC wiring.
    b. Separate analog wiring from 120 V discrete or power wiring.
9. Size boxes in accordance with NEC requirements and to provide sufficient room for the future components and cables indicated on the Drawings.
10. For fire-rated construction, provide materials and installation for use in accordance with the listing requirements of the classified construction.

C. Outlet boxes:
1. Locate outlet boxes as indicated on the Drawings:
    a. Adjust locations so as not to conflict with structural requirements or other trades.
2. Use deep threaded-hub malleable iron or aluminum boxes:
    a. In hazardous areas.
    b. Where exposed to the weather.
    c. In unheated areas.
    d. Where subject to mechanical damage:
        1) Defined as exposed boxes less than 10 feet above the floor.
    e. To act as a pullbox for conductors in a conduit system.
    f. Accommodate wiring devices.
3. Use deep threaded-hub plastic coated malleable iron boxes in corrosive and NEMA Type 4X area and when the conduit system is PVC coated steel.
4. Outlet boxes may be used as junction boxes wherever possible.

D. Pullboxes and junction boxes:
1. Size pullboxes in accordance with NEC requirements and to provide sufficient room for any future conduits and cables as indicated on the Drawings.
2. Install pullboxes such that access to them is not restricted.

E. For boxes not indicated:
1. Provide types and mountings as required to suit the equipment and that will be consistent with the conduit system and environmental conditions as indicated in Section 16050 - Common Work Results for Electrical.
2. Outlet, switch, and junction boxes for flush-mounting in general purpose locations:
    a. One-piece, galvanized, pressed steel.
3. Ceiling boxes for flush mounting in concrete:
    a. Deep, galvanized, pressed steel.
4. Outlet, switch, and junction boxes where surface mounted in exposed locations:

a. Cast ferrous boxes with mounting lugs, zinc or cadmium plating finish.

5. Outlet, control station, and junction boxes for installation in corrosive locations:
   a. Fiberglass reinforced polyester, stainless steel, or plastic coated steel to match the conduit system.
   b. Furnished with mounting lugs.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 REINSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 16050 - Common Work Results for Electrical.

3.11 PROTECTION

A. As specified in Section 16050 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Switches.
   2. Receptacles.
   3. Plates.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Federal Specifications (FS):
   1. W-C 596 - Connector, Electrical, Power, General Specification for.
   2. W-S 896/2 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

C. National Electrical Manufacturers Association (NEMA):
   1. WD1 - General Color Requirements for Wiring Devices.
   2. ICS 5 - Industrial Control and Systems, Control Circuit and Pilot Devices.
   3. OS1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
   4. WD6 - Wiring Devices Dimensional Specifications.

D. Underwriters Laboratories Inc. (UL):
   1. 20 - General Use Snap Switches.
   2. 498 - Standard for Attachment Plugs and Receptacles.
   3. 514D - Cover Plates for Flush-Mounted Wiring Devices.
   4. 943 - Ground-Fault Circuit-Interrupters.
   5. 1472 - Solid State Dimming Controls.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions:
   1. GFCI: Ground fault circuit interrupter.

1.04 SYSTEM DESCRIPTION

A. Switches, receptacles, and plates as indicated on the Drawings wired and operable to form a complete system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
   1. Catalog cut sheets.

C. Shop drawings:
   1. Engraving schedule:
      a. Furnish complete engraving schedule for engraved nameplates.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Wiring devices shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050 - Common Work Results for Electrical.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.09 WARRANTY

A. As specified in Section 16050 - Common Work Results for Electrical.

1.10 SYSTEM START-UP

A. As specified in Section 16050 - Common Work Results for Electrical.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switches:
   1. One of the following or equal:
      a. Hubbell.
      b. Leviton.
      c. Cooper Wiring Devices.
   2. Switches for hazardous areas: One of the following or equal:
      a. Appleton.
      b. Crouse-Hinds.
   3. Occupancy Sensor Switches: The following or equal:
      a. WattStopper.
      b. Cooper Wiring Devices.
   4. Dimmer switches: The following or equal:
      a. Lutron.
      b. Cooper Wiring Devices.

B. Receptacles:
   1. General purpose receptacles: One of the following or equal:
      a. Hubbell.
      b. Leviton.

c. Cooper Wiring Devices.

2. Receptacles for hazardous areas: One of the following or equal:
   a. Crouse-Hinds.
   b. Appleton.
3. 250 VAC receptacles: One of the following or equal:
   a. Hubbell.
   b. Cooper Wiring Devices.
4. 480-Volt, 3-phase receptacles: One of the following or equal:
   a. Crouse-Hinds.
   b. Hubbell.
   c. Russellstol™.

C. Plates:
1. General location: The following or equal:
   a. Pass and Seymour.
   b. Cooper Wiring Devices.
2. Wet or corrosive areas: One of the following or equal:
   a. Hubbell.
   b. Cooper Wiring Devices.
   c. Thomas and Betts.
   d. Pass and Seymour.
3. In-use covers: One of the following or equal:
   a. TayMac.
   b. Cooper Wiring Devices.
   c. Pass and Seymour.
   d. Thomas and Betts.

2.02 MANUFACTURED UNITS

A. Switches:
1. General:
   a. 120-277 VAC.
   b. 20 ampere.
   c. Listed in accordance with UL 20.
   d. Designed and constructed in accordance with FS W-S-896/2.
   e. Back and side wired unless otherwise indicated.
   f. Integral grounding terminal.
   g. Totally enclosed:
      1) Color-coded body with color corresponding to ampere rating.
   h. Provide switches with the operator style and contact arrangement as indicated on the Drawings and as required for proper operation.
   i. Color:
      1) Ivory in finished areas.
      2) Brown in all other areas.
2. General purpose switches:
   a. Toggle type.
3. Toggle switches used for programmable panelboards shall be as recommended by the panelboard manufacturer.
4. Switches for office areas:
   a. Rocker type.
   b. Rectangular.
5. Switches for use with photocell:

a. Maintained contact.
b. Two circuit.
c. Three position:
1) Center off.

6. Switches for hazardous areas:
a. Suitable for use in Class I Division 1 and Class I Division 2 locations.
b. Factory sealed.
c. Through-feed or dead-end as required.

7. Occupancy sensor switches:
a. Wall switch with dual-technology passive infrared and ultrasonic sensor.
1) Configured such that lights turn on only when both infrared and ultrasonic sensors detect activity, but do not turn off as long as either sensor detects activity.
b. Selectable “automatic-on” mode activated by sensors or “manual-on” mode activated by pushbutton.
c. Adjustable 5-30 minute time delay.
d. Selectable audible alert as a warning before lights turn off.
e. Rated for fluorescent lighting loads of up to 800W.
f. True multi-way switching allowing identical controls at any location for multi-way switching applications.

8. Dimmer switches:
a. Shall be rectangular design with LED light level indicators.
b. Suitable for use with type of lamp switched.

B. Receptacles:
1. General purpose receptacles:
a. Single or duplex as indicated on the Drawings.
b. 125 VAC.
c. 20 ampere or as indicated on the Drawings.
d. NEMA Type 5-20R configuration for 20 ampere receptacles.
e. Other NEMA configurations as indicated on the Drawings.
f. Listed in accordance with UL 498.
g. Designed and constructed in accordance with FS W-C-596.
h. Back and side wired.
i. One-piece, rivet-less mounting strap.
j. Color:
1) Ivory in finished areas.
2) Brown in all other areas.
3) Orange when powered by a UPS.

2. Ground fault interrupter receptacles (GFCI):
a. 125 VAC.
b. 20 ampere.
c. Trip level 4-6 milliampere.
d. Individual and feed through protection.
e. UL 943 and UL 498 listed.
f. NEMA Type 5-20R configuration.
g. For damp or wet locations:
1) Weather resistant, in accordance with UL 498.

3. Receptacles for hazardous areas:
a. 125 VAC.
b. 20 ampere.
c. Factory sealed.

d. Single receptacle.
e. 2-wire, 3-pole.
f. Grounded through extra pole and shell.
g. Dead-front construction.
h. Interlocked to prevent plug from being withdrawn until circuit has been broken.

4. 250 VAC receptacles:
   a. 2-pole, 3-wire grounding for 240 VAC circuits.
   b. 3-pole, 4-wire grounding for 208 VAC 3-phase circuits.
   c. Ampere rating as indicated on the Drawings.
   d. Provide NEMA configuration as indicated on the Drawings as required by the equipment connected to the outlet.
5. 480 VAC receptacles:
   a. 3-pole, 4-wire grounding.
   b. Ampere rating as indicated on the Drawings.
   c. Spring door on receptacle.
   d. Furnish one matching plug for each 480-volt power receptacle.

C. Plates:
1. General location:
   a. Type 302 or 304 stainless steel.
   b. Brushed satin finish.
   c. Minimum thickness: 0.032 inches.
   d. Rectangular or square shape.
   e. Engraving:
      1) Engrave each switch plate with the following:
         a) Area served.
         b) Panelboard and Circuit.
      2) Engrave each receptacle plate with the following:
         a) Panelboard and Circuit.
      3) Treat engraving to improve visibility.
      4) Characters shall be block letter pantograph engraved with a minimum character height of 1/8-inch.
   f. Coordinate the number of gangs, number, and type of openings with the specific location.
2. Outdoor and wet areas requiring NEMA Type 4 or NEMA Type 4X enclosures:
   a. General:
      1) UL listed for wet locations.
      2) Gasketed.
      3) Die cast metal:
         a) Match material to box material.
   b. Switches:
      1) Lever operated:
         a) Provide toggle switch.
   c. Receptacles:
      1) Weather proof in-use cover:
         a) Die cast metal construction with electrostatic powder coating for corrosion resistance.
         b) Gasketed.
         c) Lockable.
         d) UL listed and in accordance with NEC.
3. Corrosive areas:

a. Neoprene.
b. Gasketed.
c. Weatherproof.

D. Data and communications jacks:
1. Process network jacks - panel/enclosure mounted:
a. Network jacks located in process areas shall have a NEMA Type 4 rating (with closure cap).
b. Mounting of network jacks in control panels shall be accomplished using bulkhead connectors and environmental enclosure caps, which are permanently attached to the bulkhead fitting.
c. Network jacks shall have RJ-45 connections on both sides of connector (bulkhead pass through) allowing for direct connection to the network switch and computer with standard patch cords. No punch down PC board connections shall be allowed.
d. Manufactured by Woodhead Connectivity.
2. Process network jacks - conduit body mounted:
a. Network jacks located in process areas shall have a NEMA Type 4 rating (with closure cap).
b. Mounting of network jacks in conduit bodies adapter (with minifast connector) shall be accomplished using conduit body insert and environmental enclosure caps.
c. PC board connections are not to be allowed.
d. Furnish 10 RJ-45 to minifast connector patch cable 3 feet in length.
e. Manufactured by InterlinkBT.
3. Network/phone jacks:
a. Network jacks located in computer rooms shall be installed per the installation details indicated on the Drawings.
b. Standard Decora wall plates shall be used with QuickPort modules and inserts.
c. Plugs shall be color coded as indicated in the installation details indicated on the Drawings.
d. Manufactured by Leviton Quickport series.

PART 3 EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Mounting heights:
1. Process and production areas:
a. Switches and receptacles 48 inches from finished floor to top of plate.
2. Offices and finished areas:
a. Switches: 48 inches from finished floor to top of plate.
b. Receptacles: 18 inches from finished floor to center of plate.

C. Switches:
1. Over 300 Volts:
a. Where switches used in systems of more than 300 volts between conductors, are to be ganged in outlet boxes, provide switches having no exposed live parts or use barriers between the individual switches.

D. Receptacles:
    1. Provide GFCI receptacles as indicated on the Drawings.
        a. Provide weather resistant GFCI receptacles in all wet or damp areas.
            1) As specified in Section 16050 - Common Work Results for Electrical.
    2. Mount non-weatherproof receptacles vertically:
        a. Ground slot down.
    3. Mount weatherproof receptacles horizontally:
        a. Neutral slot up.
    4. 3-phase receptacles shall be consistent with respect to phase connection at the receptacle terminals. Correct errors in phasing at the source and not the receptacle.

E. Ensure all plates make a firm seal with wall for recessed mounted devices:
    1. Outside edges of plates parallel with building lines.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.03 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

3.04 PROTECTION

A. As specified in Section 16050 - Common Work Results for Electrical.

END OF SECTION

SECTION 16150

LOW VOLTAGE WIRE CONNECTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Wire connecting devices.
   2. Terminations.
   3. Splices.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.

C. CSA International (CSA):
   1. C22.2 - No.197-M1983 (R2208) - PVC Insulating Tape.

D. Underwriters Laboratories, Inc. (UL):
   1. 510 - Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Provide a complete system of wiring connectors, terminators, fittings, etc. for a complete wiring system suitable for the cables and conductors used.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
   1. Catalog cut sheets.
   2. Installation instructions.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050 - Common Work Results for Electrical.

B. All materials shall be UL listed.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050 - Common Work Results for Electrical.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.09 WARRANTY

A. As specified in Section 16050 - Common Work Results for Electrical.

1.10 SYSTEM START-UP

A. As specified in Section 16050 - Common Work Results for Electrical.

1.11 MANUFACTURERS

A. Manufacturers for each type of technology are specified with the equipment in this Section.

1.12 EQUIPMENT

A. Control connections:
   1. Use insulated ring type wire terminators for connections to all screw terminals:
      a. With chamfered/funneled terminal barrel entry.
      b. Deep internal serrations.
      c. Long barrel design to reduce electrical resistance and increased insulator-barrel surface area to ensure that the insulator remains in contact with the barrel.
      d. Electroplated-tin copper conductor.
      e. Manufacturer: The following or equal:
         1) Thomas and Betts, Stakon.
   2. For process equipment connections work from manufacturer's drawings.

B. Joints, splices, taps, and connections:
   1. 600-volt conductors:
      a. Use solderless connectors.
      b. Use only plated copper alloy connectors or lugs:
         1) Aluminum connectors or lugs are not acceptable for copper conductors.
      c. Under those specific conditions where aluminum conductors have been allowed or are specified then the connectors for aluminum conductors shall be specifically designed for that purpose.
      d. For wire Number 10 AWG and smaller use compression splice caps, with insulating caps:
         1) Manufacturer: The following or equal:
            a) Buchanan 2006S or 2011S, with 2007 or 2014 insulating caps.
      e. For wire Number 8 AWG and larger, use heavy duty copper compression connectors:
         1) Manufacturer: One of the following or equal:
            a) Burndy.
            b) Thomas and Betts.

f. Heat shrink tubing:
1) Suitable for indoors, outdoors, overhead, direct burial or submerged applications.
2) Minimum shrink ratio: 4 to 1.
3) Continuous operating temperature: -55 degrees Celsius to 110 degrees Celsius.
4) Internally applied adhesive sealant.
5) Cross-linked polyolefin:
a) Manufacturers, one of the following or equal:
(1) 3M ITCSN.
(2) Thomas & Betts Shrink-Kon.

2. Instrumentation class cable splices:
a. Suitable for indoor, outdoors, weather exposed, direct buried, or submersed applications.
b. Utilizing an epoxy, polyurethane, and re-enterable compounds.
c. For use with shielded or unshielded plastic- and rubber-jacketed, signal, control, and power cables rated up to 1 kilovolt.
d. Two-part mold body with tongue and groove seams and built in spacer webbing.
e. Manufacturer: The following or equal:
1) 3M - Scotchcast 72-N.

C. Insulating tape:
1. General purpose insulating tape:
a. Minimum 7 mil vinyl tape.
b. Suitable for application in an ambient of -18 degrees Celsius (0 degrees Fahrenheit).
c. Operating range up to 105 degrees Celsius (220 degrees Fahrenheit).
d. Flame retardant, hot- and cold- weather resistant, UV resistant.
e. For use as a primary insulation for wire cable splices up to 600 VAC.
f. Meeting and complying with:
1) ASTM D3005 Type I.
2) UL 510.
3) CSA C22.2.
g. Manufacturer: The following or equal:
1) 3M - Scotch Number Super 33+.

2. General-purpose color-coding tape:
a. Minimum 7 mil vinyl tape.
b. Suitable for application on PVC and polyethylene jacketed cables.
c. For use indoors and outdoors in weather protected enclosures.
d. Available with the following colors:
1) Red.
2) Yellow.
3) Blue.
4) Brown.
5) Gray.
6) White.
7) Green.
8) Orange.
9) Violet.
e. For use as phase identification, marking, insulating, and harnessing.
f. Meeting and complying with:
1) UL 510.

2) CSA C22.2.

g. Manufacturer the following or equal:
   1) 3M - Scotch Number 35.

PART 2 EXECUTION

2.01 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Load connections:
   1. Connect loads to the circuits as indicated. Color-code all branch circuits as specified in Section 16123 - 600-Volt or Less Wires and Cables.

C. Zero to 600-volt systems:
   1. Make all connections with the proper tool and die as specified by the device manufacturer.
   2. Use only tooling and dies manufactured by the device manufacturer.
   3. Insulate all connections and splices with Scotch 33+ tape and Scotchfill, or pre-molded plastic covers, or heat shrink tubing and caps.
   4. Number all power and control wires before termination.

D. Motor connections (600 volts and below):
   1. Terminate wires with compression type ring lugs at motors.
   2. Connection at both the motor leads and the machine wires shall have ring type compression lugs.
   3. Cover bolted connectors with a heat shrinkable, cross-linked polyolefin material formed as a single opening boot:
      a. In damp and wet locations, use a complete kit containing mastic that shall seal out moisture and contamination.
      b. Shrink cap with low heat as recommended by manufacturer.
   4. Wire markers shall be readable after boot installation.
   5. Manufacturer: The following or equal:
      a. Raychem MCK.

2.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

2.03 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

2.04 PROTECTION

A. As specified in Section 16050 - Common Work Results for Electrical.

END OF SECTION

SECTION 17050

COMMON WORK RESULTS FOR PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. General requirements applicable to all Process Control and Instrumentation Work.
   2. General requirements for process control and instrumentation submittals.
   3. ICSC must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.

B. Interfaces to equipment, instruments, and other components:
   1. Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers, which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.
   2. Provide all material and labor needed to install the actual equipment furnished, include all costs to add any additional instruments, wiring, control system inputs/outputs, controls, interlocks, electrical hardware etc., which may be necessary to make a complete, functional installation based on the actual equipment furnished:
      a. Make all changes necessary to meet the manufacturer's wiring requirements.
   3. Submit all such changes and additions to the Engineer for acceptance as specified in Manatee County Front end document. IFBC No. XXXX.
   4. Review the complete set of Drawings and Specifications in order to ensure that all items related to the instrumentation and control systems are completely accounted for. Include any items indicated on the Drawings or in Specifications from another discipline in the scope of Work:
      a. If a conflict between Drawings and Specifications is discovered, refer conflict to the Engineer as soon as possible for resolution.
      b. The Owner and Engineer are not responsible for providing detailed loop diagrams for Contractor furnished equipment.

C. All instrumentation, and control equipment and systems for the entire project to comply with the requirements specified in the Instrumentation and Control Specifications, whether referenced in the individual Equipment Specifications or not:
   1. The requirements of the Instrumentation and Control Specifications apply to all Instrumentation and Control Work specified in other Specifications, including HVAC controls, packaged mechanical systems, LCPs, VCPs, etc.

2. Inform all vendors supplying instrumentation, control systems, panels, and/or equipment of the requirements of the Instrumentation and Control Specifications.
3. The Owner is not responsible for any additional costs due to the failure of the Contractor to notify all subcontractors and suppliers of the Instrumentation and Control Specifications' requirements.

D. Contract Documents:
   1. General:
      a. The drawings and specifications are complementary and are to be used together in order to fully describe the Work.
   2. Specifications:
      a. Manatee County Front end document. IFBC No. XXXX. govern the Work.
      b. These requirements are in addition to all General Requirements.
   3. Contract drawings:
      a. The Instrumentation and Control Drawings show in a diagrammatic manner, the desired locations, and arrangements of the components of the Instrumentation Work. Follow the drawings as closely as possible, use professional judgment and coordinate with the other trades to secure the best possible installation, use the entire drawing set for construction purposes.
      b. Locations of equipment, control devices, instruments, boxes, panels, etc. are approximate only, exercise professional judgment in executing the Work to ensure the best possible installation:
         1) The equipment locations and dimensions indicated on the Drawings and elevations are approximate. Use the shop drawings to determine the proper layout, foundation, and pad requirements, etc. for final installation. Coordinate with all subcontractors to ensure that all instrumentation and control equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.
         2) The Contractor has the freedom to select any of the named manufacturers as identified in the individual Specifications; however, the Engineer has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the Contractor's responsibility to ensure that the equipment being furnished fits within the defined space.
      c. Installation details:
         1) The Contract Drawings include installation details showing means and methods for installing instrumentation and control equipment. For cases where typical details are not provided or compatible with an installed location, develop installation details that are necessary for completing the Work, and submit these details for review by the Engineer.
      d. Schematic diagrams:
         1) All controls are shown de-energized.
         2) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.
         3) Add slave relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing

relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.

4) Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.
5) Control schematics are to be used as a guide in conjunction with the descriptive operating sequences indicated on the Drawings or in the Specifications. Combine all information and furnish a coordinated and fully functional control system.

E. Alternates/Alternatives:
1. Substitute item provisions as specified in Manatee County Front end document. IFBC No. XXXX.

F. Changes and change orders:
1. As specified in Manatee County Front end document IFBC No. XXXX.

1.02 REFERENCES

A. Code standards and compliance:
1. The following codes and standards are hereby incorporated into this Section:
a. American National Standards Institute (ANSI).
b. American Petroleum Institute (API):
1) RP 550 - Manual on Installation of Refinery Instruments and Control Systems; Part II-Process Stream Analyzers; Section 5-Oxygen Analyzers.
2) RP 551 - Process Measurement Instrumentation.
c. International Organization for Standardization (ISO):
1) 9001 - Quality Management Systems - Requirements.
d. International Society of Automation (ISA):
1) 5.1 - Instrumentation Symbols and Identification.
2) 5.4 - Instrument Loop Diagrams.
3) 20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.
e. National Electrical Manufacturers Association (NEMA):
1) 250 - Enclosures for Electrical Equipment (1000 V Maximum).
f. National Fire Protection Association (NFPA).
g. Nation Fire Protection Association (NFPA 70) National Electrical Code (NEC). Applies to all applicable specifications for the entire project.
h. Nation Fire Protection Association (NFPA 70E) Standard for Electrical Safety in the Workplace. Applies to all applicable specifications for the entire project.
i. National Fire Protection Association (NFPA 79) Electrical Standard for Industrial Machinery. Applies to all applicable specifications for the entire project.
j. National Institute of Standards and Technology (NIST).
k. Underwriters Laboratories, Inc. (UL):
1) 508 - Standard of Safety for Industrial Control Equipment.
2) 508A - Standard of Safety for Industrial Control Panels.

B. Compliance with Laws and Regulations:
1. As specified in Manatee County Front end document. IFBC No. XXXX.

1.03 DEFINITIONS

A. Definitions of terms and other electrical and instrumentation considerations in accordance with:
   1. Factory Mutual (FM).
   2. International Electro technical Commission (IEC).
   3. Institute of Electrical and Electronics Engineers (IEEE).
   4. International Society of Automation (ISA).
   5. International Organization for Standardization (ISO).
   6. National Electrical Code (NEC).
   7. National Electrical Manufacturers Association (NEMA).
   8. International Electrical Testing Association (NETA).
   9. National Fire Protection Association (NFPA).
   10. National Institute of Standards and Technology (NIST).
   11. Underwriters Laboratories (UL).

B. Specific definitions:
   1. Control circuit: Any circuit operating at 120 volts alternating current (VAC) or direct current (VDC) or less, whose principal purpose is the conveyance of information (including performing logic) and not the conveyance of energy for the operation of an electrically powered device.
   2. Panel: An instrument support system that may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems.
   3. Power circuit: Any circuit operating at 90 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.
   4. Signal circuit: Any circuit operating at less than 50 VAC or VDC, which conveys analog information or digital communications information.
   5. Digital bus: A communication network, such as PROFIBUS, Foundation Fieldbus, or DeviceNet, allowing instruments and devices to transmit data, control functions, and diagnostic information.
   6. 2-Wire transmitter (loop powered): A transmitter that derives its operating power supply from the signal transmission circuit and requires no separate power supply connections. As used in this Section, 2-wire transmitter refers to a transmitter that provides a signal such as 4 to 20 mA 24VDC regulation of a signal in a series circuit with an external 24 VDC driving potential:
      a. Fieldbus communications signal or both.
   7. Powered transmitters: A transmitter that requires a separate power source (120 VAC, 240 VAC, etc.) in order for the transmitter to develop its signal. As used in this Section, the produced signal may be a 4 to 20 mA 24VDC signal, a digital bus communications signal, or both.
   8. System supplier - As specified in ICSC Qualifications in the Quality Assurance article of this Section.
   9. Modifications: Changing, extending, interfacing to, removing, or altering an existing circuit.

C. NEMA:
   1. Type 1 enclosure in accordance with NEMA 250.
   2. Type 2 enclosure in accordance with NEMA 250.
   3. Type 3 enclosure in accordance with NEMA 250.
   4. Type 3R enclosure in accordance with NEMA 250.

5. Type 3S enclosure in accordance with NEMA 250.
6. Type 3X enclosure in accordance with NEMA 250.
7. Type 3RX enclosure in accordance with NEMA 250.
8. Type 3SX enclosure in accordance with NEMA 250.
9. Type 4 enclosure in accordance with NEMA 250.
10. Type 4X enclosure in accordance with NEMA 250.
11. Type 5 enclosure in accordance with NEMA 250.
12. Type 6 enclosure in accordance with NEMA 250.
13. Type 6P enclosure in accordance with NEMA 250.
14. Type 12 enclosure in accordance with NEMA 250.
15. Type 12K enclosure in accordance with NEMA 250.
16. Type 13 enclosure in accordance with NEMA 250.

D. Acronym definitions:
1. ACB: Automatic current balance.
2. ATS: Automatic Transfer Switch.
3. CCS: The PCS central computer system (CCS) consisting of computers and software. The personal computer-based hardware and software system that includes the operator interface, data storage, data retrieval, archiving, alarming, historian, reports, trending, and other higher level control system software and functions.
4. DPDT: Double-pole, double-throw.
5. ES: Enterprise system: Computer based communications or data sharing system utilized for non-process control functions such as E-mail, sharing files, creating documents, etc.
6. FAT: Factory acceptance test also known as Source Test.
7. HART: Highway addressable remote transducer.
8. HOA: Hand-Off-Auto control function that is totally PLC based. In the Hand mode, equipment is started or stopped, valves are opened or closed through operator direction under the control of the PLC software. In the Auto mode, equipment is started or stopped and valves are opened or closed through a control algorithm within the PLC software. In the Off mode, the equipment is prohibited from responding from the PLC control.
9. HMI: Human machine interface is a software application that presents information to an operator or user about the state of a process, and to accept and implement the operators control instructions. Typically information is displayed in a graphical format.
10. ICSC: Instrumentation and control system contractor: Subcontractor who specializes in the design, construction, fabrication, software development, installation, testing, and commissioning of industrial instrumentation and control systems.
11. IJB: Instrument junction boxes: A panel designed with cord sets to easily remove, replace, or relocate instrument signals.
12. I/O: Input/Output.
13. IP: Internet protocol or ingress protection.
14. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.
15. LAN: Local area network: A control or communications network that is limited to the physical boundaries of the facility.
16. LOI: Local Operator Interface is an operator interface device consisting of an alphanumeric or graphic display with operator input functionality. The LOI is

typically a flat panel type of display mounted on the front of an enclosure with either a touch screen or tactile button interface.

17. LOR: Local-Off-Remote control function. In the Remote mode, equipment is started or stopped, and valves are opened or closed through the PLC based upon the selection of the HOA. In the Local mode, equipment is started or stopped, valves are opened or closed based upon hardwired control circuits completely independent of the PLC with minimum interlocks and permissive conditions. In the Off mode, the equipment is prohibited from responding to any control commands.
18. NJB: Network junction box. An enclosure that contains multiple access points to various networks within the facility. Networks could be Ethernet, Ethernet/IP, Fieldbus, RIO, etc.
19. OIT: Operator Interface Terminal: This is a Panel Mount PC device, typically a flat panel type of display mounted on the front of an enclosure with a touch screen and panel mount keyboard. This device acts as a panel mount SCADA workstation.
20. P&ID: Process and instrumentation diagram.
21. PC: Personal computer.
22. PCIS: Process control and instrumentation system: Includes the entire instrumentation system, the entire control system, and all of the Work specified in the Instrumentation and Control Specifications and depicted on the Instrumentation Drawings. This includes all the PCS and instruments and networking components as well as the various servers, workstations, thin clients, etc.
23. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.
24. PCS: Process Control System: A general name for the computerized system that gathers and processes data from equipment and sensors and applies operational controls to the process equipment. It includes the PLCs and/or RIOs, LOIs, HMIs, both LCPs, VCPs and all data management systems accessible to staff.
25. PJB: Power junction box: An enclosure with terminal blocks that distribute power to multiple instruments.
26. PLC: Programmable logic controller.
27. PS: Power supply.
28. RIO: Remote I/O device for the PLC consisting of remote I/O racks, or remote I/O blocks.
29. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.
30. SCADA: Supervisory control and data acquisition system: A general name for the computerized system that gathers and processes data from sensors and equipment located outside of the facility, such as wells, lift stations, metering stations, etc.
31. SPDT: Single-pole, double-throw.
32. SPST: Single-pole, single-throw.
33. UPS: Uninterruptible power supply.
34. VCP: Vendor control panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, LOI, HMI, etc.
35. WAN: Wide area network: A control or communications network that extends beyond the physical boundaries of the facility.

1.04 SYSTEM DESCRIPTION

A. General requirements:

1. The work includes installing a new SCADA system and removal of the existing HSQ SCADA system at the Lake Manatee WTP. The work includes design, fabrication, demolition, installation, programming, startup and commissioning of the new SCADA system. The areas of plant include all HSQ RTU's will be removed and replaced with Allen Bradley PLC's. The HSQ SCADA system will be replaced with Citect SCADA software and associated hardware as indicated in the project specifications and on the drawings. A detailed cutover plan is required for transition from HSQ to Citect. The plan should include all required details for transition; engineering submittals, schedule, shutdowns (if any), work included, phases of work, testing, and training. The first stage should be the installation of the new SCADA network. Second Stage should be relocation of existing HSQ Computers. Third stage should be installation of new PLC backpanels, Fourth Stage should be installation of I/O points. Fifth stage should be testing of new PLC/SCADA system at the plant. Sixth stage should be installation of new wireless equipment & testing. The existing HSQ SCADA system must remain fully functional during the installation of the new SCADA system.
2. The existing HSQ SCADA/Control system will remain operational while the new SCADA system is installed. Each existing RTU to be replaced and/or upgraded will be taken offline while the new PLC and controls are installed. When each new PLC is installed, tested and accepted, it shall be operational with the new Citect SCADA system. Only one existing RTU will be upgraded at a time. When the RTU to PLC upgrade has been accepted by the owner and engineer, the contractor can begin work on the next RTU replacement per the contractor’s cut over plan. Include in the cut over plan, a minimum of 7 days of uninterrupted operation without failure of the new PLC, controls, and SCADA system prior to acceptance of the RTU upgrade. For RTU-1, 2, & 3: The new control panels must first be tested and placed into operation in Hand prior to testing and placing into operation in Automatic from SCADA.
3. The Work includes everything necessary for and incidental to executing and completing the instrumentation and control system work indicated on the Drawings and specified in the Specifications and reasonably inferable there from including but not limited to:
    a. Design, develop, and draft, control panel designs, and all other drawing submittals specified in the Instrumentation and Control Specifications.
    b. Prepare the test plan, the training plan, and the spare parts submittals.
    c. Procure all hardware.
    d. Provide all SCADA system hardware.
    e. Provide all SCADA system software.
    f. Develop PLC and SCADA programs (Provided by Owner’s subcontractor)
    g. Submit Graphics, Reports, and conduct specified meetings. (Provided by Owner’s subcontractor)
    h. Fabricate panels.
    i. Perform factory tests on panels.
    j. Provide all radio licensing
    k. Provide complete physical field radio survey.
    l. Perform bench calibration and verify calibration after installation.
    m. Oversee and certify installation of the PCS system.
    n. Oversee, document, and certify loop testing.

o. Oversee, document, and certify system.
p. Installation Testing.
q. Oversee and document Functional Testing.
r. Conduct the Process Operational Period and the Instrumentation and Controls Process Performance Testing.
s. Prepare operation and maintenance manuals.
t. Conduct training classes.
u. Integrate the PCS with instrumentation and control devices provided under other sections.
v. Provide Record Drawings and Loop Drawings associated with Instruments and equipment:
    1) As specified in the Contract Documents.
    2) For Owner furnished items.
    3) For interfaces with existing equipment.
w. Resolve signal, power, or functional incompatibilities between the PCS and interfacing devices.
x. Perform all required corrective and preventative maintenance.

4. It is the intent of these Specifications that the entire electrical power, instrumentation, and control system be complete and operable. Provide all necessary material and labor for the complete system from source of power to final utilization equipment, including all connections, testing, calibration of all equipment furnished by others, as well as equipment furnished by the Contractor, whether or not specifically mentioned but which are necessary for successful operation.
5. Provide the complete operating PCS to perform the specified monitoring, communications, alarm, control, display, and reporting functions in accordance with the PCS requirements.
6. Coordinate all aspects of the Work between Contractor and all subcontractors before bidding to ensure that all costs associated with a complete installation are included. The Owner is not responsible for any change orders due to lack of coordination of the Work between the Contractor, the ICSC, the other subcontractors, or suppliers.
7. Furnish detailed, complete, and thorough operations and maintenance documentation, including but not limited to operations manuals, maintenance manuals, as-built wiring drawings, training manuals, as-built software documentation, and all other documentation required to operate, modify, and maintain all parts of the PCS.
8. Where demolition is indicated on the Drawings, the electrical subcontractor is responsible for disconnecting equipment electrical connections and rendering the equipment safe. The ICSC is responsible for physically removing all instrumentation to be demolished and return it either to the Owner or dispose of it as directed by the Owner's representative. The ICSC shall be responsible for any program modifications needed based on the demolition of the equipment, both for the loops directly and indirectly affected.
9. Portions of this Project involve installation in existing facilities and interfaces to existing circuits, power systems, controls, and equipment.
    a. Perform and document comprehensive and detailed field investigations of existing conditions (circuits, power systems, controls, equipment, etc.) before performing any Work.
    b. Provide and document interface with, modifications to, upgrade, or replacement of existing circuits, power systems, controls, and equipment.

10. Revise in a manner as directed by the Engineer all I/O and addressing that the Engineer determines to be unacceptable as a result of a lack of Contractor coordination between Contract Documents and all suppliers.
11. The contractor shall provide new wire tags (labels) for all field PLC/RTU control wiring on both ends of the conductor. Each control wire shall receive a minimum of two new wire labels, one label on the conductor in the control panel, RTU, or MCC, the other label will be on the field side of the same conductor. The field side includes instrument, MCC, Field enclosure, terminal cabinet, etc.
12. Defective Work:
    a. As specified in Manatee County Front end document. IFBC No. XXXX.

B. Existing system:
    1. This project is a control system upgrade that encompasses many automation upgrades. The project will require implementation in several phases. Each phase will need to be planned and fully executed as if they were individual projects. This includes submittals, programming development meetings, testing, and training.

C. New system: The new SCADA system consists of Citect SCADA software, Nutanix Hardware Platform, Network Equipment, Allen Bradley PLC's, replacing all HSQ equipment. New Server cabinet, new workstations, new PLC equipment (some in plant control panels to be updated, some replaced, see specifications and contract drawings for details). New wireless communication equipment.

D. Operating facility:
    1. As specified in Section 01140 - Work Restrictions.
    2. Portions of this existing facility must remain fully functional throughout the entire construction period. In consideration of this requirement, comply with the following guidelines:
        a. All outages must be of minimal duration and fully coordinated and agreed to by the Owner. Adjust the construction to meet the requirements of the Owner.
        b. As weather and facility demand conditions dictate, re-adjust the construction schedule to meet the demands placed upon Owner by its users.
        c. Where portions of the Work are in existing facilities and require interface to existing circuits, power systems, controls and equipment, perform comprehensive and detailed field investigations of existing conditions. Determine all information necessary to document, interface with, modify, upgrade, or replace existing circuits, power systems, controls, and equipment.
    3. According to individual circumstances and in compliance with the Drawings, extend or replace conduit and cable connections from existing locations.
    4. Where shown or specified, replace existing field instruments with new.
    5. Contractor is responsible for the integrity and measurement accuracy of all loops.
    6. Any defect found in existing equipment is the responsibility of the Owner. Contractor is not responsible for defects on existing Owner components.
    7. The standards of documentation, instrument tagging, cable and conductor termination, terminal identification and labeling that apply to the new installation apply equally to the existing installation.

8. The following list details RTU operational and signal dependency. The designated RTU depends on the "signals or controlled from" RTU. Contractor shall make all necessary accommodations to operate the new RTU/PLC while the existing RTU's are still operational or under modifications per the contractors cut over plan.

   A. Clear Well B:
   Designated RTU/DCU 2
   Pump 1, 2, and 3
   Runtimes pumps 1-5

   Signals or Controlled from or by RTU/DCU 5
   Pumps 4 and 5
   Level
   Pressure

   B. Tainter Gates:
   Designated RTU 20

   Signals or Controlled from or by RTU/DCU 5
   Open/Close Gates 1, 2 and 3

   C. Basin A:
   Designated RTU/DCU 5

   Signals or Controlled from or by RTU 50
   A1 Post Mix pH
   A2 Post Mix pH

   D. Filters 1-6:
   Designated RTU 50

   Signals or Controlled from or by RTU/DCU 5
   Effluent set point
   Back Wash Control
   Flume Level control
   Turbidity

   E. Basin B:
   Designated RTU/DCU 5

   Signals or Controlled from or by RTU 50
   Post Mix pH

   F. Filters 7-12:
   Designated RTU 51

   Signals or Controlled from or by RTU/DCU 5
   Effluent Set Point
   Flume Level

   G. A/B Lime Feeder:
   Signals or Controlled from or by RTU/DCU 3
   North and South Feeder (Signals from Feeders PLC)

   Signals or Controlled from or by RTU/DCU 5

North and South Slaker
Slurry Mixer

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures and this Section.

B. General:
   1. Instruct all equipment suppliers of submittals and operation and maintenance manuals of the requirements in this Section.
   2. Furnish the submittals required by each section in the Instrumentation Specifications.
   3. Adhere to the wiring numbering scheme specified in Section 16075 - Identification for Electrical Systems throughout the Project:
      a. Uniquely number each wire.
      b. Wire numbers must appear on all Equipment Drawings.
   4. Use equipment and instrument tags, as indicated on the Drawings, for all submittals.

C. Submittal preparation:
   1. During the period of preparation of submittals, the Contractor shall authorize direct, informal liaison between the ICSC and the Engineer for exchange of technical information. As a result of this liaison, certain minor refinements and revisions may be authorized informally by the Engineer, which do not alter the scope of Work or cause increase or decrease in the Contract price or times. During this informal exchange, no oral statement by the Engineer shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant exception to, or variation from, these Contract Documents.
   2. In these Contract Documents, some items of Work are represented schematically, and are designated for the most part by numbers, as derived from criteria in ISA-5.1:
      a. Employ the nomenclature and numbers designated in this Section and indicated on the Drawings exclusively throughout shop drawings, data sheets, and similar submittals.
      b. Replace any other symbols, designations, and nomenclature unique to a manufacturer's, suppliers, or subcontractor's standard methods with those identified in this Section and indicated on the Drawings.

D. Specific submittal requirements:
   1. Shop drawings:
      a. Required for materials and equipment listed in this and other sections.
      b. County will review all submittals in addition to Consultant submittal review.
      c. Furnish sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications.
      d. Shop drawings requirements:
         1) Front, side, and, rear elevations, and top and bottom views, showing all dimensions.
         2) Locations of conduit entrances and access plates.
         3) Component layout and identification.

4) Schematic and wiring diagrams with wire numbers and terminal identification.
5) Connection diagrams, terminal diagrams, internal wiring diagrams, conductor size, etc.
6) Anchoring method and leveling criteria, including manufacturer's recommendations for the Project site seismic criteria.
7) Weight.
8) Finish.
9) Nameplates:
a) As specified in Section 16075 - Identification for Electrical Systems or as indicated on the Drawings.
10) Temperature limitations, as applicable.

e. Use equipment and instrument tags as depicted on the P&IDs for all submittals.
f. Adhere to wiring numbering scheme outlined in Section 16075 - Identification for Electrical Systems throughout the Project:
1) Uniquely number each wire per the Specifications.
g. Wire numbers must appear on all equipment drawings.
h. Organize the shop drawing submittals for inclusion in the Operation and Maintenance Manuals:
1) Furnish the initial shop drawing submittal bound in one or more standard size, 3-ring, D-ring, loose-leaf, vinyl plastic, hard-cover binders suitable for bookshelf storage.
2) Binder ring size: 2 inches.
i. Include the letterhead and/or title block of the firm responsible for the preparation of all shop drawings. Include the following information in the title block, as a minimum:
1) The firm's registered business name.
2) Firm's physical address, email address, and phone number.
3) Owner's name.
4) Project name and location.
5) Drawing name.
6) Revision level.
7) Personnel responsible for the content of the drawing.
8) Date.
j. The work includes modifications to existing circuits:
1) Clearly show all modifications to existing circuits.
2) In addition, show all existing unmodified wiring to clearly depict the functionality and electrical characteristics of the complete modified circuits.

2. Product data:
a. Submitted for non-custom manufactured material listed in this and other sections and shown on shop drawings.
b. Include:
1) Catalog cuts.
2) Bulletins.
3) Brochures.
4) Quality photocopies of applicable pages from these documents.
5) Identify on the data sheets the Project name, applicable specification section, and paragraph.
6) Identify model number and options for the actual equipment being furnished.

7) Neatly cross out options that do not apply or equipment not intended to be supplied.

c. Use equipment and instrument tags as depicted on the P&IDs for all submittals.

d. Adhere to wiring numbering scheme outlined in Section 16075 - Identification for Electrical Systems throughout the Project:
   1) Uniquely number each wire per the Specifications.

e. Wire numbers must appear on all equipment drawings.

3. Detailed sequence of operation for all equipment or systems.
   a. Operational Manual:
      1) Prepare and provide a simplified version of the standard manufacturer's HMI software and system operations manual that includes basic instructions in the application of the system as required for operators in day-to-day operations.
   b. Control System Software Record Documents:
      1) Include complete documentation of all the software programs provided for the entire control and PCS system, including:
         a) Listings of all application software on both hard copy and DVD, DVD-ROM, and CD-ROM.
         b) Database, both hard copy and DVD, DVD-ROM, and CD-ROM.
         c) Communication protocols.
         d) All documentation necessary to maintain, troubleshoot, modify, or update the software system.
   c. Organize the operation and maintenance manuals for each process in the following manner:
      1) Section A - Process and Instrumentation Diagrams.
      2) Section B - Control Descriptions.
      3) Section C - Loop Drawings.
      4) Section D - Instrument Summary.
      5) Section E - Instrument Data Sheets and Brochures.
      6) Section F - Sizing Calculations.
      7) Section G - Instrumentation Installation Details.
      8) Section H - Test Results.
      9) Section I - Operational Manual.
      10) Section J - Spare Parts List.
      11) Section K - Control System Software.
4. Material and equipment schedules:
   a. Furnish a complete schedule and/or matrix of all materials, equipment, apparatus, and luminaries that are proposed for use:
      1) Include sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
5. Itemized instrument summary:
   a. Submit a hard copy of the instrument summary.
   b. List all of the key attributes of each instrument including:
      1) Tag number.
      2) Manufacturer.
      3) Model number.
      4) Service.
      5) Area location.
      6) Calibrated range.
      7) Loop drawing number.
   c. Associated LCP, VCP, PCM, or PLC.

6. Instrument data sheets and cut sheets:
    a. Furnish fully completed data sheets, both electronically in Microsoft Word or Excel and in hard copy, for each instrument and component according to ISA-20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves. The data sheets provided with the instrument specifications are preliminary and are not complete. They are provided to assist with the completion of final instrument data sheets. Additional data sheets may be required. Include the following information on the data sheet:
        1) Component functional description specified in this Section and indicated on the Drawings.
        2) Manufacturers model number or other product designation.
        3) Tag number specified in this Section and indicated on the Drawings.
        4) System or loop of which the component is a part.
        5) Location or assembly at which the component is to be installed.
        6) Input and output characteristics.
        7) Scale range with units and multiplier.
        8) Requirements for electric supply.
        9) Requirements for air supply.
        10) Power consumption.
        11) Response timing.
        12) Materials of construction and of component parts that are in contact with, or otherwise exposed to, process media, and or corrosive ambient air.
        13) Special requirements or features, such as specifications for ambient operating conditions.
        14) Features and options that are furnished.
    b. Provide a technical brochure or bulletin (“cut sheet”) for each instrument on the project. Submit with the corresponding data sheets:
        1) Where the same make and model of instrument is used in 2 or more applications on the project, and the process applications are nearly identical, and the materials, features and options are identical submit one brochure or bulletin for the set of identical instruments.
        2) Include a list of tag numbers for which it applies with each brochure or bulletin.
        3) Furnish technical product brochures that are complete enough to verify conformance with all Contract Document requirements, and to reflect only those features supplied with the device.
        4) Cross out models, features, options, or accessories that are not being provided.
        5) Clearly mark and identify special options and features.
    c. Organization: Index the data sheets and brochures in the submittal by systems or loops.
7. Control panel hardware submittal:
    a. Submit the following in 1 submittal package.
    b. Complete and detailed bills of materials:
        1) Including quantity, description, manufacturer, and part number for each assembly or component for each control panel.
        2) Include all items within an enclosure.
    c. Complete grounding requirements for each system component including any requirements for PLCs, process LANs, and Control System equipment.

d. Requirements for physical separation between control system components and 120 VAC, 480 VAC, and medium voltage power cables.
e. UPS and battery load calculations to show that the backup capacity and time meet the specified requirements.
f. Provide a data sheet for each control system component together with a technical product brochure or bulletin, which include:
    1) The manufacturer's model number or other identifying product designation.
    2) Tag and loop number.
    3) System to which it belongs.
    4) Site to which it applies.
    5) Input and output characteristics.
    6) Requirements for electric power.
    7) Device ambient operating requirements.
    8) Materials of construction.

8. Installation recommendations:
    a. Submit the manufacturer’s printed recommendations for installation of instrumentation equipment.
9. Training submittals:
    a. Develop and submit for review a general training plan for approval by Owner within 14 calendar days from Notice to Proceed. Include complete descriptions of all planned training classes, a preliminary training schedule, a list of all proposed instructors along with resumes, examples of proposed training manuals, and a description of any special training tools to be used (simulators, self-paced modules, personal computer-based training, etc.).
    b. The Engineer will review the general training plan. Special emphasis will be placed on review of the qualifications of the proposed instructors and the timing of the individual courses to maximize their effectiveness. If, in the opinion of the Engineer, the proposed instructors are not sufficiently qualified to conduct the specified training courses, or lack experience, where required, on the specific configuration of the system, provide more qualified instructors.
    c. The general training plan and schedule shall be updated by the Contractor at the beginning of each Phase and approved by the Owner a minimum of 30 days prior to commencement of training.
    d. Training course plan submittals:
        1) For each training course or other training activity, submit a detailed, complete outline and agenda for each lesson as specified in Section 01756 - Commissioning.
        2) Describe any student pre-requisites for the course or training activity.
        3) Provide an updated schedule for all sessions of the course, including dates, times, durations, and locations.
        4) Submit training materials.
    e. Incorporate all submittal review comments into the course.
    f. Do not conduct training courses before review and acceptance of the Course Plan submittal for the course.
10. Project Record documents:
    a. Furnish as specified in Section 01770 - Closeout Procedures.
    b. Record Drawing requirements:
        1) Provide Project Record Drawing of all Instrumentation Drawings.
        2) Update Record Drawings weekly.

3) Record Drawings must be fully updated as a condition of the monthly progress payments.
4) Clearly and neatly show all changes including the following:
a) All existing pipe, conduit, wire, instruments or other structures encountered or uncovered during construction.

11. Loop Drawings:
a. Submit loop drawings for every analog, discrete, and fieldbus signal and control circuit:
1) Provide a loop drawing submittal that completely defines and documents the contents of each monitoring, alarming, interlock, and control loop on this Project.
2) This requirement applies to all signal and control circuits associated with equipment on this Project including vendor supplied equipment packages and control panels.
3) Provide loop drawings in the format indicated in the contract drawings. Provide all tagging in accordance with the Owner's standard.
b. Show every instrument and I/O point on at least one loop diagram.
c. Provide a complete index in the front of each bound volume:
1) Index the loop drawings by systems or process areas.
d. Provide drawings showing definitive diagrams for every instrumentation loop system:
1) Show and identify each component of each loop or system using requirements and symbols from ISA-5.4.
2) Furnish a separate drawing sheet for each system or loop diagram.
e. In addition to the ISA-5.4 requirements, show the following details:
1) Functional name of each loop.
2) Reference name, drawing, and loop diagram numbers for any signal continuing off the loop diagram sheet.
3) Show all terminal numbers, regardless of the entity providing the equipment.
4) MCC panel, circuit, and breaker numbers for all power feeds to the loops and instrumentation.
5) Designation of and, if appropriate, terminal assignments associated with, every manhole, pull-box, junction box, conduit, and panel through which the loop circuits pass.
6) Show vendor control panel, instrument panel, conduit, junction box, equipment and PCS terminations, termination identification, wire numbers and colors, power circuits, and ground identifications.
7) If a circuit is continued on another drawing, show the name and number of the continuation drawing on the loop drawing. Provide complete references to all continuation drawings whether vendor control panels, other loop drawings, existing drawings provided by the Owner, or other drawings.
f. In addition to the above requirements, provide loop diagrams in accordance with the example loop diagram as indicated on the Drawings.

12. Instrument Installation Drawings:
a. Submit, instrument installation, mounting, and anchoring details for all components and assemblies, including access requirements and conduit connection or entry details.
b. Furnish for each instrument a dedicated 8 1/2-inch by 11-inch installation detail that pertains to the specific instrument by tag number.

c. For each detail, provide certification and the hard copies, by the instrument manufacturer, that the proposed installation is in accordance with the instrument manufacturer's recommendations and is fully warrantable.
d. For each detail, provide, as a minimum, the following contents:
    1) Necessary sections and elevation views required to define instrument location by referencing tank, building or equipment names and numbers, and geographical qualities such as north, south, east, west, basement, first floor, etc.
    2) Ambient temperature and humidity where the instrument is to be installed.
    3) Corrosive qualities of the environment where the instrument is to be installed.
    4) Hazardous rating of the environment where the instrument is to be installed.
    5) Process line pipe or tank size, service and material.
    6) Process tap elevation and location.
    7) Upstream and downstream straight pipe lengths between instrument installation and pipe fittings and valves.
    8) Routing of tubing and identification of supports.
    9) Mounting brackets, stands, anchoring devices, and sun shades.
    10) Conduit entry size, number, location, and delineation between power and signal.
    11) NEMA ratings of enclosures and all components.
    12) Clearances required for instrument servicing.
    13) List itemizing all manufacturer makes, model numbers, quantities, lengths required, and materials of each item required to support the implementation of the detail.

13. Control Panel Drawings:
    a. Layout Drawings:
        1) Submit panel, enclosure, console, furniture, and cabinet layout drawings for all items provided.
        2) As a minimum, include the following information:
            a) To scale front, side, and plan views.
            b) Dimensions.
            c) Interior and exterior arrangements.
            d) Mounting information, including conduit entrance location.
            e) Finish data.
            f) Tag number and functional name of items mounted in and on each panel, console, and cabinet.
            g) Nameplate legend including text, letter size, materials, and colors.
    b. Wiring and piping diagrams:
        1) Submit panel wiring and piping diagrams for every panel that contains wiring and/or piping.
        2) Include the following information:
            a) Name of panel.
            b) Wiring and piping sizes and types.
            c) Terminal strip numbers.
            d) Wire tags and labels.
            e) Functional name and manufacturer's designation for items to which wiring and piping are connected.

f) Electrical control schematics in accordance with ANSI standards.

c. Installation drawings:
   1) Provide site-specific installation drawings for all control equipment panels, including dimensions.
   2) Provide scaled drawings and show the position of the equipment at its intended installation location.
   3) Show the placement of all equipment being provided under this Contract and its spatial relationship to all other equipment located in the abutting and adjoining areas.
   4) Show all required access and clearances associated with the equipment with a statement of compliance to manufacturer's recommendations, NEC, and other applicable codes.

14. Schematic Diagrams:
    a. Submit schematic diagrams for all electrical equipment in ladder diagram format.
    b. Include device and field connection terminal numbers on all schematic diagrams.
    c. Incorporate equipment manufacturer’s shop drawing information into the schematic diagrams in order to document the entire control system.
15. Control System Diagram:
    a. Submit a complete set of control system diagrams including the following information:
       1) All PLCs, workstations, printers, communication devices, and communication links:
          a) Show all PLCs with their current I/O allocation, and future I/O allocation, current plus spares provided, and maximum potential I/O based on available slots.
       2) All cables required for communication requirements.
       3) Show each component fully annotated with conduit size and number associated with the power source.
16. Process Control Software Submittal:
    a. In accordance with Product Data and Shop Drawing general requirements.
    b. Submit a complete description of the standard application software programs, operating system and utility programs, including modifications and explanation of how the specific functional requirements are met:
       1) Provide a cross-reference between the Specification requirements and the software submittal, in order to provide the Engineer the ability to identify how each specified requirement or function is met.
    c. A complete listing of the PCS system point I/O database:
       1) Include for each data point, relevant parameters such as range, contact orientation, limits, incremental limits, I/O card byte, I/O hardware address, and PLC assignment.
       2) Organize on a site-by-site basis, separate by point type.
       3) In addition to the active I/O points, list the implemented spare I/O points and the available I/O points remaining on each card, as well as other defined future points specified or shown.
       4) Upon completion of the Work, update all I/O lists to indicate the final as-built configuration of the systems:
          a) Organize as-built I/O list on a site-by-site basis, separated by equipment and point type.

d. Detailed descriptions of procedures used to implement and modify control strategies and database construction.
e. Preliminary overview, screens, station graphic displays, and preliminary reports.
f. Refer to Section 17762 - Control Systems: SCADA Software for additional requirements.

17. Instrumentation and Control System Contractor Statement of Qualifications:
    a. Submit statement of qualifications of the proposed ICSC in accordance with subsequent requirements of this Section.
18. Control Descriptions:
    a. For each control loop, provide a detailed functional description of the operation of the equipment, signals, and controls as shown on the P&IDs:
        1) Include all functions depicted or described in the Contract Documents.
        2) Include within the Control Description content:
            a) All specific requirements.
            b) All common requirements that pertain in general to all loops.
            c) Listing all ranges, setpoints, timers, values, counter values, etc.
19. Test Procedure Submittals:
    a. Submit the proposed procedures to be followed during tests of the PCS and its components in 2 parts:
        1) Preliminary Submittal: Outline of the specific proposed tests and examples of proposed forms and checklists.
        2) Detailed Submittal: After successful review of the Preliminary Submittal, submit the proposed detailed test procedures, forms, and checklists. Include a statement of test objectives with the test procedures.
20. Test reports:
    a. As specified in Section 01330 - Submittal Procedures.

1.06 QUALITY ASSURANCE

A. Manufacture instruments at facilities certified to the quality standards of ISO 9001.

B. ICSC qualifications:
    1. General information on the proposing company:
        a. Document that the ICSC company has been actively involved in the instrumentation, PLC-based control systems business for a minimum of five years and has adequate facilities, organization structure, manpower, and technical and managerial expertise to properly perform the Work as specified in these Specifications.
    2. Similar project experience of the company:
        a. Provide a list of at least 3 successfully completed projects for a water and/or wastewater system of similar scope and complexity in which the proposing firm used components the same as those intended for use on this Project. The proposing firm must have performed, for each listed project, system engineering, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), software configuration and documentation, field testing, calibration and process start-up, operator instruction, and maintenance training. In addition, provide the following information for each project:

1) Name of plant or system owner, contact name, and current telephone number. Design engineer's name, address, and telephone number. Failure to provide current contact information may result in the listed project being disqualified for use in meeting the minimum requirements for prequalification.
2) Manufacturer and model number(s) of the PLC based control system and the computer-based SCADA system used for both hardware and software.
3) Brief description of the system.
4) Approximate number of input and output signals: analog, digital, and fieldbus.
5) Brief application software description.
6) Contracted cost of the system, separate by base amount and any change orders for the completed projects.
7) Duration of the project and date of completion.

3. Information on the proposed Project team members:
   a. Provide the name and resume of the individual persons who will be responsible for each of the following:
      1) Office engineering and management of this Project.
      2) Lead for software configuration/programming.
      3) Individual who will be responsible for the hardware and hardware interface design.
      4) Individual who will be responsible for field testing, calibration, and process start-up.
      5) Individual who will be responsible for operator training.
   b. All of these individuals must be permanent employees of the proposing firm.
4. Determination of the proposed ICSC qualifications is at the sole discretion of the Engineer.

C. Furnish all equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

D. The ICSC must have their own operating UL listed panel fabrication facility. All panels must be fabricated at this facility and meet all UL 508/508A requirements.

E. ICSC:
1. Contractor, through the use of a qualified ICSC, is responsible for the implementation of the PCIS and the integration of the system with other required instrumentation, control devices, and software.
2. The ICSC assumes full responsibility, through the Contractor, to perform all work to select, furnish, install, test, calibrate, and place into operation all instrumentation, controls, telemetry equipment, control panels, and control system, for a complete, integrated and functional PCIS system.
3. Due to the complexities associated with the interfacing of numerous control system devices, it is the intent of these Specifications that the ICSC be responsible for the integration of the PCIS with existing devices and devices provided under the Contract Documents with the objective of providing a completely integrated control system.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 01600 - Product Requirements.

B. Store all equipment and materials delivered to the job site in a location that will not interfere with the construction or the Owner's operations.

C. Shipping precautions:
   1. After completion of shop assembly, successful Source Test, pack all equipment, cabinets, panels, and consoles in protective crates and enclose in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.
   2. Place dehumidifiers when required, inside the polyethylene coverings.
   3. Skid-mount the equipment for final transport.
   4. Provide lifting rings for moving without removing protective covering.
   5. Display boxed weight on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

D. Special instructions:
   1. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.
   2. The Contractor shall ship the PCS equipment listed below to Programmer's office within 175 days after Notice to Proceed is issued to the Contractor:
      a. PLCs to be programmed by Programmer, including all chassis, power supplies, CPUs, IO modules, cables, programming software, and related equipment.
      b. All network communications equipment and cables less than 10 feet in length.
      c. Any personal computers and related software.
   3. The Programmer shall be allowed to keep the above equipment for a minimum of 180 calendar days and additionally until 30 days prior to the start of the factory test for the applicable PLC control panels. The Contractor shall allow sufficient time in the Project Schedule for this 180 day requirement. The Contractor is responsible to obtain necessary submittal reviews, order equipment, and allow sufficient delivery time to comply with this requirement. No schedule extension shall be allowed due to failure of the Contractor to comply with these requirements.
   4. The Contractor shall also supply, for the use of the Programmer, samples of any devices or equipment that will communicate to the Programmer-programmed PLCs using Modbus, Modbus plus, Fieldbus, or any other digital network. These samples must be shipped to the Programmer's facility and remain there for a minimum of 90 days prior to the PLC panel factory tests.
   5. Contractor shall be responsible for shipping the above equipment from the Programmer's facility. At the designated time for shipment of the above equipment to the factory test site or the field (whichever applies), the Contractor shall send personnel to the Programmer's office to package and ship the equipment to the factory test site. The Contractor shall have sole responsibility to package and ship the equipment, including packing materials and shipping charges. Prior to packaging and shipping, the Contractor shall examine and test all equipment, as needed, and shall certify, in writing, that the equipment appears to be in proper working order, and shall deliver the

certification to the Programmer, who will forward copies to the Owner and Engineer.

6. The ICSC is responsible to perform successfully all Network device configuration, radio device configuration, wireless path studies and SCADA hardware including NUTANIX equipment and platform.

E. Tagging:
   1. Tag each component and/or instrument to identify its location, instrument tag number, and function in the system.
   2. Coordinate tag scheme with Manatee County CMMS. Coordination meeting(s) with county is required.
   3. Firmly attach a permanent tag indelibly machine marked with the instrument tag number, as given in the tabulation, on each piece of equipment constituting the PCS.
   4. Tag instruments immediately upon receipt in the field.
   5. Prominently display identification on the outside of the package.
   6. Utilize the Tag and Loop Number identifications shown as provided by Manatee County.

F. Delivery and inspection:
   1. Deliver products in undamaged condition, in manufacturer's original container or packaging with identifying labels intact and legible. Include date of manufacture on label.

1.08 PROJECT OR SITE CONDITIONS

A. Site conditions:
   1. Provide a PCS, including all equipment, raceways, and any other components required for a complete installation that meets the environmental conditions for the Site as specified in the General Requirements and below.
      a. Provide all equipment and construction techniques suitable for the site wind loading criteria
   2. Altitude, temperature and humidity:
      a. Provide all equipment and instrumentation fully rated for continuous operation at this altitude, temperature and humidity conditions with no additional derating factors applied.
      b. Provide additional temperature conditioning equipment to maintain all equipment and instrumentation in non-conditioned spaces or outdoors subject to these ambient temperatures 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature as determined by the equipment manufacturer's guidelines:
         1) Provide all power wiring for these devices (e.g., heaters, fans, etc.), whether or not indicated on the Drawings.
   3. Area classifications:
      a. Furnish enclosures that match the area classifications as specified in Section 16050 - Common Work Results for Electrical.
   4. Site security:
      a. Abide by all security and safety rules concerning the Work on the Site, as specified in Section 01329 - Safety Plan.

1.09 SEQUENCING

A. General:
   1. As specified in Sections 01312 - Project Meetings and 01756 - Commissioning.
   2. Testing requirements are specified in Sections 01756 - Commissioning, 17950 - Testing, Calibration, and Commissioning and other sections.
   3. General scheduling requirements are specified in Section 01324C - Progress Schedules and Reports - Small Projects
   4. Commissioning requirements as specified in Section 01756 - Commissioning.

B. Pre-submittal conferences:
   1. Before producing any submittals, schedule a pre-submittal conference for the purposes of reviewing the entire project, equipment, control philosophy, schedules, and submittal requirements.
   2. The Contractor, instrumentation and control subcontractor, electrical subcontractor, and all manufacturers furnishing major pieces of equipment must attend, including but not limited to:
      a. Vendor control panels.
      b. Chemical feed systems.
      c. Motor control centers.
      d. Switchgear.
      e. Variable frequency drives.
      f. Lighting.
      g. Engine generators.
   3. The Programmer shall be invited to attend the pre-submittal conference.

C. System configuration meetings:
   1. Review the system configuration, the system database/County CMMS tagging schemes, control schemes, displays, etc. with the Engineer and Owner on at least 4 occasions during development.
   2. Preliminary meeting: Before configuration work is begun. The Programmer must bring to this meeting example of displays, display symbols, etc. to show the capabilities of the system software.
   3. Intermediate review meeting: Held after the initial database is entered and typical screens and reports have been entered.
   4. Network configuration/security meeting: Held after preliminary meeting and before first graphics review meeting.
   5. Final review meeting: Held after initial completion of all configuration work. This final meeting may not be held in conjunction with the Source Test. Make final format revisions after this review.
   6. Additional requirements as specified in Section 17100 - Control Strategies. Attend meetings to coordinate the PCS system configuration, the system database, control schemes, displays, etc., with the Programmer, Engineer and Owner on at least three occasions during development.
   7. Preliminary meeting: Contractor shall provide a list of each PLC and other programmable devices that will interface to the rest of the control system, including make, model, and a description of the interface.
   8. Intermediate review meeting: Held after approximately one-half of the interface submittals identified in the Pre-submittal Conferences paragraph above have been submitted. Individuals responsible for programming PLCs and other

programmable devices supplied by Contractor shall attend this meeting. Meet to discuss all control system interface submittals and their requirements.

9. Final review meeting: Held after all HMI/LOI interface submittals have been submitted. Meet to discuss HMI/LOI interface submittals and requirements.
10. Additional requirements as specified in Sections 17100 - Control Strategies and 17720 - Control Systems: Programmable Logic Controllers. Individuals responsible for programming PLCs and other programmable devices supplied by Contractor shall attend this meeting by telephone conference call.

D. Control logic meetings
   1. Review the PLC programming with the Engineer, and Owner on at least 3 occasions during development. Individuals responsible for programming PLCs and other programmable devices supplied by Contractor shall attend this meeting by telephone conference call.
      a. Preliminary meeting:
         1) Contractor shall provide a list of each PLC and other programmable devices that will interface to the rest of the control system, including make, model, and a description of the interface; provide contact information for each individual responsible for programming each said PLC and device; and provide a listing of the submittals that will contain HMI/LOI interface information with a schedule for when each submittal will be provided.
      b. Intermediate review meeting: Held after approximately one-half of the interface submittals identified in the Pre-submittal Conferences paragraph above have been submitted.
         1) Individuals responsible for programming PLCs and other programmable devices supplied by Contractor shall attend this meeting.
         2) Meet to discuss all control system interface submittals and their requirements.
      c. Final review meeting: Held after all HMI/LOI interface submittals have been submitted.
         1) Meet to discuss HMI/LOI interface submittals and requirements.
   2. Additional requirements as specified in Sections 17100 - Control Strategies, 17101 - Specific Control Strategies, 17720 - Control Systems: Programmable Logic Controllers and 17762 - Control Systems: SCADA Software.

E. Source testing:
   1. Before the delivery and installation of control panels, PLCs, control system equipment, and other PCS components at the job site, but after the procurement and assembly of components, perform Source Test.
   2. Schedule the Source Test after receiving approval of the Source Test procedures submittal.
   3. Submit a copy of the test procedures including all forms at least 21 days before any scheduled test date**.**
   4. Notify the Engineer of scheduled tests a minimum of 15 days before the date of the test.

F. General Field Start-Up and testing procedures:
   1. As specified in Section 01756 - Commissioning.

2. Programmer will commence loop validation testing with contractor after contractor has successfully completed loop testing and contractor has submitted certified loop verification forms for each RTU.

G. Installation testing:
   1. As specified in Section 01756 - Commissioning.
   2. Commence after acceptance of all training, wire test, calibration tests, and loop validation tests, and all inspections have demonstrated that the PCIS complies with all Contract requirements.
   3. Acceptance of the PCIS Installation testing must be provided in writing by the Owner before the performance testing may begin.

H. Training:
   1. As specified in Section 01756 - Commissioning

I. Functional testing:
   1. Representatives from each of the following groups shall be in attendance during the functional Testing: Programmer, System Supplier**.** Commence after acceptance of all training, wire test, calibration tests, and loop validation tests, and all inspections have demonstrated that the PCIS complies with all Contract requirements.
   2. Loop validation test.
   3. As specified in Section 17950 - Testing, Calibration, and Commissioning.
      a. Notify the Owner of scheduled tests a minimum of 21 days before the estimated completion date of installation and wiring of the PCIS.
      b. Complete loop validation testing a minimum of 5 days before the pre-commissioning phase of the project.
      c. Loop validation certifications:
         1) After the field device loop tests have been successfully completed as specified in Section 17950 - Testing, Calibration, and Commissioning for all individual instruments, all separate analog control networks, all valves, all VCPs, all motors, all local operator interface panels, all motor control centers, etc., submit a certified copy of all test forms signed by the Contractor, Vendor, and the Owner's representative with test data entered, together with a clear and unequivocal statement that all instrumentation, including all control and signal wiring, has been successfully calibrated, inspected, and tested.
            a) Acceptance of the PCIS Installation Testing must be provided in writing by the Engineer before the Process Operational Period may begin.
      d. The Programmer will assist with Functional Testing for PLCs programmed by the Programmer, as specified in Section 17950 - Testing, Calibration, and Commissioning.

J. Provide all special tools and spare parts, as specified in the Maintenance paragraph of this Section, before Process Operational Period commences, suitably wrapped, and identified.

K. Process Operational Period:
   1. Upon completion of the Process Operational Period, conduct an Instrumentation and Controls Process Performance Test as a condition for Project final completion.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. Provide additional warranty as specified in the individual Instrumentation and Control Specifications that extends beyond the Correction Period, as specified in Manatee County Front end document. IFBC No. XXXX.

1.12 SYSTEM PROCESS START-UP

A. Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:
   1. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the Engineer.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE

A. Before Substantial Completion, perform all maintenance activities required by the Contract Documents including any calibrations, final adjustments, component replacements or other routine service required before placing equipment or systems in service.

B. Furnish all spare parts as required by the Contract Documents.

C. Spare parts:
   1. Furnish the spare parts selected by the Engineer from the priced list of spare parts in the hardware submittal.
   2. Furnish a price list of all special tools required to calibrate and maintain all of the instrumentation provided under the Contract Documents. Furnish the special tools selected by the Engineer from the priced list.

D. Provide additional spare parts specified in other sections of the Instrumentation and Control Specifications.

E. Submit all special tools and spare parts, suitably wrapped and identified, before Process Operational Period commences.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide similar items from a single manufacturer throughout the PCIS portion of the Project.

B. Allowable manufacturers are specified in individual instrument and equipment specifications.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Furnish all materials under this Contract that are new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these devices and that bear all approvals and labels as required by the Specifications.

B. Provide materials complying with the applicable industrial standard as specified in the Contract Documents.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS

A. Furnish all meters, instruments, and other components that are the most recent field proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise specified to match existing equipment.

B. Unless otherwise specified, furnish individual instruments that have a minimum accuracy of within 0.5 percent of full scale and a minimum repeatability of within 0.25 percent of full scale.

C. Signal transmission:
   1. Analog signals:
      a. Furnish analog measurements and control signals that vary in direct linear proportion to the measured variable, unless otherwise indicated.
      b. Furnish electrical analog signals outside control panels that are 4 to 20 milliamperes 24 VDC, except as indicated.
      c. Electrically or optically isolate all analog signals from other signals.
      d. Furnish regulated analog signals that are not affected by changes in supply voltage or load resistance within the unit's rating.
      e. Maintain the total 4 to 20 milliamperes loop impedance to 10 percent below the published value at the loop operating voltage.
      f. Where necessary, reduce loop impedance by providing current-to-current (I/I) isolation amplifiers for signal re-transmission.
   2. Pneumatic signals:
      a. All pneumatic signals: 3 to 15 pounds per square inch gauge.
   3. Discrete input signals:
      a. As indicated in the controller hardware specification.
   4. Discrete output signals:
      a. Dry contacts or TRIAC outputs (with express written approval by the Engineer) as needed to coordinate with the field device.
      b. Provide external terminal block mounted fuse with blown fuse indication for all discrete outputs.
      c. Provide interposing relays for all discrete outputs for voltage and/or current compatibilities.
      d. Provide interposing relays as required for functionality of the control circuit.
   5. Signal performance and design criteria:
      a. Stability:

1) After Controls have taken corrective action, oscillation of the final control element shall not exceed 2 cycles per minute or a magnitude of motion of 0.5 percent of full travel.

b. Response:
   1) Any change in setpoint or controlled variable shall produce a corrective change in position of the final control element and stabilized within 30 seconds.

c. Agreement:
   1) Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 percent of full scale over a 6:1 operating range.

d. Repeatability:
   1) For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position the final element.

e. Sensitivity:
   1) Controls shall respond to a setpoint deviations and measured variable deviations within 1.0 percent of full scale.

f. Performance:
   1) All instruments and control devices shall perform in accordance with the manufacturers' specifications.

D. Discrete circuit configuration:
   1. Configure discrete control circuits to fail safe, on loss of continuity or loss of power.
   2. Alarm contacts: Fail to the alarm condition.
   3. Control contacts fail to the inoperative condition unless otherwise indicated on the Drawings.

E. Grounding:
   1. Provide control panels with a signal ground bus, isolated from the power ground bus:
      a. Provide multiple panels in one location with a common point for signal ground bus connection to ground.
   2. Ground single-point ground shields and measurement loops at the source panel external terminals, unless otherwise noted, by bonding to the control panel signal ground bus.
   3. Provide isolating amplifiers within control panels for field equipment possessing a grounded input or output, except when the panel circuit is galvanic ally isolated.

F. Instrument air:
   1. Where indicated on the Drawings, provide dry, filtered control air at 30 pounds per square inch gauge nominal pressure piped to all field instruments and instrument panels requiring air:
      a. Provide each field instrument with an integral, non-adjustable filter/regulator assembly to provide regulated air.
      b. Provide each instrument panel requiring air with an adjustable filter/regulator assembly with gauge and an air manifold to provide air to pneumatic instruments.
      c. Filter all air to 5-micron maximum particle size.

d. Provide low pressure switch to alarm on insufficient air supply.

2.07 ACCESSORIES

A. Nameplates:
   1. Provide a nameplate for each controller, instrument transducer, instrument power supply, solenoid, or any other control device located either in the field or within panels.
   2. All nameplates shall be of identical style, color, and material throughout the facility.
   3. Device nameplates shall include:
      a. Designations as indicated on the Drawings and identified on the Process and Instrumentation Drawings.
         1) Device tag and loop number ID (e.g., FIT-60.011).
         2) PLC ID (e.g., PLC-11).
         3) Power information (e.g., PCM-11, 120VAC).
      b. White lettering on a black background, laminated plastic.
   4. All instruments shall be equipped with Type 316 stainless steel nameplate with the instrument tag stamped in 3/8-inch letters and connected to the instrument using Type 316 stainless steel wire.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Provide all equipment that is new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products that bear all approvals and labels as required by the Specifications.

B. Arrange with all manufacturers of the equipment and fabricators of panels and cabinets, to allow the Owner and Engineer to inspect and witness the testing of the equipment at the site of fabrication:
   1. Equipment includes the cabinets, special control systems, flow measuring devices, and other pertinent systems and devices.

C. Source Test is specified in Section 17950 - Testing, Calibration, and Commissioning.

PART 3 EXECUTION

3.01 EXAMINATION

A. The ICSC is required to visit the site and attend a pre-bid conference. Examine the premises completely before bidding. It is the ICSC's responsibility to be fully familiar with the existing conditions and local requirements and regulations.

B. Review the existing Site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.

C. Provide a complete instrumentation and control system:
   1. Install all extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical, and process control and instrumentation system.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Equipment locations indicated on the Drawings may change due to variations in equipment size or minor changes made by others during construction:
   1. Verify all dimensions as indicated on the Drawings:
      a. Actual field conditions govern all final installed locations, distances, and levels.
   2. Review all information indicated on the Drawings, including architectural, structural, mechanical, instrumentation, and the accepted electrical, instrumentation, and mechanical shop drawings, and coordinate Work as necessary to adjust to all conditions that arise due to such changes.
   3. Make minor changes in location of equipment before rough in, as directed by the Owner or Engineer.

B. Perform all related Electrical Work in accordance with the applicable sections of the Electrical Specifications.

C. The PCIS configurations are diagrammatic:
   1. The locations of equipment are approximate unless dimensioned.
   2. Where Project conditions require, make reasonable changes in locations and arrangements.

D. Conduit, cables, and field wiring:
   1. Provide all PCS equipment cables, and process LAN communication networks under the Instrumentation and Control Specifications.
   2. Provide terminations and wire identification as specified in the Electrical Specifications.
   3. Protect all wiring from sharp edges and corners.
   4. Provide all conduits, fittings, boxes, etc. in accordance with all the requirements of the Electrical Specifications.

E. Equipment tie-downs:
   1. Anchor all instruments, control panels, and equipment by methods that comply with seismic and wind bracing requirements, which apply to the Site.
   2. All control panels, VCPs, LCPs, RTUs, PCMs, etc., shall be permanently mounted and tied down to structures.

F. Instrument tagging:
   1. As specified in Section 16075 - Identification for Electrical Systems.
   2. Provide all field-mounted instruments with nameplates:
      a. Nameplates engraved with the instrument’s full tag number as indicated on the Drawings:

1) Affix tags with stainless steel wire fasteners.

3. Provide all back of panel instruments with nameplates:
   a. Engraved with the instrument's full tag number as indicated on the Drawings:
4. Provide all front of panel instruments with a nameplate:
   a. Engraving to include the following:
      1) Instrument's full tag number.
      2) Service description.
   b. Nameplates:
      1) Secure nameplates to the panel with stainless steel screws.
      2) Use an accepted adhesive if screws would violate the NEMA or other ratings of the enclosure.

G. Cable and conductor termination:
   1. Terminate all cables and conductors on terminal blocks.
   2. Terminal blocks and all wire terminations shall be touch safe design to protect against accidental touch.
   3. Terminal block enclosures:
      a. Suitable for the area classification as specified in Section 16050 - Common Work Results for Electrical.

H. Surge protection:
   1. Provide surge protection for all inputs and outputs of the PLC in all control panels. Mount the surge protectors inside the control panels. Wire the surge protectors between the PLC I/O modules and the field terminal blocks inside the control panel.
   2. Provide outdoor field instrument loops with voltage surge protection units installed on the instruments and the panel.
   3. Individually fuse each 4 to 20 milliampere direct current loop with a 1/16 ampere fuse between power supplies and receiver surge protectors.
   4. Provide voltage surge protection for 4 wire transmitters and analyzers:
      a. Protect both power source and signal loop.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Owner Training:
   1. Demonstration requirements are specified in Section 17950 - Testing, Calibration, and Commissioning.

Table 1			
Course Title	**Minimum Course Length (hours per session)**	**Personnel (Estimated Number of Students)**	**Minimum Number of Sessions**
System Overview	8	10	2
Operator Training - Basic	24	10	2
Operator Training - Advanced	16	5	2
CIS (Computer) Equipment Maintenance	16	4	2
HMI Software	40	3	2
Historian System Training	24	5	2
Reports Training	4	5	2
PLC Hardware	16	4	2
PLC Software	32	6	2
LOI Hardware and Software	16	5	2
Network Equipment	16	4	2
Follow-Up Training	8	5	2

2. Training course requirements:
   a. System overview training:
      1) Furnish training courses that give the Owner's supervisory level personnel an overview of all elements of the PCIS system that focus on the overall functional aspect of elements of the control system and provide an understanding of the interaction of the various components.
      2) Furnish a training course that gives the Owner's supervisory level personnel an overview of the new Contractor-provided elements of the PCIS system. Focus on the overall functional aspects of each new elements of the control system, particularly the mechanical system vendor-provided control packages.
   b. Operator training:
      1) Furnish training courses that instruct system operators in the efficient operation of all aspects of the PCIS that include not only the general operation of the control system but also the operation of specific system features.
      2) Furnish training courses that instruct system operators in the efficient operation of Contractor-provided aspects of the PCIS that include not only the general operation of each control system but also the operation of specific system features.
      3) Operator's training shall include the following for each vendor package and programmable device:
         a) Control system overview: Architecture, equipment functions, software components, etc.
         b) Display navigation, overview, and types of displays.

c) Process and equipment monitoring and control: Basic principles and operation.
d) Logging ON and OFF the system and description of the security and access system.
e) Alarm subsystem.
f) Trending: Provide a thorough session on how to use all trending functions.
g) Reports: How to access, print, and review content.
h) Control strategies: Present an average 15-minute review of each control strategy, including a hands-on demonstration of screens and operator functions for each.
i) Instruction on the use of all operational functionality alarm logging, trending, displays, database, reports, and control software developed for the Project and incorporated in the installed PCIS system.

c. CIS computer equipment maintenance training:
1) Furnish training courses that will enable maintenance technicians to perform troubleshooting and repair of all system computer equipment. Include the theory of operation of the system as a whole, including related operating system and utility software.

d. HMI software training:
1) Furnish training courses that will enable the Owner's staff to develop and maintain all aspects of the operator interface system applications.
2) Include topics:
a) Operating systems and utilities such as virus protection software.
b) Point (tag) database development and modification.
c) Graphic screen creation and editing.
d) Scripting.
e) I/O servers, drivers, etc.
f) PLC interface functions and software.
g) Displays, scripts conventions, and documentation.
h) Trending.
i) Alarms and events.
j) System security, access levels, and areas of responsibility.
k) General system maintenance, including backups, history data archive, version control, file naming and cataloging conventions, and system file housekeeping.
3) Address not only the procedures associated with the control system's standard software packages, but in addition include material explaining the specific conventions used in developing the Project's system applications (graphics, PLC/RTU interface, scripts, control strategies, trends, etc.). In addition, provide instruction in the use of techniques for developing and maintaining current, comprehensive documentation for all installed system applications.

e. Historian system training:
1) Furnish the following training:
a) Introduction to relational databases.
b) Introductory training on the specific relational database program used for the historian server.
c) How to set up points for historian logging.

d) How to develop, edit, and print custom reports, in detail.
e) Introduction to use of the query language.
f) System maintenance.
g) Interface to networks outside of the control system.

f. Report training:
1) Furnish training courses that will enable the Owner's staff to develop and maintain all aspects of reports.
2) Include topics:
a) Generation of a developed report.
b) Generation of a new report.
c) Modification and editing of reports.
d) Formatting reports.
e) Manual entry and automatic entry of data from a database.

g. PLC hardware training:
1) Furnish training on PLC hardware and on related components, including battery backup equipment, UPSs, LOI hardware, control circuits, and analog circuits.
2) Furnish training on PLC hardware principles, product features, proper installation, operation, troubleshooting, and maintenance.
3) PLC training may be provided by manufacturer's certified trainers.

h. PLC software training:
1) Furnish training on PLC software.
2) Two types of training are required, basic and project-specific:
a) Basic PLC software training covers the principles of PLC programming and the specific features and function of the PLC products used on this Project, provided by one of the PLC manufacturer's certified trainers.
b) Project-specific PLC software training covers the programming conventions, new standardized software modules, specific control strategy programs, and documentation created for the Work performed under this Contract. This training includes the specific knowledge needed to modify, expand, duplicate, troubleshoot, and repair the PLC programs provided under this Contract, provided by a qualified member of the ICSC individual who is thoroughly familiar with the delivered system, and is one of the senior programmers who programmed the PLCs for this Project.

i. LOI hardware and software training:
1) Provide the following:
a) Overview of hardware and firmware, including starting, stopping, and PLC interface.
b) Configuration of tag database.
c) Creating, editing, and saving display screens.
d) Troubleshooting.

j. Network equipment training:
1) Furnish basic training on all network hardware, switch and router configuration and software, and network monitoring software.
2) Include a detailed description and explanation of the installed network architecture, media, and functions.
3) Furnish an overview of the function and operation of each piece of network equipment.
4) Furnish training on network maintenance troubleshooting and repair.

5) Furnish training on how to install spare or off-line backup equipment.
6) Basic network overview:
   a) Discuss a basic network overview for each site.
   b) Discuss the architecture (loop, star, etc.), media redundancy, and items that are not readily apparent to staff.
   c) Discuss how to monitor the network health through the HMI network screen.
   d) Discuss both enterprise level networks, the PCS communications network, and the field network.
7) Ethernet switches:
   a) Discuss the various types of switches (Layer 2, Layer 3, etc.).
   b) Discuss switch health monitoring through the HMI.
   c) Discuss the VLAN configuration (what ports should be used for what network, etc.).
   d) Discuss testing procedures.
8) Field networks:
   a) General:
      (1) Discuss general principles behind likely device failures and actions to take to resolve such failures for each type of field network.
   b) Modbus networks:
      (1) Discuss Modbus TCP/IP and Modbus RTU converters for the SKF.
9) Wireless networks:
   a) Discuss parameters specific to wireless networks including, but not limited to: remote resetting options, bandwidth availability, channel speed, and ultimate channel capacity.

k. Follow-up training:
   1) Provide a series of on-site follow-up training classes beginning after process start-up of the SCADA/PCIS system. The intent for these classes is to provide the Owner's personnel the opportunity for a review and "refresher" of the training topics and material after they have had some experience using the system.
   2) Mutually schedule and develop the content of these classes with the Owner no later than 1 month before the beginning of the first session:
      a) Schedule at the Owner's discretion on non-consecutive days spaced out over the process start-up and warranty period.

3. Recording training sessions:
   a. Record all training.
   b. Provide pre-recorded audio-visual presentations and Produce audio-visual presentations by recording the actual training sessions of the Owner's personnel.
   c. Furnish digital video disk (DVD) format.
   d. These disks become the property of the Owner and cover, in detail, the training for the specific hardware and software of all the systems provided for the Project.
   e. Provide all the necessary cameras and recording equipment.

3.08 FIELD QUALITY CONTROL

A. Inspection:

1. Allow for inspection of PCIS installation as specified in Section 01450 - Quality Control.
2. Provide any assistance necessary to support inspection activities.
3. Engineer inspections may include, but are not limited to, the following:
    a. Inspect equipment and materials for physical damage.
    b. Inspect installation for compliance with Drawings and Specifications.
    c. Inspect installation for obstructions and adequate clearances around equipment.
    d. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.
    e. Inspect equipment nameplate data to verify compliance with design requirements.
    f. Inspect cable terminations.
    g. Inspect/witness instrument calibrations/verifications.
4. Inspection activities conducted during construction do not satisfy inspection requirements specified in Section 17950 - Testing, Calibration, and Commissioning.

B. Instrument Installation Inspection:
1. Provide any assistance necessary to support inspection activities.
2. Inspections may include, but are not limited to, the following:
    a. Inspect equipment and materials for physical damage.
    b. Inspect the installed arrangement, lay lengths, orientation, piping obstructions, etc., that could affect the instruments accuracy or repeatability.
    c. Inspect installation for compliance with Drawings and Specifications.
    d. Inspect installation for obstructions and adequate clearances around equipment.
    e. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.
    f. Inspect equipment nameplate data to verify compliance with design requirements.
    g. Inspect cable terminations.
    h. Inspect/witness instrument calibrations/verifications.
3. Inspection activities conducted during construction do not satisfy inspection requirements specified in Section 17950 - Testing, Calibration, and Commissioning.
4. Field acceptance testing: (Functional Testing) is specified in Section 17950 - Testing, Calibration, and Commissioning. Additional general requirements are specified in Section 01756 - Commissioning.

C. Installation supervision:
1. Ensure that the entire PCIS is installed in a proper and satisfactory manner. At a minimum, the ICSC shall provide the following services:
    a. Installation resources:
        1) Coordinate with the Contractor regarding installation requirements of the Contract Documents.
    b. Provide technical assistance to installation personnel by telephone:
        1) Furnish installation personnel with at least 1 copy of the accepted submittals, including all installation details.
    c. Periodic inspections during the construction period.

d. A complete check of the completed installation to ensure that it is in conformance with the requirements of the equipment manufacturer and the Contract Documents.
e. Field verify accuracy and calibration of all instruments.

3.09 ADJUSTING

A. Control valves:
1. Stroke all control valves, cylinders, drives and connecting linkages from the control system as well as local control devices and adjust to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position.
2. Check control valve actions and positioner settings with the valves in place to ensure that no changes have occurred since the bench calibration.

B. Make all revisions necessary to the control system software, as directed by the Engineer.
1. It is understood that the Contractor knows and agrees that changes will be required in the control system software during the Source Testing, Functional Testing, Process Operational Period, Process Start-Up, and during the Project Correction Period.

3.10 CLEANING

A. As specified in Section 01770 - Closeout Procedures.

B. Vacuum clean all control panels and enclosures before process start-up and again after final completion of the project.

C. Clean all panel surfaces.

D. Return to new condition any scratches and/or defects.

E. Wipe all instrument faces and enclosures clean.

F. Leave wiring in panels, manholes, boxes, and other locations in a neat, clean, and organized manner:
1. Neatly coil and label all spare wiring lengths.
2. Shorten, re-terminate, and re-label excessive spare wire and cable lengths, as determined by the Engineer.

G. As specified in other sections of the Contract Documents.

3.11 PROTECTION

A. Protect all Work from damage or degradation until date of Substantial Completion.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17100

CONTROL STRATEGIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Contractor-developed loop description submittal requirements.
   2. ICSC as defined in specification section 17050 must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.
   3. General programming requirements.
   4. Common control functions:
      a. General control and monitoring functions to be provided throughout the PCS system.
         1) These requirements apply to all systems, and supplement the specific loop descriptions in Section 17101 - Specific Control Strategies and information indicated on the Drawings.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Hardwired control: Control circuitry that does not utilize software to initiate functionality.

C. Hardwired interlocks: A safety or protective feature that will interrupt operation of the equipment in all operating modes with no required operator intervention.

D. Software interlocks: A safety or protective feature that will interrupt operation of the equipment when the PLC has control.

E. Slew rate: Rate of change in respect to time.

F. Clamp: Imposed upper and lower limits on setpoints to eliminate entries outside the allowable control parameters.

G. Watchdog timer: Timers imposed to test components such as discrete I/O to verify the health of the card.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS (NOT USED)

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION (NOT USED)

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. General programming requirements:
   1. Coordinate with Manatee County CMMS project for tag database naming and tagging convention.
      a. Submit names for Owner approval.
      b. Unless otherwise noted, utilize floating-point format for all PLC algorithms and calculations.
      c. Provide PLC logic to convert raw input values into engineering units in a floating-point format.
   2. Store all adjustable parameters in the PLC, and configure so that an operator with sufficient security access can change the parameters from the LOI or HMI. Update and display the current value at all locations, regardless of where the last change was made.
   3. Reusable PLC code blocks:
      a. New code blocks that the Contractor would like to use as a standard shall be submitted to Owner for review and approval.
   4. Documentation:
      a. All control logic shall be completely annotated including all rungs, instructions, and tags.
      b. Each routine shall have a title and a detailed description of the control strategy represented by the control logic. Where parameters are passed to the routine, all parameters shall be defined in the routine description.
      c. Analog tag descriptions representing process variables shall include the engineering unit range of the analog variable.
      d. Digital tag descriptions shall include the On and Off state labels.
      e. Complete, grammatically correct sentences and terminology, consistent with water treatment processes, shall be utilized in the development of rung and routine descriptions.
      f. All equations developed in the process logic shall be fully documented in the rung or routine description. A description of each constant and variable utilized in the equation shall be defined including engineering units.
   5. Program slew rates for setpoints as needed to limit the effect of updated setpoints on the process:
      a. Provide for control setpoints and manual speed and position selections.
      b. Store new setpoints in one register, and gradually ramp the actual setpoint register at the slew rate until it reaches the new value.
      c. Provide operator access to change slew rates from the HMI.
   6. Saved setpoints:
      a. Provide an operator selection to save all setpoint values.

b. Provide an operator selection to restore all setpoints to the last saved value.

7. Store a copy of all adjustable parameters and accumulated and integrated totals in PCS:
   a. Upon re-loading of the PLC program, re-load these values to the PLC from PCS or processor memory card.
8. Calculated values:
   a. Program calculations such that division by zero errors cannot occur.
   b. Prevent calculations from generating values that exceed the limits of the equipment or data type structures (integers) internal to the PLC.
   c. Configure counting functions (start counts and operation counts) to allow a minimum of 10,000 counts, and to roll-over to zero at an even decimal interval (1 followed by 4 or more zeros).
   d. Configure integrating functions to accurately accumulate the maximum rate from the instrument/equipment (totalizers, run time meters) for 30 years.
9. Timers:
   a. Provide programmable settling and proving timers in control sequences as required for starting and stopping of equipment to allow the process to settle down before proceeding with any additional control functions.
      1) The settling timers may be overridden by setting the timer to 0 seconds.
10. Control Panel status:
   a. Design the PLC system to function as a stand-alone unit that performs all of the control functions described in this Section completely independent from the functions of the PCS system PC-based operator interfaces:
      1) Failure of the PCS system shall not impact data acquisition, control, scaling, alarm checking, or communication functions of the PLC.
   b. Furnish a minimum of 1 screen that depicts the status of all enclosures containing PLCs, communication equipment, UPS or I/O in the control system, including but not limited to the following:
      1) PLC cabinet over-temperatures from high temperature switch.
      2) Intrusion status on all enclosures equipped with intrusion switches.
      3) AC power failure:
         a) Monitor ahead of UPS.
      4) DC power supply failure:
         a) For redundant power supplies, alarm when either power supply or the diode bridge fails.
      5) UPS failure signal.
      6) UPS Low Battery signal.
      7) Digital bus network Coupler and or Gateway failure signal.
      8) Ethernet Switch failure signal.
11. PLC system communication status:
   a. Furnish a minimum of 1 screen to display all communication errors and status within the PCS:
      1) Communication between PCS and PLCs, PLC to PLC, PLC to RIO and PLC and or PCS to VCP.
      2) 4-20 mA HART interface cards.
      3) Digital bus network status:
      4) Modbus Gateway modules.
      5) Display status of each node, and summary of failures over the past 60 minutes.

b. Generate a communications alarm if any communication fault is detected or there is no response from a node for more than a user specified time.
c. In the event of communications loss:
    1) Continue normal operation at each PLC.
    2) Where control parameters are received over a communications link:
        a) If a link fails where process elements use the remote value for closed-loop control, hold operating status, speed and position, of the process elements at their last state before the communication alarm, unless other I/O local to that PLC indicates shutdown or over-ride conditions:
            (1) Ensure that the operator can control the process using PCI\S HAND mode at the local LOI.
        b) If a link fails where process elements use the remote value to determine setpoints, continue to operate using the last value received:
            (1) Provide a manual over-ride entry at the local LOI to allow an operator to enter a different value for any such remote signal.
            (2) Generate an alarm whenever an over-ride value is in use.

12. 4-20 mA Hart interface cards:
    a. Provide the following HART protocol information for each populated channel on the card:
        1) Process variable values:
            a) Primary process variable (analog): 4-20 mA current signal.
            b) Primary process variable (digital): Digital value in engineering units.
            c) Percent range: Primary process variable expressed as percent of calibrated range.
            d) Loop current: Loop current value in milliamps.
            e) Secondary process Variable 1: Digital value in engineering units available from multivariable devices (if applicable).
        2) Host commands:
            a) Set primary variable units.
            b) Set upper range.
            c) Set lower range.
            d) Set damping value.
            e) Set message.
            f) Set tag.
            g) Set date.
            h) Set descriptor.
            i) Perform loop test: Force loop current to specific value.
            j) Initiate self-test: Start device self-test.
            k) Get more status available information.
        3) Status and diagnostic alerts:
            a) Device malfunction: Indicated device self-diagnostic has detected a problem in device operation.
            b) Configuration changed: Indicates device configuration has been changed.
            c) Cold start: Indicates device has gone through power cycle.
            d) More status available: Indicates additional devices status data available.

e) Primary variable analog output fixed: Indicates device in fixed current mode.
f) Primary variable analog output saturated: Indicates 4-20 mA signal is saturated.
g) Secondary variable out of limits: Indicates secondary variable value outside the sensor limits.
h) Primary variable out of limits: Indicates primary variable value outside the sensor limits.

4) Device identification:
a) Instrument tag: User defined, up to 8 characters.
b) Descriptor: User defined, up to 16 characters.
c) Manufacturer name (code): Code established by HCF and set by manufacturer.
d) Device type and revision: Set by manufacturer.
e) Device serial number: Set by manufacturer.
f) Sensor serial number: Set by manufacturer.

5) Calibration information:
a) Date: Date of last calibration, set by user.
b) Upper range value: Primary variable value in engineering units for 20 mA point, set by user.
c) Lower range value: Primary variable value in engineering units for 4 mA point, set by user.
d) Upper sensor limit: Set by manufacturer.
e) Lower sensor limit: Set by manufacturer.
f) Sensor minimum span: Set by manufacturer.
g) PV damping: Primary process variable damping factor, set by user.
h) Message: Scratch pad message area (32 characters), set by user.
i) Loop current transfer function: Relationship between primary variable digital value and 4-20 mA current signal.
j) Loop current alarm action: Loop current action on device failure (upscale/downscale).
k) Write protect status: Device write-protect indicator.

C. Common control functions:
1. Incorporate common control functions into all control loops and devices and into the control programming, whether or not specifically shown in the specific control descriptions or elsewhere in the Contract Documents.
2. Alarms:
a. Generate alarms within the PLC logic.
b. Generate a warning whenever an override value is in use.
c. Indicate alarms at the LOI and HMI. Enable acknowledgement from either the HMI or the LOI.
d. Generate high, high-high, low, and low-low level alarms where indicated:
1) Provide an alarm reset deadband for each analog value to prevent excessive repeated alarms.
2) Provide logic and timers to inhibit analog alarms based on process events. For example, inhibit low flow alarms when a pump is stopped, or has not been running long enough to establish flow.
e. Flash all alarm and fail conditions and their respective indicators on the PCS graphic screens and local indicating lights until the condition is

acknowledged by the operator, even if the alarm condition is no longer present.

f. Once the alarm is acknowledged by an operator, display alarm conditions in a steady state (not flashing) while the alarm condition is still present:
   1) Flash with a cycle rate of 1/2 second on and 1/2 second off.
g. Once the alarm has been cleared and the operator has acknowledged the alarm or fails condition, turn the graphic alarm indicator off.
h. For all alarms that do not have inherent timers, provide an operator-adjustable proving timer to limit nuisance alarms, continuously adjustable from zero seconds to 100 minutes. The initial setting of proving timers shall be zero seconds:
   1) The PLC shall start the timer when it first detects an alarm condition, and shall only activate the alarm after the timer has expired.
   2) If the alarm condition clears while the timer is running, the timer shall reset, and the alarm shall not be activated.
i. Use interlocks and proving timers to prevent alarms from operating due to power loss, except for loss of power alarms.
j. Furnish an alarm silence pushbutton at each PCM, LOI, or LCP with an audible alarm to signal the PLC to turn off the audible alarm until the next alarm occurs.
k. Lamp test: Furnish lamp test pushbuttons at each control panel with more than 10 pilot lights, that illuminates all pilot lights on the panel:
   1) The lamp test may sequence through blocks of lights.
   2) Minimum on time for each lamp during lamp test 15 seconds.
l. Horns and Beacons:
   1) Activate PCM horn and beacon on all critical alarms and on other alarms as defined by the Facility Alarm Philosophy as will be discussed in the SCADA coordination meetings.
   2) Deactivate PCM horn and beacon when PCM reset pushbutton is activated.
   3) Silence PCM horn when PCM silence pushbutton is activated.
m. Dual analog instruments:
   1) For applications where 2 or more analog instruments are measuring the same process variable:
      a) Generate an operator adjustable percent deviation alarm.
      b) Allow operator to take each instrument out of service when an instrument is out of service.

3. Where a reset is shown for counts, totals and times maintained in the PLC:
   a. Provide a reset selection on the HMI screen that displays the value.
   b. Provide a preset function on the HMI to allow an operator-entered value to become the current accumulated total.
   c. Limit access to the reset and preset functions to operators with suitable security level.
   d. Log the value before reset, operator, time, and date of reset in the PCS archive.
   e. Log the value before preset, preset value, operator, time, and date of preset in the PCS archive.
4. Where start counts are required in this Section, count starts for each piece of equipment (off to on transitions of running status) in the PLC:
   a. Display total starts on PCS screens, and provide a reset function.
   b. Where indicated, calculate number of starts for each day:
      1) Display current day and previous day starts on PCS displays.

2) Do not reset daily start count when overall count is reset.
3) Archive starts for each day through PCS.

5. Where run time accumulation is required in this Section, integrate accumulated run time to the nearest 0.1 hour whenever the running status input indicates that the equipment is running:
   a. Display total run time in hours on PCS screens.
   b. Where indicated, calculate total run time for each day:
      1) Display current day and previous day run time on the HMI to the nearest 0.1 hour.
      2) Do not reset daily run time when overall time is reset.
      3) Archive run time for each day through PCS.
6. For all monitored analog values:
   a. Convert all values to engineering units in floating-point format within the PLC.
   b. Maintain trends in PCS.
      1) Display minima and maxima on the HMI, and archive through PCS.
   c. Flows and Weights:
      1) Totalize flows in the PLC logic:
      2) Where totalized flows are input to a discrete input, count input pulses and multiply by the volume per pulse.
      3) Where no totalizer input is shown, integrate the analog input over time.
      4) Display totals on the HMI and LOI.
      5) Archive totals to the historical database through PCS.
   d. Generate an alarm whenever an over-ride value is in use.
   e. Calculate hourly, daily, and monthly averages:
      1) Calculations shall be performed by the PLC.
      2) Display averages on the HMI, and archive through PCS.
      3) Display minima and maxima on the HMI, and archive through PCS.
   f. Calculate minimum and maximum values each day, and month:
      1) Calculations may be performed by the PLC or PCS.
      2) Display minima and maxima on the HMI, and archive through PCS.
   g. Generate an alarm whenever an over-ride value is in use.
7. Analog data processing:
   a. Engineering units conversion:
      1) Use engineering units for all analog point values. Convert analog inputs to engineering units.
   b. Analog magnitude checking:
      1) Provide upper and lower limits to prevent operator-entered values (setpoints, etc.) from falling outside acceptable limits.
   c. Analog value quality:
      1) Monitor analog values received at each PLC from analog inputs or communications from another PLC or RIO specific to critical analog values, and generate alarms for the following conditions:
         a) Rate of change in excess of acceptable limit:
            (1) Provide a separate rate limit for each value.
         b) Stale value:
            (1) For analog signals that come from analog inputs or calculations using analog inputs, which are expected to have some variation each time the input is read, alarm when there is no change in the value for 10 times the normal expected scan or communication update.

8. Analog device override (LOI and HMI):
    a. Provide the following functions from the HMI and the local LOI all controlling analog input:
        1) An over-ride value to be used in place of the analog input:
            a) Enter in engineering units:
                (1) Display the calibrated range in engineering units.
                (2) Only allow entries within the calibrated range of the instrument.
            b) When the analog input is enabled, track the analog input so that the over-ride matches the analog input value when the input is initially disabled.
            c) Maintain over-ride status and value in the PLC.
            d) Only allow access to over-ride selections and settings to operators with sufficient security.
        2) An enable/disable selection:
            a) When enabled, the value used by the PCS system is equal to the analog input value.
            b) When disabled, the analog input is ignored, and the over-ride value is used for all control and display functions.
            c) Generate an alarm whenever an analog input is disabled.
            d) Enter a value for the analog input from the PCS system to the PLC.
        3) Use the over-ride value for all display and control functions instead of the actual analog input value.
    b. Provide the following functions in the PLC, with selections and value entry from the HMI and/or LOI:
        1) An over-ride value to be used in place of the normal output value:
            a) Enter in percent of output span.
            b) When the analog output is enabled, track the analog input so that the over-ride matches the analog output value when the output is initially disabled.
        2) An enable/disable selection:
            a) When enabled, the value sent to the output is the value determined by the PLC based on the control logic or operator-entered value in PCS HAND.
            b) When disabled, the calculated PCS HAND values are ignored, and the over-ride value is sent to the output.
            c) Generate an alarm whenever an analog output is disabled.
9. Tank and vessel levels:
    a. Display all tank and vessel levels as both a level (typically in feet) and a volume (typically in gallons):
        1) Some individual displays may be only level or volume, when agreed to by the Owner and Engineer during screen meetings.
    b. Monitor rate of change of volume on all tanks and vessels:
        1) Establish the maximum withdraw rate at which the volume should decrease (all pumps or feeders operating at maximum output). Generate an alarm whenever the volume decreases faster than this rate.
        2) Establish the minimum fill rate at which the volume should increase when filling. Generate an alarm whenever the volume increases faster than this rate. Verify tank and vessel level is fluctuating to verify the validity of the IO register. If it is determined the register is

not active or failed in a manner that leaves a stagnant value generate an alarm.

10. I/O filtering and processing:
    a. Analog input filtering:
        1) For each analog input provide an adjustable first order filter, for the purpose of smoothing out spikes and other noise for analog transmitter input signals. By default, configure analog inputs with no filtering affect.
        2) Monitor analog input signal quality:
            a) Over range: The input value is above the normal range (typically over 21 mA).
            b) Under range: The input value is below the normal range (typically under 3 mA, indicating a probable broken connection).
            c) Generate alarms for over or under range inputs.
            d) Do not use over or under range values for control or calculation purposes:
                (1) Where a second instrument is provided to monitor the same condition (a redundant instrument, or additional instruments furnished for averaging or different operating modes), and has a valid signal, use that input for control.
        3) Digital input filtering (proving timer):
            a) Provide an adjustable time delay function (0-10 seconds) on discrete input for the purpose of de-bouncing.
            b) By default, discrete inputs shall be configured with de-bounce timers set to zero seconds.
11. Instrument scaling (HMI/LOI):
    a. Provide 1 or more maintenance screens to display ranges and trigger points for all field instruments:
        1) For analog instruments, use input scaling values in the PLC to determine minimum and maximum calibration points.
12. PCS HAND-OFF-AUTO:
    a. Where indicated, provide HAND-OFF-AUTO and START-STOP selections in the PCS, accessed from an LOI or HMI for operators with sufficient security, to provide the following operating modes:
        1) PCS AUTO: The normal, automatic control mode of the strategy which allows full PLC control in response to process conditions and programmed sequences.
        2) PCS HAND: Enables PCS Manual control where control decisions are made by an operator through the PCS START-STOP, OPEN/CLOSE, or other selections as indicated.
        3) PCS OFF: Automated PCS control is disabled and PLC calls for all associated equipment to stop and valves to close or go to their identified safe state.
        4) Program the PLC so that switching a strategy between AUTO and HAND (either direction) occurs with a smooth transition. Keep running or position status unchanged when control is switched to HAND until a change is requested using the operator selections (START, STOP, OPEN, CLOSE). Keep running and position status unchanged when control is switched to AUTO until the control logic determines a change is required.
13. Display the current status of all operator selections (PCS HAND/AUTO, PCS START/STOP, etc.) on LOI and HMI.

14. Interlocks:
    a. Implement software interlocks where indicated to place equipment in a safe condition in response to impending hazardous process conditions. Apply software interlocks when equipment is operating in PCS AUTO or PCS HAND:
15. Permissives:
    a. Implement software permissives where indicated to prevent equipment from starting in an unsafe condition.
    b. Apply software permissives when equipment is operating in PCS AUTO or PCS HAND.
16. Process control algorithms:
    a. Jog and hold: Unless otherwise indicated, use jog and hold control algorithms where possible:
        1) When the error between process variable and setpoint is beyond a setpoint deadband:
            a) Jog valve or ramp speed in the required direction for a preset “Jog Time” or until the process variable reaches or passes the setpoint.
            b) Then hold speed or position through a setpoint “Hold Time.”
            c) Continue alternating jog and hold until the error is less than the deadband.
        2) Provide operator access to Jog Time and Hold Time setpoints from the HMI.
    b. PID algorithms: Use where indicated, or where necessary to provide fast response:
        1) Provide a PID faceplate with the following displays and functions for each PID control algorithm:
            a) Display Output, CV.
            b) Display Setpoint, SP.
            c) Display Process Variable, PV.
            d) Allow for operator selection of Automatic or Manual control of the output.
            e) Under Manual control of output allow the operator to enter the desired output value.
            f) Allow for input of the 3 Proportional, Integral, and Derivative tuning parameters only for high access level privelages.
            g) Configure PID loops to prevent reset windup when controlled equipment is operating in Manual (local or PCS), or when the equipment has reached a physical limit.
            h) When controlled equipment is being operated in remote PCS HAND, configure the PID function to track the process variable to provide a smooth transfer between Manual and Automatic modes.
            i) Provide selectable slew rates with adjustable setpoints to allow the PID algorithm to slowly ramp to its final value to minimize system disturbance.
17. Equipment alternating and sequencing:
    a. Distribute number of starts and run time equally between identical equipment.
18. Motor control:

a. Monitor the device's LOCAL-OFF-REMOTE (LOR) switch (the hard-wired switch at the MCC, drive or equipment) to determine when the PLC has control of the associated equipment:
    1) Display current REMOTE status on the PCS screens.
b. Monitor the device's running status from the starter auxiliary or run status input:
    1) Display the current status (running or stopped) on the PCS screens.
    2) Use status to calculate total run time and daily run time, and to count total starts and daily starts.
    3) Provide time stamp for each start.
    4) For motors 200 HP and greater, provide software to prevent exceeding the manufacturer's recommended maximum starts per hour.
c. When equipment control has been given to the PLC as reported by the LOCAL-OFF-REMOTE switch, allow selection of PCS AUTO or PCS HAND control modes based upon operator selection using the PCS screens.
d. Starting, stopping and running when the device LOR is in LOCAL:
    1) With the LOR switch in the LOCAL position, the motor is controlled by the START and STOP pushbuttons.
    2) With the LOR switch in the OFF position, the motor is prohibited from running.
    3) With the LOR switch in the REMOTE position, the motor is controlled remotely.
e. Starting, stopping and running when the device LOR is in REMOTE:
    1) When the motor is expected to be running (PLC has issued a START or RUN due to process conditions or operator selection), LOR is in REMOTE, and the device is not reported to be running, start an operator adjustable "Control Activation" timer:
        a) Provide "Control Activation" timers for each piece of controlled equipment:
            (1) If the LOR and required running status do not change, and the PLC does not receive running status within the "Control Activation" time period:
                (a) De-activate the output.
                (b) Place the device in a "Failed" state.
                (c) Generate a "Failed to Respond" alarm.
    2) When the motor is not expected to be running (PLC has issued a STOP or removed the RUN output), LOR is in REMOTE, and the device is reported to be running, start the "Control Activation" timer:
        a) If the LOR and required stopped status do not change, and the PLC does not lose the running status within the "Control Activation" time period:
            (1) Keep the RUN output off or the STOP output on.
            (2) Place the device in a "Failed" state.
            (3) Generate a "Failed to Respond" alarm.
    3) Re-establish PLC control of a device in a "Failed" state only after the following:
        a) An operator turns the device's LOR switch out of REMOTE, and back to REMOTE (i.e., REMOTE input to the PLC cycles off and back on).

f. Where motor winding high temperature switches or RTD temperature elements are shown, generate an alarm when high temperature is sensed (contact opens or temperature above the high alarm setpoint), but do not stop the motor unless otherwise indicated.
g. Motor equipped with current detection shall shut down and report a “failed” status on detection of high current.
h. Control two-speed motors similar to other motors, except as listed below:
    1) Motor states are RUN-FAST, RUN-SLOW, and STOP.
    2) Start all two-speed motors in the RUN-SLOW state. If or when the high speed is required (RUN-FAST operator selection or process conditions), transition to RUN-FAST after a designated time.
    3) When transitioning from RUN-FAST to RUN-SLOW, remove the RUN-FAST output or issue a STOP, then wait for a “Fast to Slow” time delay before energizing the RUN-SLOW or START-SLOW output.
i. Speed control:
    1) Modulate speed on VFD-driven motors using jog and hold, or PID control algorithms to maintain process conditions as described in the specific loop descriptions.
    2) Operate speed control within a pre-defined range:
        a) Minimum speed as determined by equipment manufacturer. The higher of:
            (1) Minimum motor speed to maintain adequate cooling for the type of load driven (constant or variable torque).
            (2) Minimum equipment speed, such as minimum speed to deliver flow or to deliver minimum flow for equipment cooling or lubrication.
        b) Maximum speed 100 percent (60 hertz) or as identified by equipment manufacturer.
    3) Where multiple equipment may operate together to maintain the same process condition:
        a) Provide an operator selection for starting sequence.
        b) Start the first equipment at a preset starting speed.
        c) When one or more equipment is running and the speed control algorithm reaches a preset “Start Next” speed value (initially 95 percent of speed range) through a preset time delay:
            (1) Start the next available equipment at the preset starting speed.
            (2) Ramp up the started equipment and ramp down the previously running equipment to the mid operating speed (adjustable in the PLC). Determine preset values for each condition based on equipment and system characteristics to provide approximately the same total flow or process condition with the new load running at the mid speed (for example if one pump is running and the second pump will be added, then the total flow of both pumps running at mid operating speed should be approximately the same as flow of one pump at Start Next speed).
            (3) Once both equipment reach the mid operating speed, resume the speed control algorithm for those equipment.
            (4) Operate all equipment at the same speed following the output of the speed control algorithm.

d) When two or more pieces of equipment are running, monitor for a “Stop Next” condition:
(1) Where flow rate is monitored, use a preset “Stop Next” flow rate for each possible number and combination of equipment:
(a) Determine initial “Stop Next” speed based on the flow that can be provided with one fewer piece of equipment running at a speed slightly below the “Start Next” speed.
(2) When the “Stop Next” condition exists through a preset time delay:
(a) Ramp speed of running equipment except for the equipment to be stopped up to a preset value based on the number of items running. Determine preset values for each condition based on equipment and system characteristics to provide approximately the same total flow or process condition with one fewer load running (typically slightly below the preset “Start Next” speed) while ramping speed of equipment to be stopped down to the preset minimum speed.
(b) Operate all remaining equipment at the same speed following the output of the speed control algorithm. Stop the load once it reaches minimum speed.

19. Gate and valve control:
a. Monitor the device’s LOCAL-STOP-REMOTE (LSR) switch(es) (the integral switch in the actuator or hard-wired switch at the local control station):
1) Display current REMOTE status on PCS screens.
b. Start an “Open Activation” timer whenever the device is expected to be open (PLC has issued an OPEN command in PCS AUTO, or OPEN was selected in PCS HAND):
1) Initially set “Open Activation” time to twice the normal opening time.
2) If the LSR position and open command do not change, and the PLC does not receive fully open status feedback within the “Open Activation” time period:
a) De-activate the open output.
b) Place the device in a “Failed” state.
c) Generate a “Failed to Open” alarm.
c. Start a “Close Activation” timer whenever the device is expected to be closed (PLC has issued a CLOSE command in PCS AUTO, or CLOSE was selected in PCS HAND):
1) Initially set “Close Activation” time to twice the normal closing time.
2) If the LSR position and close command do not change, and the PLC does not receive fully closed status feedback within the “Close Activation” time period:
a) De-activate the close output.
b) Place the device in a “Failed” state.
c) Generate a “Failed to Close” alarm.
d. Limit the number of open/close /commands so that it does not exceed the manufacturer requirements.
e. For modulating valves (valves controlled from either a 4-20 mA signal or digital communications command) with position feedback, start a “Position

Error" timer whenever the position feedback differs from the required position command by more than a setpoint error when the LSR is in REMOTE:

1) For analog modulating devices, error is determined by position feedback differing from position command by more than the setpoint error.
2) For discrete modulating devices, error is determined by feedback not changing in the correct direction, or changing at less than a setpoint rate, when the OPEN or CLOSE PLC output is active.
3) Initially set the "Position Error" time to 60 seconds.
4) If the LSR position does not change, and position error stays outside of the setpoint error through the "Position Error" time period:
    a) Place the device in a "Failed" state.
    b) Generate a "Position Fail" alarm.

f. Provide separate time delay settings for each function and for each device.
g. If the valve position inputs indicate an invalid state (i.e., valve open and closed at the same time), place the device in a "Failed" state and generate an "Invalid State" alarm.
h. Re-establish PLC control of a device in a "Failed" state only after one of the following:
    1) An operator turns the device's LSR switch out of REMOTE and back to REMOTE (i.e., REMOTE input to the PLC cycles off and back on).
    2) An operator acknowledges the fault from PCS.
i. For all alarm conditions, control other devices (as stopping pumps, etc.) as stated in the individual loop descriptions to make the system safe.
j. For discrete modulating valves (valves positioned to intermediate positions to control process values through discrete OPEN and CLOSE outputs), count the number of actuations (OPEN or CLOSE commands) per hour in the PLC:
    1) Display count on the HMI.

20. Chemical systems (LOI/HMI):
    a. Provide the following chemical system screens:
        1) Where one LOI manages more than one chemical system, a main menu screen that will allow the operator to access the individual chemical system screens using software keys.
        2) One or more screens for each individual chemical system controlled at that location, containing:
            a) All status displays (running, failed, etc.).
            b) Selections (lead/lag, which process flow to pace to, etc.).
            c) Setpoint entry and display.
            d) Calculated feed requirement (result of flow pacing calculation) in engineering units (typically milligrams of chemical per liter). Dry Feeders will be controlled dosing by % speed and tracking flow by pounds per minute.
            e) Output signal to feeder in percent of full span.
            f) Actual chemical flow rate from flowmeter (where shown).
            g) Process flow rate(s) used to pace each chemical on the individual chemical screens (PROC FLOW):
                (1) Where different process flows can be selected for flow pacing, display and identify the selected source.

b. Chemical system calculations: Perform calculations as in the individual loop descriptions. Use the following assumptions, unless otherwise noted:
    1) Where chemical flow feedback is not used, assume feeder output is linear in response to control signal.
    2) Zero signal (typically 4 milliamperes) produces zero flow.
    3) Perform flow-pacing calculations using as described in the individual loop descriptions.
c. Provide the setpoints and selections in the individual loop descriptions. Typical setpoints include:
    1) QMAX: Maximum calibration value:
        a) Chemical flow rate measured from calibration column at maximum feeder output (typically in gallons of solution per hour or milliliters of solution per minute).
    2) CONC: Chemical concentration:
        a) The concentration of the chemical in the solution to be fed, in percentage of chemical solution.
    3) DENSITY:
        a) Density of the chemical solution to be fed in engineering units or as a specific gravity.
        b) Used to calculate the concentration of the chemical in the solution.
    4) DOSE: Desired dosage:
        a) Desired chemical concentration in the process stream in engineering units (typically milligrams of chemical per liter of process fluid).
    5) FLOW SEL: Selection of process stream(s) for flow pacing.
    6) OPEN LOOP:
        a) Selection of method of controlling chemical flow-paced feed rate.
        b) OPEN LOOP: Signal to feeder is based on feeder calibration (QMAX) to deliver calculated chemical solution feed rate. Chemical solution flowmeter is not used for control.
d. Chemical control algorithms:
    1) Flow pacing algorithm: Operator selects a desired dose and the control system adjusts the chemical feed rate to dose based on process flow, chemical concentration, and feeder calibration. The calculation is as follows (units may vary from those shown in the calculation below):

$$FEEDER\ FLOW\ (\frac{ml}{min}) = \frac{21.948 * DOSE\left(\frac{mg}{L}\right) * PROCESS\ FLOW\,(MGD)}{CONC\left(\frac{lb}{gal}\right)}$$

$$FEEDER\ FLOW\ (\%) = \frac{FEEDER\ FLOW\,(\frac{ml}{\min})}{QMAX(\frac{ml}{\min})}$$

    2) Flow pacing with closed loop algorithm: Operator selects a desired dose and the control system adjusts the speed of the chemical feeder through a speed control signal to match the measured chemical feed rate to a flow rate setpoint. This flow rate setpoint shall

be derived from the process flow and operator setpoints for dosage and concentration. The calculation is as follows (units may vary from those shown in the calculation below):

$$\boldsymbol{FEEDER\ FLOW}\ (\frac{\boldsymbol{ml}}{\boldsymbol{min}}) = \frac{\boldsymbol{21.948 * DOSE}\left(\frac{\boldsymbol{mg}}{\boldsymbol{L}}\right) * \boldsymbol{PROCESS\ FLOW(MGD)}}{\boldsymbol{CONC}\left(\frac{\boldsymbol{lb}}{\boldsymbol{gal}}\right)}$$

a) Adjust the speed of the chemical feeder using a PID control algorithm to maintain the calculated FEEDER FLOW:
   (1) SP = Calculated FEEDER FLOW.
   (2) PV = Chemical Flow.
   (3) CV = Speed of the Chemical Feeder.

3) Flow pacing with analyzer trim algorithm: Operator selects a desired dose and desired analyzer setpoint band and the control system adjusts the chemical feed rate to dose based on process flow, chemical concentration, process analyzer output, and feeder calibration. The calculation is as follows (units may vary from those shown in the calculation below):

$$\boldsymbol{PRE\ TRIM\ FLOW}\ \left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right) = \frac{\boldsymbol{21.948 * DOSE}\left(\frac{\boldsymbol{mg}}{\boldsymbol{L}}\right) * \boldsymbol{PROCESS\ FLOW(MGD)}}{\boldsymbol{CONC}\left(\frac{\boldsymbol{lb}}{\boldsymbol{gal}}\right)}$$

$$\boldsymbol{TRIM\ MULTIPLIER} = \frac{\boldsymbol{AI} - \frac{\boldsymbol{1}}{\boldsymbol{2}}\boldsymbol{(QAH + QAL)}}{-\frac{\boldsymbol{1}}{\boldsymbol{2}}\boldsymbol{(QAH - QAL)}}$$

Clamp the trim multiplier output to a maximum of 1 and minimum of -1.

$$\boldsymbol{TRIM\ ADDER}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right) = \boldsymbol{0.10} * \frac{\boldsymbol{AI} - \frac{\boldsymbol{1}}{\boldsymbol{2}}\boldsymbol{(QAH + QAL)}}{-\frac{\boldsymbol{1}}{\boldsymbol{2}}\boldsymbol{(QAH - QAL)}} * \boldsymbol{PRE\ TRIM\ FLOW}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right)$$

$$\boldsymbol{FEEDER\ FLOW}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right) = \boldsymbol{PRE\ TRIM\ FLOW}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right) + \boldsymbol{TRIM\ ADDER}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right)$$

$$FEEDER\ FLOW\ (\%) = \frac{FEEDER\ FLOW(\frac{ml}{\min})}{QMAX(\frac{ml}{\min})}$$

4) Flow pacing with closed loop and analyzer trim algorithm: Operator selects a desired dose and desired analyzer setpoint band and the control system adjusts the speed of the chemical feeder through a

speed control signal to match the measured chemical feed rate to a flow rate setpoint. An additional control algorithm is used in the calculation to fine-tune the feed based on an analytical measurement as measured by the process analyzer.

$$\boldsymbol{PRE\ TRIM\ FLOW}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right)=\frac{\boldsymbol{21.948}*\boldsymbol{DOSE}\left(\frac{\boldsymbol{mg}}{\boldsymbol{L}}\right)*\boldsymbol{PROCESS\ FLOW(MGD)}}{\boldsymbol{CONC}\left(\frac{\boldsymbol{lb}}{\boldsymbol{gal}}\right)}$$

$$\boldsymbol{TRIM\ MULTIPLIER}=\frac{\boldsymbol{AI}-\frac{\boldsymbol{1}}{\boldsymbol{2}}\boldsymbol{(QAH+QAL)}}{-\frac{\boldsymbol{1}}{\boldsymbol{2}}\boldsymbol{(QAH-QAL)}}$$

CLAMP THE TRIM MULTIPLIER OUTPUT TO A MAXIMUM OF 1 AND MINIMUM OF -1.

$$\boldsymbol{TRIM\ ADDER}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right)=\boldsymbol{0.10}*\frac{\boldsymbol{AI}-\frac{\boldsymbol{1}}{\boldsymbol{2}}\boldsymbol{(QAH+QAL)}}{-\frac{\boldsymbol{1}}{\boldsymbol{2}}\boldsymbol{(QAH-QAL)}}*\boldsymbol{PRE\ TRIM\ FLOW}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right)$$

$$\boldsymbol{FEEDER\ FLOW}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right)=\boldsymbol{PRE\ TRIM\ FLOW}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right)+\boldsymbol{TRIM\ ADDER}\left(\frac{\boldsymbol{ml}}{\boldsymbol{min}}\right)$$

a) Adjust the speed of the chemical feeder using a PID control algorithm to maintain the calculated FEEDER FLOW:
   (1) SP = Calculated FEEDER FLOW.
   (2) PV = Chemical Flow.
   (3) CV = Speed of the Chemical Feeder.

21. Breaker status:
    a. Display the following data to the extent it is available from the specified device:
       1) Open.
       2) Closed.
       3) Tripped.
       4) Ground fault.
       5) Settings.
       6) Racked out.
22. Power Data:
    a. Retrieve data from:
       1) Power Quality Meters (PQMs) at 480V.
       2) Main Breaker Protective Relays on 12.47 kV Switchgear.
       3) Generator Master Control Panel.
       4) Digital bus networks, as indicated.
       5) Where available, use EtherNet IP communications.
    b. Display the following data (to the extent it is available) from the specified device.
       1) Current Amp:

a) A-Phase.
b) B-Phase.
c) C-Phase.

2) Volts: V:
a) A-Phase.
b) B-Phase.
c) C-Phase.

3) Reactive power: kVA].
4) Real power: kW.
5) Apparent power: kVA.
6) Power factor.
7) Energy: kW*hr.
8) Demand peak: Amp.
9) Demand peak: kW.

c. For engine/generator system monitoring, also display percent of rated output.

23. Power Supply and Distribution displays Power Quality Meters display:
a. In addition to the Power Data listed above, display the following (where available) from PQMs, Protective Relays, and Generator Master Control Panel:
1) Frequency: Hertz.
2) THD (current and voltage): up to 31st harmonic.

b. Calculate, indicate, historize, and trend data in a 12.47 kV Meter Table that lists measurements from the following Protection Relays:
1) Protection Relay on 52-G1.
2) Protection Relay on 52-G2.
3) Protection Relay on 52-M1.
4) Protection Relay on 52-M2.
5) Protection Relay on 52-M3.
6) Display calculated values for "Load At 12.47 kV", which sums the current, kW, and kW-hr values for all five Protection Relays.
7) Display calculated values for "Load At 480V", which sums the current, kW, and kW-hr values for all PQM meters.
8) Display calculated values for "Transformer and Line Losses", which subtracts "Load at 480V" from "Load At 12.47 kV" for current, kW, and kW-hr values for all PQM meters.

c. Display the data in a 480V Meter Table that lists measurements from all power quality meters on the plant.

24. Digital bus Starters, RVSS and VFDs equipped with EtherNet IP communications:
a. Communicate and display all values listed in the equipment specifications, indicated on the Drawings, or listed below.
b. Communicate start and stop commands, and receive running feedback over the fieldbus network.
c. Provide data entry screen for the cost of electricity in dollars per (kw*hr), which will be used in calculations for display.
d. Monitor the following additional values, and display on the HMI:
1) Motor current, phase A, B, and C.
2) Over current alarm.
3) Under current alarm.
4) Running status.
5) Phase loss.

6) Stall.
7) Number of starts.
8) History of past 5 trips.

e. Calculate, indicate, historize, and trend, the following additional values:
1) Full Load Amps (static value, Engineer will provide).
2) Average Motor Operating Current.
3) Run Time (Hours).
4) Operating Hours (Hours/Year).
5) Average Load Factor (equals Average Motor Current Operating Current/Full Load Amps) - *display as a percentage.*
6) Annual Energy Use (kW*hr).
7) Annual Operating Cost (dollars).
8) Percent of Site Electric Use (equals Annual Energy Use/Sum of Annual Energy (kW*hr) values for all PQM meters).

f. For Variable Frequency Drives:
1) Speed command.
2) Speed feedback.

g. For RVSS, Variable Frequency Drives, and where otherwise shown or available, monitor the following over the digital bus network:
1) Line voltage.
2) Power.
3) Power factor.
4) Over voltage alarm.
5) Under voltage alarm.
6) Over current alarm.
7) Under current alarm.
8) Indicate, historize, trend, and alarm data as indicated in the ACS I/O Tables on the Drawings.

25. Calculate, indicate, historize, and trend plant-wide calculated values for kW by the following Groups.
a. Calculated values (summed from starter data for all equipment within the Groups identified below):
1) Demand peak: Amp
2) Demand peak: kW.
3) Electric Power Consumption, by Process Group (kW): kW.
4) Electric Power Consumption, by Process Group (percent): percent (equals Electric Power Consumption, by Process Group (kW)/Sum of Electric Power Consumption on all 480V Meters).
5) Electric Energy Consumption, by Process Group (kW*hr): kW*hr
6) Electric Energy Consumption, by Process Group (percent): percent (equals Electric Energy Consumption, by Process Group (kW)/Sum of Electric Energy Consumption on all 480V Meters).

b. Display a Process Energy Consumption Table that lists the calculated values for each of the identified Groups.
c. Display a Process Energy Pie Graph that portions wedges according to the values calculated in Electric Energy Consumption, by Process Group (5). Label wedges, (with numeric percentage), for Groups to cover at least 90 percent of the Pie Graph. The remainder wedge of Pie Graph area can be labelled as "Other" (with numeric percentage).

26. Instruments equipped with digital bus communications:
a. Communicate and display all values listed in the equipment specifications, or listed below:

1) Instrument diagnostics.
2) Communications health.
3) Process variable.
4) Alarm summary.
5) All totalizers (if applicable).
6) Indicate, historize, trend, and alarm data as indicated in the ACS I/O Tables on the Drawings.

27. Calculate, indicate, historize, and trend calculated values for additional, process-specific measurements. Algorithms will be provided by the Engineer.
28. Valves and gate operators equipped with digital bus communications:
    a. Communicate and display all controls and data listed in the equipment specification, as listed below:
        1) Open, close, or direct position commands.
        2) Fully open and closed status.
        3) Position.
        4) High torque, overload, and other applicable alarms.
        5) Indicate, historize, trend, and alarm data as indicated in the ACS I/O Tables on the Drawings.
    b. Establish initial torque curves using manufacturer's software for performance tracking and wear.
29. Power failure:
    a. Retain all operating setpoints during power failure.
    b. Restore plant operation to the state it was before the power loss:
        1) Store the operating state of all major equipment and systems in the PLC, and retain the last state during a power loss.
    c. Provide an operator selection to permit the plant to re-start. Once re-start is selected:
        1) Allow plant loads to re-start, and allow loads to sequence on and ramp up following normal control logic. Where loads were operating in PCS HAND, restore their operation to the state before the power loss.
        2) Use the logic described above for preventing concurrent starts to provide necessary delays between each start.
    d. Operating on generator power:
        1) Include running and starting kW and kVA requirements for each major equipment and system in registers in the PLC:
            a) Where running load can vary due to speed, valve position, etc., use the normal starting value plus 25 percent of the difference between the maximum and minimum values.
        2) Inhibit starting of loads from process control logic and from operator selection (in PCS HAND) that will exceed generator capability.
        3) Generate the following alarms:
            a) Generator near capacity: When measured kW or kVA reaches 90 percent of the rating of running generators.
            b) Generator at capacity: When measured kW or kVA reaches 95 percent of the rating of running generators.
            c) Unable to start: When an operator selects a load that would exceed generator starting or running capacity.
            d) Insufficient capacity: When the control system needs to start a load, but is inhibited due to generator capacity.

4) Whenever the Generator at Capacity alarm is active, inhibit starting of any loads, and inhibit increase in speed of all control loops, and other changes that would increase electrical load.
5) Display the following power system data on the HMI and LOI in numerical and graphical formats:
    a) Available power.
    b) Current power demand.
    c) Capacity of the generator.
    d) Current power demand load as a percentage of capacity.
    e) Generator frequency.

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17101

SPECIFIC CONTROL STRATEGIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. ICSC as defined in specification section 17050 must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.
   2. Loop descriptions:
      a. Specific control requirements and functional descriptions for individual control loops.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS

A. Develop detailed loop descriptions based on the information in the Contract Documents, and submit as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.
   1. For each control loop, provide a detailed functional description of the operation of the equipment, signals, and controls:
      a. Include all functions depicted or described in the Contract Documents.
      b. Include the following within each loop description:
         1) All requirements specific to that loop.
         2) Common control requirements applicable to that loop.
         3) List of all ranges, setpoints, timers, values, counters, etc.
   2. Where there are similar loops with identical control, such as multiple loops for individual raw water pumps, only 1 loop description need be developed and the remaining loops may reference that loop description.
   3. Loop description format: As specified in this Section.

B. Loop number and title.
   1. References:
      a. List drawings that are specifically referenced.

2. Abstract:
    a. General description of how the loop works, what devices are involved, and how the process will be controlled.
    b. Process values, setpoints, and limits, including units and ranges:
        1) Show span and range values for analog inputs and outputs, and operating point and deadband for discrete inputs.
3. Hardwired control:
    a. Detailed description of the control functions at the local level.
    b. Function of local operator interfaces.
    c. Operation of hardwired field pilot controls:
        1) Pushbuttons.
        2) Selector switches.
        3) Potentiometers.
        4) Pilot lights, indicators, and other displays.
4. Hardwired interlocks:
    a. Explanation of the operation of system interlocks and hardwired permissive conditions.
5. PLC control:
    a. Detailed description of the control functions that are under control of the PLC.
    b. Operator controls and automatic controls.
    c. Setpoints, alarms, etc.:
        1) Include units and ranges for analog values.
        2) Include span and range for analog inputs and outputs.
        3) Include operating point and deadband for discrete inputs, and identify conditions where contacts are open, and when they close.
    d. Control sequences.
    e. Software interlocks:
        1) Operation of system software interlocks.
6. PCS/LOI/HMI control:
    a. Detailed description of the operator controls.
    b. Setpoints, alarms, etc.
7. Indicators and alarms:
    a. List any indicators and alarms specific to the loop that are not covered in the common control strategies.
8. Failure modes:
    a. List any failure modes specific to the loop that are not covered in the common control strategies.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY (NOT USED)

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION (NOT USED)

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

A. Tainter Gates:
   1. Abstract:
      a. There are three tainter gates: North, Central, and South.
   2. Hardwire Control:
      a. In the gate house there are existing control stations for each gate. The existing control stations will remain in place and in operation. The control stations include the following operator controls:
         1. Two position key lock selector switch, "SCADA/Manual."
         2. Gate Up push button.
         3. Gate Down pushbutton.
         4. Gate Up stop push button.
         5. Gate Down stop push button.
         6. Gate Up pilot light.
         7. Gate Down pilot light.
         8. Power by remote operation pilot light.
         9. Power by control station pilot light.
      b. When the operator selects manual for a specific gate by moving the key lock selector switch to manual, the operator will have the ability to control the specific gate from the local push buttons.
      c. When the operator selects SCADA for a specific gate by moving the key lock selector switch to SCADA, the operator will have the ability to control the specific gate from the SCADA system.
   3. PLC control:
      a. Manual Control: Each gate shall include a SCADA Open - Stop - Close selector switch. Operator selects open, stop or close from SCADA screen for selected gate. When operator selects open, the gate will begin to open. When operator selects stop, the gate will stop. When operator selects close, the gate will close. When any of the operator selected functions are selected, an alarm will annunciate.
      b. Automatic Control: Each gate when operating in automatic mode shall move to an operator level setpoint. The operator will select automatic

mode of operation from the SCADA Hand Off Auto Selector switch. The gate will move up or down depending on present position to the operator level setpoint.

4. PCS/LOI/HMI control:
    a. A formula to calculate Inflow in cubic feet per second will be provided by Manatee County.
    b. Each gate shall have a SCADA Hand - Off - Auto selector switch
    c. Each gate shall have a SCADA Open - Stop - Close push button.
5. Indicators and alarms:
    a. When operator selects a function; open, close, or stop, an alarm will annunciate and display on the SCADA system
    b. Each gate; North, Central, and South has a high level alarm.
    c. A maximum gate opening alarm will be set by the operator. This setpoint will require security privilege.
    d. A maximum gate angle alarm will be set by the operator. This setpoint will require security privilege.
    e. Full Open Indication
    f. Full Close Indication
    g. Gate Travelling indication
6. Failure modes: The SCADA [Open - Stop - Close] selector switch shall be developed such that the operator cannot select open or close without selecting stop.

B. Powdered Activated Carbon:
1. Abstract:
    a. There are two (2) carbon silos, and three (3) feeders. The flow is from Raw Water Pump Station #1 and Raw Water Pump Station #2. Flow values from each pump station are provided by the operator through the SCADA system. Old silo has 2 separate feeders and 2 discharge lines to either raw water 1 or raw water 2. New silo has 1 feeder for both Raw Water 1 or Raw Water 2 pump station. Old Silo will require space for two separate feeder speed controls when operating both independently.
2. PLC control:
    a. Manual Control: Operator sets the Raw 1, Raw 2, and Total flow values in MGD. Operator sets the carbon dose value in mg/L.
    b. Automatic Control: PLC calculates the following values for each of the 3 feeders and displays on the SCADA system. Operators must have access via the SCADA system to adjust feeder calculations:
        1) Pounds per minute value: The following equation is provided: ((Raw Water 1 Flow + Raw Water 2 Flow)*8.34*Dose)/1440.
        2) Percent Speed for Old Silo, North and South Feeders: ((Pounds per minute/3.1)/7.1).
        3) Percent Speed for New Silo: ((Pounds per minute/0.26)/120).
        4) Raw 1 split Flow: (Raw 1 Flow/(Raw 2 Flow +Raw 1 Flow))*(Total Flow).
        5) Raw 2 Split Flow: (Raw 2 Flow/(Raw 2 Flow +Raw 1 Flow))*(Total Flow.
3. PCS/LOI/HMI control:
    a. Each Silo will have a Raw 1 flow setpoint in MGD.
    b. Each Silo will have a Raw 2 flow setpoint in MGD.
    c. Each Silo will have a Total Flow setpoint in MGD.
4. Indicators and alarms:

a. Each Silo will have a Raw 1 flow setpoint in MGD.
b. Each Silo will have a Raw 2 flow setpoint in MGD.
c. Each Silo will have a Total Flow setpoint in MGD.
d. Each Silo will have a Pounds per minute value.
e. Each Silo will have a %Speed.
f. Each Silo will have a Raw 1 Split Value.
g. Each Silo will have a Raw 2 Split Value.
h. Silo levels.
i. Silo Hi Level Alarm.
j. Silo Lo Level Alarm.
k. Hopper High Level.
l. Hopper Low Level.

C. Raw Water Pump Station #1:
1. Abstract:
a. There are five (5) Raw Water Pumps in Raw Water Pump Station #1. The pumps are controlled via soft starts.
2. PLC control:
a. Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
3. PCS/LOI/HMI control:
a. Each pump shall have a SCADA Hand-Off-Auto selector switch.
b. Each pump shall have a SCADA Start and Stop push button.
4. Indicators and alarms:
a. Provide an alarm for the operators to shut down Ammonia and Fluoride systems in the event Raw Water Flow has stopped.
b. Each pump will have a pump RUN indication.
c. Each Pump will have a pump OFF indication.
d. Each Pump will have a pump FAIL indication.
e. Each Pump will alarm when there is a change of state.
f. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump is equipped with a discharge pressure switch. When the pump is called to start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
g. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
h. Provide "Uncommended Change of State Alarm."
5. Failure modes:
a. When a pump is called to run and the discharge pressure switch for the specific pump does not change state after a pre-determined time, the pump will alarm under a fail to start logic.

D. Raw Water Pump Station #2:
1. Abstract:
a. There are three (3) Raw Water Pumps in Raw Water Pump Station #2. This pump station will be modified by others under a separate contract. All PLC control work performed by others.
2. PLC control:

a. Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.

3. PCS/LOI/HMI control:
   a. Each pump shall have a SCADA Hand-Off-Auto selector switch.
   b. Each pump shall have a SCADA Start and Stop push button.
4. Indicators and alarms:
   a. Provide an alarm for the operators to shut down Ammonia and Fluoride systems in the event Raw Water Flow has stopped.
   b. Each pump will have a pump RUN indication.
   c. Each Pump will have a pump OFF indication.
   d. Each Pump will have a pump FAIL indication.
   e. Each Pump will alarm when there is a change of state.
   f. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump is equipped with a discharge pressure switch. When the pump is called to start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
   g. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
   h. Provide "Uncommended Change of State Alarm."
5. Failure modes:
   a. When a pump is called to run and the discharge pressure switch for the specific pump does not change state after a pre-determined time, the pump will alarm under a fail to start logic.

E. East County Wellfield:
1. Abstract:
   There are 7 wells; #1, #2 #3, #4, #5, #6, #7 included in the east county wellfield. There are 5 monitoring wells also in the east county wellfield #50, #51, #52, #53, #54.
2. PLC control:
   a. Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
3. PCS/LOI/HMI control:
   a. Each pump shall have a SCADA Hand-Off-Auto selector switch.
   b. Each pump shall have a SCADA Start and Stop push button.
4. Indicators and alarms:
   a. Each pump will have a pump RUN indication.
   b. Each Pump will have a pump OFF indication.
   c. Each Pump will have a pump FAIL indication.
   d. Each Pump will alarm when there is a change of state.
   e. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon the contactor/motor starter run auxiliary contact. When the pump is called to start and the contactor/motor starter auxiliary contact does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
   f. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.

g. Each well will have a low flow alarm. The operator will select a low flow setpoint via the SCADA system. When the pump is operational, if the flow drops below the low flow alarm setpoint for a predetermined time, a low flow alarm will annunciate.
h. Instantaneous Process flow will be displayed for each well.
i. Totalized Flow will be displayed for each well.
j. Well pressure will be displayed for each well.
k. Monitoring well level will be displayed for each well.
l. Display all East County wells totalized flows. This value will be a calculation of all East County well flows.
m. Display all well draw down levels. There shall be an Operating range, warning range, and alarm range on the level indicator for each well.
n. For each well draw down level, provide an operator selectable alarm value. When the level falls below the operator setpoint, an alarm shall annunciate.

5. Failure modes:
a. When a pump is called to run and the discharge pressure switch for the specific pump does not change state after a pre-determined time, the pump will alarm under a fail to start logic.

F. North & South Degasifiers:
1. Abstract:
a. There are 3 blowers on each side of the degasifiers. Degasifiers treat raw groundwater from the wellfields. Each degasifier has its own blower and valves.

2. PLC control:
a. Manual Control: When the hardwired local/remote switch is in remote, the SCADA system can control the blowers. When the local/remote switch is in remote, the Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.

3. PCS/LOI/HMI control:
a. Each blower shall have a SCADA Hand-Off-Auto selector switch.
b. Each blower shall have a SCADA Start and Stop push button.

4. Indicators and alarms:
a. Each Blower will have a blower RUN indication.
b. Each Blower will have a blower OFF indication.
c. Each Blower will have a blower FAIL indication.
d. Each Valve will have an Open Indication.
e. Each Valve will have a Closed Indication.
f. Each Blower will alarm when there is a change of state.

5. Failure modes:
a. When a blower is called to run and the run switch for the specific blower does not change state after a pre-determined time, the blower will alarm under a fail to start logic.

G. Basin Overview:
1. Abstract:
a. There are 3 basins: A, B, & C. Basin A has very low amount of SCADA monitoring. Basin B control and monitoring consists of the operator selecting valve control (clarifier to remove sludge) either East or West. The operator selects the amount of time the valve is opened and closed.

The pumps will operate based upon float level control. The pumps send the sludge on the other side of the street from the plant to the drying beds. For Basin C, there are 2 modes of operation for each basin. The operator will select either Mode 1 or Mode 2.

2. PLC control:
   a. FLOCC A, B, C Manual Valve Control: The Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects a position setpoint from the SCADA screen.
   b. FLOCC A, B, C Auto Valve Control: The operator selects Auto from the SCADA Hand - Off - Auto software switch. Operator selects a flow setpoint. The control system will adjust the position of the valve to maintain the flow entered by the operator.
   c. Modes: There are 2 modes of operation for Basin C. When a mode is selected, valves stroke to position per existing table located on existing HSQ screen.
3. Basin C Mode 1 Automatic Operation:
   a. When the bridge reaches either auger (east or west), pump 2 starts. When bridge pulls away from either auger, pump 2 stops.
4. Basin C Mode 2 Automatic Operation:
   a. Pump 1 Operates sending sludge from east auger to basin and recirculates sludge to rapid mix (RM).
   b. Pump 3 operates sending sludge from west auger to basin and recirculates sludge to RM.
   c. When bridge travels over the east or west auger the following occurs:
      1) East Auger:
         a) Pump 1 stops.
         b) Valve E, F and H will open.
         c) Valve B will close.
         d) Pump 2 Starts and pumps for the amount of time set by the operator.
         e) Fresh water valve opens and flushes the system for the amount of time set by the operator then the fresh water valve will close.
         f) Pump 2 stops.
         g) Valve B opens.
         h) Valve E, F and H will close.
         i) Pump 1 Starts.
      2) West Auger:
         a) Pump 3 Stops.
         b) Valve J, F and H will open.
         c) Valve L will close.
         d) Pump 2 Starts and pumps for the amount of time set by the operator.
         e) Fresh water valve opens and flushes the system for the amount of time set by the operator then the fresh water valve will close.
         f) Pump 2 stops.
         g) Valve L opens.
         h) Valve J, F and H will close.
         i) Pump 3 starts after sludge removed based on operator time setpoint.
5. PCS/LOI/HMI control:
   a. Each valve shall have a SCADA Hand-Off-Auto selector switch.
   b. Each modulating valve will have a SCADA position setpoint.

c. Each discrete valve will have a SCADA open and close push button.

6. Indicators and alarms:
   a. Each Valve will have an opened indication.
   b. Each Valve will have a closed indication.
   c. FLOCC A, B, C Valve position and position setpoint.
   d. Bridge direction and run status will be shown. Bridge position based upon timers. Manatee County will provide initial timer settings for bridge position setting.
   e. Each pump will have a pump RUN indication.
   f. Each Pump will alarm when there is a change of state.
   g. Each Pump will have a pump OFF indication.

H. Filters 1-12:
   1. Abstract:
      a. Each filter will have an individual screen for monitoring as well as the Filter 1-12 status screen and A/B Filters Status Chart.
   2. PLC control:
      a. Manual Control: Backwash of filters is initiated manually from the local control panel. The backwash sequence (timers, low flow rate, high flow rate, etc.) is controlled via the control panel in the main control room.
      b. Automatic Control: The Effluent Valve is automatically controlled based upon flow from the filters. The flume level control will determine the flow setpoint for each filter. If a filter goes offline during operation, the control system will recalculate the flow setpoint based upon the number of filters running. Flume level controls the flume level and flow for each filter. A PID equation will control each filter valves based upon the flume level. As the flume level changes, the flow from each filter will change. The flow signal shall include dampening to reduce the amount of setpoint fluctuation. The operator sets a flume level maximum and minimum setpoint. The setpoint for the effluent valve is calculated by the following formula; [(Flume average level - Flume Level Minimum SP) / Flume Range] * Flume Maximum Level SP. Flume average level is calculated by sampling the actual level signal over a 60 second time period. The Flume Level range is the Maximum SP - Minimum SP. Each filter will control its Effluent valve to maintain the flume level.
         1) PCS/LOI/HMI control: Each Effluent Valve will be controlled either manually or automatic.
         2) Flume Level maximum and minimum will be controlled via the operator through SCADA.
         3) Effluent Valve setpoint will be calculated from the formula described above.
   3. Indicators and alarms:
      a. Each Valve will have a Opened Indication.
      b. Each Valve will have a Closed Indication.
      c. Operator can change backwash source.
      d. Operator can select if backwash is enabled/disabled.
      e. Waste time can be adjusted by the SCADA system.
      f. Operator can enable/disable a specific filter backwash.
      g. All Flume level and flow control setpoints as detailed above. Failure modes:
         1) When a filter goes offline, the flow setpoint will change to accommodate the reduction in the number of filters running.

2) When a filter goes online, the flow setpoint will change to accommodate the increase in the number of filters running.

I. Filters 13-18:
   1. Abstract:
      a. Filters 13-18 (in Bay C) are utilized for Lime Softening and Surface Water Filters. Valves include: Influent, Effluent, Surface, Waste, Drain, Backwash.
   2. PLC control:
      a. Manual Control: Backwash of filters is completely manual from the local control panel.
      b. Automatic Control: The Effluent Valve is automatically controlled based upon flow from the filters. The flume level control will determine the flow setpoint for each filter. If a filter goes offline during operation, the control system will recalculate the flow setpoint based upon the number of filters running. Flume level controls the flume level and flow for each filter. A PID equation will control each filter valves based upon the flume level. As the flume level changes, the flow from each filter will change. The flow signal shall include dampening to reduce the amount of setpoint fluctuation. The operator sets a flume level maximum and minimum setpoint. The setpoint for the effluent valve is calculated by the following formula; [(Flume average level - Flume Level Minimum SP) / Flume Range] * Flume Maximum Level SP. Flume average level is calculated by sampling the actual level signal over a 60 second time period. The Flume Level range is the Maximum SP - Minimum SP. Each filter will control its Effluent valve to maintain the flume level.
         1) PCS/LOI/HMI control: Each Effluent Valve will be controlled either manually or automatic.
         2) Flume Level maximum and minimum will be controlled via the operator through SCADA.
         3) Effluent Valve setpoint will be calculated from the formula described above.
   3. Indicators and alarms:
      a. Each Valve will have a Opened Indication.
      b. Each Valve will have a Closed Indication.
      c. All Flume level and flow control setpoints as detailed above. Failure modes:
         1) When a filter goes offline, the flow setpoint will change to accommodate the reduction in the number of filters running.
         2) When a filter goes online, the flow setpoint will change to accommodate the increase in the number of filters running.

J. Clearwell A:
   1. Abstract:
      a. There are 5 High Service Pumps, 1 surface wash pump, and 1 backwash pump. High Service Pumps deliver water to distribution system. Each High Service Pump array has as separate flow meter.
   2. PLC control:
      a. High Service Pumps Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.

3. PCS/LOI/HMI control:
    a. Each Pump shall have a SCADA Hand-Off-Auto selector switch.
    b. Each Pump shall have a manual start and stop pushbutton.
4. Indicators and alarms:
    a. Each pump will have a pump RUN indication.
    b. Each Pump will have a pump OFF indication.
    c. Each Pump will have a pump FAIL indication.
    d. Each Pump will alarm when there is a change of state.
    e. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump is equipped with a discharge pressure switch. When the pump is called to start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
    f. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
    g. Each Valve will have an opened indication.
    h. Each Valve will have a closed indication.
    i. Clearwell Level Alarm: Operator selects Lo, and Lo-Lo alarm setpoints from the SCADA system.
    j. Display clearwell level. There shall be an Operating range, warning range, and alarm range on the level indicator.

K. Clearwell B:
1. Abstract:
    a. There are 5 High Service Pumps. High Service Pumps deliver water to the distribution system. Each High Service Pump array has as separate flow meter.
2. PLC control:
    a. High Service Pumps Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
3. PCS/LOI/HMI control:
    a. Each Pump shall have a SCADA Hand-Off-Auto selector switch.
    b. Each Pump shall have a manual start and stop pushbutton.
4. Indicators and alarms:
    a. Each pump will have a pump RUN indication.
    b. Each Pump will have a pump OFF indication.
    c. Each Pump will have a pump FAIL indication.
    d. Each Pump will alarm when there is a change of state.
    e. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump is equipped with a discharge pressure switch. When the pump is called to start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
    f. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
    g. Each Valve will have an opened indication.
    h. Each Valve will have a closed indication.
    i. Clearwell Level Alarm: Operator selects Lo, and Lo-Lo alarm setpoints from the SCADA system.

j. Display clearwell level. There shall be an Operating range, warning range, and alarm range on the level indicator.

L. Clearwell C:
1. Abstract:
a. There are 3 Transfer Pumps, 2 surface wash pumps, and 2 High Service pumps. Transfer Pumps deliver water to the Ground Storage Tanks. Each High Service Pump array has as separate flow meter. High Service Pumps deliver water to the distribution system.
2. PLC control:
a. Operator can select Ground Storage Tank or Backwash Control.
b. Pumps rotation shall be by alternation based upon lead/lag selection by operator. Lead/lag will rotate after each pump cycle.
c. Transfer Pumps Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
d. Ground Storage Mode:
1) When Transfer Pumps are delivering water to the Ground Storage Tanks, the Ground Storage Tanks fill valve must be opened prior to pump operation.
2) When Transfer Pumps are delivering water to the Ground Storage Tanks in Automatic Mode, the pumps will be called on/off based upon level setpoints of the clearwell C level. The operator will set the lead pump on level, lag pump on level, lag-lag pump on level, and all pumps off level. If a pump fails for any reason, the PLC shall call the next available pump in the rotation sequence. Operator shall select the lead pump. Lead pump will rotate after completion of pump running cycle
e. Backwash Mode:
1) When operator performs a backwash, the transfer pumps must first be taken offline, then the backwash SCADA selector switch will be visible.
2) When backwash is selected, backwash and Ground Storage Tank valves will change state automatically
3) When backwash is selected, backwash valve flow control modulation is via a separate PID controller in a separate control panel. The analog valve signal from the PID controller is sent to the RTU for control of the valve.
4) When backwash is selected, control of the pumps is manual through the SCADA system.
f. High Service Pumps:
1) High Service Pumps are manual control from SCADA. All High service pumps are constant speed.
3. PCS/LOI/HMI control:
a. Each Pump shall have a SCADA Hand-Off-Auto selector switch.
b. Each Pump shall have a manual start and stop pushbutton.
c. Ground Storage Tank/Backwash selector switch.
4. Indicators and alarms:
a. Each pump will have a pump RUN indication.
b. Each Pump will have a pump OFF indication.
c. Each Pump will have a pump FAIL indication.
d. Each Pump will alarm when there is a change of state.

e. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump is equipped with a discharge pressure switch. When the pump is called to start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
f. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
g. Each Valve will have an opened indication.
h. Each Valve will have a closed indication.
i. Clearwell Level Alarm: Operator selects Hi-Hi, Hi, Lo, and Lo-Lo alarm setpoints from the SCADA system.
j. Display clearwell level. There shall be an Operating range, warning range, and alarm range on the level indicator.

M. Ground Storage Tanks:
1. Abstract:
a. There are 2 Ground Storage Tanks. There are 3 High Service Pumps. The High Service Pumps are constant speed.
2. PLC control:
a. Manual Pump Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
b. Manual Valve Control: Operator Selects Hand from the SCADA Hand - Off- Auto selector switch. Operator selects Open from the Open - Stop-Close selector switch to open the valve. Operator selects stop to stop the valve. Operator selects close to close the valve.
3. PCS/LOI/HMI control:
a. Each Pump shall have a SCADA Hand-Off-Auto selector switch.
b. Each Pump shall have a manual start and stop pushbutton.
c. Each valve shall have a SCADA Hand-Off-Auto selector switch.
d. Each valve will have a SCADA open and close push button
4. Indicators and alarms:
a. Each pump will have a pump RUN indication.
b. Each Pump will have a pump OFF indication.
c. Each Pump will have a pump FAIL indication.
d. Each Pump will alarm when there is a change of state.
e. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump is equipped with a discharge pressure switch. When the pump is called to start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
f. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
g. Each Valve will have an opened indication.
h. Each Valve will have a closed indication.
i. Each valve shall have a SCADA Hand-Off-Auto selector switch.
j. Each valve will have a SCADA open and close push button.
k. Ground Storage Tank(s) Level Alarm: Operator selects Hi-Hi, Hi, Lo, and Lo-Lo alarm setpoints from the SCADA system.

l. Display Ground Storage Tank(s) level. There shall be an Operating range, warning range, and alarm range on the level indicator.

N. Backwash and Sludge Decant Return Pumps:
1. Abstract:
a. The backwash pumps and sludge return pumps are controlled via a separate vendor control panel.
2. PLC control:
a. N/A.
3. PCS/LOI/HMI control:
a. Each Pump shall have a SCADA Hand-Off-Auto selector switch.
b. Each Pump shall have a manual start and stop pushbutton.
4. Indicators and alarms:
a. Each pump will have a pump RUN indication.
b. Each Pump will have a pump OFF indication.
c. Each Pump will have a pump FAIL indication.
d. Each Pump will alarm when there is a change of state.
e. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump is equipped with a discharge pressure switch. When the pump is called to start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
f. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
g. Each Valve will have an opened indication.
h. Each Valve will have a closed indication.
i. Each valve shall have a SCADA Hand-Off-Auto selector switch.
j. Each valve will have a SCADA open and close push button.

O. Sedimentation B:
1. PLC control:
a. Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
b. Automatic Control: Operator selects Auto from SCADA Hand-Off-Auto software switch. Operator selects the amount of time the valves are opened and closed. Operator selects East or West valves. Pumps operate based upon float level control. Pumps shall rotate lead after each cycle.
2. PCS/LOI/HMI control:
a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
b. Each Pump will have a manual start and stop pushbutton.
c. Each Valve will have an on/off time setting.
d. An East/West Valve control selector switch will be available on the SCADA screen.
3. Indicators and alarms:
a. Each pump will have a pump RUN indication.
b. Each Pump will have a pump OFF indication.
c. Each Pump will have a pump FAIL indication.
d. Each Pump will alarm when there is a change of state.
e. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump

is equipped with a discharge pressure switch. When the pump is called to start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
f. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
g. Flow value will be displayed.

P. A, B, & C Lime Slaker:
1. PLC control:
a. Feeder Speed and Feeder control.
2. PCS/LOI/HMI control:
a. Feeder Speed is adjustable from SCADA in percentage.
3. Indicators and alarms:
a. If lime slaker is not running, an alarm shall annunciate.
b. Each silo hatch will alarm when opened.
c. Silo level alarms will be displayed.

Q. Ground Water Quick Lime System:
1. Abstract:
a. The lime silo drops product into a volumetric feeder. The feeder sends product to the lime slaker. Lime slurry travels to C Rapid Mix. The system is controlled manually.
2. PLC control:
a. N/A.
3. PCS/LOI/HMI control:
a. Refer to existing HSQ Graphics.
4. Indicators and alarms:
a. Refer to existing HSQ Graphics.

R. Surface Water Quick Lime System:
1. Abstract:
a. The lime silo drops product into a volumetric feeder. The feeder sends product to the lime slaker which generates slurry to send to a splitter box. The system is controlled manually.
2. PLC control:
a. N/A.
3. PCS/LOI/HMI control:
a. N/A.
4. Indicators and alarms:
a. N/A.

S. Ammonia System:
1. Abstract:
a. The system consists of two 1,000 gallon horizontal anhydrous ammonia tanks. Each tank is 5,000 pounds. Therefore the system consists of two 5,000 pound ammonia tanks. Each has an evaporator and requisite protective components. The chemical travels through 2 rotameters and a series of isolation and needle valves for manual control. The chemical has destinations of the blending chamber or C post mix.
2. PLC control:
a. N/A.

3. PCS/LOI/HMI control:
    a. N/A.
4. Indicators and alarms:
    a. Leak Detection.

T. Sodium Hypochlorite System:
1. Abstract:
    a. There are 6 Sodium hypochlorite pumps. There are 2 sodium hypochlorite tanks.
2. PLC control:
    a. Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
    b. When speed is selected in Automatic mode, speed of the pump shall be determined from chemical dosage calculations.
    c. When speed is selected in Manual mode, speed of the pump shall be determined from operator set point.
    d. PLC calculates the following values for each Pump:
        1) Percent Speed: (Gallons per Day/1440/2)/5.238/(Pump Stroke %/100)*100.
        2) Expected Flow (gph) (Use 274.7 for Pumps 1 & 2, Use 32 for Pumps 3 & 4, Use 39 for Pumps 5 & 6: (274.7, 32 or 39) *(%Speed*%Stroke) / 600000.
        3) Gallons Per Day Flow: (Setpoint ppm*8.34*basin flow)/9.4/(Bleach concentration/100).
3. PCS/LOI/HMI control:
    a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
    b. Each Pump will have a manual start and stop pushbutton.
    c. Each Pump will have a speed.
    d. Bleach Concentration shall be set by the operator.
4. Indicators and Alarms
    a. Each pump will have a pump RUN indication.
    b. Each Pump will have a pump OFF indication.
    c. Each Pump will have a pump FAIL indication.
    d. Each Pump will alarm when there is a change of state.
    e. Sodium Hypochlorite Tank(s) Level Alarm: Operator selects Order, Hi-Hi, Hi, Lo, and Lo-Lo alarm setpoints from the SCADA system.
    f. Display each Sodium Hypochlorite Storage Tank(s) level. There shall be an Operating range, warning range, and alarm range on the level indicator.
    g. Operator provides Basins A, B, & C flow values in MGD.
    h. Operator provides a setpoint ppm.

U. Fluoride System:
1. Abstract:
    a. There are 2 Fluoride pumps. The pumps are rated @ 15.85 gph, 0.2642 gpm. There is 1 bulk fluoride storage tank. There is 1 fluoride day tank.
2. PLC control:
    a. Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.

b. When speed is selected in Automatic mode, speed of the pump shall be determined from chemical calculations.
c. PLC calculates the following values for each Pump:
    1) Percent Speed: (Gallons per Day/1440)/(Design gpm/%accuracy * 100).
    2) Expected Flow (gpm): (15.85)*(%Speed)/6000.
    3) Gallons Per Day Flow: (Setpoint ppm*8.34*basin flow)/9.8/(Fluoride concentration/100).
d. When speed is selected in Manual mode, speed of the pump shall be determined from operator set point.
e. Pumps will shut down if surface water flow is zero.

3. PCS/LOI/HMI control:
    a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
    b. Each Pump will have a manual start and stop pushbutton.
    c. Each Pump will have a manual speed setpoint.
    d. Each Pump will have Fluoride concentration setpoint.
    e. Each Pump will have dosage setpoint.
    f. Each Pump will have a draw down results value.
    g. Each Pump will have a ml/minute value.
4. Indicators and Alarms
    a. Each pump will have a pump RUN indication.
    b. Each Pump will have a pump OFF indication.
    c. Each Pump will have a pump FAIL indication.
    d. Each Pump will alarm when there is a change of state.
    e. Fluoride Day Tank Level Alarm: Operator selects Hi-Hi, Hi, Lo, and Lo-Lo alarm setpoints from the SCADA system.
    f. Display each Fluoride Day Tank level. There shall be an Operating range, warning range, and alarm range on the level indicator.
    g. Each Pump will have Fluoride concentration setpoint.
    h. Each Pump will have dosage setpoint.
    i. Each Pump will have a draw down results value.
    j. Each Pump will have a ml/minute value.

V. Phosphate System:
1. Abstract:
    a. There is 1 Phosphate pump. The pump is a progressive cavity pump rated for 5.0 gpm maximum flow.
2. PLC control:
    a. Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
    b. When speed is selected in Automatic mode, speed of the pump shall be determined from chemical calculations. Dosage is set to 1.80 ppm based on the flows through all 3 treatment trains, A, B, & C. Phosphate solution is 0.226 pounds per gallon.
    c. Pounds per Day is calculated: Flow * 8.34 * Dosage.
    d. Gallons Per Day is calculated: Pounds per Day/Pounds per Gallon.
    e. When speed is selected in Manual mode, speed of the pump shall be determined from operator set point.
3. PCS/LOI/HMI control:
    a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
    b. Each Pump will have a manual start and stop pushbutton.

c. Each Pump will have a speed.
d. Each Pump will have a dosage setpoint.
e. Each Pump will have a pounds per day calculation.
f. Each Pump will have a pounds per gallon calculation.
g. Each Pump will have a gallons per day calculation.
h. Each Pump will have a gallons per minute calculation.
i. Each Pump will have a % speed calculation.

4. Indicators and Alarms
   a. Each pump will have a pump RUN indication.
   b. Each Pump will have a pump OFF indication.
   c. Each Pump will have a pump FAIL indication.
   d. Each Pump will alarm when there is a change of state.
   e. Each Pump will have a dosage setpoint.
   f. Each Pump will have a pounds per day Indication.
   g. Each Pump will have a pounds per gallon Indication.
   h. Each Pump will have a gallons per day Indication.
   i. Each Pump will have a gallons per minute Indication.
   j. Each Pump will have a % speed Indication.

W. Polymer System:
1. Abstract:
   a. There are 4 Polymer pumps. Two polymer pumps serve the surface water and two polymer pumps serve the ground water. The surface water polymer pumps are rated 90 gph that draw from either A or B polymer batching system and discharge into the flocculators. Each destination has a separate flow meter. The operators adjust the speed and stroke of the pumps to meet gpm. The ground water polymer pumps are rated 300 gph that draw from the C polymer batching system to discharge to the C-1/C-2 flocculator.
2. PLC control:
   a. Manual Control: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
   b. When speed is selected in Automatic mode, speed of the pump shall be determined from chemical calculations. For surface water: Polymer batch concentration is such that it produces 1.8% solution or 0.018 pounds per gallon. The setpoint is 0.12 ppm based on the flows through basins A and B. For ground water: Polymer batch concentration is such that it produces 1.8 percent solution or 0.018 pounds per gallon. The setpoint is 0.35 ppm based on the flows through basin C.
   c. Pounds per Day is calculated: Flow * 8.34 * Dosage.
   d. Gallons Per Day is calculated: Pounds per Day/Pounds per Gallon.
   e. When speed is selected in Manual mode, speed of the pump shall be determined from operator set point.
3. PCS/LOI/HMI control:
   a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
   b. Each Pump will have a manual start and stop pushbutton.
   c. Each Pump will have a speed.
   d. Each Pump will have a dosage setpoint.
   e. Each Pump will have a pounds per day calculation.
   f. Each Pump will have a pounds per gallon calculation.
   g. Each Pump will have a gallons per day calculation.

h. Each Pump will have a gallons per minute calculation.
i. Each Pump will have a % speed calculation.

4. Indicators and Alarms:
   a. Each pump will have a pump RUN indication.
   b. Each Pump will have a pump OFF indication.
   c. Each Pump will have a pump FAIL indication.
   d. Each Pump will alarm when there is a change of state.
   e. Each Pump will have a dosage setpoint.
   f. Each Pump will have a pounds per day indication.
   g. Each Pump will have a pounds per gallon indication.
   h. Each Pump will have a gallons per day indication.
   i. Each Pump will have a gallons per minute indication.
   j. Each Pump will have a % speed indication.

X. Alum System:

1. Abstract:
   a. There are 4 Alum pumps. The pumps are progressive cavity rated for 5.0 gpm maximum flow. There are 3 places that can receive alum (A and B rapid mix surface water and C basin). Alum concentration is 48 percent, approximately 11.0 pounds, with aluminum content of 8.3 percent. Approximately 5.4 pounds per gallon of active ingredient.
2. PLC control:
   a. Manual Control: Operator selects Hand from SCADA Hand off Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
   b. When speed is selected in Automatic mode, speed of the pump shall be determined from chemical calculations.
   c. Pounds per Day is calculated: Flow * 8.34 * Dosage.
   d. Gallons Per Day is calculated: Pounds per Day/Pounds per Gallon.
   e. When speed is selected in Manual mode, speed of the pump shall be determined from operator set point.
3. PCS/LOI/HMI control:
   a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
   b. Each Pump will have a manual start and stop pushbutton.
   c. Each Pump will have a manual speed setpoint.
   d. Each Pump will have a dosage setpoint.
   e. Each Pump will have a pounds per day calculation.
   f. Each Pump will have a pounds per gallon calculation.
   g. Each Pump will have a gallons per day calculation.
   h. Each Pump will have a gallons per minute calculation.
   i. Each Pump will have a % speed calculation.
4. Indicators and Alarms:
   a. Each pump will have a pump RUN indication.
   b. Each Pump will have a pump OFF indication.
   c. Each Pump will have a pump FAIL indication.
   d. Each Pump will alarm when there is a change of state.
   e. Each Pump will have a dosage setpoint.
   f. Each Pump will have a pounds per day calculation.
   g. Each Pump will have a pounds per gallon calculation.
   h. Each Pump will have a gallons per day calculation.
   i. Each Pump will have a gallons per minute calculation.
   j. Each Pump will have a % speed calculation.

Y. Elwood Park #1 Ground Storage and Booster Station:
   1. Abstract:
      a. There are 3 ground storage tanks. There are 7 pumps. Pumps 1, 6, & 7 are tank pumps. Pumps 2-5 are in line pumps. The pumps are constant speed. Pump #1 discharges twice the amount as pumps 6 & 7.
   2. PLC control:
      a. Manual Control:
         1) Pumps: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
         2) Valves: Operator Selects Hand from the SCADA Hand - Off- Auto selector switch. Operator selects Open from the Open - Stop-Close selector switch to open the valve. Operator selects stop to stop the valve. Operator selects close to close the valve.
   3. PCS/LOI/HMI control:
      a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
      b. Each Pump will have a manual start and stop pushbutton.
      c. Each valve shall have a SCADA Hand-Off-Auto selector switch.
      d. Each valve will have a SCADA open and close push button.
      e. Each Pump will alarm when there is a change of state.
      f. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a flow switch. Each pump is equipped with a discharge flow switch. When the pump is called to start and the flow switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
      g. During operation of the pump, if the pump discharge flow switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
      h. Ground Storage Tank(s) Level Alarm: Operator selects Hi-Hi, Hi, Lo, and Lo-Lo alarm setpoints from the SCADA system.
   4. Indicators and Alarms:
      a. Each pump will have a pump RUN indication. Pump run indication is based upon a flow switch.
      b. Each Pump will have a pump OFF indication.
      c. Each Pump will have a pump FAIL indication.
      d. Each Valve will have an opened indication.
      e. Each Valve will have a closed indication.
      f. Display Ground Storage Tank(s) level. There shall be an Operating range, warning range, and alarm range on the level indicator.
      g. Display Ground Storage Tank(s) Level alarms.
      h. Display Ground Storage Tank hatch alarms.
      i. Display Generator status.
      j. Display system pressure.
      k. Display system flow.
      l. Display valve position.
      m. Display control cabinet temperature.

Z. Elwood Park Booster Station #2:
   1. Abstract:
      a. There are 3 pumps. This is an in-line booster pump station. Pump #2 is VFD, all others are constant speed.
   2. PLC control:
      a. Manual Control:

1) Pumps: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
2) Valves: Operator Selects Hand from the SCADA Hand - Off- Auto selector switch. Operator selects Open from the Open - Stop-Close selector switch to open the valve. Operator selects stop to stop the valve. Operator selects close to close the valve.

3. PCS/LOI/HMI control:
   a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
   b. Each Pump will have a manual start and stop pushbutton .
   c. Each valve shall have a SCADA Hand-Off-Auto selector switch.
   d. Each valve will have a SCADA open and close push button.
   e. Each Pump will alarm when there is a change of state.
   f. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump is equipped with a discharge pressure switch. When the pump is called to start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
   g. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
4. Indicators and Alarms:
   a. Each pump will have a pump RUN indication.
   b. Each Pump will have a pump OFF indication.
   c. Each Pump will have a pump FAIL indication.
   d. Each Valve will have an opened indication.
   e. Each Valve will have a closed indication.
   f. Display door switch status.
   g. Display system pressure.
   h. Display system flow.

AA. Hospital Booster Station:
1. Abstract:
   a. There are 2 pumps. The Pumps are constant speed.
2. PLC control:
   a. Manual Control:
      1) Pumps: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
      2) Valves: Operator Selects Hand from the SCADA Hand - Off- Auto selector switch. Operator selects Open from the Open - Stop-Close selector switch to open the valve. Operator selects stop to stop the valve. Operator selects close to close the valve.
3. PCS/LOI/HMI control:
   a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
   b. Each Pump will have a manual start and stop pushbutton
   c. Each valve shall have a SCADA Hand-Off-Auto selector switch.
   d. Each valve will have a SCADA open and close push button
   e. Each Pump will alarm when there is a change of state.
   f. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump is equipped with a discharge pressure switch. When the pump is called to

start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.

g. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.

4. Indicators and Alarms:
   a. Each pump will have a pump RUN indication.
   b. Each Pump will have a pump OFF indication.
   c. Each Pump will have a pump FAIL indication.
   d. Each Valve will have an opened indication.
   e. Each Valve will have a closed indication.
   f. Display system pressure.
   g. Display system flow.

BB. Cortez Booster Station:

1. Abstract:
   a. There are 3 pumps. The Pumps are variable speed. There is 1 ground storage tank. Booster Pumps # 1 and #2 are controlled from Discharge Pressure. Booster Pump #3 is controlled from Suction Pressure. Booster Pumps #1 & #2 are inline pumps. Booster Pump #3 draws from the ground storage tank.
2. PLC control:
   a. Automatic Control:
      1) Booster Pump #3 speed can be based upon a setpoint for suction pressure or discharge pressure. When the Booster Pump #3 control switch is selected to Suction pressure, Booster Pump #3 will operate to maintain suction pressure to the station. When Booster Pump #3 control switch is selected to Discharge pressure, Booster Pump #3 will operate to maintain discharge pressure.
      2) Pump Staging Sequence Booster Pump #1, Booster Pump #2 & (Booster Pump 3 -when Booster Pump 3 is selected for discharge pressure operation):

Sequence of Operation:

Stage	Pumps Running	Increase Stage	Reduce Stage
1	All Pumps Off	Pressure remains below set point for preset time period	--
2	Lead Booster Pump	Pump speed remains at 58.5 Hz for preset time period	Finished water flow remains below (operator adjustable setpoint) gpm for preset time period
3	Lead Booster Pump and Lag Booster Pump.	Pump speed remains > 58.5 Hz for preset time period	Finished water flow remains below (operator adjustable setpoint) gpm for preset time period
4	Booster Pump #1, Booster Pump #2, (Booster Pump #3.- must be selected for Discharge PSI operation)	Pump Speed remains >58.5Hz for preset time period	Finish water flow remains below (operator adjustable setpoint) gpm for preset time period.

3) Booster Pumps #1 and #2 speed is based upon operator setpoint for discharge pressure. When discharge pressure falls below pressure setpoint for a pre-determined amount of time, the lead pump is called to start.
4) Lead pump rotates every pumping cycle. Operator can override by selecting lead pump.
5) If lead pump fails for any reason, lead pump shall rotate to next available pump in the sequence.

b. Manual Control:
1) Pumps: Operator selects Hand from SCADA Hand - Off - Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
2) Valves: Operator Selects Hand from the SCADA Hand - Off- Auto selector switch. Operator selects Open from the Open - Stop-Close selector switch to open the valve. Operator selects stop to stop the valve. Operator selects close to close the valve.

3. PCS/LOI/HMI control:
a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
b. Each Pump will have a manual start and stop pushbutton.
c. Each valve shall have a SCADA Hand-Off-Auto selector switch.
d. Each valve will have a SCADA open and close push button.
e. Each Pump will alarm when there is a change of state.
f. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a pressure switch. Each pump is equipped with a discharge pressure switch. When the pump is called to start and the pressure switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
g. During operation of the pump, if the pump discharge pressure switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
h. Pressure setpoint for both suction and discharge pressure.
i. Booster Pump #3 shall have a SCADA selector switch that allows this pump to be controlled via suction or discharge pressure.

4. Indicators and Alarms:
a. Each pump will have a pump RUN indication.
b. Each Pump will have a pump OFF indication.
c. Each Pump will have a pump FAIL indication.
d. Each Valve will have an opened indication.
e. Each Valve will have a closed indication.
f. Display system pressure (discharge and suction).
g. Display system flow.
h. Display tank level.
i. Display tank alarms.
j. Display pumps speed.
k. Display lead pump.

CC. Northwest Ground Storage and Booster Station:
1. Abstract:
a. There are 3 pumps. The Pumps are variable speed. There is 1 ground storage tank. There are a minimum of 6 automated control valves.

2. PLC control:
a. Automatic Control:

1) Pump Staging Sequence:

b. Sequence of Operation:

Stage	Pumps Running	Increase Stage	Reduce Stage
1	All Pumps Off	Pressure remains below set point for preset time period	--
2	Lead Booster Pump	Pump speed remains at 58.5 Hz for preset time period	Finished water flow remains below (operator adjustable setpoint) gpm for preset time period
3	Lead Booster Pump + Lag 1 Booster Pump	Pump speed remains > 58.5 Hz for preset time period	Finished water flow remains below (operator adjustable setpoint) gpm for preset time period
4	Lead Booster Pump + Lag 1 Booster Pump + Lag 2 Booster Pump	Pump speed remains > 58.5 Hz for preset time period	Finished water flow remains below (operator adjustable setpoint) gpm for preset time period

1) Booster Pumps speed is based upon operator setpoint for discharge pressure. When discharge pressure falls below pressure setpoint for a pre-determined amount of time, the lead pump is called to start.
2) Lead pump rotates every pumping cycle. Operator can override by selecting lead pump.
3) If lead pump fails for any reason, lead pump shall rotate to next available pump in the sequence.
4) There are 6 modes of operation. The modes of operation effect the valve positions. Operator can select mode of operation from SCADA.

Modes of Operation Table

Mode	Description	Control Valves
1	Normal	
2	Flow to Pumps from System Only	SV112 Closed MV107 Open MV108 Open MV109 Closed MV110 Open MV111 Open MV112 Closed
3	Flow to Pumps from Tank Only	SV112 Open MV107 Open MV108 Open MV109 Closed MV110 Closed MV111 Open MV112 Open

4	Flow to Pumps 1 & 2 from System and Pump 3 from Tank	SV112 Open MV107 Open MV108 Open MV109 Closed MV110 Open MV111 Closed MV112 Open
5	Tank Filled by Pumps (SV 112 closed)	SV112 Closed MV107 Open MV108 Closed MV109 Open MV110 Open MV111 Open MV112 Closed
6	Tank and Pump Station Bypassed	SV112 Closed MV107 Closed MV108 Closed MV109 Open MV110 Open MV111 Open MV112 Closed

3. Manual Control:
    a. Pumps: Operator selects Hand from SCADA Hand off Auto software switch. Operator selects start from SCADA start push button. Operator Selects stop from SCADA stop push button.
    b. Valves: Operator Selects Hand from the SCADA Hand - Off- Auto selector switch. Operator selects Open from the Open - Stop-Close selector switch to open the valve. Operator selects stop to stop the valve. Operator selects close to close the valve.
4. PCS/LOI/HMI control:
    a. Each Pump will have a SCADA Hand-Off-Auto selector switch.
    b. Each Pump will have a manual start and stop pushbutton
    c. Each valve shall have a SCADA Hand-Off-Auto selector switch.
    d. Each valve will have a SCADA open and close push button
    e. Each Pump will alarm when there is a change of state.
    f. Each Pump will have a pump FAIL TO START indication. Currently the pump fail to start indication is based upon a flow switch. Each pump is equipped with a discharge flow switch. When the pump is called to start and the flow switch does not change state after a predetermined time, a fail to start alarm will be annunciated at the SCADA system.
    g. During operation of the pump, if the pump discharge flow switch changes state for a predetermined time, the pump fail to start alarm will annunciate.
    h. Pressure setpoint for both suction and discharge pressure.
    i. Tank Fill operation setpoints by operator via SCADA.
5. Indicators and Alarms:
    a. Each pump will have a pump RUN indication.
    b. Each Pump will have a pump OFF indication.
    c. Each Pump will have a pump FAIL indication.
    d. Each Valve will have an opened indication.
    e. Each Valve will have a closed indication.
    f. Display system pressure (discharge and suction).

g. Display system flow.
h. Display tank level.
i. Display tank alarms.
j. Display pumps speed.
k. Display lead pump.
l. Hatch alarms.

DD. Sludge Thickener:
1. Abstract:
a. This is an existing vendor control system with SCADA monitoring and control. New SCADA screens shall be developed similar to the existing SCADA screens as well as additional control and monitoring features of the Local HMI as required by Manatee County.

EE. BTU (Biological Treatment Unit):
1. Abstract:
a. This is an existing system that was recently constructed. The existing system will be replicated for this project.

FF. Aquifer Storage & Recovery:
1. Abstract:
a. This is an existing system that is not in use. The existing system will be replicated for this project.

GG. Elevated Tanks:
1. Abstract:
a. There are elevated tanks throughout the service area. Those include WTP, 59th St., Northwest, Palmetto, North County, & Port Manatee.
b. PLC control:
1) Manual Control: Operator can open and close each valve from the SCADA system if the valves are in remote position.
2) Automatic Control: Operator will control the fill start level and fill stop level from the SCADA system. The local PLC will utilize the operator setpoints to open the fill valve when the tank level reaches the fill start level setpoint. When the tank level reaches the fill stop level the valve will close.
2. PCS/LOI/HMI control: Fill valve is controlled locally at the elevated tank.
3. Indicators and Alarms:
a. Tank Level.
b. High Level.
c. High-High Level.
d. Low Level.
e. Low Low Level.

HH. Generator Load Shedding:
1. Abstract:
a. There are 3 Standby Generators. Maximum of 2 generators will operate during an electrical power loss. If one generator circuit breaker is closed, the maximum load is approximately 1900 KW. If two generator circuit breakers are closed, the maximum load is approximately 4000 KW.
b. PLC control:

1. The operator will select the major equipment that will be required to operate under generator operation. A load shedding selection matrix will provided on the SCADA system. Operator selects the equipment from the load shedding selection matrix. KW ratings for each equipment will be required to calculate the amount of total KW selected from the load shedding selection matrix. Based upon the amount of available generator power, the equipment will start in a timed sequence. The timed sequence will be operator adjustable. The start sequence will be selected by the operator from the selected load shedding matrix. The load shedding matrix shall be developed such that the operator cannot exceed the amount available KW. Equipment not selected from the load shedding matrix will not be permitted to operate while the generators are delivering power to the plant.

2. PCS/LOI/HMI control:
   a. Operator selects equipment from the load shedding matrix that will be utilized during generator operation.
3. Indicators and Alarms:
   a. Generator 1, 2, & 3 status.
   b. Equipment Load shedding matrix.
   c. Equipment start sequence under generator operation.
   d. Equipment start delay setpoint.
   e. Available Power (KW).
   f. Selected Power (KW) based upon selections from load shedding matrix.

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17710

CONTROL SYSTEMS: PANELS, ENCLOSURES, AND PANEL COMPONENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Design, fabrication and assembly of all instrumentation enclosures, control panels and components provided under this contract, including but not limited to:
      a. Custom built instrumentation and control panels, including all enclosures for hand stations controllers, low voltage power distribution and marshalling panels.
      b. Control panels furnished as part of equipment systems specified in other Divisions, such as vendor control panels (VCPs) and chemical feed panels.
      c. Control components.
      d. Control panel installation.

B. ICSC as defined in specification section 17050 must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.

C. Provide all control panels identified in Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. C62.41.1 - Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.

C. Underwriters Laboratories Inc. (UL):
   1. 508 - Standard for Industrial Control Equipment.
   2. 508A - Standard for Industrial Control Panel.
   3. 913 - Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1, Hazardous (Classified) Locations.
   4. 1283 - Standard for Electromagnetic Interference Filters.
   5. 1449 - Standard for Surge Protective Devices.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definitions:

1. The term “panel” in this Section is interchangeable with the term “enclosure.”

1.04 SYSTEM DESCRIPTION

A. Panel dimensions:
   1. Minimum dimensions are scalable from or as indicated on the Drawings and are based upon manufacturer’s non-certified information. It is the responsibility of the Contractor or manufacturer to design and size all panels:
      a. Size panels to provide space for all equipment, wiring, terminations, and other items in the panel, including space for future build out.
      b. Panel sizes that substantially deviate (within 3 inches in any dimension) from the sizes indicated on the Drawings must be approved by the Engineer.
      c. Maximum panel depth: 30 inches, unless otherwise indicated.

B. Structural design:
   1. Completed and installed panel work shall safely withstand seismic requirements at the project site as specified in Section 16050 - Common Work Results for Electrical. Enclosures and internal equipment shall be braced to prevent damage from specified forces.

1.05 SUBMITTALS

A. Provide submittals as specified in Section 01330 - Submittal Procedures and Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide a control panel hardware submittal for each control panel and enclosure being provided on this project, including but not limited to:
   1. Product data:
      a. Enclosure construction details and NEMA type.
      b. Manufacturer's literature and specification data sheets for each type of equipment to be installed within or on the panel or enclosure.
   2. Shop drawings:
      a. Scaled, detailed exterior panel (front and side views) and interior panel layout showing equipment arrangement and dimensional information:
         1) Provide draft for review and approval by Engineer. The Engineer has the authority to substantially alter initial panel layouts.
      b. Complete nameplate engraving schedule.
      c. Structural details of fabricated panels.
   3. Calculations:
      a. For assembled enclosures and other equipment with a weight of 200 pounds or more, provide calculations for:
         1) Weight including panel internal components.
         2) Seismic forces and overturning moments.
         3) Shear and tension forces in connections.
      b. Cooling calculations, including but not limited to:
         1) Highest expected ambient temperature for the enclosure's location.
         2) Internal heat load.
         3) Exposure to direct sunlight.
         4) Dimensions of the enclosure in inches.

5) Maximum allowable temperature inside the enclosure, based on the lowest operating temperature limit of the installed components.

1.06 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Assemble panels, enclosures, and rack systems along with all internal and external devices, wiring, equipment, and materials in a facility that is recognized by UL to assemble and certify UL-labeled control panels:
   1. Provide all components and equipment with UL 508 listing.
   2. Provide fuses for all equipment that is not UL or UR listed.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Project environmental conditions as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
   1. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. As listed below in the individual component paragraphs.

B. Provide instruments and other components performing similar functions of the same type, model, or class, and from 1 manufacturer.

2.02 EXISTING PRODUCTS

A. Provide labor and materials for complete modifications to existing panels as required.

B. Field cut and refinish existing panel faces to original condition to accommodate installation of new instruments, removal of existing instruments, and fitting of blanks to suit new layouts. New instrument supports shall be provided as required for complete installation.

2.03 MATERIALS

A. Construct and finish enclosures using materials capable of withstanding the mechanical, electrical, and thermal stresses, as well as the effects of humidity and corrosion that are likely to be encountered in normal service:
   1. Enclosures shall have the following properties:
      a. NEMA Type 1: Steel.
      b. NEMA Type 4: Steel with gasketed door, raintight.
      c. NEMA Type 4X: Type 316 stainless steel
      d. NEMA Type 4X: Polycarbonate or fiberglass reinforced polyester (FRP) in corrosive areas where stainless steel is incompatible.
      e. NEMA Type 12: Steel with gasketed door, dusttight.
      f. NEMA Type 7: Cast aluminum.

B. Bolting material:
   1. Commercial quality 1/2-inch diameter, stainless steel hex-head Grade 5 bolts, nuts, and washers, with unified coarse (UNC) threads.
   2. Carriage bolts for attaching end plates.
   3. All other bolted joints shall have S.A.E. standard lock washers.

2.04 MANUFACTURED UNITS

A. Panels/enclosures:
   1. Manufacturers: One of the following or equal:
      a. Rittal.
      b. Pentair (formerly Hoffman Engineering).
      c. Saginaw Control & Engineering.
   2. Panel assembly:
      a. General guidelines for panel fabrication include:
         1) Continuous welds ground smooth.
         2) Exposed surfaces free of burrs and sharp edges.
         3) Base formed of heavy channel iron, either galvanized or powder coated, minimum 1/2-inch holes at 12-inch spacing to accommodate anchoring of freestanding enclosures to floor.

b. Construct enclosure and mounting panel using stretcher-level quality sheet metal having minimum thickness not less than the following sizes (U.S. Standard Gauge):

Enclosure Height (inches)	Minimum Enclosure Steel Thickness (gauge)	Minimum Back Mounting Panel Thickness (gauge)
Wall-mounted up to 48	14	14
Up to 57	12	12
57 - 69	12	10
69 - 82	12, except 10 on back	10
82 or more	10	10

1) Use heavier sheet metal to meet seismic requirements at the project site or when required due to equipment requirements.

c. Construct supporting frame structure with angled, channeled, or folded rigid section of sheet metal, rigidly attached to and having essentially the same outer dimensions as the enclosure surface and having sufficient torsional rigidity to resist the bending moments applied via the enclosure surface when it is deflected.

d. Provide stiffeners for back mounting panels in enclosures larger than 4 feet. In addition, secure the panels in place by collar studs welded to the enclosure.

e. Door construction:
   1) Turned-back edges suitably braced and supported to maintain alignment and rigidity without sagging.
   2) Sufficient width to permit door opening without interference with rear projection of flush-mounted instruments.
   3) Heavy-gauge piano-type continuous stainless steel hinges.
   4) For NEMA Type 12, Type 4, and Type 4X, provide oil-resistant neoprene sealing gasket and adhesive to seal cover to enclosure.
   5) Gasket installed to seal against roll lip on the enclosure opening.

f. Latches:
   1) For panels, provide each door with a 3-point latching mechanism and locking handle with rollers on the ends of the latch rods. Latch rods shall be connected to a common door handle, hold doors securely, and form a compressed seal between door and gasket, at the top, side, and bottom.
      a) Provide padlock for each enclosure with padlock provisions.
   2) Include an oiltight key-locking, 3-point latching mechanism on each door:
      a) Provide 2 keys per panel.
      b) All locks keyed alike.
   3) For large NEMA Type 4 and NEMA Type 4X cabinets not available with 3-point latching hardware, provide multiple clips and padlock hasps.

g. Panel cut-outs:
   1) Cut, punch, or drill cutouts for instruments, devices, and windows. Smoothly finish with rounded edges.

2) Allow a minimum of 3-inch envelope around all displays, controllers, and monitors.
3) Reinforce around cut-outs with steel angles or flat bars for the following:
a) Large panel cutouts; for example, openings for local operator interfaces.
b) Pilot device groupings, where the removed metal exceeds 50 percent of the available metal.

3. In addition to the requirements specified above, the following requirements for NEMA Type 4X powder coated stainless steel enclosures apply:
a. Minimum 14-gauge, Type 304 stainless steel.
b. Captive stainless steel cover screws threaded into sealed wells.
c. Inside finish: White polyester powder coating.
d. Specifically designed for use with flange-mounted disconnect handles where required or as indicated on the Drawings.
4. In addition to the requirements specified above, the following requirements apply for NEMA Type 4X non-metallic enclosures:
a. Fiberglass construction.
b. 10-gauge plate-steel reinforcing on the sides, top, and bottom.
c. All seams sealed.
d. Fiberglass hinges with no exposed metal parts.
e. Captivate stainless steel door screws.
f. Provisions for internal, sidewall mounting panels either by welded channels to the interior, or by welded collar studs.
g. Provide aluminum mounting panels.
h. Non-metallic enclosures are not an acceptable substitute for stainless steel.
5. Outdoor panels. Supplementary requirements for panels located outdoors are as follows:
a. All enclosures located outdoors shall be explicitly designed and rated for outdoor service by the manufacturer.
b. Door hardware: Stainless steel.
c. Provide factory installed rain canopy and sun shield for all enclosures
d. Bases: Heavy channel, gasketed stainless steel bases, flanges up, for anchoring to pad.

B. Arrangement of components:
1. Arrange panel internal components for external conduit and piping to enter into panel either from above or below.
2. Arrange panel instruments and control devices in a logical configuration, associating pushbutton and selector switches with related readout devices, or as indicated on the Drawings.
3. Mount internal control components on an internal back panel. Devices may be mounted on the side panel only by special permission from the Engineer.
4. All control-panel-mounted operator interface devices shall be mounted between 3 feet and 5 feet above finished floor.

C. Overcurrent protection:
1. Main overcurrent device:
a. Where the electrical power supply voltage to the control panel is more than 120 VAC, provide the panel with a flange-mounted disconnect

handle operating a molded-case circuit breaker and provide a control power transformer for 120-VAC circuits:
1) Door-mounted disconnect handles are not acceptable.
2) Mechanically interlock the disconnect switch with the control enclosure doors so that no door can be opened unless the power is disconnected, and the disconnect switch cannot be closed until all doors are closed.
3) Provide means to defeat the interlock.
4) Lockable in the off position.

b. Control panels supplied with 120 VAC:
1) Provide an internal breaker with the line side terminals covered by a barrier.
2) Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning statement requiring the source to be disconnected before opening the door to the enclosure.

2. Selection and ratings of protective devices:
a. Interrupting ratings: Not less than the system maximum available fault current at the point of application.
b. Voltage rating: Not less than the voltage of the application.
c. Select current rating and trip characteristics to be suitable for:
1) Maximum normal operating current.
2) Inrush characteristics.
3) Coordination of the protective devices to each other and to the source breaker feeding the panel.

3. Provide a separate protective device for each powered electrical device:
a. An individual circuit breaker for each 120-VAC instrument installed within its respective control panel and clearly identified for function.
b. An individual fuse for each PLC discrete output. Provide with individual blown fuse indication external of the I/O card:
1) Size external fuse to open before any I/O-card-mounted fuses.
2) Individual discrete inputs shall use a 0.5-ampere fuse.
c. Control loops can use individual 5-ampere fuse for the loop.
d. Install protective devices on the back mounting panel and identify by a service nameplate in accordance with the wiring diagrams.

4. Fuses for 4 to 20 milliamperes signals:
a. Provide durable, readily visible label for each fuse, clearly indicating the correct type, size, and ratings of replacement fuse:
1) Label shall not cover or interfere with equipment manufacturer's instructions.
b. An individual 1/2-ampere fuse for each 4 to 20 milliamperes analog loop powered from the control panel.
c. Provide fuses rated for the voltage and available short-circuit current at which they are applied.
d. Manufacturers: One of the following or equal:
1) Ferraz Shawmut.
2) Littelfuse.
3) Bussmann.

5. Fuse holders:
a. Modular type:
1) DIN rail mounting on 35-millimeter rail.

2) Touch-safe design: All connection terminals to be protected against accidental touch.
3) Incorporates blown-fuse indicator.
4) Plug-in style fuse terminals and fuse plugs are not acceptable.

b. Provide nameplate identifying each fuse:
1) As specified in Section 16075 - Identification for Electrical Systems.

c. Manufacturers: One of the following or equal:
1) Phoenix Contact.
2) Allen-Bradley, 1492-FB Series B.

6. Control circuit breakers:
a. DIN rail mounting on 35-millimeter rail.
b. Manual OPEN-CLOSE toggle switch.
c. Rated for 250 VAC.
d. Interrupting rating: 10 kiloampere (kA) or available fault current at the line terminal, whichever is higher.
e. Current ratings: As indicated on the Drawings or as required for the application.
f. Provide nameplate identifying each circuit breaker:
1) As specified in Section 16075 - Identification for Electrical Systems.

g. Manufacturers: One of the following or equal:
1) Phoenix Contact.
2) ABB.
3) Allen-Bradley.
4) Square D.

D. Conductors and cables:
1. Power and control wiring:
a. Materials: Stranded, soft annealed copper.
b. Insulation: 600 volts type MTW.
c. Minimum sizes:
1) Primary power distribution: 12 AWG.
2) Secondary power distribution: 14 AWG.
3) Control: 16 AWG.

d. Color:
1) AC power (line and load): Black.
2) AC power (neutral): White.
3) AC control: Red.
4) AC control: Yellow for foreign voltages.
5) DC power and control (ungrounded): Blue.
6) DC power and control (grounded): White with Blue stripe.
7) Ground: Green.

2. Signal cables:
a. Materials: Stranded, soft annealed copper.
b. Insulation: 600 volts, PVC outer jacket.
c. Minimum size: 18 AWG paired triad.
d. Overall aluminum shield (tape).
e. Copper drain wire.
f. Color:
1) 2-Conductor:
a) Positive (+): Red
b) Negative (-): Black.
2) 3-Conductor:

a) Positive (+): Red.
b) Negative (-): Black.
c) Signal: White.

g. Insulate the foil shielding and exposed drain wire for each signal cable with heat-shrink tubing.

E. Conductor identification:
1. Identify each conductor and cable with unique wire numbers as specified in Section 16075 - Identification for Electrical Systems.
2. Readily identified without twisting the conductor.

F. General wiring requirements:
1. Wiring methods: Wiring methods and materials for panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise specified.
2. Install all components in accordance with the manufacturer's instructions included in the listing and labeling.
3. Provide a nameplate on the cover of the control panel identifying all sources of power supply and foreign voltages within the control panel.
4. Provide transformers, protective devices, and power supplies required to convert the supply voltage to the needed utilization voltage.
5. Provide power surge protection for all control panels.
6. Provide signal surge protection within control panels for each analog I/O, discrete I/O, and data line (Copper Ethernet, Coax, Fieldbus signals) that originates from outdoor devices.
7. Provide non-metallic ducts for routing and organization of conductors and cables:
a. Provide wiring separation plan.
b. Size ducts for ultimate build-out of the panel, or for 20-percent spare, whichever is greater.
c. Provide separate ducts for signal and low-voltage wiring from power and 120-VAC control wiring:
1) 120 VAC: Grey colored ducts.
2) 24 VDC: White colored ducts.
8. Cables shall be fastened with cable-mounting clamps or with cable ties supported by any of the following methods:
a. Screw-on cable tie mounts.
b. Hammer-on cable-tie mounting clips.
c. Fingers of the nonmetallic duct.
9. Wire ties:
a. No wire ties inside wire duct.
b. Use Panduit Cable tie installation tool, with tension control/cutoff.
c. Verify cut ends are cut flush filed smooth after installed.
10. Provide supports at the ends of cables to prevent mechanical stresses at the termination of conductors.
11. Support panel conductors where necessary to keep them in place.
12. Wiring to rear terminals on panel-mount instruments shall be run in nonmetallic duct secured to horizontal brackets run adjacent to the instruments.
13. Conductors and cables shall be run from terminal to terminal without splice or joints. Exceptions:
a. Factory-applied connectors molded onto cables shall be permitted. Such connectors shall not be considered as splices or joints.

14. The control panel shall be the source of power for all 120-VAC devices interconnected with the control panel including, but not limited to:
    a. Solenoid valves.
    b. Instruments both mounted in the control panel and remotely connected to the control panel.

G. Provide power circuits for all Contractor and Vendor-furnished PLC cabinets in accordance with the PLC and Instrument Power wiring diagrams Indicated on the Drawings or as specified.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS

A. Thermal management:
1. Provide heating, cooling, and dehumidifying devices in order to maintain all instrumentation and control devices to within a range as specified in Section 17050 - Common Work Results for Process Control and Instrumentation.
2. Air conditioner:
    a. Provide solid-state cabinet coolers or air conditioning units on all outdoor panels containing electronic components such as local operator interface (LOI) units, panel instruments, programmable logic controllers, or remote I/O.
    b. Provide filters on intake and exhaust openings.
    c. Increase panel sizes as needed to accommodate cooling units.
    d. Enclosure rating: NEMA Type 4X.
    e. Closed-loop design.
    f. Power supply: 120 VAC.
    g. Utilize a CFC-free refrigerant
    h. Manufacturers: The following or equal:
        1) Kooltronic, Integrity Series 21.
3. Heating:
    a. Provide all panels located in areas that are not climate controlled with thermostatically controlled strip heaters, except where all of the following conditions apply:
        1) The panel is not supplied with 120 VAC power.
        2) There are no electronics or moisture-sensitive devices in the enclosure.
        3) The panel is smaller than 38 inches high.
4. Enclosure temperature sensor as indicated on the Drawings:
    a. Provide wall-mounted RTD transmitter (to measure internal cabinet temperature) in all enclosures containing electrical components such as PLCs, RTUs, RIO, and VFDs.
    b. Platinum RTD.
    c. 4-20 mA DC output.
    d. Sensor and electronic enclosure.
    e. Accuracy: Within 2 degrees Fahrenheit.
    f. Manufacturers: One of the following or equal:
        1) Omega, EWS Series.
        2) TCS Basys Controls, TS Series.

5. Enclosure temperature switch:
    a. Provide wall-mounted bimetallic switch transmitter (to measure internal cabinet temperature in all enclosures) containing electrical components such as PLCs, RTUs, RIO, and VFDs.
    b. Sensor and electronic enclosure.
    c. Accuracy: Within 2 degrees Fahrenheit.
    d. Manufacturers: One of the following or equal:
        1) Hoffman ATEMNC.
        2) Pfannenberg FLZ.
6. Status relays and discrete inputs for switches, power supplies, and fieldbus devices (if applicable):
    a. Provide as indicated on the Drawings or as specified.

B. Panel meters:
1. Pointer type:
    a. Suitable for panel mounting.
    b. Minimum scale length: 3 inches.
    c. Calibrated in engineering units.
    d. Accuracy: Within 2 percent of span.
    e. NEMA Type 4/IP65 sealed front metal bezel.
    f. Manufacturers: One of the following or equal:
        1) Yokogawa.
        2) Red Lion.
2. Digital process indicators:
    a. General:
        1) Integral provisions for scaling.
        2) Scale to process engineering units.
        3) Switch-programmable decimal points.
        4) NEMA Type 4/IP65 sealed front bezel.
    b. Current and voltage indicators:
        1) 3-1/2-digit minimum.
        2) Minimum character height: 0.5 inches.
        3) Accuracy:
            a) AC/DC volts: Within 0.1 percent of reading plus 2 digits.
            b) DC current: 4 to 20 milliamperes; within 0.1 percent of reading plus 1 digit.
            c) DC voltage: 0 to 10 volts; within 0.1 percent of reading plus 1 digit.
    c. Operating voltage: 120 VAC.
    d. Operating temperature: 0 to 60 degrees Celsius.
        1) Manufacturers: One of the following or equal:
            a) Precision Digital.
3. Digital bar graph meter:
    a. Self-contained instruments that display process signals directly in engineering units, both in decimal format and as a bar graph display.
    b. Suitable for panel mounting.
    c. LED display:
        1) Not less than 3 decimal digits.
        2) Not less than a 101-segment LED bar graph.
    d. Input signal:
        1) All conventional current loops and voltage control signals.
    e. Minimum sample rate of once per second.

f. Provisions for field-adjustable scaling and/or offset.
g. Accuracy shall be within 1 least-significant digit.
h. Manufacturers: One of the following or equal:
1) Ametek Dixson.
2) Yokogawa.
3) Weschler Instruments.

4. Counters:
a. 6 digits.
b. Switch-selectable inputs:
1) Switch contacts.
2) CMOS.
3) TTL.
4) Magnetic pickup.
5) RLC sensors.
c. Selectable up/down control via external signal.
d. Remote reset.
e. Remote inhibit to prevent accumulating counts.
f. Programmable to enable or disable front panel reset.
g. Non-volatile memory to retain all data upon loss of supply power.
h. Sunlight readable.
i. Operating temperature: 0 to 50 degrees Celsius.
j. Manufacturers: The following or equal:
1) Red Lion, PAX Series.

C. Pilot devices:
1. General:
a. Provide operator pushbuttons, switches, and pilot lights, from a single manufacturer.
b. Size:
1) 30.5 millimeters.
c. Heavy duty.
d. Pushbuttons:
1) Contacts rated:
a) NEMA Type A600.
e. Selector switches:
1) Contacts rated:
a) NEMA Type A600.
b) Knob type.
2) Provisions for locking in the OFF position where lockout provisions are indicated on the Drawings.
f. Pilot lights:
1) Type:
a) LED.
2) Push to test.
3) Lamp color:
a) On/Running/Start: Green.
b) Off/Stop: Grey.
c) No Communication: White.
d) Alarm: Amber.
e) Position: Blue.
f) Opened: Green.
g) Closed: Grey.

h) Failure: Red.

2. Indoor and outdoor areas:
   a. NEMA Type 4/13.
   b. Manufacturers: One of the following or equal:
      1) Allen-Bradley, Type 800T.
      2) Square D, Class 9001, Type K.
3. Corrosive areas:
   a. NEMA Type 4X.
   b. Corrosion resistant.
   c. Exterior parts of high-impact strength fiberglass-reinforced polyester or multiple-layer epoxy-coated zinc.
   d. Manufacturers: One of the following or equal:
      1) Square D, Class 9001, Type SK.
      2) Allen-Bradley Type 800H.
4. Hazardous (Classified) Areas/Class I Division 2:
   a. NEMA Type 4X.
   b. Corrosion resistant.
   c. Exterior parts of high-impact strength fiberglass-reinforced polyester or multiple-layer epoxy-coated zinc:
      1) All contacts contained within a hermetically sealed chamber:
         a) Pushbuttons.
         b) Selector switches.
         c) Push-to-test contacts on pilot lights.
      2) UL listed and labeled for Class I Division 2 areas.
   d. Manufacturers: One of the following or equal:
      1) Cutler Hammer, Type E34.
      2) Allen-Bradley, Type 800H.

D. Potentiometer and slidewire transmitters:
   1. Provide a DC output in proportion to a potentiometer input.
   2. Potentiometer input:
      a. 100 ohms to 100 K ohms.
      b. Impedance Greater or equal to 1 M ohms.
      c. Zero turn-up: 80 percent of full-scale input.
      d. Span turn-down: 80 percent of full-scale input.
   3. Field-configurable output:
      a. Voltage and current: All conventional current loops and voltage control signals.
   4. Accuracy including linearity and hysteresis within 0.1 percent maximum at 25 degrees Celsius.
   5. Operating temperature: 0 to 55 degrees Celsius.
   6. Supply power: 9 to 30 VDC.
   7. Manufacturers: The following or equal:
      a. Phoenix Contact.

E. Signal isolators and converters:
   1. Furnish signal isolators that provide complete isolation of input, output, and power input:
      a. Minimum isolation level: 1.5 kilovolts AC/50 hertz for at least 1 minute.
      b. Adjustable span and zero.
      c. Accuracy: Within 1.0 percent of span.
      d. Ambient temperature range: -20 to +65 degrees Celsius.

2. Manufacturers: One of the following or equal:
    a. Phoenix Contact, MCR Series.
    b. Acromag, 1500, 600T, 800T, Flat Pack, or ACR Series.
    c. Action Instruments, Q500 Series or Ultra SlimPakII.
    d. AGM Electronics, Model TA-4000.

F. Relays:
1. General:
    a. For all types of 120-VAC relays, provide surge protection across the coil of each relay.
    b. For all types of 24-VDC relays, provide a free-wheeling diode across the coil of each relay.
2. General purpose:
    a. Magnetic control relays.
    b. NEMA Type A300 rated:
        1) 300 volts.
        2) 8 Amps continuous (minimum).
        3) 7,200 volt-amperes make.
        4) 720 volt-amperes break.
    c. Plug-in type.
    d. LED indication for energization status.
    e. Test button
    f. Coil voltages: As required for the application.
    g. Minimum poles: DPDT.
    h. Touch-safe design: All connection terminals to be protected against accidental touch.
    i. Enclose each relay in a clear plastic heat and shock-resistant dust cover.
    j. Quantity and type of contact shall be as indicated on the Drawings or as needed for system compatibility.
    k. Relays with screw-type socket terminals.
    l. Provide additional (slave/interposing) relays when the following occurs:
        1) The number or type of contacts shown exceeds the contact capacity of the specified relays.
        2) Higher contact rating is required in order to interface with starter circuits or other equipment.
    m. DIN rail mounting on 35-millimeter rail.
    n. Ice-cube-type relays with retainer clips to secure relay in socket.
    o. Integrated label holder for device labeling.
    p. Manufacturers: One of the following or equal:
        1) Allen-Bradley, Type 700 HC.
        2) Square D, Type K.
        3) Phoenix Contact, PLC Series.
        4) Potter and Brumfield, Type KRP or KUP.
        5) IDEC, R* Series (* = H, J, R, S, U).
3. Latching:
    a. Magnetic-latching control relays.
    b. NEMA Type B300 rated:
        1) 300 volts.
        2) 10 Amps continuous.
        3) 3,600 volt-amperes make.
        4) 320 volt-amperes break.
    c. Plug-in type.

d. DIN rail mounting on 35-millimeter rail.
e. Coil voltage: As required for the application.
f. Minimum poles: 2 PDT; as required for the application. Plus 1 spare pole.
g. Touch-safe design: All connection terminals to be protected against accidental touch.
h. Clear cover for visual inspection.
i. Provide retainer clip to secure relay in socket.
j. Provide LED pilot light on relays when enabled.
k. Provide push to test feature.
l. Manufacturers: One of the following or equal:
1) Square D, 8501, Type K.
2) IDEC, RR2KP Series.

4. Time delay:
a. Provide time-delay relays to control contact transition time.
b. Contact rating:
1) 240 volts.
2) 10 Amps continuous.
3) 3,600 volt-amperes make.
4) 360 volt-amperes break.
c. Coil voltage: As required for the application.
d. Provide pneumatic or electronic type with on-delay, off-delay, and on/off-delay:
1) For off-delay, use true power-off time-delay relays. Where the required timing range exceeds capability of the off-delay relay use, signal off-delay where power loss will not cause undesirable operation or pneumatic time-delay relays.
e. Minimum poles: 2 PDT.
f. Units include adjustable dial with graduated scale covering the time range in each case.
g. Minimum timing range: 0.1 seconds to 10 minutes, or as required for the application.
h. Manufacturers: One of the following or equal:
1) IDEC, RTE Series.
2) Agastat, Series 7000 (pneumatic).
3) Allen-Bradley, Type 700-HR.

G. Terminal blocks:
1. DIN rail mounting on 35-millimeter rail.
2. Suitable for specified AWG wire.
3. Rated for 15 amperes at 600 volts.
4. Screw terminal type.
5. Provide mechanism to prevent wire connection from loosening in environments where vibration is present. This mechanism shall not cause permanent deformation to the metal body.
6. Finger-safe protection for all terminals for conductors.
7. Construction: Polyamide insulation material capable of withstanding temperature extremes from - 40 to 105 degrees Celsius.
8. Terminals: Plainly identified to correspond with markings on the diagrams:
a. Permanent machine-printed terminal identification.
9. Disconnect-type field signal conductor terminals with socket/screw for testing.
10. Identify terminals suitable for use with more than 1 conductor.
11. Position:

a. So that the internal and external wiring does not cross.
b. To provide unobstructed access to the terminals and their conductors.

12. Provide minimum 25-percent spare terminals.
13. Manufacturers: One of the following or equal:
    a. Phoenix Contact, UT4 Series.
    b. Allen-Bradley, 1492 Series.

H. Wire duct:
1. Provide flame retardant plastic wiring duct, slotted with dust cover.
2. Type:
    a. Wide slot.
    b. Narrow slot.
3. Manufacturers: The following or equal:
    a. Panduit.

I. Din rail:
1. Perforated steel.
2. 35 mm width.
3. 15 mm deep.
4. Provide 2-inch offset using one of the following:
    a. Offset brackets.
    b. Preformed standoff Din Rail Channel.

J. Surge protection devices:
1. 120-volt control power for panels:
    a. Panels without a UPS:
        1) Provide surge protection device (SPD) for panel power entrances:
            a) Nominal 120-VAC with a nominal clamping voltage of 200 volts.
            b) Non-faulting and non-interrupting design.
            c) A response time of not more than 5 nanoseconds.
        2) Control panel power system level protection, non-UPS powered:
            a) Designed to withstand a maximum 10-kA test current of an 8/20 µs waveform according to IEEE C62.41.1 Category C Area.
            b) For panels receiving power at 120 VAC, provide surge protection at secondary of main circuit breaker.
            c) Provide both normal mode noise protection (line to neutral) and common mode (neutral to ground) surge protection.
            d) DIN rail mounting.
            e) Attach wiring to the SPD by means of a screw-type cable-clamping terminal block:
                (1) Gastight connections.
                (2) The terminal block: Fabricated of non-ferrous, non-corrosive materials.
            f) Visual status indication of MOV status on the input and output circuits.
            g) Dry contact rated for at least 250 VAC, 1 Amp for remote status indication.
            h) Meeting the following requirements:
                (1) Response time: Less than or equal to 100 ns.
                (2) Attenuation: Greater than or equal to -40 dB at 100 kilovolt-hertz as determined by a standard 50-ohm insertion test.

(3) Safety approvals:
(a) UL 1283 (EMI/RFI Filter).
(b) UL 1449 2nd Edition.
i) Manufacturers: One of the following or equal:
(1) Phoenix Contact, Type SFP Filter.
(2) Liebert, Accuvar Series.
(3) Islatrol.
b. Panels with a UPS:
1) Provide surge protection on the control power source at each panel containing power supplies, or electronic components including PLCs, I/O, HMI, and digital meters.
2) Location:
a) For panels with a UPS, install surge protection ahead of UPS and maintenance bypass switch.
(1) Surge protection is not required for 120-VAC circuits that are only used for panel lights and receptacles.
3) MCOV: 150 VAC.
4) Surge capability (8/20 µs wave): 10 kA.
5) Peak let-through: 620V L-N, 850V L-G.
6) Manufacturers: One of the following or equal:
a) Phoenix Contact, Plugtrab PT Series.
b) MTL Surge Technologies, MA15 Series.
c. For panels receiving power at 480 VAC, provide surge protection on the 120-VAC control power transformer secondary.
2. Instrument, data, and signal line protectors (traditional I/O) - panel mounted:
a. Surge protection minimum requirements: Withstand a 10-kA test current of an 8/20 µs waveform in accordance with IEEE C62.41.1 Category C Area.
b. DIN rail mounting on 35-millimeter rail (except field-mounted SPDs).
c. SPDs consisting of 2 parts:
1) A base terminal block.
2) A plug protection module:
a) Replacing a plug shall not require the removal of any wires nor interrupt the signal.
b) Base and plug coded to accept only the correct voltage plug.
d. SPD:
1) Manufacturers: One of the following or equal:
a) Phoenix Contact, Plugtrab Series.
b) Bournes, Series 1800.
3. Instrument, data, and signal line protectors (traditional I/O) - field mounted:
a. Surge protection minimum requirements: Withstand a minimum 10-kA test current of an 8/20 µs waveform in accordance with IEEE C62.41.1 Category C Area.
b. Manufacturers: One of the following or equal:
1) Plugtrab, PT Series.
2) MTL, TP48 Series.

K. Horns and beacons:
1. Beacons/horn combination units:
a. Manufacturers: The following or equal:
1) Federal Signal Corp., Multi-Status LED 108i with tone module.
b. LED Colors: Red, Green, and Amber.

c. Power: 120VAC.
d. Provide accessories such as pipe mount flange, pipe extensions, corner mount brackets, or wall mount brackets as needed.
e. Horn rated 80 dB minimum at 10 feet.

2. Dedicated beacon unit:
   a. Manufacturers: One of the following or equal:
      1) Federal Signal Corp., Starfire Series.
      2) Allen-Bradley, 855 B *-* 10 Series.
      3) Edwards, 102 Series.
3. Dedicated horn unit:
   a. Electromechanical:
      1) Manufacturers: One of the following or equal:
         a) Federal Signal, 350 or 31X Series.
         b) Edwards, 878EX or 879EX Series.
   b. Electronic:
      1) Manufacturers: One of the following or equal:
         a) Federal Signal, 300GCX or 300X Series.
         b) Allen-Bradley, 855H or 855XH Series.
         c) Edwards, 5530M or 5533MD Series.
   c. Rated for 80 dB minimum at 10 feet.

L. Power supplies:
1. Design power supply system so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the system operation.
2. Convert 120 VAC to 24-volt DC or other DC voltages required or as required for the application.
3. Provide backup 24 VDC power supply units to automatically supply the load upon failure of the primary supply.
4. Provide power supply arrangement that is configured with several modules to supply adequate power in the event of a single module failure:
   a. Provide automatic switchover upon module failure.
   b. Alarm contacts monitored by the PLC.
5. Sized to provide 40-percent excess rated capacity.
6. UL 508C listed to allow full-rated output without de-rating.
7. Provide fuse or short-circuit protection.
8. Provide a minimum of 1 set of dry contacts configured to change state on failure for monitoring and signaling purposes.
9. Output regulation: Within 0.05 percent for a 10-percent line change or a 50-percent load change:
   a. With remote voltage sensing.
10. Operating temperature range: 0 to 50 degrees Celsius.
11. Touch-safe design: All connection terminals to be protected against accidental touch.
12. DIN rail mounting on 35-millimeter rail.
13. Provide self-protecting power supplies with a means of limiting DC current in case of short circuit.
14. Manufacturers: One of the following or equal:
    a. Fully redundant:
       1) Phoenix Contact, Quint Power Supply with SFB technology.
          a) Phoenix Contact Quint - o-ring redundancy module.
       2) IDEC, PS5R Series:

a) With redundancy Diode.
b. Sola.
c. Acopian.
d. PULS.

M. Intrinsic safety barriers:
1. Transformer isolated barrier:
a. Containing a transformer to provide complete:
1) Isolation between the safe and hazardous areas for loop-powered devices.
2) 3-way isolation between the safe area, hazardous area, and power supply powered devices.
b. Resistor for current limitation.
c. Fuses for short-circuit protection.
d. Provide barriers with pluggable connectors that are coded for easy replacement.
e. Transmission error shall be less than or equal to 0.1 percent of full-scale.
f. DIN rail mounting on 35-millimeter rail.
g. Approvals:
1) FM.
2) UL 913.
2. Types:
a. Switch isolators:
1) Designed and approved for use with discrete inputs.
2) Supply power: 20 to 30 VDC.
3) Output to track input.
4) LED in the cover to indicate the status of the input.
5) Selector switch to change the logic of the input.
6) Input: Dry contact.
7) Output: SPDT relay.
b. Transmitter and converters for use with 4- to 20-milliampere signals without Hart® communications capability:
1) Designed and approved for use with 4- to 20-milliampere analog signals.
2) Designed for powering 2- and/or 3-wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
3) Supply voltage: 20 to 30 VDC.
c. Transmitter and converters for use with 4- to 20-milliampere signals with Hart® communications capability:
1) Designed and approved for use with 4- to 20-milliampere analog signals.
2) Designed for powering 2- and/or 3-wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
3) Transfer digital signals from the hazardous area to the safe area.
4) Complete bi-directional communication between a smart transmitter located in the field and the suitable equipment located in the safe area.
5) Supply voltage: 20 to 30 VDC.
3. Manufacturers: One of the following or equal:
a. Phoenix Contact, ME Series.

b. Pepperl + Fuchs.

N. Limit switches:
1. NEMA Type 4X.
2. AC contact rating 120 volts, 10 A.
3. DC contact rating 125 volts, 0.4 A.
4. Provide robust actuation mechanism not prone to degradation.
5. Provide complete actuator mechanism with all required hardware.
6. Allows for contact opening even during contact weld condition.
7. UL approved.
8. Operating temperature range: -18 to +110 degrees Celsius (0 to 230 degrees Fahrenheit).
9. Manufacturers: One of the following or equal:
a. Allen-Bradley, 802 Series.
b. Square D.

O. Current switches:
1. Operate from 120-VAC supply voltage.
2. 1 normally open and normally closed contacts.
3. Adjustable current setting.
4. Manufacturers: The following or equal:
a. Zelio®, RM35.

P. Current transmitters:
1. Input current range:
2. Output: 4-20 mA
3. Operate from 24 VDC supply voltage.
4. Output overload protected.
5. Accuracy: Within 0.5 percent Full-Scale.
6. Ripple and Noise: 1 percent Max., peak to peak.
7. Frequency: 50/60 .hertz.
8. Manufacturer:
a. CR Magnetics: CR4320 series.
b. American Aerospace: 1070 Series.
c. Phoenix Contact: MCR Series.

2.07 ACCESSORIES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide panels with an inside protective pocket to hold the panel drawings. Ship panels with 1 copy of accepted Shop Drawings including, but not limited to, schematic diagram, connection diagram, and layout drawing of control wiring and components in a sealed plastic bag stored in the panel drawing pocket.

C. Provide 15-inch floor stands or legs where needed or as indicated on the Drawings.

D. Provide a folding shelf for enclosures that contain programmable controllers. The shelf shall be mounted on the inside surface of the door, capable of supporting a laptop computer.

E. Provide nameplate to each panel as indicated on the Drawings:

1. Provide as specified in Section 16075 - Identification for Electrical Systems on all internal and external instruments and devices.
2. Provide a nameplate with the following markings that is plainly visible after installation:
    a. Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the panel can be identified.
    b. Supply voltage, phase, frequency, and full-load current.
    c. Power source or circuit ID.
    d. Short-circuit current rating of the panel based on one of the following:
        1) Short-circuit current rating of a listed and labeled assembly.
        2) Short-circuit current rating established utilizing an approved method.

F. Lighting:
1. Provide 1 luminaire for each section, on the interior of the panel, spaced evenly along the top-front of the enclosure door opening(s):
    a. Covered or guarded.
    b. Provide On-Off door-activated switches where indicated on the Drawings.
    c. 120-volt, single-phase, 15-amp style plug.
    d. Provide 4,000 K, 900 Lumens - LED fixture.
        1) Provide additional fixtures for every 36 inches of width.

G. Receptacles:
1. Provide 1 duplex receptacle located every 4 feet of enclosure width, spaced evenly along the back mounting panels.
2. GFCI, 120-volt, single-phase, 15-amp style plug.
3. Provide circuit breaker or fuse to limit receptacle draw to 5 amperes.

H. Grounding:
1. Provide the following:
    a. Grounding strap between enclosure doors and the enclosure.
    b. Equipment grounding conductor terminals.
    c. Provide equipment ground bus with lugs for connection of all equipment grounding wires.
    d. Bond multi-section panels together with an equipment grounding conductor or an equivalent grounding bus.
2. Identify equipment grounding conductor terminals with the word "GROUND," the letters "GND," the letter "G," or the color green.
3. Signal (24 VDC) grounding: Terminate each drain wire of a signal (shielded) cable to a unique grounding terminal block, or common ground bus at the end of the cable as shown on the Loop Drawings.
4. Ensure the continuity of the equipment grounding system by effective connections through conductors or structural members.
5. Design so that removing a device does not interrupt the continuity of the equipment-grounding circuit.
6. Provide an equipment-grounding terminal for each incoming power circuit, near the phase conductor terminal.
7. Size ground wires in accordance with NEC and UL Standards, unless noted otherwise.
8. Connect all exposed, noncurrent-carrying conductive parts, devices, and equipment to the equipment-grounding circuit.
9. Connect the door stud on the enclosures to an equipment-grounding terminal within the enclosure using an equipment-bonding jumper.

10. Bond together all remote and local control panels, processor racks, and conductive enclosures of power supplies and connect to the equipment-grounding circuit to provide a common ground reference.

I. Provide sunshades and insulation for all outdoor installations.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Finishes:
   1. Metallic (non-stainless):
      a. Metal surfaces of panels shall be prepared by chemical cleaning and mechanical abrasion in accordance with the finish manufacturer's recommendations to achieve a smooth, well-finished surface.
      b. Scratches or blemishes shall be filled before finishing. One coat of zinc phosphate shall be applied per the manufacturer's recommended dry-film thickness and allowed to dry before applying the finish coat.
      c. Finish coat shall be a baked polyester-urethane powder, aliphatic air-dry polyurethane, or epoxy enamel to meet NEMA rating specified application.
      d. Exterior of enclosures located outdoors shall be UV-resistant polyester powder coating. Total dry film thickness shall be 3 mils, minimum.
   2. Stainless steel:
      a. Stainless enclosures shall be provided with a Number 4 brushed finish - not painted.

B. Colors:
   1. Exterior color of panels mounted indoors shall be manufacturer's standard light gray.
   2. Exterior of panels mounted outdoors shall be manufacturer's standard white.
   3. Panel interiors shall be manufacturer's standard white.

2.11 SOURCE QUALITY CONTROL

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation location for the instrument and verify that the instrument will work properly when installed.
   1. Notify the Engineer promptly if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install enclosures so that their surfaces are plumb and level within 1/8-inch over the entire surface of the panel; anchor securely to wall and structural supports at each corner, minimum. Direct attachment to drywall is not permitted.

B. Install the enclosure per guidelines and submitted installation instructions to meet the seismic requirements at the project site.

C. Provide floor stand kits for wall-mounted enclosures larger than 48 inches high.

D. Provide 3-1/2-inch high concrete housekeeping pads for freestanding enclosures.

E. Install gasket and sealing material under panels with floor slab cutouts for conduit:
   1. Undercoat floor-mounted panels.

F. Provide a full-size equipment-grounding conductor in accordance with NEC included with the power feeder. Terminate to the incoming power circuit-grounding terminal.

G. All holes for field conduits, etc. shall be cut in the field. There shall be no additional holes, factory cut holes, or hole closers allowed. Incorrect holes, additional holes, or mis-cut holes shall require that the entire enclosure be replaced.

H. Control panels that are adjacent to motor control centers shall be fully wired to the motor control centers using wireways integral to the motor control center or additional conduits as needed. These interconnections are not shown or reflected on the Conduit Schedule, but shall be shown on the Loop Drawings prepared by the Contractor.

I. Provide individually fused analog input module points with blown-fuse indicator lights, mounted external of the module on the output terminal strip.

J. Side panels:
   1. Side panels shall be kept free off all control equipment and devices. Any deviation must be sent to the engineer in writing asking for a deviation.

3.04 ERECTION, INSTALLATION, APPLICATION, AND CONSTRUCTION (NOT USED)

3.05 REPAIRS/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17712

CONTROL SYSTEMS: UNINTERRUPTIBLE POWER SUPPLIES 10 KVA AND BELOW

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Single-phase double conversion uninterruptible power supplies rated 10 kilovolt-amperes and below.
   2. Uninterruptible power supplies rated 10 kilovolt-amperes and below.

1.02 REFERENCES

A. As specified in Sections 16050 - Common Work Results for Electrical and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Federal Communications Commission (FCC):
   1. FCC Part 15, Class A.
   2. FCC Part 15, Class B.

C. Institute of Electrical and Electronic Engineers (IEEE):
   1. 519 - IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
   2. 1184 - IEEE Guide for Batteries for Uninterruptible Power Supply Systems.
   3. C62.41 - IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

D. Underwriters Laboratories, Inc. (UL):
   1. UL 1778 - Standard for Uninterruptible Power Supply Systems and Equipment.

1.03 DEFINITIONS

A. As specified in Sections 16050 - Common Work Results for Electrical and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definitions:
   1. Critical load: Load supplied by the UPS.
   2. MOV: Metal oxide varistor.

1.04 SYSTEM DESCRIPTION

A. Provide complete, factory-assembled, wired, and tested, true on-line double conversion UPS equipment including, but not limited to, rectifier, DC bus, inverter, battery charger, batteries, automatic bypass, and ancillary components as specified in this Section and as indicated on the Drawings.

B. UPS loads as indicated on the Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Product data:
   1. Manufacturer and model number.
   2. Catalog data.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
      d. Weight.
   4. Ratings:
      a. Input voltage.
      b. Output voltage.
      c. Input/output power factor.
      d. Efficiency.
      e. Harmonic distortion.
      f. Runtime.
   5. Noise specifications.
   6. Heat dissipation.
   7. Warranties and maintenance contracts:
      a. Documentation to demonstrate conformance to specifications noted in this Section.
      b. Descriptive package of offerings of preventative and full service maintenance contracts for both UPS system and batteries.
      c. Extended warranty options available.
   8. All communications requirements such as software, cards, etc.
   9. Alarms and status available for remote monitoring and system health.

C. Shop drawings:
   1. Power distribution block diagrams.
   2. Front and rear views of equipment enclosures:
      a. Front elevation including all control and indicating devices.
   3. Support points and weight of overall equipment.
   4. Schematic and control wiring diagrams including, but not limited to:
      a. Line and load terminals.
      b. Alarm and status terminals.
      c. Manual maintenance bypass switch terminals.
      d. External Battery or Step-down/Step-up Transformers if any.
      e. External wiring requirements for all communication signals.
   5. Switching and overcurrent protective devices.

D. Calculations:
   1. Include derating for temperature and elevation as necessary.
   2. UPS sizing computation:
      a. Apply safety factors as specified in this Section.
      b. Provide itemized list of critical loads, including individual VA and watt ratings.
   3. Battery time calculation based on specified runtime for total load with the safety factor multiplied to it. Table/graph for back-up time calculation.

4. Load calculation shall include power for all shown in the power distribution drawing, which include but not limited to PLC power supply, field instruments (120VAC and 24VDC), Instrument power, Ethernet switches, and I/O modules. Refer to Network Drawings for additional information and notes.
5. Total battery recharge time as a function of capacity utilized.

E. Record documents:
1. Provide Record Drawings of installed unit(s) including layout and wiring.

F. Manufacturer's field reports.

G. Operation and maintenance manuals:
1. System instruction manuals that describe troubleshooting, installation, operations, and safety procedures.
2. Recommendations for maintenance procedures and intervals.
3. Battery data/replacement information.
4. Parts list.

1.06 QUALITY ASSURANCE

A. Manufacturer qualifications:
1. A minimum of 10 years' experience in the design, manufacture, and testing of solid-state UPS systems.
2. ISO 9001 certified.

B. Regulatory requirements for complete UPS system:
1. UL listed per UL Standard 1778.
2. IEEE C62.41, Categories A & B.
3. FCC 15:
a. Greater than 2,000 VA - Class A.
b. Less than 2,000 VA - Class B.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Double-conversion true-online UPS manufacturers: One of the following or equal:
   1. Free-standing UPS, 700-3,000 VA:
      a. Vertiv, Liebert GXT4.
      b. Eaton Corp., Powerware 9130.
   2. Din Rail Mount UPS; 300-1500VA
      a. Sola SDU Series, 0-50 Degrees C
      b. Allen Bradley 1609 series, 0-50 Degrees C.
   3. Rack-mounted UPS, 700-3,000 VA:
      a. Vertiv, Liebert GXT4.
      b. Eaton Corp., Powerware 9130 RM.
   4. Free-standing UPS, above 3 kVA:
      a. Vertiv - Liebert [ ].
   5. Eaton Corp. - Powerware Rack-mounted UPS, above 3 kVA:
      a. Vertiv - Liebert [ ].
      b. Eaton Corp. - Powerware.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Double conversion true on-line UPS system requirements:
   1. System characteristics:
      a. Provide rack-mount or free-standing UPS as specified and as indicated on the Drawings.
      b. The minimum VA rating of the UPS shall be greater than or equal to the safety factor (as indicated in the UPS schedule) times the connected load or 700 VA, whichever is greater.
      c. Battery runtime at full load and site ambient temperature as indicated in the UPS schedule.
      d. Efficiency greater than 85 percent AC-AC, all modes.
      e. Acoustical noise:
         1) Less than 55 dBA at 5 feet.
      f. Output connections:
         1) Receptacles:
            a) 700-2,500 VA units:
               (1) Provide a minimum of four NEMA Type 5-15R or Type 5-20R receptacles.
            b) 3,000 VA units:
               (1) Provide a minimum of four NEMA Type 5-20R receptacles.
               (2) Provide at least one NEMA Type L5-30R receptacle.

c) Greater than 3,000 VA units:
(1) Provide a minimum of four NEMA Type 5-20R receptacles.
(2) Provide at least one NEMA Type L14-30R receptacle.
2) Provide hardwired connections as indicated on the Drawings.
g. Protection:
1) Undervoltage:
a) Operate on battery power if incoming source voltage goes below UPS system limits of operation.
2) Overvoltage:
a) Operate on battery power if incoming source voltage exceeds UPS system limits of operation.
3) Overcurrent:
a) Provide input and output current-limiting protection to ensure adequate overcurrent protection for UPS.
4) Surge protection:
a) MOV-based.
2. Electrical characteristics:
a. AC input:
1) Single-phase.
2) Voltage as indicated in the UPS schedule.
a) Fully functional within +10 percent, -15 percent of nominal voltage at full load without depleting battery.
b) 120 V input:
(1) 2-wire plus ground.
c) 208/120 V or 240/120 input:
(1) 3-wire plus ground.
3) Current:
a) Reflected total harmonic distortion (THD) less than 25 percent at rated load.
4) Frequency range of operation:
a) 57-63 hertz.
5) Power factor:
a) Not less than 0.95 lagging at rated load.
b. AC output:
1) Single-phase.
2) Voltage:
a) Regulation:
(1) Within 3 percent for 3,000 VA rating and below.
(2) Within 5 percent for greater than 3,000 VA rating - static load.
(3) Within 10 percent for greater than 3,000 VA rating - dynamic load.
b) Total harmonic distortion (THD) when operating on incoming power:
(1) Not more than 3 percent for linear loads with a crest factor of 3:1.
(2) Not more than 5 percent for non-linear loads with a crest factor of 3:1.
c) Transient response:
(1) Within 7 percent for a 20-100 percent step load.
(2) Transient recovery time to nominal voltage within 166 milliseconds.

3) Load power factor:
    a) UPS shall be capable of supporting the critical loads for all power factors experienced for their full range of operation.
4) Frequency regulation:
    a) Within 3.5 hertz when on utility power.
    b) Within 1.0 hertz when on UPS power.

3. Environmental requirements:
    a. Operating ambient temperature:
        1) UPS module: 50 degrees Fahrenheit to 104 degrees Fahrenheit (10 degrees Celsius to 40 degrees Celsius).
        2) Battery: 68 degrees Fahrenheit to 86 degrees Fahrenheit (20 degrees Celsius to 30 degrees Celsius).
    b. Operating altitude:
        1) Project site conditions as specified in Sections 16050 - Common Work Results for Electrical and 17050 - Common Work Results for Process Control and Instrumentation Systems
4. System components:
    a. Surge protective devices:
        1) MOV-supplied protection.
    b. Inverter:
        1) Pulse-width modulated AC output signal.
        2) Overload withstand minimum time without transferring to bypass:
            a) 101 to 110 percent for 2 minutes.
            b) 111 to 125 percent for 10 seconds.
            c) 126 to 150 percent for 1 second.
            d) Greater than 150 percent for 96 milliseconds.
        3) Transfer load to bypass when overload capacity is exceeded.
    c. Battery rectifier/charger:
        1) Recharge batteries to 90 percent in 6 hours or less.
    d. Batteries:
        1) VRLA (valve regulated lead acid), sealed, maintenance free.
        2) Minimum 3-year float service life at 25 degrees Celsius.
        3) Integral to UPS enclosure or housed in a matching enclosure.
        4) Less than and including 6,000 VA: Hot-swappable.
        5) Automatically perform routine battery health monitoring and provide visual, audible, and/or serial warnings if abnormal battery conditions exist.
    e. Automatic bypass switch:
        1) Integral to UPS system.
        2) Sense UPS overload, inverter failure, or over temperature, and automatically transfer loads to source power.
        3) Maximum detect and transfer time of 4-6 milliseconds.
        4) Automatic re-transfer without power interruption to critical load.
        5) Input shall match output in phase, voltage, frequency, and grounding.
        6) Rated to carry the full input current of the UPS.
        7) Provide ability for manual operation.
    f. Manual maintenance bypass switch:
        1) Provides isolation of the UPS for maintenance purposes.
        2) Make-before-break design so that UPS can be isolated from the critical loads by placing these loads on source power without interruption of operation.
        3) Utility and UPS status indications.

4) Supply necessary input/output cords and receptacles for connections with power source and UPS.
5) Transfer time less than 6 milliseconds.
6) Rated to carry the full input current of the UPS.
7) Standalone UL-listed.
8) Input match output in phase, voltage, frequency, and grounding.
9) UPS input connection and UPS output plug:
   a) 700 to 3,000 VA units: NEMA receptacle and plug to match UPS connections.
   b) Above 3,000 VA units: NEMA receptacle and plug or hardwiring to match UPS connections.
10) Utility and load connections:
   a) As indicated on the Drawings.
11) 700 to 3,000 VA units: One of the following or equal:
   a) Vertiv, Liebert Micropod 2U.
   b) Eaton Corp., Powerware HotSwap.
12) Above 3,000 VA units: By manufacturer of UPS, with connections matched for operation with UPS.

g. UPS chassis:
   1) Electrically isolate from AC output neutral.
   2) Include an equipment ground terminal.
h. Cooling:
   1) Forced air cooled.
i. Locally displayed system indicators:
   1) Audible alarms during abnormal conditions:
      a) UPS fault or overload condition.
      b) Battery on.
      c) Low battery.
      d) Automatic bypass on/off.
      e) Input power on.
      f) Battery testing mode.
j. Controls:
   1) Front-panel pushbuttons:
      a) UPS start-up, shutdown, and manual bypass (for automatic bypass).
      b) Testing.
      c) Visual/audible alarms reset.
   2) Applicable controls as specified in Communications Requirements.
k. Alarm contacts:
   1) Provide relay interface card and required interposing relays for 120 VAC discrete input status signals:
      a) Low battery.
      b) UPS alarm.
      c) On UPS power.
l. Communications requirements:
   1) Ethernet via SNMP - allow remote indication of all alarms and status signals present in the UPS:
      a) Provide manufacturer’s software as required.

B. Rack-mount Standby UPS requirements:
   1. Provide rack-mount or free-standing UPS as specified and as indicated on the Drawings.

2. The minimum VA rating of the UPS shall be greater than or equal to the safety factor (as indicated in the UPS schedule) times the connected load or 700 VA, whichever is greater.
3. Battery runtime at full load and site ambient temperature as indicated in the UPS schedule.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Do not utilize extension cords, adapters, or other electrical connectors for UPS input.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIRS/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL

A. Perform inspections and test procedures before UPS startup:
1. Inspect equipment for signs of damage.
2. Verify installation as indicated on the Drawings and specified in the Specifications.
3. Inspect cabinets for foreign objects.
4. Verify neutral and ground conductors are properly sized and terminated.
5. Inspect battery cases.
6. Inspect batteries for proper polarity.
7. Check power and control wiring for tightness.
8. Check terminal connectors for tightness.
9. Ensure connection and voltage of the battery string(s).

3.08 ADJUSTING (NOT USED)

3.09 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.12 SCHEDULES

TAG	MINIMUM RUNTIME	INPUT VOLTAGE / CONNECTION	SAFETY FACTOR	NOTES
Master Radio	30 Minutes	120Vac	1.5	
All other	15 Minutes	120Vac	1.5	

END OF SECTION

SECTION 17720

CONTROL SYSTEMS: PROGRAMMABLE LOGIC CONTROLLERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Programmable logic controller (PLC) based control systems hardware.
   2. Development software to be used with the specified PLC hardware.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Institute of Electrical and Electronics Engineers (IEEE).

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definitions:
   1. CPU: Central processing unit.
   2. I/O: Input/Output.

C. Specific definitions:
   1. Development operating software: The software provided by the PLC manufacturer for use in programming the PLC.
   2. Application software: The software that is programmed specifically for the Project.

1.04 SYSTEM DESCRIPTION

A. Provide all PLC hardware as indicated on the Drawings and as specified in this Section.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Product data:
   1. CPU:
      a. Processor type.
      b. Processor speed.
      c. Memory.
      d. Internal processor battery backup time.
   2. I/O modules:

a. Type.
b. Standard wiring diagram.

C. Calculations:
1. Submit calculations or documented estimate to verify that memory requirements of this Section are met, including spare requirements. If possible, use PLC manufacturer's calculation or estimating worksheet.
2. Submit calculations to verify that spare I/O requirements of this Section are met.
3. Submit calculations to verify that PLC power supply requirements of this Section are met.
4. Submit for approval successful Rockwell Integrated Architecture for each RTU (Processor, rack, power supply, I/O modules, and network) for this project. The integrated architecture will identify all connected equipment to the PLC and its operating parameters.

D. Product data:
1. Programming languages.
2. Operating system requirements.

E. Control logic:
1. Fully annotated copy of programmed PLC logic.
2. Cross-referenced index of all PLC registers or points.

F. Provide application software for the specific Project process requirements.
1. Fully annotated copy of programmed PLC logic in its native format.
2. Cross-referenced index of all PLC registers or points.

1.06 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. ICSC as defined in specification section 17050 must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.

C. Provide PLC hardware manufactured at facilities certified to the quality standards of ISO 9001.

D. Additional requirements:
1. Provide PLC system components by a single manufacturer:
a. Third-party communication modules may be used only for communication or network media functions not provided by the PLC manufacturer.
2. Use PLC manufacturer approved hardware, such as cable, mounting hardware, connectors, enclosures, racks, communication cable, splitters, terminators, and taps.
3. All PLC hardware, CPUs, I/O devices, and communication devices shall be new, free from defects, and produced by manufacturers regularly engaged in the manufacture of these products.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. In addition to the spare parts requirements specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems
   1. CPU: 1 spare for each type of CPU in the system.
   2. I/O cards: 3 spares for each type of I/O card in the system.
   3. Power supplies: 2 spares for every power supply in the system.
   4. Network/communications cards: 1 spare for every network or communications card in the system.
   5. Remote adapter: 1 spare for every remote adaptor in the system.
   6. Chassis: 1 spare for each chassis size in the system.

C. Installed spare requirements:
   1. I/O points:
      a. Provide total of 25 percent spare I/O capacity for each type of I/O at every PLC and remote inputs and outputs (RIO).
      b. Wire all spare I/O points to field terminal blocks in the same enclosure the PLC resides in.
   2. PLC backplane capacity:
      a. Provide 25-percent or 3 spare backplane slots, whichever is greater, in all racks containing I/O.
   3. PLC memory:
      a. Provide 50-percent spare program volatile memory.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Rockwell Automation:
      a. ControlLogix.
      b. CompactLogix.

B. The PLC programming software system shall be manufactured by PLC hardware manufacturer:
   1. Rockwell Software:
      a. Studio 5000 Logix Designer Professional.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Programmable logic controller:
   1. Construction:
      a. Furnish plug-in modular system.
      b. Provide PLCs capable of operating in a hostile industrial environment without fans, air conditioning, or electrical filtering:
         1) Temperature: 0 to 60 degrees Celsius.
         2) RFI: 80 to 1,000 MHz.
         3) Vibration: 10 to 500 hertz.
         4) Humidity: 0 to 95 percent.
      c. Provide internal power supplies designed to protect against overvoltage and frequency distortion characteristics frequently encountered with the local power utility.
      d. Design the PLC system to function as a standalone unit that performs all of the control functions described in this Section completely independent from the functions of the HMI system PC-based operator interfaces:
         1) Failure of the HMI system shall not impact data acquisition, control, scaling, alarm checking, or communication functions of the PLC.
   2. CPU:
      a. Configure each CPU so that it contains all the software relays, timers, counters, number storage registers, shift registers, sequencers, arithmetic capability, and comparators necessary to perform the specified control functions.
      b. Capable of interfacing with all discrete inputs, analog inputs, discrete outputs, analog outputs, and communication cards to meet the specified requirements.
      c. Capable of supporting and implementing closed-loop floating-point math and PID control that is directly integrated into the CPU control program.
      d. For RTU’s 1-5 PLC minimum CPU will be 1769-L33ER. For Master Radio PLC provide 1756-L73 CPU minimum, no exceptions.
   3. Memory:
      a. Non-volatile memory: On-board complementary metal-oxide-semiconductor (CMOS), electrically erasable programmable read-only memory (EEPROM), PCMCIA, compact flash card, or SD card.

b. Supply with sufficient memory to implement the specified control functions plus a reserve capacity as specified with the requirements of this Section:
    1) Reserve capacity:
        a) Totally free from any system use.
    2) Programmed in a multi-mode configuration with multiple series or parallel contacts, function blocks, counters, timers, and arithmetic functions.

4. Programming:
    a. Provide a system where processors are programmed by:
        1) Portable laptop computer both locally and via the PLC control network.
5. PLC power supply:
    a. Input: 120 VAC, where available.
    b. Mounted in the PLC housing or as indicated on the Drawings.
    c. Sized to power all modules mounted in that housing including an average module load for any empty housing slots plus 50 percent above that total.
6. PLC input/output, I/O modules:
    a. General:
        1) Compatible with all of the PLCs being furnished under the contract and by the same manufacturer as the PLCs.
        2) Provide I/O modules that:
            a) Isolate in accordance with IEEE Surge Withstand Standards and NEMA Noise Immunity Standards.
            b) Provide A/D and D/A converters with optically or galvanically isolated inputs and outputs.
            c) Accept dual-ended inputs.
        3) The use of common grounds between I/O points is not acceptable.
        4) Provide modules that are removable without having to disconnect wiring terminals:
            a) Utilize a swing-arm or plug-in wiring connector.
        5) Provide at each PLC the I/O modules for the following:
            a) Designated future I/O points contained in the I/O Lists and/or shown on the P&IDs, control schematics, or described in the control strategies.
            b) Installed spare capacity in accordance with the requirements of this Section.
            c) Wire all spares provided to the field terminal strip.
        6) Condition, filter, and check input signals for instrument limit conditions.
        7) Filter, scale, and linearize the raw signal into an engineering-units-based measurement.
        8) Alarm measurements for high, low, rate-of-change limits, and alarm trends.
        9) Provide external fuses mounted on the field connection terminal block for all discrete input, discrete output, and analog input I/O points.
        10) When multiple cards of the same I/O type are provided and parallel equipment, instrumentation, or redundant processes exist, distribute I/O among cards to ensure that a single card failure will not render an entire process unavailable.
    b. Discrete input modules:

1) Defined as contact closure inputs from devices external to the input module.
2) Provide inputs that are optically isolated from low-energy common-mode transients to 1,500 volts peak from users wiring or other I/O modules.
3) Individually isolated inputs.
4) With LEDs to indicate status of each discrete input.
5) Input voltage: 24 VDC.
6) Provide input module points that are individually fused with blown-fuse indicator lights, mounted external of the module on the output terminal strip:
    a) Coordinate external fuse size with the protection located on the module, so that the external fuse opens first under a fault condition.

c. Discrete output modules:
1) Defined as contact closure outputs for ON/OFF operation of devices external to the output module:
    a) Triac outputs may be used, with the permission of the Engineer. Care must be used in applying this type of module to ensure that the leakage current through the output device does not falsely signal or indicate an output condition.
2) Optically isolated from inductively generated, normal mode and low-energy common-mode transients to 1,500 volts peak.
3) LEDs to indicate status of each output point.
4) Output voltage: 24VDC.
5) Individually isolated outputs.

d. Analog input modules:
1) Provide differential type analog inputs. Single Ended analog inputs are not acceptable.
2) Signal type: Provide 4-20 mA for most applications; other levels are acceptable to interface to vendor control panels.
3) Analog-to-digital conversion: Minimum 12-bit precision with the digital result entered into the processor.
4) The analog-to-digital conversion updated with each scan of the processor.
5) Individually isolated each input.
6) Coordinate the size of the external fuse with the protection located on the module, so that the external fuse opens first under a fault condition.

e. Analog output modules:
1) Signal type: Provide 4-20 mA for most applications; other levels are acceptable to interface to vendor control panels.
2) Individual isolated output points each rated for loads of up to 1,200 ohms.

7. Communications modules:
a. Remote I/O adapter module:
1) For any PLC location requiring more than 1 housing to mount all of the I/O modules or that is identified as a RIO, provide the appropriate remote I/O adapter module for communication with the secondary housing(s).
2) Install the RIO adapter module in the PLC backplane and the RIO backplane.

3) Provide adapter modules that support all available types of I/O modules required.
4) Provide all network taps, connectors, termination resistors, drop cables, and trunk cables necessary for remote I/O communications.
5) Complete diagnostic LEDs.

b. Network communications modules:
1) General:
a) Install communications modules in the PLC backplane.
2) Ethernet:
a) Ports: RJ-45.
b) Communication rate: 100 Mbit/s.
c) Allen-Bradley ControlLogix -1756-EN2T or 1756-EN2TR where required. Compactlogix: Single Ethernet Port or PLC with 2 Ethernet ports embedded switch where required.
3) Modbus where required:
a) Ports: 2.
b) Each port individually configurable as Modbus Master or Slave.
4) Provide all network taps, connectors, termination resistors, drop cables, and trunk cables necessary for remote I/O communications.

B. HMI system interface:
1. As specified in Section 17733 - Control Systems: Network Materials and Equipment and Section 17762 - Control Systems: SCADA Software.

C. PLC programming software:
1. Furnish operating software capable of monitoring and/or controlling the PLCs via the PLC data network:
a. Contain diagnostics to collect troubleshooting and performance data and display it in easy to understand graphs and tables.
b. Monitor devices at each drop on the PLC data network for proper communications.
c. Provide the ability to program all PLCs on the PLC data network from Workstation #4 (Development Node) and Programming Laptop. Provide 2 PLC programming software licenses as required.
2. PLC programming laptop/desktop operating system:
a. Microsoft Windows 10 Pro.
3. The PLC programming software shall be suitable for the PLCs specified above.
4. PLC programming software for all programming, monitoring, searching, and editing:
a. Usable both on-line, while connected to the PLC, and off-line.
b. The operating software shall display multiple series and parallel contacts, coils, timers, counters, and mathematical function blocks.
c. Capable of disabling/forcing all inputs, outputs, and coils to simulate the elements of the ladder logic; forced elements shall be identifiable by means of color change.
d. Include a search capability to locate any address or element and its program location.
e. Display at the EC, PLC status information, such as faults and communication errors and amount of memory remaining.
5. The PLC programming software shall support the following programming languages:

a. Ladder Diagram.

6. Generate a PLC program printout, which is fully documented, through the PLC programming software:
   a. Fully documented program listings include, as a minimum, appropriate rungs, address, and coils shown with comments to clarify to a reader what that segment of the program accomplishes on an individual line-by-line basis.
   b. Include a sufficient embedded comment for every rung of the program explaining the control function accomplished in said rung.
   c. Use a mnemonic associated with each contact, coil, etc. that describes its function.
   d. Utilize the tag and loop identification as contained in the P&IDs:
      1) If additional internal coils, timers, etc. are used for a loop, they shall contain the loop number.
   e. Provide a cross-reference report of program addresses.
7. Software functions automatically without operator intervention, except as required to establish file names and similar information:
   a. Furnish the operating system software that is the standard uncorrupted product of the PLC manufacturer with the following minimum functions:
      1) Respond to demands from a program request.
      2) Dynamic allocation of the resources available in the PLC. These resources include main memory usage, computation time, peripheral usage, and I/O channel usage.
      3) Allotment of system resources based on task priority levels such that a logical allocation of resources and suitable response times are ensured.
      4) Queuing of requests in order of priority if one or more requested resources are unavailable.
      5) Resolution of contending requests for the same resource in accordance with priority.
      6) Service requests for execution of one program by another.
      7) Transfer data between programs as requested.
      8) Management of all information transfers to and from peripheral devices.
      9) Control and recovery from all program fault conditions.
      10) Diagnose and report real-time hardware device errors.
8. Program execution:
   a. Application software - program execution scheduled on a priority basis:
      1) Develop all PLC logic utilizing ladder logic only, no exceptions.
      2) A multilevel priority interrupt structure is required.
      3) Enter into a list of pending programs a program interrupted by a higher priority program:
         a) Resume its execution once it becomes the currently highest priority program.
      4) Schedule periodic programs.
      5) Base the allocation of resources to a time-scheduled program on its relative priority and the availability of resources.
      6) Indirect addressing is prohibited from this project.
      7) Limited add on instructions (AOI) is acceptable. Prior to program development a discussion will be necessary to provide details of owner preferences utilizing AOI's.

9. Start-up and restart:
    a. Provide software that initializes and brings a PLC or any microprocessor-based hardware unit from an inactive condition to a state of operational readiness.
    b. Initialization:
        1) Determination of system status before start-up of initializing operating system software and initializing application software.
        2) Loading of all memory-resident software, initializing timers, counters, and queues, and initialization of all dynamic database values.
10. Shutdown:
    a. Where possible, provide orderly shutdown capability for shutdowns resulting from equipment failure, including other PLC processor failures, primary power failure, or a manually entered shutdown command.
    b. Upon loss of primary power, a high-priority hardware interrupt initiates software for an immediate, orderly shutdown.
    c. Hardware is quickly and automatically commanded to a secure state in response to shutdown command or malfunction.
    d. Alarm PLC failure at the operator interface level.
11. Diagnostics:
    a. Furnish diagnostic programs with the PLC software package to detect and isolate hardware problems and assist maintenance personnel in discovering the causes for system failures.
    b. Use the manufacturer's standard diagnostic routines as much as possible.
    c. Furnish diagnostic software and test programs for each significant component in the control system.
    d. As a minimum, provide diagnostic routines to test for power supply, central processing unit, memory, communications, and I/O bus failures.
12. Calendar/time program:
    a. The calendar/time program to update the second, minute, hour, day, month, and year and transfer accurate time and date information to all system-level and application software.
    b. Variations in the number of days in each month and in leap years must be handled automatically by the program.
    c. The operator must be able to set or correct the time and date from any operator interface, only at the highest security level.
13. Algorithms:
    a. Implementation of algorithms for the determinations of control actions and special calculations involving analog and discrete data.
    b. Algorithms must be capable of outputting positional or incremental control outputs or providing the product of calculations.
    c. Algorithms must include alarm checks where appropriate.
    d. Provide, as a minimum, the following types of algorithms:
        1) Performs functions such as summing several variables, raising to a power, roots, dividing, multiplying, and subtracting.
        2) A switch algorithm, which reads the current and value from its input address and stores it as the value of its output address. 2 types of switches shall be accommodated: 2 outputs with 1 input and 1 output with 2 inputs.
        3) A 3-mode proportional-integral-derivative, PID, controller algorithm, with each of the 3 modes independently adjustable, supports both direct and reverse-acting modes.
        4) Lead, lag, dead time, and ratio compensators.

5) Integration and totalization of analog process variables.

14. Furnish a comprehensive database for the analog inputs, calculated values, control modules, and outputs:
    a. In addition, provide spare database points for future expansion.
15. One integrated database can be utilized for all types of analog points or separate databases for each type; in either case, the database for each point must include all specified aspects.
16. All portions of the database must be available for use by the display, report, and other specified software modules.
17. All of the data fields and functions specified below must be part of the point definition database at the operator interface. Provide the capability to define new database points through the point display specified below as well as modifying defined points through these displays. This point definition and modification must include all of the features and functions defined below. The analog database software must support the following functions and attributes:
    a. Analog input signal types: Differential Signal Type.
        1) Provide software at the remote terminal units (RTUs) and PLCs to read variable voltage/current signals and pulse duration/frequency type analog input signals.
    b. Input accuracy:
        1) Inputs must be read with an accuracy of within 0.05-percent full-scale or better.
        2) Data conversion errors must be less than 0.05-percent full-scale.
        3) Pulse accumulation error less than or equal to 1 count of actual input count at a scan rate of once per minute.
        4) Maintain for a minimum of 1 year the system accuracy stated above without adjustments.
    c. Blocking:
        1) Provide mechanisms to inhibit or block the scanning and/or processing of any analog input through the operator interface.
        2) For any input so blocked, the operator may manually enter a value to be used as the input value.
    d. Filtering:
        1) For each analog input, provide a first order lag digital filter with an adjustable filter factor.
    e. Linearizing:
        1) Where analog inputs require square root extraction or other linearization, provide a mechanism to condition the filtered data before the process of scaling and zero suppression takes place.
    f. Calculated values:
        1) Provide means to allow for pseudo-inputs calculated by algebraic and/or Boolean expressions utilizing real inputs, other calculated values, constants, etc.
        2) These values must be handled the same as real inputs in terms of record-keeping, alarming, etc.
    g. Scaling and zero suppression:
        1) Provide a conversion program to convert input values into engineering units in a floating-point format.
    h. Alarms:
        1) Provide an alarm program to check all analog variables against high-high, high, low, and low-low alarm limits.

2) When an analog value exceeds a set limit, it must be reported as an alarm based on individually set priority level for each alarm point.
3) Provide an adjustable hysteresis band in order to prevent excessive alarms when a variable is hovering around an alarm limit.
4) Must be possible to inhibit alarms based on external events, e.g., lock-out low pump flow alarm when the pump is off.

i. Averages:
1) Provide a program to calculate and store hourly, daily, and monthly averages of analog variables.
2) Continuously compute averages, e.g., the average for the current period to the present point in time must be stored in memory and available for use in displays, etc.
3) Update hourly averages each minute or at the polling interval for the selected variable.
4) Update daily averages at least once each hour and calculate using the results of the hourly averages.
5) Update monthly averages at least once each day and calculate using the results of the daily averages.
6) At the end of each averaging period, store the average values for the period on the hard disk for historical record-keeping and reset the present period average register to the present value of the variable.
7) The active database must include the present period average and previous period average for each variable and averaging period.

j. Totals:
1) Provide a program to calculate and store hourly, daily, and monthly totalization of analog variables.
2) Assign a scaling factor to each variable to convert to the appropriate units based on a 1-minute totalizing interval.
3) Assign a separate factor for each totalizing interval.
4) Variables for which totalization is inappropriate must have scaling factors of zero.
5) At the end of each totalizing period, store the totalized values for the period on the hard disk for historical record-keeping and reset the present period totalization register to zero.
6) The active database must include the present period total and previous period total for each variable and totalizing period.

k. Engineering units:
1) Provide software to allow the system and the operator to convert all the measured analog variables to any desired engineering units.
2) The operator must be able to view displays and generate reports of any measured variable in one or more engineering units such as flow in gpm, mgd, cfs, and acre-feet per day.
3) Pre-program the conversion of the engineering units, and, if not pre-programmed, the operator must be able to program new engineering unit conversions by using simple methods, e.g., multiplication of the database attributes by a constant.
4) The programming method must be at a level and compatible with the specified training of the operator and the Owner's personnel.
5) New conversions must not require the services of a special programmer and/or special, high-level, programming training.

l. Control modules:

1) For each control function configured, whether processed at the RTU, PLC, or operator interface, maintain a file of necessary data including input values, setpoints, constants, intermediate calculated values, output value and limit clamps, etc.
2) Input and output assignments, setpoints, and constants must be adjustable by the operator through the operator interface.
3) Provide control algorithms for manual control with output values adjustable by the operator.

m. Analog outputs:
1) Analog outputs must be maintained as part of the database.
2) These outputs must be adjustable manually by the operator through the operator interface or through automatic control algorithms.

18. Some of the above functions may be better accomplished in the data acquisition and graphic display software package; it is the responsibility of the ICSC to optimize the location of the various functions between all software packages.

D. General control functions:
1. Analog control functions:
a. PID, lead/lag, signal select, alarm, limit, delay, and time base.
b. Furnish the control system complete with a library of mathematical/calculation software to support averaging, weighted average, addition, subtraction, multiplication, division, square root extraction, exponential, AND, OR, NAND, NOR, XOR, and NXOR functions.
c. All math utilities must be linkable to process data points or manual inputs via control block configuration.
d. By linking control blocks to data points, the math library must support system unit conversion and calculation requirements.
2. Discrete control functions:
a. AND, OR, NOT, EXCLUSIVE OR, comparators, delays, and time base.
3. Software support:
a. Retain in firmware all control and logic functions at each RTU and PLC and in RAM at the operator interface.
b. Call each function as required by the configured controls to perform the intended function.
4. Control and status discrepancies:
a. Generate a discrepancy/fail alarm for any pump, valve, or final control element if a discrepancy exists between a system or operator command and the device status.
1) For example, the system commands to start (call), and the pump fails to start (run status report back), within predetermined operator-programmable time delay (time disagree), then a discrepancy (fail) alarm shall be generated.
b. Involuntary change in the device's status must also generate an alarm:
1) For example, a pump starts when not commanded to do so, or a pump shuts down while running even though it still has a command to run.
c. Each command, status, and alarm must cause the color of the symbol to change.
d. Because many discrete final control elements have a cycle time in excess of the scan interval, provide each control output with an associated delay

period selected to be longer than the operating period of the control element:
1) Delay periods for each final control element must be adjustable at the operator interface.
2) List all time delays in the final documentation.

5. Some of the above functions may be better accomplished in the data acquisition and graphic display software package; it is the responsibility of the ICSC to optimize the location of the various functions between all software packages.

E. Control configuration:
1. Provide software to allow control strategies to be developed, and their operation initiated through the operator interface.
2. Provide standardized control point displays for defining the control functions including the function type, input/output addresses, setpoints, tuning constants, etc.
3. Provide a mechanism to link separate control functions together into an integrated control strategy.
4. Provide a mechanism to download operational/control setpoints developed at any operator interface to any PLC or RTU for operational implementation.
5. Provide a mechanism to define and implement operational/control setpoints locally at the PLC or RTU, and to upload them to the operator interface for operational record-keeping.
6. Perform control configurations on-line at the operator interface; the PLC or RTU may be taken off-line when being configured or downloaded.

F. Remote inputs and outputs (RIOs):
1. Compatible with all of the PLCs being furnished under this Contract, shall be by the same manufacturer as the PLCs, and, as a minimum, include:
a. Power supply.
b. Rack.
c. Backplane.
d. Communications module.
e. I/O modules.
f. Enclosure.
2. Provide all cables and software needed for a complete and operational RIO system as specified in the Contract Documents.
3. Provide a group of pre-assigned diagnostic registers to report RIO system faults to the driver PLC.
4. The control system must continue operation should a fault occur on a single RIO drop:
a. Upon clearing the fault, restart communications to that drop automatically.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Utilize personnel to accomplish or supervise the physical installation of all elements, components, accessories, or assemblies:
   1. Employ installers who are skilled and experienced in the installation and connection of all elements, components, accessories, and assemblies.

C. All components of the control system including all data network cables are the installation responsibility of the ICSC unless specifically noted otherwise.

D. General:
   1. The control system logic program shall reside at the PLC level.

E. Use the tag and loop identifications found on the P&IDs for all tags used and/or assigned as part of the application software work provided by the ICSC.

F. Program the PLC logic using the following language(s):
   1. Ladder Diagram.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

A. Provide a minimum of 4 CD/DVD copies of the following:
   1. Application software:
      a. Finalized fully annotated copy of programmed PLC logic in its native format.
      b. Cross-referenced index of all PLC registers or points.
      c. Include a full PLC logic, comments and cross-reference report in PDF format.

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Tailor training specifically for this Project that reflects the entire control system installation and configuration.

C. Perform training by pre-approved and qualified representatives of the ICSC and/or manufacturer of the PLC hardware and programming software:
   1. A representative of the ICSC may perform the PLC hardware training only if the representative has completed the manufacturer's training course for the PLC hardware.
   2. A representative of the ICSC may perform the PLC programming software training only if the representative has completed the manufacturer's training course for the PLC programming software.

3.11 PROTECTION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17721

CONTROL SYSTEMS: LOCAL OPERATOR INTERFACE (LOI)

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Local Operator Interface (LOI) control systems hardware and software.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SYSTEM DESCRIPTION

A. Provide all LOI hardware identified in the Contract Documents.

1.05 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Product data:
   1. Complete manufacturer's brochures for each item of equipment.
   2. Complete manufacturer's brochures that identify LOI software and options. Mark up to clearly show options and components to be provided, and cross out any options or components that will not be provided.
   3. Manufacturer's operation and installation instructions.
   4. Additional requirements:
      a. Display type and size.
      b. Operator input.
      c. Processor type and speed.
      d. Memory size.
      e. Programming protocols.
      f. Communication protocols.
      g. Power requirements.
      h. Operating temperature and humidity ranges. NEMA ratings.

C. Shop drawings:
   1. Furnish the following:
      a. System block diagram showing relationship and connections between devices. Include manufacturer and model information, and address settings.

b. Mounting drawings with dimensions and elevations for each equipment location, including identification of all components, preparation and finish data, and nameplates.
c. Electrical connection diagrams.
d. Complete grounding requirements.

2. Graphic Screens:
   a. Color printouts of each graphic screen and all control pop-ups.
3. Furnish data sheets for each component together with a technical product brochure or bulletin:
   a. Manufacturer's model number.
   b. Project equipment tag.
4. Complete and detailed bills of materials identified by each cabinet. Include with each bill of material item the following:
   a. Quantity.
   b. Description.
   c. Manufacturer.
   d. Part numbers.

D. Operation and maintenance manuals:
   1. Complete installation, operations, calibration, and testing manuals as described in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

E. Record documents:
   1. Electrical connection diagrams revised to reflect any changes made in the field and submitted as record Drawings.

1.06 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. ICSC as defined in specification section 17050 must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.

C. Examine the complete set of Contract Documents and verify that the LOI equipment is compatible with the installed conditions.

D. Notify the Engineer if any installation condition does not meet the manufacturer's recommendations or specifications.

E. Provide LOI hardware manufactured at facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

F. System compatibility:
   1. The software must be the standard operating software system designed specifically for use with the LOI hardware.
   2. The software must be furnished and developed by the manufacturer of the LOI hardware.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.08 PROJECT OR SITE CONDITIONS

A. Project environmental conditions as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
   1. Provide LOI equipment suitable for the installed site conditions including, but not limited to, site altitude, site seismic conditions, humidity, and ambient temperatures.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide system upgrades and maintenance fixes for a period of 3 years from substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Allen-Bradley, PanelView Plus 1500.

B. Provide the LOI graphic software system manufactured by the LOI hardware manufacturer.

C. One of the following no equal:
   1. Rockwell, FactoryTalk View Studio ME.
      a. Provide two licenses. One each for Programming Laptop and Workstation # 4.

2.02 MATERIALS (NOT USED)

2.03 MANUFACTURED UNITS

A. Local Operator Interface:
   1. General:
      a. Provide Local Operator Interface located on the face of the PCM as indicated on the Drawings.
      b. NEMA 4X rated.
      c. Local Operator Interface consists of graphical display screen with operator input capabilities.
      d. Capable of stand-alone operation in conjunction with 1 PLC.
      e. Equipped with data network communication capabilities.
   2. Display:
      a. Type:
         1) Color TFT LCD screen.
      b. Resolution:
         1) 1024 by 768 pixels.
      c. Size: 15.0 Inch.
      d. Easy display viewing at any angle in various ambient light conditions.
      e. Operator input:
         1) Configurable touch screen with programmable function keys.
      f. Screen update speed: The screen update speed and screen change speed less than 1 second.
      g. Provide following features for outdoor use:
         1) Anti-glare screen overlay.
         2) Luminescence: Minimum 1,000 cd/m2 Nits.
   3. Graphic configuration:
      a. Easily configured graphics by:
         1) Portable laptop computer both locally and via the PLC data network.
         2) Workstation # 4 via the PLC data network.
      b. As specified in this Section.
   4. Memory:
      a. Application:
         1) 1 GB Flash EPROM.
   5. CPU: Minimum 100 MHz.
   6. Communications:
      a. Ethernet.
   7. Environment:
      a. Temperature: 0 to 55 degrees Celsius.
      b. Relative humidity: 5 to 95 percent.
   8. Electrical:
      a. Power supply:
         1) 24 VDC.
         2) 120 VAC.

B. Local Operator Interface software:
   1. Provide a complete software package to be used for programming the necessary screens and operator interaction with the LOIs.
   2. Operating system:
      a. Microsoft Windows 10.
   3. Furnish software with preconfigured symbols, objects, graphics, and imported bitmaps for the generation of the displays.

4. Software must allow bitmaps to be imported or exported to or from other applications.
5. Capable of generating custom reports, complete with screen prints.
6. Capable of working with multiple screens concurrently.
7. Provide dialog boxes for defining object attributes.
8. Configure objects using fill in dialog boxes.
9. Furnish graphic and text editor that allows custom formatting in order to customize and change the appearance of objects and text:
    a. Allow selection of different fill patterns to define object status.
10. As a minimum, provide the following object capabilities:
    a. Operator inputs:
        1) Momentary pushbutton.
        2) Maintained pushbutton.
        3) Latched pushbutton.
        4) Multistate pushbutton.
        5) Keypad enable button.
        6) Cursor point.
    b. Control list selectors:
        1) Standard control list.
        2) Piloted control list.
    c. Global objects.
    d. Display objects:
        1) Bar graph.
        2) Scale.
        3) Message display.
        4) Multistate indicator.
        5) List indicator.
        6) Numeric data display.
    e. Screen selector objects:
        1) Go to.
        2) Return.
        3) Screen list selector.
    f. Embedded variables:
        1) Time.
        2) Date.
        3) Numeric variable.
    g. Graphics:
        1) Lines.
        2) Shapes.
        3) Freeform drawings.
        4) Imported graphics.
        5) Background text.
        6) Selection table for standard ISA symbols.
        7) PID controller faceplate.
    h. Alarm screens.
11. Documentation:
    a. Provide complete user documentation, including examples of how to operate the various modules within the system.
    b. Provide the documentation in electronic format, HTML based with the ability to search for topics by keyword or search or specific text.
12. On-line help:

a. Provide an on-line "help" facility, based upon Windows standard Hypertext:
    1) Useful, context-sensitive information on the operation of the package:
        a) That can be invoked on-line through a point-and-click operation.
        b) The "help" facility must also support the ability to perform full text word search, add custom comments, bookmark topics, copy and pasting into another application, printing, and use of system fonts and colors.

2.04 EQUIPMENT (NOT USED)

2.05 COMPONENTS (NOT USED)

2.06 ACCESSORIES

2.07 MIXES (NOT USED)

2.08 FABRICATION (NOT USED)

2.09 FINISHES (NOT USED)

2.10 SOURCE QUALITY CONTROL

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

PART 3 EXECUTION

3.01 EXAMINATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. All components of the control system including all data network cables are the installation responsibility of the ICSC unless specifically noted otherwise.

C. Provide panel support bracing if more than 25 percent of the area has been removed to allow for the mounting of the LOI.

D. All tags used and/or assigned as part of the application programming work are to use the tag and loop identifications found on the P&IDs.

E. Station graphics:
    1. Configure the graphic display for each device both in the treatment plant, and/or process area, including but not limited to:

a. Symbols for:
    1) Pumps.
    2) Valves.
    3) Major instruments.
    4) Flowmeters.
    5) Pressure transmitter.
    6) Major equipment.
b. Alarm symbols including intrusion alarm.
c. Relevant test and operational data.
d. Status for each controller or controlled device:
    1) Hand-Off-Auto Status.
    2) Local-Off-Remote Status.
    3) Run.
    4) Call.
    5) Fail.
    6) Open.
    7) Close.
    8) Hold.
    9) Modulate.
    10) Running.
e. Depict a change of state of pumps and valves by a change in color.

2. Production and usage bar graph:
    a. Depict the production for each site and/or piece of equipment, as determined during the requisite graphics meeting, within the treatment plant, summarized to type, and total usage, with a bar graph and numeric value for each analog value.
3. System level summary:
    a. Show the level for the plant influent and effluent production, etc., via a display using bar graphs and numbers, as determined during the requisite graphics meeting.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Perform the training using pre-approved and qualified representatives of the ICSC and or manufacturer of the LOI software:
   1. A representative of the ICSC may perform the training only if the representative has completed the manufacturer's training course for the LOI software.

3.11 PROTECTION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17730

CONTROL SYSTEMS: SCADA COMPUTER EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. PC-based SCADA system hardware, including:
      a. SCADA Servers.
      b. Operator Workstations.
      c. OIT (Operator Interface Terminal)/ Industrial Panel Computer.
      d. Portable Computer.
      e. Printers.
      f. KVM Console/Switch.
      g. Workstation UPS.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definitions:
   1. CAL: Client access license.
   2. RAID: Redundant array of independent disks.
   3. SNMP: Simple network management protocol.

1.04 SYSTEM DESCRIPTION

A. Provide all SCADA computer equipment identified in the Contract Documents.

B. Miscellaneous requirements:
   1. All material used in satisfying the equipment requirements shall be new and unused and must be actively marketed by the original equipment manufacturer for new applications at the time of the factory demonstration test. The Contractor shall not use equipment destined for installation or spare parts for the Owner’s system for any reason other than development and testing of the system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Shop drawings:

1. Server Rack power schematic.
2. Server Rack layout.

1.06 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. ICSC as defined in specification section 17050 must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE

A. Servers:
   1. Provide a 3-year on-site manufacturer’s service plan, with 3-year unlimited phone support.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commonality:
   1. The SCADA system shall utilize the same brand and type of computer for like functions throughout the system.
   2. Where possible, use the same processor family throughout.

3. Use a single PC computer manufacturer throughout the Project, including those used for diagnostics and maintenance.

B. Manufacturers:
   1. As indicated below.

C. Systems management architecture:
   1. All processors, servers, workstations, network software, bridges, and other manageable objects shall have simple network management protocol (SNMP) agents included.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. General:
   1. The hardware identified in this Section is considered the minimum, acceptable configuration. It is the Contractor's responsibility to upgrade and expand the hardware configuration if necessary to satisfy software and system performance requirements of the Project.
   2. Proposed substitutions must meet or exceed the specifications of the equipment listed.

B. Servers:
   1. General:
      a. SCADA Servers: Windows 2016 Standard Server 64 Bit is the required operating system, alternates will not be allowed. Include minimum 10 Client Access Licenses (CALs) plus any additional required CALs.
      b. Provide Following Minimum Windows Server 2016 Licenses:
         1) (1) One Windows 2016 standard (16 core) license.
         2) (17) Seventeen Windows 2016 standard additional APOS (16 core) licenses.
         3) (3) Three Windows 2016 standard additional APOS (4 core) licenses.
   2. The SCADA Nutanix Hardware Platform shall meet the following minimum requirements:
      a. Manufacturers: One of the following no equal:
         1) Nutanix NX-1365-G6, 3 Nodes Hardware Platform.
      b. Rack Space: 2U Rack Mount Chassis.
      c. Processor: (6) Intel Skylake Processor 2.2 GHz 10-Core Skylake 4114 CPU. Two Processors per node or total of six (6) processors. C-CPU-4114.
      d. Main memory: (12) 32 GB DDR4 2666MHz Memory. Four (4) per node or a total of twelve (12) memory modules. C-MEM-32R4-26A.
      e. Hard disk(s):
         1) (6) 4TB 3.5-inch Hard Drive. Two (2) per node or a total of six (6) drives. C-HDD-4TB-A5-A.
         2) (3) 960GB 3.5-inch SSD. One (1) Per node or a total of three (3) drives. C-SSD-960GB-A5-A.
      f. Network cards: (3) 10Gbe Dual SFP+ Network Adapter. One (1) per node or a total of three (3) network adapters. C-NIC-10GSFP2-A.
      g. OS Media Kits: Windows Server 2016 Standard Edition.

h. AOS Software: (1) Nutanix Acropolis Software, 3 Year Subscription License. SW-AOS-PRO-PRD-3YR.
i. Hardware Support: (3) 3 Years. S-HW-PRD-1065-G6-3YR. Three years per node is required.
j. (60) L-CORES-PRO-PRD-3YR. Total quantity 60.
k. (3) L-FLASHTiB-PRO-PRD-3YR, Total Quantity 3.

3. Nutanix Startup Services: Services for base rack & stack, initial cluster set up, design and configuration shall be delivered by a Nutanix certified reseller or distributor. Contractor should get an approval for a certified reseller or distributor before procuring these services. Nutnaix certified services required for Factory Acceptance Testing and Plant Startup/Commissioning.
4. Software (VmWare):
   a. VmWare vSphere Essentials Plus Kit (One license required for the system).
   b. VmWare VCenter Server Essentials.
5. Applicable equipment (VMs):
   a. (1) VmWare vCenter Server For Essentials
   b. (1) Wonderware Historian.
   c. (2) Domain controller.
   d. (2) CitectSCADA Servers.
   e. (1) Sytech XLReporter Team Edition Server.
   f. (1) Citect Anywhere Server.

C. Keyboard-video-mouse (KVM) Console/Switch:
1. Manufacturers: One of the following or equal:
   a. Avocent, LRA185KMM8-001.
2. The KVM console/ switch shall meet the following minimum requirements:
   a. Capable of switching between 8 local or remote servers.
   b. 1U Rack Mount.
   c. 18.5" LED LCD Monitor, 16:9 Aspect Ratio.
   d. Maximum Resolution of 1600 by 1200.
   e. Built-in full desktop style keyboard with number pad, touch pad and 2 USB 2.0 pass through ports.

D. Operator Workstations :
1. Manufacturers: The following or equal:
   a. Dell, Precision Tower 5000 Series (5810).
2. General:
   a. General purpose, PC-architecture computers running Windows 10 Professional.
   b. Standalone workstations, not combined with any SCADA servers.
   c. Provide a complete set of backup/restore recovery CDs such that the portable computer may be restored to factory condition in the event of a catastrophic hard drive failure. Software recovery from a partition on the hard disk drive is not acceptable.
   d. Processor: Intel Xeon Processor E5-1603 v3 (4C, 2.8GHz, 10M, 140W) or better.
   e. Operating System: Windows 10 Pro for Workstations 64 Bit(up to 4 Cores)
   f. Chassis Options: Dell Precision Tower 5810 425W TPM Chassis, BW.
   g. Main memory: 8GB (2x4GB) 2400MHz DDR4 RDIMM ECC.
   h. Graphics card: Quadro P400, 2GB, 3 mDP.
   i. Hard disk: 1TP 3.5" SATA (7,200 RPM).

j. Productivity Software: Microsoft Office Professional 2016.
k. Integrated sound card.
l. Speakers: Desktop Stereo Speakers.
m. Network card: 2 Port, 100/1000-Base-T.
n. Optical drives: 16X DVD+/-RW with DVD burning software.
o. 4 USB ports.
p. Mouse: Wireless Optical, wheel-type, 3-button (Count Wheel click as one button).
q. Keyboard: Wireless Windows 104-key.
r. Support: 3 year ProSupport with Next Business Day Onsite Service.

3. Include each operator position an audible alarm with external volume control to allow adjustment to a level between 50-75 dBA. Capable of 2 distinctly different tones controlled by the user interface software and selectable by the user.
4. Applicable equipment:
   a. Development Workstation No. 4.
   b. Workstations No. 1, 2, 3 5 and 6.

E. LCD monitor:
1. LCD workstation monitors shall meet the following minimum requirements:
   a. LCD manufacturers: The following or equal:
      1) Dell, Ultra HD 4K Series.
   b. Viewing area: 27 inches.
   c. Aspect ratio: 16:9.
   d. Pixel pitch: 0.1554 mm.
   e. Resolution: (2160p) 3840 x 2160 (Display port: 60Hz, HDMI: 30 Hz) 1.07 Billion Colors.
   f. Interface: Display Port, HDMI Port.
   g. USB Ports: USB 3.0 Charging Ports.
   h. Contrast ratio: 1000:1 (Native) / 2000000:1 (Dynamic).
   i. Full screen image at all resolutions.
   j. Glass surface: Anti-glare, 3H Hard Coating.
   k. Mounting: Provide hardware for wall mounting.
2. Applicable equipment:
   a. Development Workstation No. 4. Dual Monitors.
   b. Workstations No. 1, 2, 3, 5 and 6. Dual Monitors each workstation.
   c. Portable Computer. Single Monitor.

F. Portable computer/ Programming Laptop:
1. Manufacturers: The following or equal:
   a. Dell, Latitude 3580.
2. General:
   a. Portable computers, PC-architecture computers running the Windows 10 Professional 64 Bit operating system.
   b. Provide a complete set of backup/restore recovery CDs such that the portable computer may be restored to factory condition in the event of a catastrophic hard drive failure. Software recovery from a partition on the hard disk drive is not acceptable.
3. Portable computer(s) shall meet the following minimum requirements:
   a. Processor: Intel Core i7-7500U (4M Cache, 3.5Ghz) or better.
   b. 15.6 (16:9) Anti-Glare, FHD (1920x1080) WLED, WLAN capable (inc. Integrated HD webcam), Non-touch.

c. Main memory: 8GB 2133MHz DDR4 (1 x 8GB).
d. Graphics card: AMD Radeon R5 M430.
e. Hard disk: 2.5" 7mm 500GM 7200rpm minimum.
f. Optical drives: 8X DVD+/-RW with DVD burning software.
g. Wireless: Qualcomm QCA61x4A 802.11ac Dual Band (2x2) Wireless Adapter + Bluetooth 4.1.
h. Integral keyboard with touchpad.
i. 4 USB ports.
j. Network port: 10/100/1000-Base-TX, Ethernet LAN.
k. USB 10/100/1000-Base-TX Network Adapter.
l. Complete set of all required cables.
m. DC power transformer for operation from 12-volt battery.
n. AC charger 65W with battery pack, lithium ion batteries.
o. Extra 65W AC Adapter.
p. Extra Battery Pack.
q. Productivity Software: Microsoft Office Professional 2016.
r. Manufacturer's user and maintenance manuals.
s. Nylon carrying case.
t. Mouse: Wireless Optical, wheel-type, 3-button (Count wheel click as one button).
u. Keyboard: Wireless Windows 104-key.
v. Support: 3 year ProSupport with Next Business Day Onsite Service.
w. Docking station/port replicator.
x. 50 percent of provided mass memory storage shall be unused and available for use by the Owner. More stringent requirements, if specified elsewhere, shall apply.

4. Applicable equipment:
   a. Programming Laptop.

G. OIT (Operator Interface Terminal)/ Industrial Panel Computer:
1. Industrial panel-mounted monitor with separate PC-architecture computer running the Windows 10 PRO 64 Bit operating system.
   a. Provide a complete set of backup/restore recovery DVD's such that the computer may be restored to factory condition in the event of a catastrophic hard drive failure. Software recovery from a partition on the hard disk drive is not acceptable.
   b. Provide a complete set of all required cables and software.
   c. Provide a Nema4X Panel Door Drawer for specified Keyboard/ Mouse.
   d. Provide manufacturer's user and maintenance manuals.
   e. Industrial panel-mounted monitor:
      1) Display size: 24-inch.
      2) Type: LCD PCAP Touch Panel - 1920x1080, 250nits, IP65, Black.
      3) Rating: NEMA Type 4.
      4) MTBF: Minimum 30,000 hours.
      5) Operating temperature: 0 - 50 Degrees Celsius.
      6) Operating relative humidity: 20 - 90 percent non-condensing.
      7) Power supply: 120 VAC.
      8) Manufacturers: One of the following or equal:
         a) SuperLogics - SL-PPC-24A-PD-AH110I-S17.
   f. Computer shall meet the following minimum requirements:
      1) Processor speed: Intel Quad Core i7-7700 3.6GHz, 8MB Cache or better.

2) Main memory: 8GB DDR4 2400 MHz.
3) Hard disk: 500 GB, Serial ATA, 6Gb/s 7200 RPM 32MB 2.5 inches minimum.
4) Video card: HD Graphics 630(65W) DVI, HDMI Out, VGA and S-Video.
5) Operating System: Microsoft Windows 10 Pro, 64Bit.
6) 4 SATA III Ports.
7) PCI Express x16 Slot.
8) 3USB 2.0 Ports and 2 USB 3.0 Ports.
9) 8X DVD/RW SATA.
10) Modem: None.
11) Network port: 10/100/1000 Base TX, Ethernet LAN.
12) Power supply: 120 VAC (12VDC 90W).
13) Warranty: Three Year 24x7 Onsite (Usa/Can).
14) Keyboard/ Mouse: SuperLogics SL-KB/MSE-USB-NEMA4X.
15) Manufacturers: One of the following or equal:
a) SuperLogics - SL-PPC-24A-PD-AH110I-S17.

2. Applicable equipment:
a. OIT (RTU-1, RTU-2 and RTU-3).

H. Printers:
1. Color laser printer (Control Room):
a. Manufacturers: The following or equal:
1) Dell, Color Multifunction Printer C5765dn (Printer/ Copier/ Scanner).
b. The laser printer shall meet the following minimum requirements:
1) Print speed, black (best quality mode): Up to 12 pages/minute; Print Quality (color): 600 by 600.
2) Scanning: 600 x 600 dpi.
3) Copy Resolution: 600 x 600 dpi (mono/ color).
4) Copy Speed: Up to 45 ppm (mono / color).
5) Printing Speed: Up to 47 ppm (mono/ color).
6) Display: 7-inch.
7) Memory: 512 MB.
8) Duplexing: Copying, Printing and Scanning.
9) Minimum of 64 MB memory.
10) Connectivity: 1000 Base TX, USB.
11) Media sizes: Letter and legal.
12) Include a minimum of 2 paper trays.
13) Provide a spare toner cartridge of each type.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Uninterruptible power supply (UPS).
1. Workstation UPS:
a. As specified in Section 17712 - Control Systems: Uninterruptible Power Supplies 10 KVA and Below for UPS requirements.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. General:
   1. Each display monitor shall be secured to the console or other work surface.
   2. Install equipment and cabling so that, in the event of an earthquake, seismic movement will not damage cables. In particular, provide appropriate slack in cables.

C. Each device with a unique IP address shall be individually labeled with its IP address. The labeling must be printed; handwritten labels will not be accepted.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL

A. As specified in Section 17950 - Testing, Calibration, and Commissioning.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Training:
   1. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17733

CONTROL SYSTEMS: NETWORK MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Materials and equipment used in process control and LAN networks including:
      a. Network switches.
      b. Media converters.
      c. Routers.
      d. Patch panels and other data network hardware.
      e. Related accessories.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. 802.3 - Ethernet.
   2. 802.11 - Wireless LANs.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SYSTEM DESCRIPTION

A. Provide, configure and make operational all network equipment identified in the Contract Documents.

B. Manatee County ITS will furnish a high availability firewall to provide security segmentation between the following networks: SCADA, PLC, server infrastructure, County LAN, and the uplink to the enterprise network. MCUD (Manatee County Utilities Division) staff, vendors, and contractors will need to work with Manatee County ITS to define an appropriate firewall policy to achieve this segmentation. All traffic will need to flow through these security devices in order to enforce the policy. Changes to the network by any staff, vendors, or contractors will need to be reviewed Manatee County ITS prior to implementation in order to ensure they do not impact the firewall operation.

C. Network/Security Meeting will be conducted with County, Engineer, and Contractor.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Product data:
   1. Include information on all test equipment.
   2. Manufacturer’s operation and installation instructions.

C. Shop drawings:
   1. Complete set of drawings including but not limited to:
      a. System block diagram showing relationship and connections between devices provided under this Contract. Include manufacturer and model information, and address settings.
      b. Network riser diagram.
      c. Network port diagram, which physically locates all ports within the facility, and identifies their patch panel and switch port.
      d. Construction drawings for all equipment cabinets, including dimensions, identification of all components, preparation and finish data, and nameplates.
      e. Electrical connection diagrams.
      f. Complete grounding requirements.
   2. Furnish data sheets for each component together with a technical product brochure or bulletin:
      a. Manufacturer's model number.
      b. Project equipment tag.
   3. Complete and detailed bills of materials broken up by each cabinet. Each bill of material item will include the following:
      a. Quantity.
      b. Description.
      c. Manufacturer.
      d. Part numbers.

D. Test reports:
   1. As specified in Sections 16125 - Fiber Optic Cable and Appurtenances, 17950 - Testing, Calibration, and Commissioning and noted in this Section.
   2. Signed test results as described in this Section.
   3. Test results shall include:
      a. Narrative describing the test procedures followed.
      b. Block diagram of test set up.
      c. Manufacturer’s information on test equipment used.
      d. Detailed test results.
      e. A narrative summarizing the results of the testing and identifying any further action required.

E. Operating manuals:
   1. Complete installation, operation, calibration, and testing manuals as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

F. Record drawings:
   1. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
   2. Electrical connection diagrams shall be revised to reflect any changes made in the field and submitted as record drawings.

1.06 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. ICSC as defined in specification section 17050 - Common Work Results for Process Control and Instrumentation Systems must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS (NOT USED)

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Ethernet switches:
   1. Managed Enterprise Ethernet switches (SCADA SWITCH A and SWITCH B stacks, Rack Mounted):
      a. Manufacturers: One of the following no equal:

1) Cisco Catalyst 3850 Series Stack.
    a) WS-C3850-24P-E.
    b) WS-C3850-24S-E.

b. Properties:
    1) Hardware:
        a) 19-inch rack mountable modular switch.
        b) Power supply:
            (1) Provide redundant power supplies.
            (2) Copper Switch: 120 VAC, 60 Hertz, 1 phase 1,100 Watts.
            (3) Fiber Switch: 120VAC, 60 Hertz, 1 phase, 350 Watts.
        c) Console management port.
        d) Redundant Fan modules.
        e) Stacking Module Slot.
        f) PoE (Copper Switch).
        g) Stacking Power Slot.
    2) Performance:
        a) Forwarding Performance: 480 Gbps.
        b) Stacking Performance: 68.4 Gbps, minimum.
        c) Switching Capacity: 92 Gbps.
        d) Gigabit throughput.
    3) Environment:
        a) Operating temperature range: 23 to 113 degrees Fahrenheit.
        b) Storage temperature range: -40 to 158 degrees Fahrenheit.
        c) Humidity: 10 to 95 percent, non-condensing.
    4) Capable of performing basic switching without special programming or configurations. Additional features available through software setup includes but not limited to:
        a) Port Monitoring.
        b) Remote switch management.
        c) Port Security.
        d) Switch meshing.
        e) Rapid Spanning Tree protocol.
    5) Capable of adding or swapping modules without interrupting the network.
    6) Connector type:
        a) Fiber: LC.
        b) Copper: RJ-45.
    7) Modules/ Ports:
        a) 10/100-Base-TX:
            (1) Protocol: IEEE 802.3 Type 10Base-T; 802.3u Type 100Base-TX.
            (2) Auto-sensing.
        b) Fiber optic 100-Base-FX:
            (1) Protocol: IEEE 802.3u Type 100Base-FX.
            (2) Full Duplex.
        c) 100/1000-Base-T:
            (1) Protocol: IEEE 802.3u Type 100Base-TX; 802.3ab Type 1000Base-T.
            (2) Auto-sensing.
        d) Mini GBIC:
            (1) Protocol: Based on GBIC module.
            (2) Full duplex.

e) Provide modules/ ports required to provide network connections as indicated on the Drawings:
(1) As required to provide the number of connections required plus 20 percent spare ports of each type used.
f) GBIC or SFP Transceiver module:
(1) Provide transceiver modules to interface with single port transceivers as required.
(a) Fiber Transceiver: Cisco GLC-GE-100FX=. Provide one Transceiver per open SFP port on the Fiber Switch. Provide Gigabit Fiber Transceivers if fiber type and length allows for a Gigabit connection.
g) Expansion Module:
(1) C3850-NM-1-1G=. Provide one per switch (SFP and Copper Switch). Provide one fiber transceiver per open SFP port.
8) Service Agreement: Provide 3 year Cisco SMARTnet extended service agreement for each Cisco switch provided for the system.
9) Spare parts:
a) Provide the following spare components:
(1) One spare Copper Ethernet switch with all options and modules as per contract documents.
(2) One spare Fiber Switch with all options and required modules as per contract documents.
(3) One Spare Switch Power Supply.
(4) One Spare Switch Fan Module.

2. Managed Process floor Ethernet switches (Workstation Panels, RTUs, Master Radio Panel, AB Backwash, BTU Panel, Fluoride Panel):
a. Manufacturers: Following models, no equal:
1) Din-Rail Mounted:
a) Allen Bradley Stratix 5700 Series: 1783-BMS06SGA.
b) Allen Bradley Stratix 5700 Series: 1783-BMS10CGP. Workstation # 4 Cabinet, RTU-2, RTU-3 and any other switch that is servicing multiple VLANs.
c) Allen Bradley Stratix 5700 Series: 1783-BMS10CGA. Provide this switch for any DLR Network in the system.
d) Allen Bradley Stratix 8000 Series: 1783-MS10T with 1783-MX04S Expansion module. Provide one fiber transceiver per open SFP port on the expansion module. RTU-1, RTU-62 and Master Radio Panel.
b. Properties:
1) Hardware:
a) Power supply:
(1) Provide redundant power supplies.
(2) 24 VDC, 350 Watts per power supply.
b) No fans or moving parts.
c) SD Card:
(1) 1784-SD1. 1GB Industrial SD Card.
2) Performance:
a) Switch fabric speed: 8 Gbps, minimum.
b) Gigabit throughput.
c) Latency 2.9 microseconds.
d) Enclosure:

(1) All metal hardened housing.
(2) 30g Shock, operating.
(3) 55g shock, non-operating.
(4) Cat 6 grounding for shield drains.

e) 10/100Base-TX RJ-45 Copper Ports.
f) 100Base-FX Full Duplex Fiber Optic Ports. Fiber Transceiver: Cisco GLC-GE-100FX=. Provide one Transceiver per open SFP port on the Switch. Provide Gigabit Fiber Transceivers if fiber type and length allows for a Gigabit connection.
g) 1,000Base-T Mini GBIC Full Duplex.
h) Ports will auto negotiate speed duplex and MDIX.
i) Capable of performing basic switching without special programming or configurations. Additional features available through software setup includes but not limited to:
(1) Full SNMP and Web Browser Management.
(2) VLAN.
(3) QoS.
(4) Trunking.
(5) CIP Messaging.
(6) Port Mirroring.
(7) DHCP Server with Option 61, Option 82 Relay Agent and Local IP Addressing.
j) OPC 2.0 Compliant Monitoring.
k) IGMP Snooping with Ethernet I/P plug & play compatibility.
l) RJ-45 Copper Ports Auto Negotiates Speed, Duplex, and MDIX.
m) Store-and-forward technology.
n) Redundant Power Inputs (10-30 VDC).
o) 802.1d, 802.1w, 802.1D RSTP.
p) Rapid Spanning Tree protocol.
q) Full Software option.
r) DLR option as required.

3) Environment:
a) Operating temperature range: -40 to 140 Degrees Fahrenheit.
b) Non-Operating temperature range: -40 to -185 Degrees Fahrenheit.
c) Humidity: 5 to 95 percent, non-condensing.

4) Warranty/ Service: Provide 3 Years of manufacturer's Warranty/ Service agreement.

5) Connector type:
a) SFP Fiber: LC.
b) Copper: RJ-45.

6) Mounting:
a) Provide hardware for 19 inch rack mounting hardware.
b) DIN Rail mounting.
c) As indicated on the Drawings.

B. Patch panels:
1. All optical fibers shall be provided with strain relief and terminated at a fiber patch panel. All patch panel terminations shall be SC type. Final connections between the patch panel and the fiber optic network equipment shall be made via fiber optic patch cords.
2. All fibers, active and dark, shall be terminated at the patch panels.

3. Interconnect and patch panel housings shall provide space for excess fiber and provide strain relief for the fiber cable.
4. Fiber cables shall be installed such that the outer sheath of the cable is carried into the interconnect enclosure or patch panels before breaking out buffer tubes.
5. Category 6 patch panels:
    a. Manufacturers: One of the following or equal:
        1) Hubbell Nextspeed. HP624.
        2) Siemon HD.
        3) Lucent Systemax.
    b. Patch panels and connectors shall meet the following (minimum) requirements:
        1) Category 6, T569A/B.
        2) RJ-45 patch cord termination: S110 UTP-STP cable termination.
        3) Capacity: 24 ports (minimum).
        4) Mounting: 19-inch rack mount.
        5) Accessories: Rear cable management bracket, individual port labels.
    c. Provide patch cables as required to support all network devices. Provide four spare straight through patch cables.
6. Fiber patch panels:
    a. Panel/ Din Rail Mounted fiber patch panel:
        1) Application: Use for termination of single cable in-side control panels.
        2) Panel mounted fiber interconnects shall be provided as complete units including the housing, the connector panels and the fiber connectors.
        3) Panel mounted fiber interconnects shall provide physical protection for both the incoming cable and the outgoing patch cords.
        4) Capacity: As shown on the plans, minimum 12 connections.
        5) Manufacturers: The following or equal:
            a) Corning Cable Systems, SPH-01P Housing and CCH-CP12-91 connector plate.
        6) Accessories:
            a) Din rail kit.
    b. Wall mounted interconnect:
        1) Application: Use for the termination of a single cable outside of cabinets, in small enclosures or as indicated on the plans.
        2) Wall mounted fiber interconnects shall be provided as complete units including the housing, the connector panels and the fiber connectors.
        3) Wall mounted fiber interconnects shall provide physical protection for both the incoming cable and the outgoing patch cords.
        4) Capacity: As shown on the plans, minimum 12 connections.
        5) Accessories:
            a) Door lock.
            b) Blanks for unused connector panels.
        6) Manufacturers: The following or equal:
            a) Corning Cable Systems, Wall-Mountable Interconnect Center.
    c. Rack mounted fiber patch panel:
        1) Application: Use for the termination of one or more fiber cables terminating on open EIA racks and in enclosures with EIA racks.
        2) Fiber patch panels shall be provided as complete units including the housing, the connector panels, mounting hardware and the fiber connectors.

3) Patch panels shall be provided with hardware for standard 19-inch or 23-inch rack mounting, as required.
4) Capacity: As shown in the Contract Documents.
5) Manufacturers: The following or equal:
a) Corning Cable Systems, Connector Module Housing.
(1) Server Rack: CCH-04U.
(2) Master Radio Panel: CCH-02U.
(3) Connector Plates: CCH-CP12-91.

7. Server cabinets:
a. Manufacturers: The following or equal:
1) Hoffman Proline.
b. Properties:
1) Glass front door (lockable).
2) Perforated rear door (lockable).
3) Perforated top with 2 cable entries.
4) Fully welded frame.
5) 42U minimum.
6) Rack mount Fan tray.
7) PDU: UNIPOWER PDUAC1US-N and PDUAC1US-E, No Equal. Quantity as required by contract drawings.
8) Velcro cable wraps.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Provide duplex patch cords to connect the interface cards provided with the associated patch panels.

B. Furnish accessories as specified in Section 17730 - Control Systems: SCADA Computer Equipment.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide installation and configuration for the new and existing managed Ethernet switches. Provide configuration of the Ethernet switch network for a complete, functioning plant control system as indicated on the Drawings and as specified herein:
   1. Refer to SCADA block diagrams for all new network connections.
   2. All PLC peer to peer communications, remote I/O and the SCADA OIT network shall be over a 100 Mbps network.
   3. Provide configuration for all managed Ethernet switches, additional Plant PLC communication cards and separate managed Ethernet switches as required, such that there is isolation of the following networks:
      a. Field and PLC I/O network: This includes the connections between the Plant PLC and:
         1) Plant PLC expansion racks.
         2) Plant PLC remote I/O (RIO) racks.
         3) Field Networks.
         4) HMI(s) part of a Plant PLC.
         5) Vendor furnished Ethernet network components.
      b. Valve Actuator network: This includes the connections between the Plant PLC and the valve master stations.
      c. PLC network: This includes the connections between the Plant PLC and other Plant PLCs.
      d. SCADA network: This includes the connections between the various SCADA equipment including but not limited to servers, workstations, and printers.
      e. Radio Network.
      f. In-Transit Network. This includes connections to the redundant Firewalls.

C. All racks shall be level and plumb.

D. Install Velcro wrap on all cable bundles within the network rack/enclosure.

E. All cables and equipment shall be installed in strict conformance with the manufacturer's recommendations:
   1. Cables shall be installed avoiding sharp bends.
   2. Install cable using lubricant designed for cable pulling.
   3. Cable ties or other cable supports shall be installed without crimping the LAN cables.
   4. Install LAN cables without splices.
   5. Installed bend radii shall not exceed 4 times the cable diameter.
   6. Terminated all pairs at the jack and the patch panel.

F. Install cables a minimum of 40 inches away from electrical motors and transformers.

G. Install cables a minimum of 12 inches away from fluorescent lighting.

H. Individual pairs will be untwisted less than 1/2 inch at termination points.

I. All cables and terminations shall be labeled with cable designations as specified in Section 16075 - Electrical Identification.

J. Each data port shall be individually labeled with its patch panel/switch port ID:
   1. Labeling must be printed - no handwritten labels will be allowed.

K. At the completion of the wiring installation, provide the following documentation:
   1. A plan-view of the premise(s) showing the jack numbering scheme.
   2. A printed certification report for the entire wiring installation showing compliance with all EIA/TIA specifications for data cable.
   3. Reports such as those generated by Fluke DSP cable certification equipment meet this requirement.
   4. Each device with a unique IP address shall be individually labeled with its IP address. The labeling must be printed; handwritten labels will not be allowed.

L. Managed Ethernet switches:
   1. Configure switches to prevent broadcast storms.
   2. Installations utilizing Rockwell PLCs and multicast messaging shall employ IGMP snooping.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING

A. Perform all firmware installations, configuration and other set up, as required, to place the network into proper operation.

3.09 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. After completion of the cable system tests and before placing the system in operation, power up all devices installed on the LAN and verify communication between the devices.

C. Verify that all equipment is operable on the network simultaneously. Confirm that all network device communications settings are properly configured.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17750

CONTROL SYSTEMS: WIRELESS COMMUNICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Radio communication system.

B. Perform an in-field radio frequency survey.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definitions:
   1. CPM: Critical path method.
   2. EIRP: Effective isotropically-radiated power.
   3. Fade margin: This is the amount of margin left to allow for the natural variations in radio performance, which will occur due to weather, air density, etc.
   4. FCC: Federal Communications Commission.
   5. ITS: Institute for Telecommunications Science.
   6. RF: Radio frequency.
   7. SIM: Subscriber identity module.

1.04 SYSTEM DESCRIPTION

A. The radio communication system will serve the following sites as required:
   1. Master Station(s).
   2. Remote Site(s).
   3. Repeater Site(s).

B. The existing system must remain operational while the RTU replacement is underway. A separate Radio Frequency (Licensed Radio Frequency Range) acquired through FCC STA (Special Temporary Authority) should be used to program the old radio system with this temporary frequency and then bring the new radios online one by one with the assigned frequency as per contract documents. Final radio replacement plan will be developed during the three mandatory Radio coordination meetings.

C. Performance requirements:
   1. The following are the radio path requirements for the in-field radio frequency survey:
      a. Minimum fade margin: 15 dB.
      b. No obstructions within the first 1/2 Fresnel Zone.
   2. Operational mode of the radio system:
      a. Bi-directional:
         1) With Ethernet interface.
   3. Radio communication system shall utilize licensed RF technology.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Prepare and submit an agenda for 3 mandatory coordination meetings.
   1. First meeting held within 30 days of the contract award:
      a. The purpose of the meeting is:
         1) For the Contractor to summarize their understanding of the Project.
         2) Discuss any proposed alternatives.
         3) Schedule access to Owner sites.
         4) Schedule the remaining 2 coordination meetings.
         5) Request any additional information required from the Owner.
   2. Second meeting held before performing the RF site survey.
      a. The purpose of the meeting is:
         1) To review the preliminary design and plan the site surveys.
         2) Select the hardware to be used during the on-site RF measurements.
   3. Third meeting held after the final RF survey report has been completed:
      a. The purpose of this meeting is:
         1) For the Contractor to present the findings of the RF survey to the Owner.
         2) To discuss the content of the report in a line-by-line manner.
         3) Outline the recommended and optimal configuration for the Owner's telemetry system architecture.

C. Submittal for telemetry system in-field radio frequency survey:
   1. Initial submittal:
      a. This has to be submitted and approved before the first coordination meeting. Submit the following for review and approval:
         1) Credentials of the firm subcontracted to perform the radio survey.
         2) Project CPM schedule.
         3) Submit a description of testing methods.
         4) Example data forms to be used during the site testing.
   2. Preliminary design submittal:
      a. For all the sites, prepare an RF path report as described below:
         1) Provide a topographic overview of the paths analyzed as part of the radio path study:
            a) Include on the overview:
               (1) Locations of all airports and airstrips located within 2,000 meters of any proposed radio site.
               (2) Provide topographical plan and profile drawings for each path.

2) Provide RF path calculations including the following information:
   a) Coordinates of each site in longitude and latitude.
   b) Distance between sites.
   c) Elevation of each site.
   d) Direction of path (degrees from north).
   e) Calculated up tilt/down tilt angles for proposed antenna mountings.
   f) Calculated free space losses.
   g) Estimated received signal: (Max EIRP in dBm - Free Space Losses - Coaxial Cable Transmission Loss +6 dB for the Receive Antenna Gain).
   h) Calculated fade margin: (Signal Strength +80 dBm).
3) Provide a computerized path analysis study for each path in the radio system. Computer software used in the study shall be based on the ITS Irregular Terrain Model and approved by the Engineer. The calculations shall be performed using the proposed antenna mounting sites and submitted radio system equipment.
4) Provide an intermodulation study for each site at the frequencies proposed and all nearby RF sources.
5) Proposed repeater sites, antenna gain improvements, antenna height mounting adjustments, or other modifications for extending all paths with insufficient fade margin for reliable operation:
   a) Provide path calculations for the revised radio paths.
6) Provide a summary of findings and recommendations for further work.

b. Submit the initial report before the second meeting described in the Submittals article under “Prepare and Submit an Agenda for 3 Mandatory Coordination Meetings". Update the initial report subsequent to on-site investigations and final design recommendations.

3. Path verification submittal:
   a. Upon completion of the RF survey, submit a final report to the Owner for review a minimum of 30 days before the third coordination meeting as specified in the Submittals article under “Prepare and Submit an Agenda for 3 Mandatory Coordination Meetings.” Summarize the RF survey results and include the following:
      1) Field data captured.
      2) Recommended antenna and repeater/receiver sites.
      3) Recommended antenna heights and types.
      4) Summary of findings and recommendations.
   b. If upon review of the RF Survey report the Owner determines that the information is insufficient or incomplete in any way, perform all necessary actions to complete the report.

D. Submit calculations to verify that mounting will withstand wind-loading criteria:
   1. Antenna mounting structures shall comply with EIA Standard 222 as well as Florida Building Code.

1.06 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. ICSC as defined in specification section 17050 must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.

C. Procedure for verifying the communications between sites shall be as follows:
   1. Perform radio path calculation study to verify the theoretical performance of the proposed paths.
   2. Field verify the radio paths using field measurement prior to installation.

D. After installation, verify through the use of field collected data, that the installed equipment conforms to reliability benchmark developed as part of the field testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Furnish all parts, materials, fluids, etc., necessary for maintenance and calibration purposes for 1 year:
   1. Deliver all supplies before Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wireless radio communication system:

1. Microwave Data Systems (MDS):
    a. MDS Orbit Platform, No Equal.
    b. Master Radio Station (Licensed): MDSMPRL4ERDNA1S2G33FULNN:
        1) GE MDS Master Station.
        2) LN4 406.1 - 470 MHz.
        3) Redundant.
        4) Simplex or Switched Carrier.
        5) Combined RX/TX.
        6) GPS.
        7) 110VAC.
        8) TNC Radio Ports.
    c. Remote Station (Licensed): MDSECRL4ENNNNNS1S1USUNNN:
        1) GE MDS Orbit ECR.
        2) Licensed Narrowband 406.1 - 470 MHz.
        3) Standard Flat Mount.
        4) TNC Radio Port.
    d. Unlicensed Spread Spectrum Radios:
        1) GE MDS Orbit ECR.
        2) 902 - 928 MHz Spread Spectrum.
        3) Standard Flat Mount.
        4) TNC Radio Port.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Licensed and unlicensed radio system:
    1. General:
        a. The radio system comprises the following:
            1) Wireless radio(s).
            2) Antennas.
            3) Surge protectors.
            4) Radio Signal Amplifier.
            5) Transmission cables.
            6) Software and other accessories as specified in the Components article.
        b. Performance requirements:
            1) Frequency: 406.1-470 MHz (Licensed), 902 - 928 MHz (Unlicensed).
            2) Operating temperature range: -40 to 158 degrees Fahrenheit.
            3) Storage Temperature range: -40 to 185 degrees Fahrenheit.
            4) Humidity: 95% at 140 degrees Fahrenheit non-condensing.
            5) Enclosure protection class: IEC IP20.
            6) Case: Rugged die-cast aluminum.
        c. Bi-directional (2-way) system:
            1) Transceiver:
                a) Carrier power: 0.1 to 10 W (Licensed, Site is Licensed up to 25W), 0.1-1W (Unlicensed) programmable.
                b) I/O interface:
                    (1) Ethernet 10/100 MB RJ-45 port.
                    (2) Serial Port.

c) Duty cycle: Continuous.
d) Power supply: 10.5 - 30 VDC.

2. Antennas:
   a. General:
      1) Wind Rating: 175 MPH.
      2) N-Type Connector.
   b. Manufacturers: One of the following or equal:
      1) Telewave, Inc., ANT Series.
      2) Kathrein Scala.
      3) Andrews.
      4) Microwave Data Systems, Clearwave 97-3194A Series.
      5) Phoenix Contact, Interface Wireless RAD-ISM Series.
   c. Antenna characteristics:
      1) Yagi antenna:
         a) Frequency range: 406.1-470 MHz (Licensed). 902 - 928 MHz (Unlicensed).
         b) Nominal impedance: 50 ohm.
         c) Connector: N-Type.
         d) Gain: As specified in the Examination article.
         e) Construction material: All welded aluminum.
         f) Operating temperature:
            (1) Stationary: -40 to 85 degrees Celsius.
            (2) Cyclic: -40 to 55 degrees Celsius.
      2) Master Radio Antenna (Licensed Radio):
         a) Frequency range: 406 - 512 MHz.
         b) Nominal impedance: 50 ohm.
         c) Connection: N-type.
         d) Gain: As specified in the Examination article. Provide a minimum of 10 -12 dBd.
         e) Construction material: All welded aluminum.
         f) Operating temperature: -40 to 75 degrees Celsius.
         g) Dipole Array.
      3) Omni-directional antenna characteristics(Unlicensed Radios):
         a) Frequency range: 902 - 928 MHz.
         b) Nominal impedance: 50 ohm.
         c) Connection: N-type.
         d) Gain: As specified in the Examination article.
         e) Construction material: All welded aluminum.
         f) Operating temperature: -40 to 75 degrees Celsius.
   d. Mounting accessories:
      1) Provide all required mounting accessories required for pole mounting, such as clamps, brackets adapters, and related hardware for a complete installation.
      2) Install Andrew Connector Weatherproofing Kit #221213 and Tape #3M1700 for all coaxial connectors.
      3) Provide mounting hardware to meet the wind and seismic requirements at the Project Site as specified in Section 16050 - Common Work Results for Electrical.
   e. Antenna structures:
      1) Antenna towers:
         a) Manufacturers: The following or equal:
            (1) Universal Manufacturing Corp.

(2) Rohn.
b) Freestanding, non-guyed.
c) Provide concrete foundation for antenna base as recommended by tower manufacturer.
d) Provide with manufacturer's recommended and supplied base and base mounting kit.
e) Suitable base for use with a concrete foundation.
f) Install with base pivot to allow installation and maintenance of antennas at ground level with no need for personnel to climb the tower.
g) Construction material: Aluminum, Galvanized Steel.

3. Surge protector:
   a. Manufacturers: One of the following or equal:
      1) Andrews:
         a) T Series Surge Arrestors.
         b) Gas Tube Surge Arrestors.
      2) Phoenix Contact, Trabtech Series.
4. Radio Signal Amplifier:
   a. Manufacturer: One of the following or equal:
      1) TPL Communications RXR Series:
         a) PA6-1DE (For Licensed Radio).
5. Transmission cables:
   a. Manufacturers: One of the following or equal:
      1) Andrews:
         a) HELIAX Cable Products.
      2) Phoenix Contact, Interface Wireless.
   b. 1/2-inch, nominal diameter (Unlicensed Radios). 1-1/4-inch, nominal diameter (Licensed Radios).
   c. Continuous section without splices or connectors other than at the radio and antenna.
   d. Cable characteristics:
      1) Attenuation: Less than 2.2 dB at 960 MHz per 100 feet (Unlicensed Radios). Less than 0.558 dB at 450 MHz per 100 feet (Licensed Radios).
      2) Characteristic impedance: 50 ohms.
      3) Coaxial shield.
      4) Dielectric: Foam PE.
6. Software:
   a. Provide software package for radio diagnostic testing.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Radio path survey:
   1. Contractor to conduct a radio path survey for determining feasibility of radio communication in the corresponding sites using licensed or license free radios.
   2. The following are the requirements for each site to perform the radio path survey:
      a. Site co-ordinates: Latitude and longitude.
      b. Radio:
         1) Manufacturer.
         2) Transmitting power.
         3) EIRP.
         4) Receiver sensitivity.
      c. Antenna:
         1) Manufacturer.
         2) Gain.
         3) Height.
      d. Antenna cable:
         1) Manufacturer.
         2) Transmission line loss.
   3. The survey shall consist of the following activities:
      a. A path study at the sites under consideration.
      b. Survey of geographical and physical relationships of the paths. Obstructions and interference, both physical and electromagnetic, line of sight availability and radio range shall be identified in the survey. Provide digital photographs for each site at each of 8 compass points.
      c. Include bit-error-rate and signal to noise ratios for each site in the final report.
      d. Based on final equipment selection and path recommendations, recalculate the fade margins for the final path design.
      e. Provide an estimate of the probability of the proposed radio path communicating with the master station in terms of a percentage.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION (NOT USED)

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING

A. Orient directional antennas as required for maximum receive strength signal intensity (RSSI) during startup.

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17762

CONTROL SYSTEMS: SCADA SOFTWARE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. SCADA system software to be used for application software development and real time operation of the SCADA system.

B. General requirements:
   1. ICSC as defined in specification section 17050 - Common Work Results for Process Control and Instrumentation Systems must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.
   2. Software provided under this Contract represents a complete and operating control software system. Achieve the functionality specified in this and other sections through a combination of standard control system software and application software developed specifically for this Project.
   3. The standard control software listed in this Section does not represent a comprehensive list of software necessary to implement the functional requirements of the Contract Documents. Provide all necessary supplemental drivers, utility software, and application software, as required, to meet the functional requirements of the Contract Documents.
   4. Applications software requirements are described in Section 17100 - Control Strategies.
   5. License all software for proper operation as described in the Contract Documents.
   6. License all software provided under this Contract to the Owner.

C. Provide copies of all software on CD, or equivalent media.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SYSTEM DESCRIPTION

A. SCADA system node descriptors:
   1. SCADA client workstation: Client workstations shall be provided with all graphic display and related software for interacting with the SCADA system

data. SCADA client's displays shall operate on data maintained by the SCADA server. Display capabilities shall include, but not be limited to:
   a. Process mimic displays.
   b. Real time and historical trend displays.
   c. Alarm summary and sub-summary displays.
   d. System utilities.
2. Citect Anywhere server: Provide Citect Anywhere server with the required software and licenses to deploy instances of SCADA client workstation to Citect Anywhere clients.
3. SCADA development node/ Workstation # 4: Provide Remote Desktop connection to Virtualized servers and provide the SCADA system development node with software and licenses required to edit the PLC programs and configuration files as part of the system application development. Unless otherwise indicated, the development node shall be complete with run time software for fully testing the application programs. Functions required at the development node include:
   a. Edit the SCADA database.
   b. Monitor and Program Wireless Radios.
   c. Edit graphic displays.
   d. Modify alarm files.
   e. Modify PLC programs.
   f. Modify programs and scripts executing at any of the workstations.
   g. Set up trends and historical displays.
   h. Edit user authorizations.
   i. Run SCADA Client software.
   j. Other functions as may be required to modify the SCADA system application software.
4. SCADA server: Provide server nodes with software and licenses as needed to communicate with the PLCs and other data providers and maintain a real time database of system values. Unless otherwise indicated, server nodes shall be equipped with client software for the viewing of the real time data. The SCADA server will include input/output drivers for interfacing with field devices, and buffer historical data, and provide data for the historian node(s). SCADA servers will maintain 5 years of local historical data. Provide redundant SCADA servers complete with software required for synchronization and auto-fail over. SCADA server will connect to both SCADA and PLC networks.
5. Historian server: The historian server collects real time/historical data from the active SCADA server and compresses the values into historical records for trending and reporting. Unless otherwise indicated, the historian server shall archive data provided by the SCADA server. The server shall be provided with software and licensing for interfacing with standard report software packages via MS-SQL, ODBC and other standard interfaces as described in this Section. Provide and configure Citect Wonderware Historian Connector on redundant CitectSCADA servers for connector redundancy.
6. VmWare VCenter Server Essentials: The VCenter Server monitors, configures, and deploys Virtual machines on Nutanix Platform.
7. Report Server: The Report server collects data from the Historian server, creates required reports at desired intervals, acts as a central store for these reports and prints the reports automatically if required.
8. Alarm node: Each client workstation is equipped with an alarm window on the operator display with local annunciation. Where a separate alarm node has

been indicated, this node shall handle the interface to telephone, paging and radio alarming systems.

B. General:
1. The Contractor shall provide SCADA and all other software, as required for a complete and functional SCADA system as indicated on the Drawings and as specified in this Section:
a. Provide, at a minimum, software on the system nodes as follows:
1) Refer to drawing 03N01 - SCADA Architecture for software and licensing requirements for VMWare and SCADA Server software.
b. Workstations:
1) Workstations (1, 2, 3, 5, 6, OIT 1, OIT 2 and OIT 3):
a) Citect SCADA 2016 (Client).
b) Microsoft Office Professional 2016.
c) Wonderware Historian Client.
d) Sytech XLReporter Client.
2) Workstation No. 4:
a) Citect SCADA 2016 (Client).
b) Microsoft Office Professional 2016.
c) Wonderware Historian Client.
d) Sytech XLReporter Client.
e) MDS Radio Configuration Software.
f) Studio 5000 Logix Designer Professional.
g) Rockwell, FactoryTalk View Studio ME.
3) Programming Laptop:
a) MDS Radio Configuration Software.
b) Studio 5000 Logix Designer Professional.
c) Rockwell, FactoryTalk View Studio ME.
c. System configuration:
1) The system consists of a primary and backup data servers configured for hot failover operation. Server nodes shall be equipped with I/O drivers for communicating with networked PLCs.
2) Client machines obtain real time data from the I/O servers. The client machines shall monitor the status of the servers and re-establish data connections with a new server in case the primary server fails.
3) Historian Server collects data from the I/O servers and provides historical data to SCADA Clients and Reporting software. HSQ Historical data will be retained by exporting it to a SQL database and then importing it in Wonderware Historian. This HSQ imported data will then be made available on SCADA for trending.
4) Report Server connects to the Historian Server, creates on-demand and periodic reports and prints these reports automatically.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Remote alarm database:
1. After development of the SCADA system database but before system start-up, provide a list of points configured for alarming and submit to the Owner and the Engineer. The Owner/Engineer will identify critical alarms for use in the

extended alarming system (e.g. dialer system, paging) and provide response descriptions.

C. Alarm descriptions shall be of sufficient detail for an accurate review by the Owner.

D. After all shop drawings submittals required herein have been favorably reviewed by the Engineer, the Programmer shall submit the following items, which must also be favorably reviewed and implemented prior to the start of system testing, the entire control system including all required software packages must be operational prior to the required factory acceptance test:
   1. All operator interface display submittals shall be in full color as they will appear on the display screen:
      a. This submittal shall be prepared after the requisite graphics meetings.
      b. The submittal shall include:
         1) Graphic displays.
            a) Provide, a minimum of following Displays:
               (1) Plant Overview.
               (2) Reservoir Tainter Gates.
               (3) Raw Water Station # 1.
               (4) Raw Water Station # 2.
               (5) East County Wellfield.
               (6) Degasifiers.
               (7) Plant Process.
               (8) "A" Basin Flocculation.
               (9) Sedimentation "A".
               (10) Filter # 1.
               (11) Filter # 2.
               (12) Filter # 3.
               (13) Filter # 4.
               (14) Filter # 5.
               (15) Filter # 6.
               (16) "B" Basin Flocculation.
               (17) Sedimentation "B".
               (18) Filter # 7.
               (19) Filter # 8.
               (20) Filter # 9.
               (21) Filter # 10.
               (22) Filter # 11.
               (23) Filter # 12.
               (24) "C" Basin Flocculation.
               (25) Sedimentation C-1.
               (26) Sedimentation C-2.
               (27) Pump Runtimes.
               (28) Filter # 13.
               (29) Filter # 14.
               (30) Filter # 15.
               (31) Filter # 16.
               (32) Filter # 17.
               (33) Filter # 18.
               (34) Blend Chamber.
               (35) Clearwell "A".
               (36) Clearwell "B".

(37) Clearwell "C".
(38) W.T.P. Ground Storage Tanks.
(39) Backwash And Sludge Return Pumps.
(40) A & B Lime Feeder.
(41) C Basin Lime Feeder.
(42) Ammonia System.
(43) Sodium Hypochlorite System.
(44) Alum System.
(45) Fluoride System.
(46) Polymer System.
(47) Phosphate System.
(48) System Flows And Pressures.
(49) W.T.P. Elevated Tank.
(50) North County Flow.
(51) Elwood Park # 1.
(52) Elwood Park Booster Station # 2.
(53) Hospital Booster Station.
(54) Cortez Booster Station.
(55) Sarasota Meter Station.
(56) 59th Street Elevated Tank.
(57) North West Elevated Tank.
(58) Palmetto Elevated Tank.
(59) North County Elevated Tank.
(60) Port Manatee Elevated Tank.
(61) Water Levels.
(62) Local Well Monitoring.
(63) Rye Bridge Conductivity.
(64) Filter Effluent Totals.
(65) Wtp Electrical.
(66) Filter Status.
(67) Midnight Totals 2.
(68) Midnight Totals.
(69) Distribution Map.
(70) Rain Gauges 0-5.25.
(71) Rain Gauges 0-10.5".
(72) Rain Gauges 0-21".
(73) Watershed.
(74) Process Costs.
(75) Carbon System.
(76) Longboat Key Meter Station.
(77) Process Costs # 2.
(78) AB Filters Status Chart.
(79) Master Slide.
(80) Aquifer Storage/Recovery Well 1 Overview.
(81) Aquifer Storage/Recovery Wells 1-6 Overview.
(82) C Filters Status Chart.
(83) ASR Well B-1.
(84) ASR Well B-2.
(85) ASR Well B-3.
(86) ASR Well B-4.
(87) ASR Well B-5.
(88) ASR Well B-6.

(89) Aquifer Recharge Mode.
(90) Aquifer Recovery Mode.
(91) Aquifer Static.
(92) Aquifer Blowoff Mode.
(93) Network Communications Status Display.
(94) Aquifer Storage Recovery Wellfield Valves.
(95) North West Ground Storage Tank.
(96) North West Pumping Data And Control.
(97) Process Operations Master.
(98) Pump Controls.
(99) Dosage Calculations.
(100) Log Help For Midnight Readings.
(101) Sludge Thickener.
(102) Sludge Thickener Alum Pumps.
(103) Sludge Thickener 2.
(104) Miscellaneous Items - Whole Plant Overview.
(105) Weather Station.
(106) BTU Overview.
(107) BTU Filter # 1.
(108) BTU Filter # 2.
(109) BTU Filter # 3.
(110) BTU Filter # 4.
(111) BTU Filter # 5.
(112) BTU Filter # 6.
(113) BTU Backwash Pump Station.
(114) BTU Blowers (For BTU BW Air Scour).
(115) BTU Filters Setpoints.
(116) BTU Flow Totals/ Setpoints.
(117) BTU Filter 1 BW Sequence.
(118) BTU Filter 2 BW Sequence.
(119) BTU Filter 3 BW Sequence.
(120) BTU Filter 4 BW Sequence.
(121) BTU Filter 5 BW Sequence.
(122) BTU Filter 6 BW Sequence.
(123) BTU Equalization (EQ) Tanks.
(124) BTU PLC Panel Status.
(125) Sludge Units.
(126) Sludge Units Schedules.
(127) East County Well Field.
(128) SCADA Page Directory.
(129) WTP Ground Storage Tanks.
(130) Distribution Map # 1, Flows, Pressures.
(131) Distribution Map # 2, Flows, Pressures.
(132) Sodium Hypochlorite - Remote Mode Control.
(133) Sodium Hypochlorite – Bleach Uses Throughout The Plant, 1.
(134) Sodium Hypochlorite - Bleach Uses Throughout The Plant, 2.
(135) Bradenton Area Map - Main Roads.
(136) Distribution System Map.
(137) Sedimentation A C1.
(138) Sedimentation Basin C2.

b) All sludge thickener displays (mimic local HMI displays).
c) A & B lime feeder: lime slaker # 1 - South and lime slaker # 2 - North (mimic local hmi displays).
d) C lime feeder: lime slaker C1 - South and lime slaker C2 - North (mimic local HMI displays).

1) Trend displays.
2) Alpha numeric displays.
3) Alarm displays.
4) Network, PLC and Device monitoring displays.
5) Report displays.

2. Each display shall be uniquely titled:
   a. Locations for process data shall be clearly identified either through the use of simulated data or by showing variables on the displays and providing a reference list describing those variables.
   b. All dynamic points shall be identified by tag number as a minimum and their operation shall be described on separate sheets:
      1) Color change.
      2) Symbol change.
   c. Three sets of submittals, with screen prints in color on a white background, are required for review by the Owner and Engineer.
   d. One set will be returned with comments.
3. All periodic and custom reports for the entire control system:
   a. Locations for process data shall be clearly identified, either through the use of simulated data or by showing variables on the report and providing a reference list describing those variables.
   b. Three sets of reports shall be submitted for review by the Engineer.
   c. One set will be returned with comments.
   d. Provide, a minimum of following Reports (Daily, Weekly, Monthly and Yearly):
      1) Filter Logs Reports, Dep Required Data.
      2) Alarm Logs Reports.
      3) Compliance Data, Dep Reports.
      4) Chemical Usage/ Costs.
      5) Flow Summary Reports.
      6) Equipment Run Hours Reports.
      7) Disinfection Monitoring Reports.
      8) Electrical Usage Reports.
      9) Plant Ph, Flows and Residual trend Reports.
      10) Up to 10 more reports as discussed and agreed upon during first and second Report Review Meetings.

E. Pre-acceptance test documentation as specified in the Sequencing article of this Section.

F. Review meeting minutes submittals:
   1. Graphics review meeting:
      a. Minutes of Graphic Review Meeting No. 1.
      b. Minutes of Graphic Review Meeting No. 2.
   2. Report review meeting:
      a. Minutes of Report Review Meeting No. 1.
      b. Minutes of Report Review Meeting No. 2.

3. Alarm review meeting:
    a. Minutes of Alarm Review Meeting No. 1.
    b. Minutes of Alarm Review Meeting No. 2.

1.06 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. The manufacturer must have a formal and documented set of quality assurance procedures that are applied to the engineering design, development, and documentation of the software:
    1. The presence of a formal quality assurance department is required.

C. Software provided under this Section shall be included in the testing specified in Section 17950 - Testing, Calibration, and Commissioning.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING

A. The following items shall be submitted with the final sets of technical manuals required as specified in the Submittals article of this Section, 15 working days before the pre-commissioning test as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems:
    1. All program manuals supplied by the manufacturers with the standard software packages.
    2. All original program disks supplied by the manufacturers with the standard software packages, including any program revisions or updates issued by the manufacturers during the construction period.
    3. All PLC program and operator interface application program files stored on labeled disks:
        a. The PLC program and operator interface application program file disks shall also be updated as required if any changes or corrections are required in this programming before Project completion.

B. Operator interface graphics generation:
    1. The Programmer through the Contractor shall schedule the operator interface graphics meetings.
    2. Topics shall include graphics for:
        a. HMI graphics.
        b. Data acquisition and graphics display system.
        c. SCADA security.
    3. The Owner and Engineer shall attend these meetings.

4. Graphics Meeting No. 1: Held in conjunction with the Preliminary Meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems:
    a. The Programmer shall chair and develop an agenda 3 weeks in advance of the meeting, which shall address the basic criteria to be adhered to in the configuration and development of graphic displays:
        1) At this meeting, the Programmer shall distribute sample display formats for illustration purposes.
        2) As a minimum, this meeting shall address the following issues:
            a) All in plant and remote site areas and conventions for identifying tag names and descriptors.
            b) Designation of groups within each plant area along with tag names and descriptors.
            c) The assignment of individual control loops and inputs to specific groups.
            d) Organization of the systems universal display hierarchy.
            e) Paging schemes to be used to enable the movement from one display to another.
            f) An itemization of the type of display to be used at each level in the graphic hierarchy, i.e., pre-formatted displays, templates, custom graphics, etc.
            g) Color convention to be employed on all graphics for the annotation of various status information, differentiation between alarms based on alarm priority, background colors, static field colors and dynamic field colors.
            h) The utilization of blinking and conditional text.
            i) Definition of graphic symbolism to be used on the Project. This listing shall include but not be limited to symbols to be used for process instrumentation, process equipment, piping, vessels and valves:
                (1) All symbolism must be specific as opposed to generic in that shapes must define both function and type, i.e., specific symbols for each valve design, each pump design, each type of flowmeter, etc.
                (2) If the Programmer's library of shapes does not adequately describe plant or field conditions, the Programmer shall develop additional shapes to meet the plant or field requirements.
                (3) Shapes and symbols used on the P&IDs shall be used as a guideline.
            j) Definition of all display select commands that enable the operator to move within the display hierarchy.
            k) The utilization of cursor movement commands which enable the operator to move within a display.
            l) Definition of control input commands which enable the operator to interact with face plates control stations and custom graphic displays to implement control functions.
            m) Definition of data input commands which enable the operator to enter numeric values into the control system.
            n) Definition of the utilization of "poke" points or fields that are dynamically sensitive to operator inputs to facilitate operator entry directly into graphic displays.

o) A review of graphic generation procedures.
p) Define SCADA security groups for Domain controller.
(1) As a minimum these security groups will be created on the Domain controller for the SCADA system:
(a) Supervisor.
(b) Operator.
(c) Engineer.
(d) Contractor.
(e) Management.
(f) ITS.
(2) Users will be assigned to these security groups and SCADA system will be configured with areas for proper access to plant control screens and pop-ups and SCADA system configuration.

b. Subsequent to the adjournment of Graphics Meeting No. 1, the Programmer shall prepare and formalize a document titled "Graphics Criteria" which shall contain detailed meeting minutes and a definition of all graphic guidelines to be adhered to:
1) This report shall be supplemented by graphic examples which illustrate the incorporation and application of each graphic criteria.
2) The report shall be submitted within 30 calendar days of the meeting's adjournment.

5. Graphics Meeting No. 2: Held in conjunction with the intermediate review meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems:
a. Subsequent to the finalization of the overall system-wide graphics criteria, the Programmer shall develop graphic packages for the entire operator interfaces being furnished under this Project.
b. At this meeting the Programmer shall submit 5 copies including:
1) A review of the graphic package developed for the process areas for content and completeness.
2) A review of all data fields that display automatically updated process information.
3) A review of all required input commands associated with the graphic access and control manipulation.
c. Subsequent to the adjournment of Graphics Meeting No. 2, the ICSC shall prepare a formalized submittal of the graphic package for review along with the detailed meeting minutes:
1) The report shall be submitted within 30 calendar days of the meeting adjournment.
6. 10 additional displays shall be configured on-line during the pre-commissioning test period.

C. Report generation:
1. The Programmer through the Contractor shall schedule the report generation meetings.
2. The Owner and Engineer shall attend these meetings.

3. Reports Meeting No. 1: Held in conjunction with the preliminary meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems:
    a. The Programmer shall chair and develop an agenda 3 weeks in advance for a meeting, which shall address the basic criteria to be adhered to in the configuration and development of the reports:
        1) At this meeting, the Programmer shall distribute sample formats for illustration purposes.
        2) As a minimum, this meeting shall address the following issues:
            a) All in plant and remote site data and conventions for identifying tag names and descriptors.
            b) Designation of groups within each plant area along with tag names and descriptors.
            c) The assignment of inputs to specific categories.
            d) Organization of the systems universal report categories.
            e) An itemization of the type of report available.
            f) Definition of terms to be used on the reports.
            g) Definition of all report commands that enable the operator to move within the report editor.
            h) The utilization of cursor movement commands which enable the operator to move within a report.
            i) Definition of data input commands which enable the operator to enter numeric values into the system.
            j) A review of report generation procedures.
        3) Subsequent to the adjournment of the Report Meeting No. 1, the Programmer shall prepare and formalize a document titled "Report Criteria" which shall contain detailed meeting minutes and a definition of all report guidelines to be adhered to:
            a) This report shall be supplemented by report examples.
            b) The report shall be submitted within 30 calendar days of the meeting's adjournment.
4. Reports Meeting No. 2: Held in conjunction with the intermediate review meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems:
    a. Subsequent to the finalization of the overall report format criteria, the Programmer shall develop report packages for review.
    b. At this meeting the Programmer shall submit 5 copies including:
        1) A review of the report package developed for the process area(s) for content and completeness.
        2) A review of all data fields for process information.
        3) A review of all required input commands associated with the report access and control manipulation.
    c. Subsequent to the adjournment of Report Meeting No. 2, the Programmer shall prepare a formalized submittal of the report package for review along with the detailed meeting minutes:
        1) The report shall be submitted within 30 calendar days of the meetings adjournment.
5. 10 additional reports shall be configured on-line during the pre-commissioning test period.

D. Alarming priority:
    1. The Programmer through the Contractor shall schedule the alarming priority meetings.
    2. The Owner and Engineer shall attend these meetings.
    3. Alarming Priority Meeting No. 1: Held in conjunction with the preliminary meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems:
        a. The Programmer shall chair and develop an agenda 3 weeks in advance for a meeting, which shall address the basic criteria to be adhered to in the prioritization of alarms:
            1) At this meeting, the Programmer shall distribute a listing of all plant alarms identified by tag names and descriptors.
            2) As a minimum, this meeting shall address the following issues:
                a) Criteria for prioritizing alarms including alarming priority levels. (i.e., Priority 3 - alarm at SCADA; Priority 2 – alarm at SCADA and autodialer; Priority 1 – alarm at SCADA, autodialer, and plant shutdown.)
                b) Alarm display banner basic criteria.
            3) Subsequent to the adjournment of the Alarming Priority Meeting No. 1, the Programmer shall prepare and formalize a document titled "Alarm Criteria" which shall contain detailed meeting minutes and a definition of all alarming guidelines to be adhered to:
                a) The report shall be submitted within 30 calendar days of the meeting's adjournment.
    4. Alarming Priority Meeting No. 2: Held in conjunction with the intermediate review meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems:
        a. Subsequent to the finalization of the overall alarm criteria, the Programmer shall develop an alarming priority spreadsheet that will be populated at this meeting.
        b. At this meeting the Programmer shall provide a spreadsheet including:
            1) A listing of all plant alarms identified by tag names and descriptors.
            2) For each alarm listed include a location to enter the alarm priority assignment.
            3) For each alarm listed include a location to enter specific comments related to that alarm.
        c. Subsequent to the adjournment of Alarming Priority Meeting No. 2, the Programmer shall prepare a formalized submittal of the alarming priority spreadsheet for review along with the detailed meeting minutes:
            1) The spreadsheet and meeting minutes shall be submitted within 30 calendar days of the meetings adjournment.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE

A. Provide 3-year extended manufacturer's warranty as follows:
   1. Dedicated technical support department or handled by programming staff or distributor.
   2. Telephone support available 24 hours per day.
   3. Email and web support addresses.
   4. FTP download area.
   5. Knowledge base.
   6. Bulletin board service.
   7. Field service.

B. Provide system upgrades and maintenance fixes for a period of 2 years from Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Following, no equal (Refer to drawing 03N001 and 03N002 for Complete List):
   1. Schneider Electric's Citect SCADA 2016.
   2. Schneider Electric's Citect AnyWhere.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. General:
   1. Unless otherwise indicated, provide all run time and development software licensed for:
      a. 5,000 tags.
      b. Unlimited screens.
      c. No direct limits on the number of connections to a server machine.
      d. Provide the number of client licenses as indicated by the number of machines shown or specified, the addition of a new client shall not require an upgrade to the server license.
   2. Provide software and licenses as required to implement the system architecture and functionality as indicated on the Drawings.
   3. License/registered all software in the Owner's name.
   4. Turn all software installed on the workstation, over to the Owner with disks, keys and manuals.
   5. The system software specified as part of this Section support SCADA system functions including, but not limited to:
      a. Human machine interface (HMI) process graphics development and display.
      b. Real time point database development and display.
      c. Historical database generation, collection, and display.
      d. Alarming subsystem.

e. Trending and report subsystems.
f. Drivers and interfaces.

6. PLC programming software is specified in Section 17720 - Control Systems: Programmable Logic Controllers.

B. Operating system software:
1. Provide all workstations and servers with operating system software compatible with the software provided under this Section:
a. Client nodes: Windows 10 Professional.
b. Server nodes: Windows 2016 Standard. As required by server processor/ Nutanix Hardware defined in 17730. Include minimum 10 Client Access Licenses (CALs) plus any additional required CALs.
c. Provide Following Minimum Windows Server 2016 Licenses:
1) (1) One Windows 2016 standard (16 core) license.
2) (17) Seventeen Windows 2016 standard additional APOS (16 core) licenses.
3) (3) Three Windows 2016 standard additional APOS (4 core) licenses.
2. Provide all operating system software as a clean install. Create a standard VM image to deploy to Workstations. Where workstations have been loaded with OEM versions of software containing trial software or other advertisements, remove the OEM software and reinstall the operating system and all drivers from the original installation disks.
3. Provide all workstations with recovery disks.

C. SCADA HMI run time software:
1. Provide run time software and licenses for all control system workstations provided.
2. Include client licenses for I/O server machines.
3. License all software in the Owner’s name.

D. SCADA server software:
1. Provide software and licenses for a full SCADA system node including I/O drivers.
2. Provide drivers for all control system devices as indicated on the Drawings.
3. Configure historical data collectors to provide data for the historical database on all I/O servers.
4. License all software in the Owner’s name.

E. Development workstations:
1. For development workstations provide all software for the generation and modification of the graphic screens, SCADA system databases, access control files and supervisory control programs.
2. The development node contains all client software and licenses for use as an additional operator display.
3. License all software in the Owner’s name.

F. Historian server:
1. Provide the latest version of the Wonderware Historian software.
2. Use data collectors to buffer historical data in the event of a loss of communication with the history server.

3. Provide Microsoft SQL client access licenses for all nodes in the system plus an allowance for 50 percent expansion.

G. Licensing:
   1. Provide hardware/ software keys. Keys will utilize the USB form factor for hardware type keys. Licensing server should be setup for management and distribution of software keys.

H. Miscellaneous software:
   1. Provide the following support software for use on the SCADA system computers. Install all software on the appropriate system node. Provide all software CD/DVD media. License all software to the Owner:
      a. Provide a copy of Microsoft Office Professional Edition 2016 for each machine in the system, Workstation, Server or Laptop (Physical or Virtualized).
      b. Provide a copy of Sytech XLReporter Team Edition for the development of report templates and the event scheduling of automatically generated reports.
      c. Provide all nodes with virus protection software.

I. Domain controller:
   1. Provide Windows Server 2016 Standard software for the Domain Controller operating system configured for use as the SCADA system domain controller.
   2. Configure the backup Domain Controller on the second Virtual Machine Host.

J. Nutanix Platform Software:
   1. Refer to Nutanix Platform Hardware specification in specification 17730 - Control Systems: SCADA Computer Equipment for software requirements.

K. Virtual Machines:
   1. Refer to drawing 03N001 and 03N002 for a list of Virtual machines required

L. Virtual Machine Host Software:
   1. VmWare vSphere Essentials Plus Kit, Latest Version.
   2. VmWare VSphere Essentials Plus Kit, 3 Year Subscription.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Install all required software and driver Service Packs and updates. At the completion of the Project, and provide installation disk(s) containing all Service Packs and updates used on the Project to the Owner.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL

A. Test all software provided as part of this Section as part of the system tests specified in Section 17950 - Testing, Calibration, and Commissioning.

B. Provide training for 2 of the Owner’s staff in the use of the specified software packages.

C. Provide training by a factory-authorized vendor.

D. The Contractor shall cover the costs of tuition, training materials, and related fees, as well as, travel and subsistence expenses for the attendees.

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17765

CONTROL SYSTEMS: PROGRAMMING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. PLC and HMI Programming:
      a. Control system programming project execution plan.
      b. Project phasing.
      c. Work development methodology.
      d. PLC programming services.
      e. HMI/PCS programming services.
      f. Process control system programming.
      g. Process control logic development.
      h. Graphical operator interface development.
      i. Report development.
      j. Alarming priority development.
      k. Historical data management.
      l. Security coordination.
      m. QA/QC review.
      n. Testing.
      o. Post-construction services.
      p. Training.
      q. O&M manuals.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS (NOT USED)

1.06 QUALITY ASSURANCE

A. ICSC as defined in specification Section 17050 - Common Work Results for Process Control and Instrumentation Systems must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.

1.07 DELIVER, STORAGE AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY (NOT USED)

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Control system programming project execution plan (PXP):
   1. Programming PXP shall be reviewed and approved by the Owner.
   2. Contractor shall not begin programming activities until approval has been received by the Owner. Multiple submittals of the Programming PXP may be required. At a minimum, the Programming PXP shall include the following information:
      a. Programming Schedule:
         1) Programming Schedule shall be coordinated with the overall Construction Schedule and shall tie to key milestones.
      b. Programming team:
         1) Develop a programming team organizational chart including the names and contact information of individuals who will be acting in the roles of Principal, Project Manager, and lead HMI/PCS Programmer(s). Provide the chart to the staff when the programming efforts begin.
         2) Programming effort shall be structured such that, in general, 1 person assumes the primary responsibility for a particular task, with at least 1 other member of the team assigned to provide an overview and to maintain a good general understanding of what is happening, such that in the event of the primary person not being available to complete the task the other member will be knowledgeable enough to enable the work to proceed with no disruption to the schedule.

B. Project phasing:
    1. Several meetings and submittals are required to complete this project successfully.
        a. Due to the phasing of the work restrictions, meetings and submittals must be furnished for each phase and cover just the material for the current phase.
        b. Control System Programming Project Execution Plan schedule should be updated and submitted to the Owner for each phase. The requirements for the first phase will be longer in duration and in content.

C. Work development methodology:
    1. Standard specific and generic documentation and procedures are to be developed, including:
        a. Identifying Generic:
            1) Device Types.
            2) Attributes.
            3) Alarm Requirements.
            4) Documentation Check Sheets.
        b. User Defined Types (UDT).
        c. User Derived Function Blocks (UDFB).
        d. Generic Graphical Format.
        e. "Pop-up" Graphical Templates.
        f. Graphics Hierarchy and Navigation.
        g. Alarm Priorities and Groups.
        h. Generic Trending Requirements.
        i. Generic Historical Data Requirements.
        j. Generic Reporting Requirements.
        k. Test plans for each SCADA system.
        l. System Test Philosophy.
        m. Final Integrated Test Specification.

D. PLC programming services:
    1. PLC programming organizational structure:
        a. For each PLC, submit a PLC programming organizational structure outline to Owner, describing, at a minimum, the proposed code organization, code format (ladder logic, function blocks), and tag organization. Each routine, subroutine, and add-on instruction shall be named and described in the outline.
        b. PLC programming task shall not commence until the organizational structure is approved by Owner.
        c. Indirect addressing is prohibited from this project.
    2. Reusable PLC code blocks:
        a. New code blocks, AOIs (Add On Instruction) and UDTs, that the Contractor would like to use as a standard shall be submitted to Owner for review and approval. Excessive use of AOIs should be avoided.
    3. PLC Programming Development Workshops:
        a. Arrange, organize, and conduct a series of no less than 2 full-day workshops with Owner. These workshops will be for the purpose of demonstrating programming organization and tagging usage. Also, use the workshops to present new and modified code blocks for potential inclusion in Owner's standards. Coordination with County CMMS tagging schemes required for compliance with this project.

E. HMI/PCS programming services:
   1. General:
      a. HMI/PCS programming shall follow Owner's.
   2. Reusable HMI graphics:
      a. Develop and use new standard graphics where appropriate.
      b. New HMI graphics or modifications to existing graphics that the Contractor would like to use as a standard shall be submitted to Owner for review and approval.
   3. HMI graphics hierarchy and organizational structure:
      a. Submit a HMI graphics hierarchy and organizational structure outline to Owner, describing, at a minimum, the proposed overview screens, process screens, control screens, diagnostics screens, trends, alarms, and events. Each screen shall be named and described in the outline. The HMI/PCS programming task shall not commence until the organizational structure is approved by Owner.
   4. HMI Graphics Development Workshops:
      a. Arrange, organize, and conduct a series of no less than 2 full-day workshops with Owner. The workshops will be for the purpose of demonstrating graphics organization, navigation, animation, and control functions. Also, use the workshops to present new and modified HMI graphics for potential inclusion in Owner's standards.
   5. HMI graphics submittal:
      a. Submit all HMI screens and pop-ups for review and approval by Owner. Screens shall be submitted in color; 1 screen or pop-up per 8 1/2-inch by 11-inch sheet. All HMI screens shall be approved by Owner prior to the start of the Software Acceptance Test.

F. Process control system programming:
   1. General:
      a. The process control system shall be programmed to manage and control the process units and supporting systems common in traditional treatment. The plant shall be capable of full automatic operation to the extent that the process control system and related equipment permits.
   2. Process unit control features:
      a. The following control features shall be provided for applicable process units and equipment.
         1) Automatic and remote manual control.
         2) PID control for process units where automatic regulation of process variables such as flow, level, and pressure is required. Cascade or compound PID control shall be provided where the process dynamics dictate such as filter flow control and chemical feed applications.
         3) Automatic and manual duty and standby assignment rotation where multiple units of equipment exist in a process unit.
         4) Fail-to-operate detection and alarming for automatic and remote controlled equipment.
         5) Suppression of all equipment alarms when an associated train is taken out of service.
   3. Programming techniques:
      a. PLC program code shall be developed in modular, object-oriented units to facilitate management and further development of the process control system. Add-on instructions or routines shall be developed to permit program code to be applied across various process applications by

manipulation of input parameters. Excessive use of Add-on instructions should be avoided. AOIs should not be nested such that control logic is hard or impossible to read. Examples of applications where object-oriented program code shall be developed include, but are not limited to, the following:

1) Data management functions such as flow totalization, statistical, and equipment runtime data generation.
2) Network node data management and monitoring functions. Individual routines or add-on instructions shall be developed for each type of network node to facilitate the future addition of devices.
3) Recurring process control functions such as fail-to-operate detection.
4) Instrument calibration management.

4. Data management functions:
   a. Program logic shall be developed to generate the following types of process data:
      1) Flow totalization:
         a) Hourly totals on a daily basis.
         b) Current and previous day daily totals.
         c) Current and previous month monthly totals.
         d) Calibration totals for metering pump calibration verification.
      2) Process Variable Statistical Data:
         a) Hourly, daily, and monthly maximum, minimum, and average data with time stamps.
      3) Equipment runtime accumulation:
         a) Daily runtime accumulator for current and previous day.
         b) Resettable maintenance runtime accumulator.
         c) Non-resettable total runtime accumulator.
5. System management functions:
   a. PLC System Diagnostic Monitoring: Monitor and report diagnostic data for each PLC system including processors, communications modules, input/output modules, etc.
   b. PLC Clock Management: Monitor and synchronize the PLC system clocks with the domain controller.
   c. Network management: Monitor and report diagnostic data for each network including diagnostic data acquired from network hardware and instrumentation. Extended diagnostics associated with PROFIBUS slave devices shall be monitored and reported.
   d. Instrument calibration: Means shall be provided to place a process variable transmitter or analyzer in hold during field calibration activities to prevent alarming and corruption of historical data.

G. Process control logic development:
   1. General:
      a. The process control system control logic development shall include the preparation of control logic required for the following:
         1) As required to implement process control strategies for the process units and system-wide control.
         2) As required to support the specified operator interface functions.
         3) As required to implement the specified system management functions.
         4) As required to implement the specified data management functions.
      b. Organization:

1) The control logic shall be organized in a hierarchical structure, which correlates to the Hierarchy Database. Individual control logic program routines shall be prepared for each system or equipment item and shall be organized by process area.

c. Documentation:
   1) All control logic shall be completely annotated including all rungs, instructions, and tags.
   2) Each routine shall have a title and a detailed description of the control strategy represented by the control logic. Where parameters are passed to the routine, all parameters shall be defined in the routine description.
   3) Analog tag descriptions representing process variables shall include the engineering unit range of the analog variable.
   4) Digital tag descriptions shall include the On and Off state labels.
   5) Complete, grammatically correct sentences and terminology, consistent with water treatment processes, shall be utilized in the development of rung and routine descriptions.
   6) All equations developed in the process logic shall be fully documented in the rung or routine description. A description of each constant and variable utilized in the equation shall be defined including engineering units.
   7) Provide Microsoft Word document for each add-on instruction that clearly and comprehensively describes the function of the instruction and the logic in the instruction.

H. Graphical operator interface development:
   1. General:
      a. The process control system graphical operator interface development shall include the preparation of the specified graphic displays in accordance with the Programming PXP and the requirements of this specification, in the contract documents. Contractor shall prepare graphic displays as may be required to provide a comprehensive process and system management graphical operator interface.
   2. Development guidelines:
      a. Graphic design: The layout and organization of each graphic display shall be consistent among the graphic display types and shall adhere to the following standards:
         1) Position similar information and features of the graphical operator interface at the same location on each display.
         2) Enclose groupings of associated data in a frame or box.
         3) Color conventions shall be consistently applied throughout the graphical interface.
            a) Light grays or a muted pastel color shall be applied as the background color.
            b) Foreground colors shall be selected to provide contrast to the background color.
            c) Verify that all colors chosen can be viewed by the end-user.
         4) Text fonts, sizes, colors, and types shall be consistently applied throughout the graphical interface.
      b. General graphic display configuration: Graphic displays shall be configured as either full screen displays or pop-up displays. Each type of display configuration shall include the following features:

1) Full screen display:
    a) Full screen displays shall be maximized, occupying the full, usable area of the window.
    b) Controls to close or minimize the window shall be disabled.
    c) Window exit control shall be embedded in the graphic display's navigational controls.
    d) Full screen displays shall remain in the background when a pop-up display is called from navigational hot links within the full screen display.
    e) Navigational and utility button bars shall be provided.

c. Pop-up display:
    1) Pop-up displays shall not occupy the full window and shall appear in the foreground when called from a full screen display.
    2) Pop-up displays shall appear at a user-defined location on the background display when called, but shall have the capability to be dragged to a different location on the screen.
    3) Pop-up displays shall not be resizable.
    4) Pop-up displays shall be provided with close control.

d. Graphic display types:
    1) Graphic displays shall be categorized as either: schematic overview, control panel, faceplate, trend, or utility.
        a) Schematic overview:
            (1) Schematic overview graphic display shall be presented as a process flow diagram and shall represent major process piping, major equipment, process variable data, and process alarm and status data. Schematic overview displays shall be prepared in accordance with the following guidelines:
                (a) Numeric display objects shall be provided to indicate the instantaneous value of all analog process data associated with the process. In addition, dynamic fill shall be used to indicate analog process data representing level. Suspect, temporally disabled, or faulty analog signals shall be identified accordingly.
                (b) Dynamic equipment symbols shall be provided to indicate run, off, and fault conditions for all major equipment associated with the process.
                (c) An alarm summary object indicating only those alarms related to the associated process shall be provided at the bottom of the display.
                (d) Continuation labels shall be provided to access associated schematic overview displays.
                (e) Hot links shall be provided on equipment symbols to provide access to an associated control panel display or faceplate.
                (f) Hot links shall be provided on numeric display objects to access associated trend displays.
                (g) Navigational and utility button bars shall be provided.
                (h) Schematic overview shall be a full screen display.
        b) Control panel:
            (1) Control panel graphic display shall be presented as a virtual control panel providing a point of operator interface for

control of a specific equipment item or system. Control panel graphic displays shall be prepared in accordance with the following guidelines:

(a) Graphical control objects representing selector switches, pushbutton, slider bars, etc., shall be provided to initiate the appropriate control function.
(b) All pertinent operating status data associated with the equipment or system controlled by the panel shall be indicated.
(c) Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.
(d) Control panels shall be configured as pop-up graphic displays.

c) PID controller faceplate:

(1) PID controller faceplate graphic display shall represent the appearance and functionality of a typical PID controller. The PID controller faceplate graphic display shall provide a point of operator interface for control of a specific process. PID controller faceplate graphic displays shall be prepared in accordance with the following guidelines:

(a) Analog data shall be presented in numerical and bar graph format.
(b) PID operating status such as mode, high/low limiting, deadband in effect, etc., shall be indicated.
(c) Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.
(d) PID controller faceplates shall be configured as pop-up graphic displays.

d) Trend display:

(1) Trend graphic display shall present a graphical trend object with the associated controls to adjust the time scale and scroll the time axis. Trend graphic displays shall be prepared in accordance with the following guidelines:

(a) A pen legend shall be provided which associates the trend plot to a process variable description through the use of color.
(b) Y-axis shall be graduated and labeled in the appropriate engineering units.
(c) Controls shall be provided to adjust the time scale and to scroll the X-axis backwards and forwards.
(d) Statistical data associated with the trended process variables shall be presented on the trend display.
(e) Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.
(f) Trend graphic displays shall be configured as pop-up graphic displays.
(g) Display overall node health for Ethernet IP Network.

e) Utility display:

(1) The utility graphic display shall present all pertinent data associated with an ancillary support system. The utility graphic display shall provide a point of operator interface for control, monitoring, and management of the specified utility system. Utility graphic displays shall be prepared in accordance with the following guidelines:
   (a) Provide a schematic representation of the utility system where specified.
   (b) Numeric display objects shall be provided to indicate the instantaneous value of all analog process data associated with the utility.
   (c) Dynamic symbols or labels shall be provided to indicate current condition of the utility and its components.
   (d) Graphical control objects representing selector switches, pushbutton, slider bars, etc., shall be provided to initiate the appropriate control function.
   (e) Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.
   (f) Control panels shall be configured as either full screen displays or pop-up graphic displays, as specified.

f) Navigation system:
   (1) The navigation system shall be configured to provide a logical, intuitive path through the graphical operator interface and also provide the flexibility to directly access graphic displays and system utilities. The graphical operator interface shall be generally organized by process area; however, shortcuts shall be provided to navigate beyond process boundaries. The graphical operator interface shall incorporate features to accommodate mouse-oriented navigation throughout the process control system. Scrollable menus, button bars, embedded hotlinks, and continuation labels shall be used to create a navigational system which provides ready-access to commonly used displays and utilities. The navigation system shall be implemented in accordance with the following guidelines:
      (a) Process overview graphic display: A process overview display schematically representing the overall facility shall function as the system startup display and "home base" for conventional system navigation. Embedded hot links shall be provided on this display to permit access to all other displays.
      (b) Continuation labels: Continuation labels shall be provided on all process schematic displays where a process line continues to another process area. These labels shall have embedded hot links to the process schematic display referenced by the label.
      (c) Graphic menu system: A graphic menu system shall be provided where the navigational control action can result in multiple options. A graphic menu display shall

be configured as a pop-up display and shall provide short cuts to associated graphic displays.

(d) Short cut icons: Short cut icons shall be utilized to provide direct access to typical display types. Short cut icons shall be provided to represent schematic displays, control panels, trend displays, and PID controller faceplates. Short cut icons shall typically be applied to pop-up displays such as graphic menus, control panels, faceplates, and trend displays.

(e) Hot links: Hot links shall be embedded in each of the following types of display objects to provide access to an associated display or menu. Equipment Symbol: Provide access to associated trend, PID controller faceplate, control panel, or graphic menu display.

(f) Numeric display: Provide access to associated trend display.

e. Additional graphic displays:

1) Graphic displays shall be developed for the following general systems:

a) Network:

(1) A graphical display shall show an overview of the entire network.

(2) Each network device (Ethernet switch, router, etc.) shall display detailed information regarding its status, alarms, and configuration.

b) Dashboard:

(1) A dashboard shall show information such as:

(a) Specific performance metrics.

(b) Dollars expended per unit GPM entering the facility. Dollars expended shall take into account items such as energy and chemical usage.

(2) Specific dashboard features shall be defined by Owner.

3. Submittals:

a. After all shop drawings submittals required herein have been favorably reviewed by the Engineer, the ICSC shall submit the following items, which must also be favorably reviewed and implemented prior to the start of system testing. The entire control system including all required software packages must be operational prior to the required factory acceptance test:

1) All operator interface display submittals shall be in full color as they will appear on the display screen:

a) This submittal shall be prepared after the requisite graphics meetings.

b) The submittal shall include:

(1) Graphic displays.

(2) Trend displays.

(3) Alpha numeric displays.

(4) Alarm displays.

2) Each display shall be uniquely titled:

a) Locations for process data shall be clearly identified either through the use of simulated data or by showing variables on

the displays and providing a reference list describing those variables.
b) All dynamic points shall be identified by tag number as a minimum and their operation shall be described on separate sheets:
(1) Color change.
(2) Symbol change.
c) 3 sets of submittals, with screen prints in color on a white background, are required for review by the Owner and Engineer.
d) 1 set will be returned with comments.
3) All periodic and custom reports for the entire control system:
a) Locations for process data shall be clearly identified, either through the use of simulated data or by showing variables on the report and providing a reference list describing those variables.
b) 3 sets of reports shall be submitted for review by the Engineer.
c) 1 set will be returned with comments.

b. Operator's reference manual:
1) The ICSC shall prepare and submit a user reference manual for the operator interface system for use by the operators. This manual shall be bound in a 3-ring binder and meet the following minimum requirements:
a) An index to the manual.
b) A list of operator interface:
(1) Display screens.
(2) Trends.
(3) Reports.
(4) With display name and description.
c) A summary of all possible commands and operator inputs to these screens including setpoints:
(1) All control actions shall be included.
d) A control system block diagram with names and locations of major components.
e) Instructions for manually printing screens or reports.
(1) Real time.
(2) Historical.
f) A summary of security levels and their privileges and limitations.
g) Spaces for operators to make notes.
2) A copy of this manual shall be provided to each operator during training on the operator interface operations:
a) The training class shall include a review of this manual with the operators in addition to more detailed instruction on the operator interface configuration and its use.

c. Review meeting minutes submittals:
1) Graphics review meeting:
a) Minutes of Graphic Review Meeting No. 1.
b) Minutes of Graphic Review Meeting No. 2.

4. Meetings:
a. Operator interface graphics generation:
1) The ICSC through the Contractor shall schedule the operator interface graphics meetings.
2) Topics shall include graphics for:

a) PCS graphics.
b) Data acquisition and graphics display system.

3) The Owner and Engineer shall attend these meetings.
4) Graphics Meeting No. 1: Held in conjunction with the System Configuration Preliminary Meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems - Common Work Results for Process Control and Instrumentation Systems:
   a) The ICSC shall chair and develop an agenda 3 weeks in advance of the meeting, which shall address the basic criteria to be adhered to in the configuration and development of graphic displays:
      (1) At this meeting, the ICSC shall distribute sample display formats for illustration purposes.
      (2) As a minimum, this meeting shall address the following issues:
         (a) All in-plant and remote site areas and conventions for identifying tag names and descriptors.
         (b) Designation of groups within each plant area along with tag names and descriptors.
         (c) The assignment of individual control loops and inputs to specific groups.
         (d) Organization of the systems universal display hierarchy.
         (e) Paging schemes to be used to enable the movement from one display to another.
         (f) An itemization of the type of display to be used at each level in the graphic hierarchy, e.g., pre-formatted displays, templates, custom graphics, etc.
         (g) Color convention to be employed on all graphics for the annotation of various status information, differentiation between alarms based on alarm priority, background colors, static field colors, and dynamic field colors.
         (h) The utilization of blinking and conditional text.
         (i) Definition of graphic symbolism to be used on the Project. This listing shall include but not be limited to symbols to be used for process instrumentation, process equipment, piping, vessels and valves:
         (j) Rockwell's standard AI/AOP libraries shall be utilized along with all faceplate templates and nomenclature.
         (k) Any new templates shall be developed and documented in a similar fashion and added to Owner's library.
         (l) All symbolism must be specific as opposed to generic in that shapes must define both function and type, e.g., specific symbols for each valve design, each pump design, each type of flowmeter, etc.
         (m) If the ICSC's library of shapes does not adequately describe plant or field conditions, the ICSC shall develop additional shapes to meet the plant or field requirements.

(n) Shapes and symbols used on the P&IDs shall be used as a guideline.
(o) Definition of all display select commands that enable the operator to move within the display hierarchy.
(p) The utilization of cursor movement commands that enable the operator to move within a display.
(q) Definition of control input commands that enable the operator to interact with face plates control stations and custom graphic displays to implement control functions.
(r) Definition of data input commands that enable the operator to enter numeric values into the control system.
(s) Definition of the utilization of "poke" points or fields that are dynamically sensitive to operator inputs to facilitate operator entry directly into graphic displays.
(t) A review of graphic generation procedures.

b) Subsequent to the adjournment of Graphics Meeting No. 1, the ICSC shall prepare and formalize a document titled "Graphics Criteria" which shall contain detailed meeting minutes and a definition of all graphic guidelines to be adhered to:
(1) This report shall be supplemented by graphic examples which illustrate the incorporation and application of each graphic criteria.
(2) The report shall be submitted within 30 calendar days of the meeting's adjournment.

5) Graphics Meeting No. 2: Held in conjunction with the System Configuration Intermediate Review Meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems - Common Work Results for Process Control and Instrumentation Systems:
a) Subsequent to the finalization of the overall system-wide graphics criteria, the ICSC shall develop graphic packages for the entire operator interfaces being furnished under this Project.
b) At this meeting the ICSC shall submit 5 copies including:
(1) A review of the graphic package developed for the process areas for content and completeness.
(2) A review of all data fields that display automatically updated process information.
(3) A review of all required input commands associated with the graphic access and control manipulation.
c) Subsequent to the adjournment of Graphics Meeting No. 2, the ICSC shall prepare a formalized submittal of the graphic package for review along with the detailed meeting minutes:
(1) The report shall be submitted within 30 calendar days of the meeting adjournment.

6) 10 additional displays shall be configured on-line during the pre-commissioning test period.
7) Minimum required displays are listed in Section 17762 - Control Systems: SCADA Software: Control Systems: 1.05.D.1.b.1.a.

I. Report development:

1. General:
    a. The ICSC through the Contractor shall schedule meetings and develop submittals as detailed in this Section.
    b. The ICSC shall develop reports.
2. Meetings:
    a. The ICSC through the Contractor shall schedule the report generation meetings.
    b. The Owner and Engineer shall attend these meetings.
    c. Reports Meeting No. 1: Held in conjunction with the System Configuration Preliminary Meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems - Common Work Results for Process Control and Instrumentation Systems:
        1) The ICSC shall chair and develop an agenda 3 weeks in advance for a meeting, which shall address the basic criteria to be adhered to in the configuration and development of the reports:
            a) At this meeting, the ICSC shall distribute sample formats for illustration purposes.
            b) As a minimum, this meeting shall address the following issues:
                (1) All in-plant and remote site data and conventions for identifying tag names and descriptors.
                (2) Designation of groups within each plant area along with tag names and descriptors.
                (3) The assignment of inputs to specific categories.
                (4) Organization of the systems universal report categories.
                (5) An itemization of the type of report available.
                (6) Definition of terms to be used on the reports.
                (7) Definition of all report commands that enable the operator to move within the report editor.
                (8) The utilization of cursor movement commands which enable the operator to move within a report.
                (9) Definition of data input commands which enable the operator to enter numeric values into the system.
                (10) A review of report generation procedures.
            c) Subsequent to the adjournment of the Report Meeting No. 1, the ICSC shall prepare and formalize a document titled "Report Criteria" which shall contain detailed meeting minutes and a definition of all report guidelines to be adhered to:
                (1) This report shall be supplemented by report examples.
                (2) The report shall be submitted within 30 calendar days of the meeting's adjournment.
    d. Reports Meeting No. 2: Held in conjunction with the System Configuration Intermediate Review Meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems - Common Work Results for Process Control and Instrumentation Systems:
        1) Subsequent to the finalization of the overall report format criteria, the ICSC shall develop report packages for review.
        2) At this meeting the ICSC shall submit 5 copies including:
            a) A review of the report package developed for the process area(s) for content and completeness.
            b) A review of all data fields for process information.
            c) A review of all required input commands associated with the report access and control manipulation.

3) Subsequent to the adjournment of Report Meeting No. 2, the ICSC shall prepare a formalized submittal of the report package for review along with the detailed meeting minutes:
a) The report shall be submitted within 30 calendar days of the meetings adjournment.

e. Develop all reports shown in the Appendix of this Section:
1) Include all fields shown.
2) Formatting shall be developed in coordination with the Owner.

f. 10 additional reports shall be configured on-line during the pre-commissioning test period.

3. Review meeting minutes submittals:
a. Report review meeting:
1) Minutes of Report Review Meeting No. 1.
2) Minutes of Report Review Meeting No. 2.
3) Minimum required Reports are listed in Section 17762 - Control Systems: SCADA Software: Control Systems: 1.05.D.3.a.

J. Alarming priority development:
1. Meetings:
a. The ICSC through the Contractor shall schedule the alarming priority meetings.
b. Owner and Engineer shall attend these meetings.
c. Alarming Priority Meeting No. 1: Held in conjunction with the preliminary meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems - Common Work Results for Process Control and Instrumentation Systems:
1) The ICSC shall chair and develop an agenda 3 weeks in advance for a meeting, which shall address the basic criteria to be adhered to in the prioritization of alarms:
a) At this meeting, the ICSC shall distribute a listing of all plant alarms identified by tag names and descriptors.
b) As a minimum, this meeting shall address the following issues:
(1) Criteria for prioritizing alarms including alarming priority levels. (e.g., Priority 3 - alarm at PCS; Priority 2 - alarm at PCS and autodialer; Priority 1 - alarm at PCS, autodialer, and plant shutdown.)
(2) Alarm display banner basic criteria.
c) Subsequent to the adjournment of the Alarming Priority Meeting No. 1, the ICSC shall prepare and formalize a document titled "Alarm Criteria" that shall contain detailed meeting minutes and a definition of all alarming guidelines to be adhered to:
(1) The report shall be submitted within 30 calendar days of the meeting's adjournment.

d. Alarming Priority Meeting No. 2: Held in conjunction with the intermediate review meeting as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems - Common Work Results for Process Control and Instrumentation Systems:
1) Subsequent to the finalization of the overall alarm criteria, the ICSC shall develop an alarming priority spreadsheet that will be populated at this meeting.
2) At this meeting the ICSC shall provide a spreadsheet including:

a) A listing of all plant alarms identified by tag names and descriptors.
b) For each alarm listed, include a location to enter the alarm priority assignment.
c) For each alarm listed, include a location to enter specific comments related to that alarm.

3) Subsequent to the adjournment of Alarming Priority Meeting No. 2, the ICSC shall prepare a formalized submittal of the alarming priority spreadsheet for review along with the detailed meeting minutes:

e. The spreadsheet and meeting minutes shall be submitted within 30 calendar days of the meetings adjournment.

2. Review meeting minutes submittals:
   a. Alarm review meeting:
      1) Minutes of Alarm Review Meeting No. 1.
      2) Minutes of Alarm Review Meeting No. 2.

K. Historical data management:
   1. General:
      a. Contractor shall prepare a list of tag names as required by Owner to identify process data that will be imported into the existing historical data management system.

L. Security coordination:
   1. Coordinate with Owner for software security requirements.
   2. Implement Owner Active Directory for logon credentials.
   3. Anti-Virus.
   4. System Logging.
   5. Patch Management server updates.
   6. Network Management.

M. QA/QC review:
   1. Once in-house testing is complete and prior to "Software Acceptance Testing," a QA/QC review must be undertaken. The review team must include:
      a. Appropriate process specialist: Process control requirement.
      b. Appropriate operations specialist familiar with the process: Client perspective: Reaction/expectation.
      c. Experienced Contractor (someone who has not been involved in the development of the code being evaluated - PLC/HMI implementation.
      d. Other software team members as appropriate.
   2. Each review will involve the above members for an initial period (length dependent upon the complexity of the plant area under consideration); followed by a period for the software team to make and test any identified changes.

N. Testing:
   1. As specified in Section 17950 - Testing, Calibration, and Commissioning - Testing, Calibration, and Commissioning.
   2. General:
      a. All process control system programming work shall be functionally tested and demonstrated to the satisfaction of Owner.
      b. Arrange, organize, and conduct each test over a period that allows sufficient time for all testing defined in the particular test. Once in-house

testing of the PLC and associated HMI development for a particular process area has been completed, the formal test will take place, where both the PLC and HMI software shall be demonstrated, with the intent of Owner approving and signing off on the tests and identifying any further enhancements. With the understanding that any agreed (documented) enhancements will be demonstrated during the Final Acceptance Test.

c. PLC Test agenda for initial workshop:
    1) Demonstrate PLC Development:
        a) Routines.
        b) Procedures.
    2) Test system development:
        a) Interface.
        b) Simulation.
    3) Control strategies:
        a) Sub-system 1:
            (1) Demonstration.
            (2) Verification.
            (3) Documentation/enhancement identification.
        b) Sub-system 2:
            (1) Demonstration.
            (2) Verification.
            (3) Documentation/enhancement identification.
        c) Sub-system 3:
            (1) Demonstration.
            (2) Verification.
            (3) Documentation/enhancement identification.
    4) Owner's review/feedback.
    5) Test procedural improvements.

d. The intent of the Final Totally Integrated System Test is to demonstrate any agreed enhancements to individual Area PLC systems and to demonstrate inter-area integration and network operation - it is not intended to repeat tests previously accepted by Owner. The agenda for the final Test will be developed based on the outcomes of the area Test and the outstanding work that has not been demonstrated to Owner previously.

3. Test plan:
    a. Prepare a test plan for each PLC/HMI/PCS node that describes the procedures to be followed during the course of testing. At a minimum, each test plan shall include testing 1 of each standard code block, UDT, graphic, and all other custom developed PLC code and graphics features, including all control strategies, alarms, security, PCS redundancy, historical collection, and network failure. Each Test plan shall be arranged by equipment, process area, and shall include a location in each section for Owner's approval signature and date. Each Test plan shall be submitted to the Owner for review and approval.
4. Test set-up:
    a. As a minimum, include and have communications configured for all networked equipment including, at a minimum: PCS servers, two PCS client nodes, 1 PLC, 1 of each type of communication card, and 1 Ethernet/IP connected device. Graphics shall be displayed on monitors configured to the same resolution as the monitors used in the final installation.

b. Use Rockwell Software emulation software running on 1 or more independent workstations or laptops to simulate the entire PLC-based control system and PLC to PLC communication, not including vendor supplied PLCs, and use emulation software such as RS Test Stand to simulate field equipment.

5. Test acceptance:
   a. Owner operations staff will witness each Test. Owner will sign and date each section of the Test plan once all tests have been satisfactorily conducted. After all sections of the plan have been approved, signed, and dated by Owner, the Contractor shall be allowed to ship the test equipment to the sites for installation.
6. Test reports:
   a. Contractor will prepare and submit a test report to Owner no more than 2 weeks from the completion of each test. At a minimum, the test report shall include a description of the tests conducted, the results of the tests, a list of deficiencies to be corrected, and a statement of acceptance or schedule for retesting.
7. Construction progress meetings:
   a. Attend weekly construction meetings held at the Plant site after integrator-supplied control panels have been delivered.
   b. Attend any other special construction meetings as requested by Owner.
   c. Provide current progress redlines of the documentation at each meetings and milestone for pay application approval.

O. Post-construction services:
   1. Assist Owner in post-construction system operations optimization including, but not limited to: control system implementation of power, energy, and chemical consumption optimization strategies developed by the Contractor or Owner. System Optimization Allowance shall be for a total of 200 hours. Post-construction system operations optimization shall take place approximately 1 year after substantial completion. Exact date(s) to be coordinated with Owner.

P. Training:
   1. As specified in Section 01756 - Commissioning.

Q. O&M manuals:
   1. Appropriate O&M manuals, in line with contract requirements, will be put together once the Final Customer FAT for each facility has been completed.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems - Common Work Results for Process Control and Instrumentation Systems.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17903

SCHEDULES: I/O LIST

PART 1 GENERAL

1.01 SUMMARY

A. The I/O list is not a take-off list. Additional information is as indicated on the Drawings and specified in the Contract Documents.

B. Tag Database development shall be coordinated with the CMMS development. Standard tagging scheme shall be utilized as directed by Manatee County.

C. Abbreviations used in the I/O list are defined on the Drawings.

D. ICSC as defined in specification section 17050 must attend the pre-bid meeting and conduct a site visit including visiting the remote sites prior to the bid opening. Non-compliance with this specification requirement will disqualify the ICSC from work on the project.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 I/O LIST

A. I/O list attached.

END OF SECTION

MANATEE COUNTY - WATER TREATMENT PLANT

EXISTING RTU'S AND INSTALLED IN/OUT PORTS

RTU #	BOARD TYPE	LOCATION	NODE	COMMUNICATION MEDIA	IP Address	MP	INPUTS/OUTPUTS DI	AI	DO	AO
Bridge Comp.		MAIN CONTROL ROOM	MANPCS	ETHERNET		192.0.54.20				
Network SW 1		MAIN CONTROL ROOM	MANSW1	ETHERNET		192.0.54.21				
Network SW 2		MAIN CONTROL ROOM	MANSW2	ETHERNET		192.0.54.22				
Alarm Bell		MAIN CONTROL ROOM	MANPL1	ETHERNET		192.0.54.25				
Printer		INSTRUMENT SHOP	MANCP1	ETHERNET		192.0.54.29				
Printer		MAIN CONTROL ROOM	MANCP0	ETHERNET		192.0.54.30				
	ITANIUM	MAIN CONTROL ROOM	MANMVA	ETHERNET	192.0.54.1	192.0.54.31				
	ITANIUM	MAIN CONTROL ROOM	MANMVB	ETHERNET	192.0.54.2	192.0.54.32				
	ALPHA	LIBRARY	MANVS1	FIBER OPTIC	192.0.54.3					
	ITANIUM	MAIN CONTROL ROOM	MANVS2	ETHERNET	192.0.54.4	192.0.54.34				
	ITANIUM	MAIN CONTROL ROOM	MANVS3	ETHERNET	192.0.54.5	192.0.54.35				
	ITANIUM	INSTRUMENT SHOP	MANVS4	FIBER OPTIC	192.0.54.6	192.0.54.36				
	ITANIUM	OPERATIONS LAB	MANVS5	FIBER OPTIC	192.0.54.7	192.0.54.37				
1	X-86	C-BASIN RAPID MIX	MANDC1	FIBER OPTIC	192.0.54.8	192.0.54.38	216	64	58	29
PLC		AB Backwash	MANDC1				0	1	20	8
2	2504	WTP - ELECTRICAL ROOM	MANDC2	FIBER OPTIC	192.0.54.9	192.0.54.39	160	83	39	18
PLC		Lime Thickener	MANDC2				51	4	54	12
3	2504	A/B CHEMICAL	MANDC3	FIBER OPTIC	192.0.54.10	192.0.54.40	64	33	22	17
4	2504	WTP - GROUND STORAGE	MANDC4	FIBER OPTIC	192.0.54.11	192.0.54.41	15	9	7	0
5	2504	MAIN CONTROL ROOM	MANDC5	ETHERNET	192.0.54.12	192.0.54.42	58	32	21	4
Spare			MANSPR	ETHERNET		192.0.54.43				
Port Terminal 1		MAIN CONTROL ROOM	MANSR1	ETHERNET	192.0.54.15					
Port Terminal 2		MAIN CONTROL ROOM	MANSR2	ETHERNET	192.0.54.16					
Port Terminal 3		MAIN CONTROL ROOM	MANSR3	ETHERNET	192.0.54.17					
Port Terminal 4		MAIN CONTROL ROOM	MANSR4	ETHERNET	192.0.54.18					
Port Terminal 5		MAIN CONTROL ROOM	MANSR5	ETHERNET	192.0.54.19					

11	2504	59TH STREET ELEVATED TANK		RADIO			7	1	3	0
12	2504	NORHT WEST ELEVATED TANK		RADIO			3	1	2	0
13	2504	PALMETTO ELEVATED TANK		RADIO			6	1	3	0
14	X-86	SARASOTA METER STATION		RADIO			3	4	0	0
15	2504	ELLENTON BOOSTER STATION		RADIO			5	8	2	0
16	2504	NORTH COUNTY ELEVATED TANK		RADIO			7	6	4	0
17	2504	ELWOOD PARK #2		RADIO			10	4	3	4
18	2504	WTP - RAW WATER #2		RADIO			6	2	3	0
19	2504	PORT MANATEE ELEVATED TANK		RADIO			17	4	5	0
20	2504	WTP - RAW WATER #1		FIBER OPTIC			8	2	7	0
21	2504	RAIN GAUGE #1		RADIO			4	0	0	0
	2504	RAIN GAUGE #2		NOT IN USE						
23	2504	RAIN GAUGE #3		RADIO			4	0	0	0
24	2504	RAIN GAUGE #4		RADIO			4	4	0	0
	2504	RAIN GAUGE #5 --> E.C.W. #1								
26	2504	RAIN GAUGE #6		RADIO			4	4	0	1
27	2504	RAIN GAUGE #7		RADIO			4	2	0	0
28	2504	RAIN GAUGE #8		RADIO			4	0	0	0
	2504	RAIN GAUGE #9		NOT IN USE						
30	2504	ELWOOD PARK #1		RADIO			26	12	10	1
31	2504	CORTEZ G.S. AND BOOSTER		MODEM			13	10	4	4
32	X-86	WTP - CARBON SILO		FIBER OPTIC			24	6	4	1

40	2504	MONITORING WELLS		RADIO			1	4	0	0
41	2504	EAST COUNTY WELL #1 <-- R.G. #5		RADIO			6	4	2	0
42	2504	EAST COUNTY WELL #2		RADIO			5	3	2	0
43	2504	EAST COUNTY WELL #3		RADIO			5	3	2	0
44	2504	EAST COUNTY WELL #4		RADIO			5	3	2	0
45	2504	EAST COUNTY WELL #5		RADIO			5	4	2	0
46	X-86	NORTH WEST GROUND STORAGE		MODEM			56	14	38	31
47	X-86	LONG BOAT KEY METER STATION		RADIO			3	2	0	0

50	2504	WTP - A BASIN GALLERY		MODEM			38	27	18	1
51	2504	WTP - B BASIN GALLERY		MODEM			38	18	18	0
52	2504	RYE BRIDGE - CONDUCTIVITY MON		RADIO			0	1	0	0
53	X-86	ASR WELLS		RADIO			67	31	30	57
54	2504	64 STATE ROAD MONITORING WELL		RADIO			2	2	0	0
		FUTURE 2		NOT IN USE						
56	X-86	EAST COUNTY WELL #6		RADIO			8	5	1	0
57	X-86	EAST COUNTY WELL #7		RADIO			8	5	1	0

Discrete Input 24 VDC	970			
Analog Input 4-20 mA		423		
Discrete Output 24 VDC			387	
Analog Output 4-20 mA				188
All Points				

WTP - C-Basin Rapid Mix	RTU 1 / DC 1	Fiber Optic

Insert V

POINT FILE SUMMARY 13-OCT-17 10:23:17								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
ASR-RCH7V6F-ED	3204	RCH PID FL	BIN	DISABLED	(ON=1)	MANDC1::1:1	251	101
ASR-RCH7V6F-SP	3200	RCH TOT FLW	ANA	0	MGD	MANDC1::1:1		10
ASR-RCHT-FLW	3201	TOTRCHFL MOD	ANA	0	MGD	MANDC1::1:1		1
ASR-RS7V6P-ED	3203	REC/ST PIDED	BIN	DISABLED	(ON=1)	MANDC1::1:1	250	100
ASR-RS7V6P-SP	3199	REC/ST 7V6SP	ANA	0	%	MANDC1::1:1		9
ASR-TEST	3088	POSITION SPT	ANA	0	% OPEN	MANDC1::1:1		
ASR-WLFVLV-AM	3145	A/M WLF VLV	BIN	AUTO	(ON=1)	MANDC1::1:1		98
ASR1-1V1-AO5	3497	POSITION SPT	ANA	0	% OPEN	MANDC1::1:1		5
ASR1-1V1-POS	3011	VLV POSITION	ANA	0	%	MANDC1::1:1	33	
ASR1-1V1-POSSP	3115	POSITION SPT	ANA	0	% OPEN	MANDC1::1:1		15
ASR1-1V1-RDY	3016	VLV RDY IND	BIN	READY	(ON=1)	MANDC1::1:1	217	
ASR1-1V1FL-IG	3249	V1FLOW IGAIN	ANA	2		MANDC1::1:1		25
ASR1-1V1FL-PG	3248	V1FLOW PGAIN	ANA	2		MANDC1::1:1		24
ASR1-1V1PAU-IG	3247	V1P AU IGAIN	ANA	0		MANDC1::1:1		21
ASR1-1V1PAU-PG	3290	V1P AU PGAIN	ANA	0		MANDC1::1:1		20
ASR1-1V1POP-IG	3291	V1P OP IGAIN	ANA	3		MANDC1::1:1		17
ASR1-1V1POP-PG	3246	V1P OP PGAIN	ANA	3		MANDC1::1:1		16
ASR1-1V1POS-ED	3137	POS CONTROL	BIN	DISABLED	(ON=1)	MANDC1::1:1	252	102
ASR1-1V2-CLOSE	3496	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANDC1::1:1		72
ASR1-1V2-CLS	3033	VALVE CLOSED	BIN	CLOSED	(ON=1)	MANDC1::1:1	229	
ASR1-1V2-OC	3044	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANDC1::1:1		71
ASR1-1V2-OPN	3029	VALVE OPEN	BIN		(ON=1)	MANDC1::1:1	228	
ASR1-1V2-RDY	3025	VLV RDY IND	BIN	READY	(ON=1)	MANDC1::1:1	230	
ASR1-7V1-CLS	3034	VALVE CLOSED	BIN	CLOSED	(ON=1)	MANDC1::1:1	236	
ASR1-7V1-OC	3045	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANDC1::1:1		74
ASR1-7V1-OPN	3021	VALVE OPEN	BIN		(ON=1)	MANDC1::1:1	235	
ASR1-7V1-RDY	3026	VLV RDY IND	BIN	NOTREADY	(ON=1)	MANDC1::1:1	237	
ASR1-7V4-CLOSE	3498	VLV CLOSE	BIN	CLOSED	(ON=1)	MANDC1::1:1		68
ASR1-7V4-CLS	3031	VALVE CLOSED	BIN	CLOSED	(ON=1)	MANDC1::1:1	223	
ASR1-7V4-OC	3042	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANDC1::1:1		67
ASR1-7V4-OPN	3019	VALVE OPEN	BIN		(ON=1)	MANDC1::1:1	222	
ASR1-7V4-RDY	3023	VLV RDY IND	BIN	READY	(ON=1)	MANDC1::1:1	224	
ASR1-7V6-POS	3012	VLV POSITION	ANA	-1	%	MANDC1::1:1	34	
ASR1-7V6-POSSP	3116	POSITION SPT	ANA	50	% OPEN	MANDC1::1:1		2
ASR1-7V6-RDY	3017	VLV RDY IND	BIN	AUTO	(ON=1)	MANDC1::1:1	218	
ASR1-7V6FL-IG	3302	V6FLOW IGAIN	ANA	-3		MANDC1::1:1		12
ASR1-7V6FL-PG	3301	V6FLOW PGAIN	ANA	-3		MANDC1::1:1		11
ASR1-7V6INI-ED	3305	RCH POS /ED	BIN	DISABLED	(ON=1)	MANDC1::1:1		105
ASR1-7V6INI-SP	3303	RCH INI POS	ANA	100	% OPEN	MANDC1::1:1		28
ASR1-7V6MIN-SP	3228		ANA	10	%	MANDC1::1:1		14
ASR1-7V6PAU-IG	3300	V6P AU IGAIN	ANA	0		MANDC1::1:1		7
ASR1-7V6PAU-PG	3299	V6P AU PGAIN	ANA	0		MANDC1::1:1		6

Discrete Input	Analog Input	Discrete Output	Analog Output
1		1	
			1
			1
1		1	
			1
		1	
	1		
			1
1			
			1
			1
			1
			1
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			1
			1
		1	
			1
			1
			1
			1

WTP - C-Basin Rapid Mix	RTU 1 / DC 1	Fiber Optic							Discrete Input	Analog Input	Discrete Output	Analog Output
ASR1-7V6POP-IG	3297	V6P OP IGAIN	ANA	3		MANDC1::1:1		4				1
ASR1-7V6POP-PG	3298	V6P OP PGAIN	ANA	3		MANDC1::1:1		3				1
ASR1-7V6POS-ED	3138	POS CONTROL	BIN	DISABLED	(ON=1)	MANDC1::1:1	249	99	1		1	
ASR1-7V7-CLS	3032	VALVE CLOSED	BIN		(ON=1)	MANDC1::1:1	226		1			
ASR1-7V7-OC	3043	VLV OPN/CLS	BIN	OPEN	(ON=1)	MANDC1::1:1		69			1	
ASR1-7V7-OPN	3020	VALVE OPEN	BIN	OPEN	(ON=1)	MANDC1::1:1	225		1			
ASR1-7V7-RDY	3024	VLV RDY IND	BIN	READY	(ON=1)	MANDC1::1:1	227		1			
ASR1-B7P1-MFLT	3040	MOTOR FAIL	BIN	NORMAL	(ON=1)	MANDC1::1:1						
ASR1-B7P1-PFLT	3038	WP FAILURE	BIN	NORMAL	(ON=1)	MANDC1::1:1						
ASR1-B7P1-RDY	3028	WP RDY IND	BIN	NOTREADY	(ON=1)	MANDC1::1:1						
ASR1-B7P1-SS	3036	WP STR/STP	BIN	OFF	(ON=1)	MANDC1::1:1						
ASR1-BLOREC-ED	3217	BLO INIT REC	BIN	DISABLED	(ON=1)	MANDC1::1:1						
ASR1-BLOSTO-ED	3223	BLO INIT STO	BIN	DISABLED	(ON=1)	MANDC1::1:1						
ASR1-RCH-FLCTL	3076	FLO CTL LOOP	BIN	DISABLE	(ON=1)	MANDC1::1:1						
ASR1-RCH-FLWSP	3082	FLOW SETPT	ANA	0	MGD	MANDC1::1:1		23				1
ASR1-RCH-INT	3348	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
ASR1-RCH-V1FED	3235	RCH V1FL ED	BIN	DISABLED	(ON=1)	MANDC1::1:1	254	104	1		1	
ASR1-RCH-V1MIN	3229	RCH V1 MIN P	ANA	0	%	MANDC1::1:1		27				1
ASR1-RECHAR-FL	3013	RECHARG FLOW	ANA	0	MGD	MANDC1::1:1	36			1		
ASR1-RECOV-FL	3014	RECOVER FLOW	ANA	0	MGD	MANDC1::1:1	35			1		
ASR1-RSVPOS-ED	3211	REC/ST PIDED	BIN	DISABLED	(ON=1)	MANDC1::1:1	253	103	1		1	
ASR1-RSVPOS-SP	3205	REC/ST POSSP	ANA	0	%	MANDC1::1:1		19				1
ASR1-TRICKL-FL	3015	TRICKLE FLOW	ANA	0	GPM	MANDC1::1:1	37			1		
ASR1-WELL-AM	3067	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1		97			1	
ASR1-WELL-APRS	3746	WELL PRESS	ANA	0	PSI	MANDC1::1:1	134			1		
ASR1-WELL-PRS	3198	WELL PRS ALM	BIN	NORMAL	(ON=1)	MANDC1::1:1	219		1			
ASR1-WP1-MFLT	3039	MOTOR FAIL	BIN	NORMAL	(ON=1)	MANDC1::1:1	234		1			
ASR1-WP1-PFLT	3037	WP FAILURE	BIN	NORMAL	(ON=1)	MANDC1::1:1	233		1			
ASR1-WP1-RDY	3027	WP RDY IND	BIN	READY	(ON=1)	MANDC1::1:1	232		1			
ASR1-WP1-SS	3035	WP STR/STP	BIN	OFF	(ON=1)	MANDC1::1:1	231	73	1		1	
ASR2-RCH-INT	3574	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
ASR2-REC-INT	3575	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
ASR3-RCH-INT	3587	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
ASR3-REC-INT	3590	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
ASR4-RCH-INT	3363	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
ASR4-REC-INT	3591	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
ASR5-RCH-INT	3588	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
ASR5-REC-INT	3592	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
ASR6-RCH-INT	3365	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
ASR6-REC-INT	3593	TOTALIZER	ANA	0	GAL	MANDC1::1:1						
BARGRAPH-TEST	4943	SETPOINT	ANA	-10.01	MGD	MANDC1::1:1						
BWR-P3-ALM	199	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	101		1			
BWR-P3-STAT	2735	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	100		1			
BWR-P4-ALM	200	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	103		1			
BWR-P4-STAT	2736	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	102		1			
BWRP-HL-LITE	1320	HIGH LEVEL	BIN	OFF	(ON=1)	MANDC1::1:1		8			1	
BWRP-WTR-HL	115	HIGH LEVEL	BIN	NORMAL	(ON=1)	MANDC1::1:1	99		1			
C-AB-POLY-FL	2633	C BASIN A&B	ANA	0	GAL/MIN	MANDC1::1:1	26			1		

WTP - C-Basin Rapid Mix	RTU 1 / DC 1	Fiber Optic							Discrete Input	Analog Input	Discrete Output	Analog Output
C-CO2-DTLBS	3340	C POST	ANA	11340.6	CFM	MANMVA::1:1						
C-CO2-INTLBS	3341	INTEGRATOR	ANA	19.67	CFM	MANMVA::1:1						
C-POLY-P3-SPC	2694	C POLYMER	ANA	99	%	MANDC1::1:1		6				1
C-POLY-P4-SPC	2695	C POLYMER	ANA	68.278	%	MANDC1::1:1		7				1
C-POLYP3-AM	2676	C BASIN	BIN	MANUAL	(ON=1)	MANDC1::1:1	212		1			
C-POLYP3-SS	2692	C POLYMER	BIN	ON	(ON=1)	MANDC1::1:1						
C-POLYP4-AM	2677	C BASIN	BIN	MANUAL	(ON=1)	MANDC1::1:1	211		1			
C-POLYP4-SS	2693	C POLYMER	BIN	ON	(ON=1)	MANDC1::1:1						
C1-FLUSH-OC	4941	FLUSH VALVE	BIN	CLOSED	(ON=1)	MANDC1::1:1						
C1-POLY-ABS	2642	C1 FLOC POLY	ANA	0.06	GPM	MANDC1::1:1						
C1-POLY-ALM	2669	FLOW ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1						
C1-POLY-CH	2646	C1 FLOC SP	ANA	-0.09	%	MANDC1::1:1						
C1-POLY-DB	2649	C1 POLYMER	ANA	0.01	GPM	MANDC1::1:1						
C1-POLY-IGAIN	2665	C1 BASIN	ANA	1.5	%/GPM	MANDC1::1:1						
C1-POLY-RUN	2685	MAG METER	BIN	OFF	(ON=1)	MANDC1::1:1						
C1B-END	4908	STP AT END	BIN		(ON=1)	MANDC1::1:1						
C1B-END-TIME	4920	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1B-F2E-TIME	4911	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1B-F2END-TIME	4921	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1B-F2W-TIME	4915	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1B-FATE-TIME	4914	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1B-FSTPW-TIME	4918	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1B-FWD-AT-EAS	4901	FWD-AT-EAST	BIN		(ON=1)	MANDC1::1:1						
C1B-FWD-ST-WES	4905	FWD-ST-WEST	BIN		(ON=1)	MANDC1::1:1						
C1B-FWD-TO-EAS	4899	BRG-2-EAST	BIN		(ON=1)	MANDC1::1:1						
C1B-FWD-TO-END	4906	FWD TO END	BIN		(ON=1)	MANDC1::1:1						
C1B-FWD-TO-WES	4902	FWD-TO-WEST	BIN		(ON=1)	MANDC1::1:1						
C1B-R2E-TIME	4916	STATE TIME	ANA	2	MIN	MANDC1::1:1						
C1B-R2STR-TIME	4912	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1B-R2W-TIME	4919	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1B-RATW-TIME	4917	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1B-REV-AT-WES	4904	REV AT WEST	BIN		(ON=1)	MANDC1::1:1						
C1B-REV-ST-EAS	4909	STP AT WEST	BIN		(ON=1)	MANDC1::1:1						
C1B-REV-TO-EAS	4903	REV TO EAST	BIN	REV2EAST	(ON=1)	MANDC1::1:1						
C1B-REV-TO-STR	4900	REV TO START	BIN		(ON=1)	MANDC1::1:1						
C1B-REV-TO-WES	4907	REV TO WEST	BIN		(ON=1)	MANDC1::1:1						
C1B-RSTPE-TIME	4913	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1B-START	4898	BRG AT START	BIN		(ON=1)	MANDC1::1:1						
C1B-STR-TIME	4910	STATE TIME	ANA	0	MIN	MANDC1::1:1						
C1FLOC-POLY-FL	2636	C1 BASIN	ANA	2.33	GAL/MIN	MANDC1::1:1	29			1		
C1POLY-PMP-DSG	2688	POLYMER PUMP	BIN	PUMP 4	(ON=1)	MANDC1::1:1						
C2-FLUSH-OC	4940	FLUSH VALVE	BIN	CLOSED	(ON=1)	MANDC1::1:1		32			1	
C2-POLY-ABS	2643	C2 FLOC POLY	ANA	0	GPM	MANDC1::1:1						
C2-POLY-ALM	2670	FLOW ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1						
C2-POLY-CH	2708	C2 FLOC SP	ANA	0	%	MANDC1::1:1						
C2-POLY-DB	2650	C2 POLYMER	ANA	0	GPM	MANDC1::1:1						
C2-POLY-IGAIN	2666	C2 BASIN	ANA	0.1	%/GPM	MANDC1::1:1						
C2-POLY-RUN	2687	MAG METER	BIN	OFF	(ON=1)	MANDC1::1:1						

WTP - C-Basin Rapid Mix	RTU 1 / DC 1	Fiber Optic						Discrete Input	Analog Input	Discrete Output	Analog Output
C2B-END	4794	STP AT END	BIN		(ON=1)	MANDC1::1:1					
C2B-END-TIME	4857	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2B-F2E-TIME	4852	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2B-F2END-TIME	4856	STATE TIME	ANA	3.5	MIN	MANDC1::1:1					
C2B-F2W-TIME	4854	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2B-FATE-TIME	4853	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2B-FSTPW-TIME	4855	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2B-FWD-AT-EAS	4790	FWD-AT-EAST	BIN		(ON=1)	MANDC1::1:1					
C2B-FWD-ST-WES	4792	FWD-ST-WEST	BIN		(ON=1)	MANDC1::1:1					
C2B-FWD-TO-EAS	4789	BRG-2-EAST	BIN		(ON=1)	MANDC1::1:1					
C2B-FWD-TO-END	4793	FWD TO END	BIN	FWD2END	(ON=1)	MANDC1::1:1					
C2B-FWD-TO-WES	4791	FWD-TO-WEST	BIN		(ON=1)	MANDC1::1:1					
C2B-R2E-REV	4946	REVERSE TIME	ANA	9	MIN	MANDC1::1:1					
C2B-R2E-TIME	4863	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2B-R2STR-REV	4948	REVERSE TIME	ANA	3	MIN	MANDC1::1:1					
C2B-R2STR-TIME	4861	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2B-R2W-REV	4944	REVERSE TIME	ANA	12	MIN	MANDC1::1:1					
C2B-R2W-TIME	4858	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2B-RATW-REV	4945	REVERSE TIME	ANA	1	MIN	MANDC1::1:1					
C2B-RATW-TIME	4859	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2B-REV-AT-WES	4796	REV AT WEST	BIN		(ON=1)	MANDC1::1:1					
C2B-REV-ST-EAS	4798	STP AT WEST	BIN		(ON=1)	MANDC1::1:1					
C2B-REV-TO-EAS	4797	REV TO EAST	BIN		(ON=1)	MANDC1::1:1					
C2B-REV-TO-STR	4799	REV TO START	BIN		(ON=1)	MANDC1::1:1					
C2B-REV-TO-WES	4795	REV TO WEST	BIN		(ON=1)	MANDC1::1:1					
C2B-RSTPE-REV	4947	REVERSE TIME	ANA	1	MIN	MANDC1::1:1					
C2B-RSTPE-TIME	4860	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2B-START	4788	BRG AT START	BIN		(ON=1)	MANDC1::1:1					
C2B-STR-TIME	4862	STATE TIME	ANA	0	MIN	MANDC1::1:1					
C2FLOC-POLY-FL	2635	C2 BASIN	ANA	0	GAL/MIN	MANDC1::1:1	129			1	
C2POLY-PMP-DSG	2689	POLYMER PUMP	BIN	PUMP 4	(ON=1)	MANDC1::1:1					
CAB-POLY-ABS	2641	C AB POLYMER	ANA	0	GPM	MANDC1::1:1					
CAB-POLY-ALM	2668	FLOW ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1					
CAB-POLY-CH	2645	C AB SP	ANA	0	%	MANDC1::1:1					
CAB-POLY-DB	2648	C AB POLYMER	ANA	0	GPM	MANDC1::1:1					
CAB-POLY-IGAIN	2664	C BASIN A+B	ANA	0.1	%/GPM	MANDC1::1:1					
CAB-POLY-RUN	2684	MAG METER	BIN	OFF	(ON=1)	MANDC1::1:1					
CABPLY-PMP-DSG	2691	POLYMER PUMP	BIN	IDLE	(ON=1)	MANDC1::1:1					
CP-POLY-ABS	2644	C POST POLY	ANA	0	GPM	MANDC1::1:1					
CP-POLY-ALM	2671	FLOW ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1					
CP-POLY-CH	2647	C POST SP	ANA	0	%	MANDC1::1:1					
CP-POLY-DB	2651	CPOST POLY	ANA	0	GPM	MANDC1::1:1					
CP-POLY-IGAIN	2667	C POST BASIN	ANA	0.1	%/GPM	MANDC1::1:1					
CPOLY-LO-LEVEL	2707	LEVEL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	213		1		
CPOST-POLY-FL	2634	C BASIN	ANA	0	GAL/MIN	MANDC1::1:1	27			1	
CPOST-POLY-RUN	2686	MAG METER	BIN	OFF	(ON=1)	MANDC1::1:1					
CPPOLY-PMP-DSG	2690	POLYMER PUMP	BIN	PUMP 4	(ON=1)	MANDC1::1:1					
DAY-OF-MONTH	4950	TIME VAR	ANA	13	DAYS	MANMVA::1:1					

WTP - C-Basin Rapid Mix		RTU 1 / DC 1		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
DAY-OF-WEEK	4949	TIME VAR	ANA	5		MANMVA::1:1						
DEG-BLWR1-LR	108	LOCAL/REMOTE	BIN	LOCAL	(ON=1)	MANDC1::1:1	31		1			
DEG-BLWR1-SS	102	START/STOP	BIN	ON	(ON=1)	MANDC1::1:1	32	1	1		1	
DEG-BLWR2-LR	109	LOCAL/REMOTE	BIN	LOCAL	(ON=1)	MANDC1::1:1	33		1			
DEG-BLWR2-SS	103	START/STOP	BIN	ON	(ON=1)	MANDC1::1:1	34	2	1		1	
DEG-BLWR3-LR	110	LOCAL/REMOTE	BIN	LOCAL	(ON=1)	MANDC1::1:1	35		1			
DEG-BLWR3-SS	104	START/STOP	BIN	ON	(ON=1)	MANDC1::1:1	36	3	1		1	
DEG-BLWR4-LR	111	LOCAL/REMOTE	BIN	LOCAL	(ON=1)	MANDC1::1:1	37		1			
DEG-BLWR4-SS	105	START/STOP	BIN	OFF	(ON=1)	MANDC1::1:1	38	4	1		1	
DEG-BLWR5-LR	112	LOCAL/REMOTE	BIN	LOCAL	(ON=1)	MANDC1::1:1	39		1			
DEG-BLWR5-SS	106	START/STOP	BIN	OFF	(ON=1)	MANDC1::1:1	40	5	1		1	
DEG-BLWR6-LR	113	LOCAL/REMOTE	BIN	LOCAL	(ON=1)	MANDC1::1:1	202		1			
DEG-BLWR6-SS	107	START/STOP	BIN	ON	(ON=1)	MANDC1::1:1	203	6	1		1	
DEG-INNOV-CLS	101	VALVE CLOSED	BIN		(ON=1)	MANDC1::1:1	30		1			
DEG-INNOV-OC	517	OPEN/CLOSE	BIN	INTER	(ON=4)	MANDC1::1:1						
DEG-INNOV-OPN	98	VALVE OPEN	BIN		(ON=1)	MANDC1::1:1	29		1			
DEG-INNOV-VAL	648	CALC VALUE	ANA	8		MANDC1::1:1	77			1		
DEG-INSOV-CLS	100	VALVE CLOSED	BIN		(ON=1)	MANDC1::1:1	28		1			
DEG-INSOV-OC	518	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1						
DEG-INSOV-OPN	97	VALVE OPEN	BIN	OPEN	(ON=1)	MANDC1::1:1	27		1			
DEG-INSOV-VAL	649	CALC VALUE	ANA	4		MANDC1::1:1	78			1		
DEG-NOBYPV-CLS	129	VALVE CLOSED	BIN	CLOSED	(ON=1)	MANDC1::1:1	44		1			
DEG-NOBYPV-OC	519	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1						
DEG-NOBYPV-OPN	125	VALVE OPEN	BIN	CLOSE	(ON=1)	MANDC1::1:1	43		1			
DEG-NOBYPV-VAL	650	CALC VALUE	ANA	0		MANDC1::1:1	79			1		
DEG-SOBYPV-CLS	128	VALVE CLOSED	BIN		(ON=1)	MANDC1::1:1	42		1			
DEG-SOBYPV-OC	520	OPEN/CLOSE	BIN	INTER	(ON=4)	MANDC1::1:1						
DEG-SOBYPV-OPN	124	VALVE OPEN	BIN	CLOSE	(ON=1)	MANDC1::1:1	41		1			
DEG-SOBYPV-VAL	651	CALC VALUE	ANA	8		MANDC1::1:1	80			1		
DENNIS-POINT	4743	C1 BASIN	ANA	0	GAL/MIN	MANDC1::1:1	20			1		
ECW-OR-LAKE-FL	4729	RAW WTR FLOW	ANA	17.59	MGD	MANDC1::1:1	117			1		
FLOC-C1MX1-ALM	136	C1 FLOC #1	BIN	NORMAL	(ON=1)	MANDC1::1:1	50		1			
FLOC-C1MX1-RUN	132	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	49		1			
FLOC-C1MX1-SPD	47	MXR 1 SPD	ANA	0	%	MANDC1::1:1	119			1		
FLOC-C1MX2-ALM	137	C1 FLOC #2	BIN	NORMAL	(ON=1)	MANDC1::1:1	52		1			
FLOC-C1MX2-RUN	133	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	51		1			
FLOC-C1MX2-SPD	48	MXR 2 SPD	ANA	73.89	%	MANDC1::1:1	120			1		
FLOC-C1MX3-ALM	138	C1 FLOC #3	BIN	NORMAL	(ON=1)	MANDC1::1:1	54		1			
FLOC-C1MX3-RUN	134	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	53		1			
FLOC-C1MX3-SPD	49	MXR 3 SPD	ANA	0	%	MANDC1::1:1	121			1		
FLOC-C1MX4-ALM	139	C1 FLOC #4	BIN	NORMAL	(ON=1)	MANDC1::1:1	56		1			
FLOC-C1MX4-RUN	135	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	55		1			
FLOC-C1MX4-SPD	50	MXR 4 SPD	ANA	0	%	MANDC1::1:1	122			1		
FLOC-C1MX5-ALM	164	C1 FLOC #5	BIN	NORMAL	(ON=1)	MANDC1::1:1	58		1			
FLOC-C1MX5-RUN	156	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	57		1			
FLOC-C1MX5-SPD	51	MXR 5 SPD	ANA	0	%	MANDC1::1:1	123			1		
FLOC-C1MX6-ALM	165	C1 FLOC #6	BIN	NORMAL	(ON=1)	MANDC1::1:1	60		1			
FLOC-C1MX6-RUN	157	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	59		1			

WTP - C-Basin Rapid Mix		RTU 1 / DC 1		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
FLOC-C1MX6-SPD	52	MXR 6 SPD	ANA	0	%	MANDC1::1:1	124			1		
FLOC-C2MX1-ALM	166	C2 FLOC #7	BIN	NORMAL	(ON=1)	MANDC1::1:1	62		1			
FLOC-C2MX1-RUN	158	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	61		1			
FLOC-C2MX1-SPD	53	MXR 1 SPD	ANA	0	%	MANDC1::1:1	125			1		
FLOC-C2MX2-ALM	167	C2 FLOC #8	BIN	NORMAL	(ON=1)	MANDC1::1:1	64		1			
FLOC-C2MX2-RUN	159	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	63		1			
FLOC-C2MX2-SPD	54	MXR 2 SPD	ANA	0	%	MANDC1::1:1	126			1		
FLOC-C2MX3-ALM	168	C2 FLOC #9	BIN	NORMAL	(ON=1)	MANDC1::1:1	66		1			
FLOC-C2MX3-RUN	160	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	65		1			
FLOC-C2MX3-SPD	55	MXR 3 SPD	ANA	0	%	MANDC1::1:1	23			1		
FLOC-C2MX4-ALM	169	C2 FLOC #10	BIN	NORMAL	(ON=1)	MANDC1::1:1	68		1			
FLOC-C2MX4-RUN	161	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	67		1			
FLOC-C2MX4-SPD	56	MXR 4 SPD	ANA	0	%	MANDC1::1:1	24			1		
FLOC-C2MX5-ALM	170	C2 FLOC #11	BIN	NORMAL	(ON=1)	MANDC1::1:1	70		1			
FLOC-C2MX5-RUN	162	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	69		1			
FLOC-C2MX5-SPD	57	MXR 5 SPD	ANA	0	%	MANDC1::1:1	17			1		
FLOC-C2MX6-ALM	171	C2 FLOC #12	BIN	NORMAL	(ON=1)	MANDC1::1:1	72		1			
FLOC-C2MX6-RUN	163	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	71		1			
FLOC-C2MX6-SPD	58	MXR 6 SPD	ANA	0	%	MANDC1::1:1	18			1		
FLT1-EF-15T	3384	TOTALIZER	ANA	8	GAL	MANMVA::1:1						
FLT1-WST-TIME	4877	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT10-WST-TIME	4886	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT11-WST-TIME	4887	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT12-WST-TIME	4888	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT2-WST-TIME	4878	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT3-WST-TIME	4879	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT4-WST-TIME	4880	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT5-WST-TIME	4881	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT6-WST-TIME	4882	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT7-WST-TIME	4883	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT8-WST-TIME	4884	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
FLT9-WST-TIME	4885	WASTE TIMER	ANA	10	MIN	MANMVA::1:1						
GEORGE	3570	TOTALIZER	ANA	0	GAL	MANMVA::1:1						
HOUR-OF-DAY	4953	TIME VAR	ANA	10	HOUR	MANMVA::1:1						
LIM-FDR1SPD-SP	700	SETPOINT	ANA	100	%	MANDC1::1:1						
LIM-FDR2SPD-SP	701	SETPOINT	ANA	100	%	MANDC1::1:1						
LIM-FDR3-ALM	186	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	86		1			
LIM-FDR3-RUN	184	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	87		1			
LIM-FDR3-SPC	2697	FEEDER 3	ANA	24	%	MANDC1::1:1		4				1
LIM-FDR3-SPD	2698	FEEDER 3 SPD	ANA	23.2	%	MANDC1::1:1	132			1		
LIM-FDR4-ALM	187	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	88		1			
LIM-FDR4-RUN	185	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	85		1			
LIM-FDR4-SPC	66	FEEDER 2	ANA	5	%	MANDC1::1:1		3				1
LIM-FDR4-SPD	60	FEEDER 2 SPD	ANA	0	%	MANDC1::1:1	133			1		
LIM-SIL-LL	188	REORDER	BIN	NORMAL	(ON=1)	MANDC1::1:1	89		1			
LIM-SILA-LLL	189	LO LEVEL	BIN	NORMAL	(ON=1)	MANDC1::1:1	90		1			
LIM-SILB-LLL	190	LO LO LEVEL	BIN	NORMAL	(ON=1)	MANDC1::1:1	91		1			
LIM-SLK3-ALM	197	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1						

WTP - C-Basin Rapid Mix		RTU 1 / DC 1		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
LIM-SLK3-RUN	191	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	95		1			
LIM-SLK4-ALM	198	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	96		1			
LIM-SLK4-RUN	192	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1						
LIM-SLKGS3-RUN	193	GRIT SEPAR	BIN	OFF	(ON=1)	MANDC1::1:1	97		1			
LIM-SLKGS4-RUN	194	GRIT SEPAR	BIN	OFF	(ON=1)	MANDC1::1:1	94		1			
LIM-SLRMX2-RUN	956	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	210		1			
MANRT01-STS	1668	DCU 1 RTU	BIN	ONLINE	(ON=1)	MANDC1::1:1						
MIN-OF-HOUR	4952	TIME VAR	ANA	23	MIN	MANMVA::1:1						
MODE1-ALM-INH	708	INHIBIT ALMS	BIN	INHBIT	(ON=1)	MANDC1::1:1						
MODE1-BYPV-ALM	705	MODE 1 ALM	BIN	NORMAL	(ON=1)	MANDC1::1:1						
MODE1-DEGV-ALM	704	MODE 1 ALM	BIN	NORMAL	(ON=1)	MANDC1::1:1						
MODE1-PGWV-ALM	707	MODE 1 ALM	BIN	NORMAL	(ON=1)	MANDC1::1:1						
MODE1-TGWV-ALM	706	MODE 1 ALM	BIN	ALARM	(ON=1)	MANDC1::1:1						
MODE1-V7-ALM	1377	VALVE 7 ALM	BIN	NORMAL	(ON=1)	MANDC1::1:1						
MONTH-OF-YEAR	4951	TIME VAR	ANA	10	MONTH	MANMVA::1:1						
PLT-INGW-ABS	1431	ABSOLUTE	ANA	3.31	MGD	MANDC1::1:1						
PLT-INGW-BIAS	847	FLOW BIAS	ANA	10	%	MANDC1::1:1						
PLT-INGW-CH	1427	SP CHANGE	ANA	0.16	MGD	MANDC1::1:1						
PLT-INGW-CLOSE	2402	LIMITORQUE	BIN	ON	(ON=1)	MANDC1::1:1		42			1	
PLT-INGW-DB	1429	SP DEADBAND	ANA	0.15	MGD	MANDC1::1:1						
PLT-INGW-ERR	848	CALC VALUE	ANA	-3.31	MGD	MANDC1::1:1						
PLT-INGW-FL	2909	PLT-GW-FL	ANA	18.31	MGD	MANDC1::1:1	113			1		
PLT-INGW-FLC	1381	PT-GW-FL	ANA	49.01	%	MANDC1::1:1		1				1
PLT-INGW-IGAIN	849	CALC VALUE	ANA	1	%MGD	MANDC1::1:1						
PLT-INGW-MANSP	1390	SETPT INH	BIN	ON	(ON=1)	MANDC1::1:1						
PLT-INGW-OPEN	2403	LIMITORQUE	BIN	OFF	(ON=1)	MANDC1::1:1		41			1	
PLT-INGW-PGAIN	850	CALC VALUE	ANA	100	%MGD	MANDC1::1:1						
PLT-INGWFL-OUT	1382	CALC VALUE	ANA	0	%	MANDC1::1:1						
PLT-INGWFL-SP	1447	SETPOINT	ANA	15	MGD	MANDC1::1:1						
PLT-INGWV-CLS	99	VALVE CLOSED	BIN		(ON=1)	MANDC1::1:1	26		1			
PLT-INGWV-OC	558	OPEN/CLOSE	BIN	MODUL	(ON=4)	MANDC1::1:1						
PLT-INGWV-OPN	96	VALVE OPEN	BIN		(ON=1)	MANDC1::1:1	25		1			
PLT-INGWV-POS	2404	CALCULATED	ANA	42.86	%	MANDC1::1:1						
PLT-INGWV-VAL	619	CALC VALUE	ANA	8		MANDC1::1:1	81			1		
POLY-FDP3-ALM	291	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	199		1			
POLY-FDP3-RUN	285	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	198	47	1		1	
POLY-FDP3-SPD	2362	FEDR 3 SPD	ANA	40.51	%	MANDC1::1:1	21			1		
POLY-FDP4-ALM	292	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	201		1			
POLY-FDP4-RUN	286	RUN STATUS	BIN	OFF	(ON=1)	MANDC1::1:1	200	48	1		1	
POLY-FDP4-SPD	62	FEDR 4 SPD	ANA	0	%	MANDC1::1:1	22			1		
RMC-PH	1369	C RAPID MIX	ANA	10.23	PH	MANDC1::1:1	130			1		
RP-HL-LITE	1321	HIGH LEVEL	BIN	OFF	(ON=1)	MANDC1::1:1		7			1	
RP-WTR-HL	114	HIGH LEVEL	BIN	NORMAL	(ON=1)	MANDC1::1:1	98		1			
RTU1-AC-FAIL	868	ON UPS	BIN	NORMAL	(ON=1)	MANDC1::1:1	23		1			
RTU1-LO-BAT	867	LOW UPS BAT	BIN	NORMAL	(ON=1)	MANDC1::1:1	24		1			
SED-C1-AMALM	1337	AUTO SW ALM	BIN	READY	(ON=1)	MANDC1::1:1						
SED-C1-MV1ALM	1388	MODE1 V ALM	BIN	ALARM	(ON=1)	MANDC1::1:1						
SED-C1BRG-ALM	172	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	73		1			

WTP - C-Basin Rapid Mix	RTU 1 / DC 1	Fiber Optic						Discrete Input	Analog Input	Discrete Output	Analog Output
SED-C1BRG-FWD	178	FORWARD MOVE	BIN	------->	(ON=1)	MANDC1::1:1	79	1			
SED-C1BRG-POS1	176	1ST POSITION	BIN		(ON=1)	MANDC1::1:1	77	1			
SED-C1BRG-POS2	177	2ND POSITION	BIN		(ON=1)	MANDC1::1:1	78	1			
SED-C1BRG-REV	179	REVERSE MOVE	BIN	REVERSE	(ON=1)	MANDC1::1:1	80	1			
SED-C1BRG-RUN	174	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	74	1			
SED-C1BRG-STP	4786	BRG STOPPED	BIN	RUNING	(ON=1)	MANDC1::1:1					
SED-C1BRG-TEMP	4642	HI TEMP ALM	BIN	NORMAL	(ON=1)	MANDC1::1:1	92	1			
SED-C1HC1-ALM	287	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	191	1			
SED-C1HC1-RUN	281	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	190	1			
SED-C1HC1-TIMR	1339		ANA	0	MIN	MANDC1::1:1					
SED-C1HC2-ALM	288	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	193	1			
SED-C1HC2-RUN	282	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	192	1			
SED-C1HC2-TIMR	4045		ANA	0	MIN	MANDC1::1:1					
SED-C1P1-ALM	272	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	174	1			
SED-C1P1-AM	269	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	172	1			
SED-C1P1-LS	293	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC1::1:1	204	33	1		1
SED-C1P1-RT	2530	C1 SLUDGE	ANA	86840	HOURS	MANDC1::1:1					
SED-C1P1-SS	148	START/STOP	BIN	ON	(ON=1)	MANDC1::1:1	173	25	1		1
SED-C1P2-ALM	274	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	186		1		
SED-C1P2-AM	271	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	184		1		
SED-C1P2-LS	294	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC1::1:1	205	34	1		1
SED-C1P2-M2	154	FLUSH VALVE	BIN		(ON=1)	MANDC1::1:1		31			1
SED-C1P2-RT	2531	C1 SLUDGE	ANA	33816	HOURS	MANDC1::1:1					
SED-C1P2-SS	150	START/STOP	BIN	OFF	(ON=1)	MANDC1::1:1	185	29	1		1
SED-C1P3-ALM	273	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	177		1		
SED-C1P3-AM	270	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	175		1		
SED-C1P3-LS	295	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC1::1:1	206	35	1		1
SED-C1P3-RT	2532	C1 SLUDGE	ANA	87988	HOURS	MANDC1::1:1					
SED-C1P3-SS	149	START/STOP	BIN	ON	(ON=1)	MANDC1::1:1	176	27	1		1
SED-C1VA-AM	201	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	106		1		
SED-C1VA-CLS	243	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	129		1		
SED-C1VA-OC	116	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1		11			1
SED-C1VA-OPN	217	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	128		1		
SED-C1VA-VAL	620	CALC VALUE	ANA	4		MANDC1::1:1	53			1	
SED-C1VB-CLS	244	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	123		1		
SED-C1VB-OC	559	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1					
SED-C1VB-OPN	218	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	122		1		
SED-C1VB-VAL	621	CALC VALUE	ANA	4		MANDC1::1:1	50			1	
SED-C1VC-CLS	245	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	125		1		
SED-C1VC-OC	560	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1					
SED-C1VC-OPN	219	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	124		1		
SED-C1VC-VAL	622	CALC VALUE	ANA	4		MANDC1::1:1	51			1	
SED-C1VD-AM	202	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	105		1		
SED-C1VD-CLS	246	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	127		1		
SED-C1VD-OC	117	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1		10			1
SED-C1VD-OPN	220	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	126		1		
SED-C1VD-VAL	623	CALC VALUE	ANA	4		MANDC1::1:1	52			1	
SED-C1VE-AM	203	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	109		1		

WTP - C-Basin Rapid Mix		RTU 1 / DC 1		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
SED-C1VE-CLS	247	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	137		1			
SED-C1VE-OC	2866	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1		14			1	
SED-C1VE-OPN	221	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	136		1			
SED-C1VE-VAL	624	CALC VALUE	ANA	0		MANDC1::1:1	57			1		
SED-C1VF-AM	204	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	107		1			
SED-C1VF-CLS	248	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	131		1			
SED-C1VF-OC	2865	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1		12			1	
SED-C1VF-OPN	222	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	130		1			
SED-C1VF-VAL	625	CALC VALUE	ANA	0		MANDC1::1:1	54			1		
SED-C1VG-CLS	249	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	133		1			
SED-C1VG-OC	561	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1						
SED-C1VG-OPN	223	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	132		1			
SED-C1VG-VAL	626	CALC VALUE	ANA	0		MANDC1::1:1	55			1		
SED-C1VH-AM	205	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	108		1			
SED-C1VH-CLS	250	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	135		1			
SED-C1VH-OC	120	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1		13			1	
SED-C1VH-OPN	224	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	134		1			
SED-C1VH-VAL	627	CALC VALUE	ANA	4		MANDC1::1:1	56			1		
SED-C1VJ-AM	206	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	104		1			
SED-C1VJ-CLS	251	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	121		1			
SED-C1VJ-OC	2867	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1		9			1	
SED-C1VJ-OPN	225	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	120		1			
SED-C1VJ-VAL	628	CALC VALUE	ANA	0		MANDC1::1:1	49			1		
SED-C1VK-AM	207	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	110		1			
SED-C1VK-CLS	252	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	139		1			
SED-C1VK-OC	122	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1		15			1	
SED-C1VK-OPN	226	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	138		1			
SED-C1VK-VAL	629	CALC VALUE	ANA	4		MANDC1::1:1	58			1		
SED-C1VL-CLS	253	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	141		1			
SED-C1VL-OC	562	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1						
SED-C1VL-OPN	227	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	140		1			
SED-C1VL-VAL	630	CALC VALUE	ANA	4		MANDC1::1:1	59			1		
SED-C1VM-CLS	254	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	143		1			
SED-C1VM-OC	563	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1						
SED-C1VM-OPN	228	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	142		1			
SED-C1VM-VAL	631	CALC VALUE	ANA	4		MANDC1::1:1	60			1		
SED-C1VN-AM	208	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANDC1::1:1	111		1			
SED-C1VN-CLS	255	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	145		1			
SED-C1VN-OC	2868	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1		16			1	
SED-C1VN-OPN	229	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	144		1			
SED-C1VN-VAL	632	CALC VALUE	ANA	0		MANDC1::1:1	61			1		
SED-C2-AGALM	1409	AUGER ALARM	BIN	READY	(ON=1)	MANDC1::1:1						
SED-C2-AMALM	1412	AUTO SW ALM	BIN	READY	(ON=1)	MANDC1::1:1						
SED-C2-AMSTEP	1415	MODE 1 STEP	ANA	0		MANDC1::1:1						
SED-C2-MV1ALM	1400	MODE2 V ALM	BIN	ALARM	(ON=1)	MANDC1::1:1						
SED-C2-MV2ALM	1404		BIN	ALARM	(ON=1)	MANDC1::1:1						
SED-C2BRG-ALM	4518	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	75		1			
SED-C2BRG-FWD	4516	FORWARD MOVE	BIN	FORWARD	(ON=1)	MANDC1::1:1	83		1			

WTP - C-Basin Rapid Mix		RTU 1 / DC 1		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
SED-C2BRG-POS1	180	POSITION 1	BIN		(ON=1)	MANDC1::1:1	81		1			
SED-C2BRG-POS2	181	2ND POSITION	BIN		(ON=1)	MANDC1::1:1	82		1			
SED-C2BRG-REV	4517	REVERSE MOVE	BIN	------>	(ON=1)	MANDC1::1:1	84		1			
SED-C2BRG-RUN	4519	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	76		1			
SED-C2BRG-STP	4787	BRG STOPPED	BIN	RUNNING	(ON=1)	MANDC1::1:1						
SED-C2BRG-TEMP	4643	HI TEMP ALM	BIN	NORMAL	(ON=1)	MANDC1::1:1	193		1			
SED-C2FL-TIMER	1407		ANA	0.01	MIN	MANDC1::1:1						
SED-C2FLS-STEP	1416	FLUSH TIMER	ANA	0	STEP #	MANDC1::1:1						
SED-C2HC1-ALM	289	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	195		1			
SED-C2HC1-RUN	283	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	194		1			
SED-C2HC1-TIMR	1405		ANA	1	MIN	MANDC1::1:1						
SED-C2HC2-ALM	290	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	197		1			
SED-C2HC2-RUN	284	RUN STATUS	BIN	ON	(ON=1)	MANDC1::1:1	196		1			
SED-C2HC2-TIMR	4044		ANA	0	MIN	MANDC1::1:1						
SED-C2M1-AVALM	1411	M1 AVAL ALM	BIN	READY	(ON=1)	MANDC1::1:1						
SED-C2M1-SS	1402	MODE 2 S/S	BIN	OFF	(ON=1)	MANDC1::1:1						
SED-C2M2-AVALM	1410	AUTO CON ALM	BIN	READY	(ON=1)	MANDC1::1:1						
SED-C2M2-SS	1403	MODE 2 SS	BIN	OFF	(ON=1)	MANDC1::1:1						
SED-C2P1-ALM	275	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	180		1			
SED-C2P1-AM	278	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	178		1			
SED-C2P1-LS	296	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC1::1:1	207	36	1			1
SED-C2P1-RT	2533	C2 SLUDGE	ANA	48760	HOURS	MANDC1::1:1						
SED-C2P1-SS	151	START/STOP	BIN	ON	(ON=1)	MANDC1::1:1	179	26	1			1
SED-C2P2-ALM	277	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	189		1			
SED-C2P2-AM	280	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	187		1			
SED-C2P2-LS	297	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC1::1:1	208	37	1			1
SED-C2P2-M2	155	FLUSH VALVE	BIN		(ON=1)	MANDC1::1:1						
SED-C2P2-RT	2534	C2 SLUDGE	ANA	7543	HOURS	MANDC1::1:1						
SED-C2P2-SS	153	START/STOP	BIN	OFF	(ON=1)	MANDC1::1:1	188	30	1			1
SED-C2P2-STBY	1408	PUMP2	BIN	STDBY	(ON=1)	MANDC1::1:1						
SED-C2P2-TEST	4811	FLUSH VALVE	BIN	OFF	(ON=1)	MANDC1::1:1						
SED-C2P2-TIMER	1406	PUMP TIMER	ANA	0	MIN	MANDC1::1:1						
SED-C2P3-ALM	276	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC1::1:1	183		1			
SED-C2P3-AM	279	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	181		1			
SED-C2P3-LS	298	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC1::1:1	209	38	1			1
SED-C2P3-RT	2535	C2 SLUDGE	ANA	70580	HOURS	MANDC1::1:1						
SED-C2P3-SS	152	START/STOP	BIN	OFF	(ON=1)	MANDC1::1:1	182	28	1			1
SED-C2VA-AM	209	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	112		1			
SED-C2VA-CLS	256	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	147		1			
SED-C2VA-OC	140	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1		17				1
SED-C2VA-OPN	230	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	146		1			
SED-C2VA-VAL	633	CALC VALUE	ANA	0		MANDC1::1:1	62			1		
SED-C2VB-CLS	257	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	149		1			
SED-C2VB-OC	564	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1						
SED-C2VB-OPN	231	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	148		1			
SED-C2VB-VAL	634	CALC VALUE	ANA	4		MANDC1::1:1	63			1		
SED-C2VC-CLS	258	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	151		1			
SED-C2VC-OC	565	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1						

WTP - C-Basin Rapid Mix		RTU 1 / DC 1		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
SED-C2VC-OPN	232	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	150		1			
SED-C2VC-VAL	635	CALC VALUE	ANA	4		MANDC1::1:1	64			1		
SED-C2VD-AM	210	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	113		1			
SED-C2VD-CLS	259	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	153		1			
SED-C2VD-OC	141	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1		18			1	
SED-C2VD-OPN	233	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	152		1			
SED-C2VD-VAL	636	CALC VALUE	ANA	0		MANDC1::1:1	65			1		
SED-C2VE-AM	211	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	114		1			
SED-C2VE-CLS	260	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	155		1			
SED-C2VE-OC	142	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1		19			1	
SED-C2VE-OPN	234	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	154		1			
SED-C2VE-VAL	637	CALC VALUE	ANA	4		MANDC1::1:1	66			1		
SED-C2VF-AM	212	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	115		1			
SED-C2VF-CLS	261	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	157		1			
SED-C2VF-OC	143	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1		20			1	
SED-C2VF-OPN	235	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	156		1			
SED-C2VF-VAL	638	CALC VALUE	ANA	0		MANDC1::1:1	67			1		
SED-C2VG-CLS	262	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	159		1			
SED-C2VG-OC	566	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1						
SED-C2VG-OPN	236	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	158		1			
SED-C2VG-VAL	639	CALC VALUE	ANA	0		MANDC1::1:1	68			1		
SED-C2VH-AM	213	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	116		1			
SED-C2VH-CLS	263	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	161		1			
SED-C2VH-OC	144	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1		21			1	
SED-C2VH-OPN	237	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	160		1			
SED-C2VH-VAL	640	CALC VALUE	ANA	0		MANDC1::1:1	69			1		
SED-C2VJ-AM	214	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	117		1			
SED-C2VJ-CLS	264	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	163		1			
SED-C2VJ-OC	145	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1		22			1	
SED-C2VJ-OPN	238	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	162		1			
SED-C2VJ-VAL	641	CALC VALUE	ANA	0		MANDC1::1:1	70			1		
SED-C2VK-AM	215	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	118		1			
SED-C2VK-CLS	265	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC1::1:1	165		1			
SED-C2VK-OC	146	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC1::1:1		23			1	
SED-C2VK-OPN	239	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	164		1			
SED-C2VK-VAL	642	CALC VALUE	ANA	0		MANDC1::1:1	71			1		
SED-C2VL-CLS	266	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	167		1			
SED-C2VL-OC	567	OPEN/CLOSE	BIN	INTER	(ON=4)	MANDC1::1:1						
SED-C2VL-OPN	240	OPEN STATUS	BIN		(ON=1)	MANDC1::1:1	166		1			
SED-C2VL-VAL	643	CALC VALUE	ANA	8		MANDC1::1:1	72			1		
SED-C2VM-CLS	267	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	169		1			
SED-C2VM-OC	568	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1						
SED-C2VM-OPN	241	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	168		1			
SED-C2VM-VAL	644	CALC VALUE	ANA	4		MANDC1::1:1	73			1		
SED-C2VN-AM	216	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1	119		1			
SED-C2VN-CLS	268	CLOSE STATUS	BIN		(ON=1)	MANDC1::1:1	171		1			
SED-C2VN-OC	147	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1		24			1	
SED-C2VN-OPN	242	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC1::1:1	170		1			

WTP - C-Basin Rapid Mix	RTU 1 / DC 1	Fiber Optic							Discrete Input	Analog Input	Discrete Output	Analog Output
SED-C2VN-VAL	645	CALC VALUE	ANA	4		MANDC1::1:1	74			1		
SED-C2WST-INH1	1413	WASTE INH	BIN	OFF	(ON=1)	MANDC1::1:1						
SED-C2WST-INH2	1414	WASTE INH	BIN	OFF	(ON=1)	MANDC1::1:1						
TU-FL-OUT	712	CALC VALUE	ANA	97.48	%	MANDC1::1:1						
TU-IN-ABS	1432	ABSOLUTE	ANA	15	MGD	MANDC1::1:1						
TU-IN-AM	713	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1						
TU-IN-BIAS	714		ANA	50	%	MANDC1::1:1						
TU-IN-CH	1428	SP CHANGE	ANA	15	MGD	MANDC1::1:1						
TU-IN-DB	1430	SP DEADBAND	ANA	0.5	MGD	MANDC1::1:1						
TU-IN-ERR	709	CALC VALUE	ANA	15	MGD	MANDC1::1:1						
TU-IN-FL	45	RAW WTR FLOW	ANA	0	MGD	MANDC1::1:1						
TU-IN-FLC	64	TREAT FLOW	ANA	0	%	MANDC1::1:1		2				1
TU-IN-IGAIN	710	CALC VALUE	ANA	1	%/MGD	MANDC1::1:1						
TU-IN-PGAIN	711	CALC VALUE	ANA	4	%/MGD	MANDC1::1:1						
TU-INDEGV-CLS	131	VALVE CLOSED	BIN		(ON=1)	MANDC1::1:1	48		1			
TU-INDEGV-OC	569	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1						
TU-INDEGV-OPN	127	VALVE OPEN	BIN	OPEN	(ON=1)	MANDC1::1:1	47		1			
TU-INDEGV-VAL	646	CALC VALUE	ANA	4		MANDC1::1:1	75			1		
TU-INFL-SP	693	SETPOINT	ANA	15	MGD	MANDC1::1:1						
TU-INLWV-CLS	130	VALVE CLOSED	BIN		(ON=1)	MANDC1::1:1	46		1			
TU-INLWV-OC	570	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC1::1:1						
TU-INLWV-OPN	126	VALVE OPEN	BIN	OPEN	(ON=1)	MANDC1::1:1	45		1			
TU-INLWV-VAL	647	CALC VALUE	ANA	4		MANDC1::1:1	76			1		
TU-INV-POS	46	VALVE POS	ANA	0	%	MANDC1::1:1	118			1		
TU2-IN-IGAIN	838	CALC VALUE	ANA	0	%/MGD	MANDC1::1:1						
TU2-IN-PGAIN	842	CALC VALUE	ANA	0	%	MANDC1::1:1						
TU3-IN-AM	846	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC1::1:1						
TU3-IN-BIAS	844		ANA	0	%	MANDC1::1:1						
TU3-IN-IGAIN	839	CALC VALUE	ANA	0	%/MGD	MANDC1::1:1						
TU3-IN-PGAIN	843	CALC VALUE	ANA	0	%	MANDC1::1:1						

Discrete Input 24 VDC	**216**			
Analog Input 4-20 mA		**64**		
Discrete Output 24 VDC			**58**	
Analog Output 4-20 mA				**29**

A/B Backwash	DC 1 PLC Modicon	Fiber Optic

Insert V

POINT FILE SUMMARY 16-OCT-17 10:38:21								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
AB-SLG-REMFLOW	4149	REMND SLG FL	ANA	0	GPM	MANDC1::2:1		1011
AB-SLG-RTSP	4150	RUN TIME SPT	ANA	120	MIN	MANDC1::2:1		1004
AB-SLGU1-AUTO	4301	UNIT 1 HOA	BIN	MANUAL	(ON=1)	MANDC1::2:1		316
AB-SLGU1-ED	4302	START	BIN	DISABLE	(ON=1)	MANDC1::2:1		82
AB-SLGU1-FAIL	4303	PUMP FAILURE	BIN	ALARM	(ON=1)	MANDC1::2:1		318
AB-SLGU1-FORWD	4304	UNIT 1 FORWD	BIN		(ON=1)	MANDC1::2:1		313
AB-SLGU1-FWDLY	4305	FWRD TIM DLY	ANA	30	SEC	MANDC1::2:1		1005
AB-SLGU1-OVRLD	4306	UNIT1 TORQUE	BIN	OVERLOAD	(ON=1)	MANDC1::2:1		315
AB-SLGU1-PLR	4307	UNIT1 REMOTE	BIN	LOCAL	(ON=1)	MANDC1::2:1		317
AB-SLGU1-POWER	4308	POWER FAIL	BIN	NORMAL	(ON=1)	MANDC1::2:1		320
AB-SLGU1-PSTA	4309	UNIT 1 STAT	BIN	OFF	(ON=1)	MANDC1::2:1		319
AB-SLGU1-REDLY	4310	REV TIME DLY	ANA	30	SEC	MANDC1::2:1		1006
AB-SLGU1-REVER	4311	UNIT 1 REVRS	BIN		(ON=1)	MANDC1::2:1		314
AB-SLGU1-SCADA	4312	AUTO MODE	BIN	MANUAL	(ON=1)	MANDC1::2:1		81
AB-SLGU1-TMCYC	4315	MIN LAST CYC	ANA	4	MIN	MANDC1::2:1		1000
AB-SLGU2-AUTO	4316	UNIT 2 HOA	BIN	MANUAL	(ON=1)	MANDC1::2:1		332
AB-SLGU2-ED	4317	START	BIN	DISABLE	(ON=1)	MANDC1::2:1		84
AB-SLGU2-FAIL	4318	PUMP FAILURE	BIN	NORMAL	(ON=1)	MANDC1::2:1		334
AB-SLGU2-FORWD	4319	UNIT 2 FORWD	BIN		(ON=1)	MANDC1::2:1		329
AB-SLGU2-FWDLY	4320	FWRD TIM DLY	ANA	30	SEC	MANDC1::2:1		1007
AB-SLGU2-OVRLD	4321	UNIT2 TORQUE	BIN	NORMAL	(ON=1)	MANDC1::2:1		331
AB-SLGU2-PLR	4322	UNIT2 REMOTE	BIN	LOCAL	(ON=1)	MANDC1::2:1		333
AB-SLGU2-POWER	4323	POWER FAIL	BIN	NORMAL	(ON=1)	MANDC1::2:1		336
AB-SLGU2-PSTA	4324	UNIT 2 STAT	BIN	OFF	(ON=1)	MANDC1::2:1		335
AB-SLGU2-REDLY	4325	REV TIME DLY	ANA	30	SEC	MANDC1::2:1		1008
AB-SLGU2-REVER	4326	UNIT 2 REVRS	BIN		(ON=1)	MANDC1::2:1		330
AB-SLGU2-SCADA	4327	AUTO MODE	BIN	MANUAL	(ON=1)	MANDC1::2:1		83
AB-SLGU2-SKSTA	4328	SLG COL STA	BIN	OFF	(ON=1)	MANDC1::2:1		
AB-SLGU2-TMCYC	4330	MIN LAST CYC	ANA	5	MIN	MANDC1::2:1		1003
MANPL1-STS	4334	PLC 1 COM	BIN	ONLINE	(ON=1)	MANDC1::2:1		
MOD-TEST	4088		ANA	0		MANDC1::2:1	1	

	Discrete Input	Analog Input	Discrete Output	Analog Output
AB-SLG-REMFLOW				1
AB-SLG-RTSP				1
AB-SLGU1-AUTO			1	
AB-SLGU1-ED			1	
AB-SLGU1-FAIL			1	
AB-SLGU1-FORWD			1	
AB-SLGU1-FWDLY				1
AB-SLGU1-OVRLD			1	
AB-SLGU1-PLR			1	
AB-SLGU1-POWER			1	
AB-SLGU1-PSTA			1	
AB-SLGU1-REDLY				1
AB-SLGU1-REVER			1	
AB-SLGU1-SCADA			1	
AB-SLGU1-TMCYC				1
AB-SLGU2-AUTO			1	
AB-SLGU2-ED			1	
AB-SLGU2-FAIL			1	
AB-SLGU2-FORWD			1	
AB-SLGU2-FWDLY				1
AB-SLGU2-OVRLD			1	
AB-SLGU2-PLR			1	
AB-SLGU2-POWER			1	
AB-SLGU2-PSTA			1	
AB-SLGU2-REDLY				1
AB-SLGU2-REVER			1	
AB-SLGU2-SCADA			1	
AB-SLGU2-SKSTA				
AB-SLGU2-TMCYC				1
MANPL1-STS				
MOD-TEST		1		

Discrete Input 24 VDC	**0**			
Analog Input 4-20 mA		**1**		
Discrete Output 24 VDC			**20**	
Analog Output 4-20 mA				**8**

WTP - Electrical Room	RTU 2 / DC 2	Fiber Optic

Insert V

POINT FILE SUMMARY 13-OCT-17 10:23:40								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
BCFL-DTHI-LEV	2308	DAY TANK	BIN	NORMAL	(ON=1)	MANDC2::1:2	179	
BCFL-FDP1-AM	2313	PUMP 1	BIN	MANUAL	(ON=1)	MANDC2::1:2	180	
BCFL-FDP1-FAIL	2303	PUMP 1	BIN	NORMAL	(ON=1)	MANDC2::1:2	175	
BCFL-FDP1-SPC	2298	SPEED CTRL	ANA	0	%	MANDC2::1:2		17
BCFL-FDP1-SS	2300	PUMP 1	BIN	OFF	(ON=1)	MANDC2::1:2	177	33
BCFL-FDP2-AM	2314	PUMP 2	BIN	MANUAL	(ON=1)	MANDC2::1:2	181	
BCFL-FDP2-FAIL	2302	PUMP 2	BIN	NORMAL	(ON=1)	MANDC2::1:2	176	
BCFL-FDP2-SPC	2299	SPEED CTRL	ANA	0	%	MANDC2::1:2		18
BCFL-FDP2-SS	2301	PUMP 2	BIN	ON	(ON=1)	MANDC2::1:2	178	34
BCFL-GPH	5014	ANALYZER	ANA	2.24	PPM	MANDC2::1:2	45	
BCFL-PPM	2297	ANALYZER	ANA	0.76	PPM	MANDC2::1:2	45	
BCFL-PPM-ALM	2327	FLUORIDE	BIN	ALARM	(ON=1)	MANDC2::1:2		
BCFL-PPM-SPT	2291	SETPOINT	ANA	0	PPM	MANDC2::1:2		
BCFL-PUMP-ALM	2326	FLOURIDE	BIN	NORMAL	(ON=1)	MANDC2::1:2		
BCFL-WS1-SCL	2309	WEIGHT SCALE	ANA	2259.3	LBS	MANDC2::1:2	46	
BLENDC-PH	1436	BLEND CHMBER	ANA	7.69	PH	MANDC2::1:2	23	
BLENDC-TURB	2912	BLEND CHAM	ANA	0.039	NTU	MANDC2::1:2	27	
BLENDCH-CHL	2924	CHLORAMINE	ANA	5.055	PPM	MANDC2::1:2	28	
C-EFF-FL-AVG	4772	EFF FLOW AVG	ANA	3.65	MGD	MANDC2::1:2		
C-FLUME-AVG	4765	LEVEL AVG	ANA	2.62	MGD	MANDC2::1:2		
C-PLT-WTR-PMP	2577	C BASIN	ANA	0	GPM	MANDC2::1:2		
C-WTR-PMP-DTFL	2578		ANA	0	XGALS	MANDC2::1:2		
CBAS-SLDG-FL	2137	SLUDGE FLOW	ANA	71.25	GPM	MANDC2::1:2	43	
CFILTERS-CL2	4395	CHLORAMINE	ANA	0.955	PPM	MANDC2::1:2	30	
CFILTERS-TUR	4396	TURBIDITY	ANA	0.186	NTU	MANDC2::1:2	32	
CPOST-CO2	1783	C POST CO2	ANA	19.68	PPM	MANDC2::1:2	24	
CWB-HSP1-ALM	409	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	150	
CWB-HSP1-ES	1610	EMERG. STOP	BIN	EMSTOP	(ON=1)	MANDC2::1:2	172	
CWB-HSP1-LS	487	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC2::1:2		26
CWB-HSP1-RT	2506	CLEARWELL B	ANA	15986	HOURS	MANDC2::1:2		
CWB-HSP1-RUN	468	CWB PUMP #1	BIN	OFF	(ON=1)	MANDC2::1:2	149	29
CWB-HSP1-SPD	32	PMP SPEED	ANA	22	%	MANDC2::1:2		
CWB-HSP1PC-ABS	1590	ABSOLUTE	ANA	61.61	PSI	MANDC2::1:2		
CWB-HSP1PC-SPC	1579	CLRWEL C	ANA	50	%	MANDC2::1:2		13
CWB-HSP2-ALM	410	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	152	
CWB-HSP2-ES	1611	EMERG. STOP	BIN	EMSTOP	(ON=1)	MANDC2::1:2	173	
CWB-HSP2-LS	488	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC2::1:2		27
CWB-HSP2-RT	2507	CLEARWELL B	ANA	7446	HOURS	MANDC2::1:2		
CWB-HSP2-RUN	469	CWB PUMP #2	BIN	OFF	(ON=1)	MANDC2::1:2	151	30
CWB-HSP2-SPD	34	PMP SPEED	ANA	5	%	MANDC2::1:2		
CWB-HSP2PC-ABS	1591	ABSOLUTE	ANA	61.61	PSI	MANDC2::1:2		
CWB-HSP2PC-SPC	1580	CLRWEL C	ANA	50	%	MANDC2::1:2		14

Discrete Input	Analog Input	Discrete Output	Analog Output
1			
1			
1			
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			1

WTP - Electrical Room		RTU 2 / DC 2		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
CWB-HSP3-ALM	411	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	154		1			
CWB-HSP3-ES	1612	EMERG. STOP	BIN	EMSTOP	(ON=1)	MANDC2::1:2	174		1			
CWB-HSP3-LS	489	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC2::1:2		28			1	
CWB-HSP3-RT	2508	CLEARWELL B	ANA	15583	HOURS	MANDC2::1:2						
CWB-HSP3-RUN	1062	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::1:2	153	31	1		1	
CWB-HSP3-SPD	35	PMP SPEED	ANA	0	%	MANDC2::1:2	33			1		
CWB-HSP3PC-ABS	1592	ABSOLUTE	ANA	61.61	PSI	MANDC2::1:2						
CWB-HSP3PC-SPC	1581	CLRWEL C	ANA	50	%	MANDC2::1:2		15				1
CWB-HSP4-RT	2509	CLEARWELL B	ANA	19703	HOURS	MANDC2::1:2						
CWB-HSP5-RT	2510	CLEARWELL B	ANA	17919	HOURS	MANDC2::1:2						
CWC-BWM-RDY	399	BCKWSH READY	BIN		(ON=1)	MANDC2::1:2	127		1			
CWC-BWMV-CLS	395	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	122		1			
CWC-BWMV-LR	397	LOCAL/REMOTE	BIN	REMOTE	(ON=1)	MANDC2::1:2	125		1			
CWC-BWMV-OC	490	OPEN CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2		12			1	
CWC-BWMV-OPN	393	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	121		1			
CWC-BWMV-VAL	617	CALC VALUE	ANA	0		MANDC2::1:2	86			1		
CWC-BWTP1-ALM	401	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	129		1			
CWC-BWTP1-LS	484	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC2::1:2	169	23	1		1	
CWC-BWTP1-RDY	3306	READY STAT	BIN	READY	(ON=1)	MANDC2::1:2	146		1			
CWC-BWTP1-RT	2516	CLEARWELL A	ANA	31115	HOURS	MANDC2::1:2						
CWC-BWTP1-RUN	456	RUN STATUS	BIN	ON	(ON=1)	MANDC2::1:2	130	35	1		1	
CWC-BWTP2-ALM	402	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	131		1			
CWC-BWTP2-LS	485	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC2::1:2	170	24	1		1	
CWC-BWTP2-RDY	3307	READY STAT	BIN	READY	(ON=1)	MANDC2::1:2	147		1			
CWC-BWTP2-RT	2517	CLEARWELL A	ANA	31416	HOURS	MANDC2::1:2						
CWC-BWTP2-RUN	457	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::1:2	132	36	1		1	
CWC-BWTP3-ALM	403	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	133		1			
CWC-BWTP3-LS	486	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC2::1:2	171	25	1		1	
CWC-BWTP3-RDY	3308	READY STAT	BIN	READY	(ON=1)	MANDC2::1:2	148		1			
CWC-BWTP3-RT	2518	CLEARWELL A	ANA	28385	HOURS	MANDC2::1:2						
CWC-BWTP3-RUN	458	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::1:2	134	37	1		1	
CWC-HSP1-ALM	406	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	142		1			
CWC-HSP1-LR	460	LOCAL/REMOTE	BIN	REMOTE	(ON=0)	MANDC2::1:2	140		1			
CWC-HSP1-LS	479	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC2::1:2	161	18	1		1	
CWC-HSP1-RT	2511	CLEARWELL C	ANA	33927	HOURS	MANDC2::1:2						
CWC-HSP1-SS	465	START/STOP	BIN	ON	(ON=1)	MANDC2::1:2	141	15	1		1	
CWC-HSP2-ALM	407	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	145		1			
CWC-HSP2-LR	461	LOCAL/REMOTE	BIN	REMOTE	(ON=0)	MANDC2::1:2	143		1			
CWC-HSP2-LS	480	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC2::1:2	163	19	1		1	
CWC-HSP2-RT	2490	CLEARWELL C	ANA	38092	HOURS	MANDC2::1:2						
CWC-HSP2-SS	466	START/STOP	BIN	OFF	(ON=1)	MANDC2::1:2	144	16	1		1	
CWC-LEV	25	LEVEL	ANA	8.89	FEET	MANDC2::1:2	22			1		
CWC-SWP-LR	459	LOCAL/REMOTE	BIN	AUTO	(ON=1)	MANDC2::1:2	135		1			
CWC-SWP1-ALM	404	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	136		1			
CWC-SWP1-LS	482	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC2::1:2	167	21	1		1	
CWC-SWP1-RUN	463	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::1:2	138		1			
CWC-SWP2-ALM	405	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	137		1			
CWC-SWP2-LS	483	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC2::1:2	168	22	1		1	

WTP - Electrical Room		RTU 2 / DC 2		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
CWC-SWP2-RUN	464	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::1:2	139		1			
CWC-TM-RDY	400	XFER READY	BIN	READY	(ON=1)	MANDC2::1:2	128		1			
CWC-TMV-CLS	396	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	124		1			
CWC-TMV-LR	398	LOCAL/REMOTE	BIN	REMOTE	(ON=1)	MANDC2::1:2	126		1			
CWC-TMV-OC	491	OPEN CLOSE	BIN	OPEN	(ON=4)	MANDC2::1:2		13			1	
CWC-TMV-OPN	394	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC2::1:2	123		1			
CWC-TMV-VAL	618	CALC VALUE	ANA	4		MANDC2::1:2	87			1		
CWC-XFER-FL	29	FINISH FLOW	ANA	15.09	MGD	MANDC2::1:2	26			1		
CWC-XFER-SS	1305	PMP ALT S/S	BIN	START	(ON=1)	MANDC2::1:2						
CWTR-PMP-INTFL	2579		ANA	0	XGALS	MANDC2::1:2						
ELEC-BUS1-KW	2715	BUSS 1 KWH	ANA	1293.93	KW	MANDC2::1:2	34			1		
ELEC-BUS1-VLT	39	BUSS 1 ACV	ANA	4133.01	ACV	MANDC2::1:2	35			1		
ELEC-BUS2-KW	37	BUSS 2 KWH	ANA	1433.47	KW	MANDC2::1:2	48			1		
ELEC-BUS2-VLT	40	BUSS 2 ACV	ANA	4126.6	ACV	MANDC2::1:2	37			1		
ELEC-GEN-KW	38	GEN KWH	ANA	0	KW	MANDC2::1:2	38			1		
ELEC-GEN-VLT	41	BAC GEN ACV	ANA	0	ACV	MANDC2::1:2	39			1		
ELEC-GEN1-ALM	476	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	165		1			
ELEC-GEN1-BKR	478	GEN 1 BRAKER	BIN	OPEN	(ON=1)	MANDC2::1:2	159		1			
ELEC-GEN1-RUN	473	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::1:2	158		1			
ELEC-GEN2-ALM	4641	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	164		1			
ELEC-GEN2-BKR	475	GEN 2 BRAKER	BIN	OPEN	(ON=1)	MANDC2::1:2	162		1			
ELEC-GEN2-RUN	474	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::1:2	160		1			
ELEC-GEN3-ALM	3942	FAIL ALARM	BIN	ALARM	(ON=1)	MANDC2::1:2	184		1			
ELEC-GEN3-BKR	3940	GEN 3 BRK	BIN	OPEN	(ON=1)	MANDC2::1:2	182		1			
ELEC-GEN3-RUN	3941	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::1:2	183		1			
ELEC-KWH-TOT	1524	TOT DEMAND	ANA	2714.72	KW	MANDC2::1:2						
ELEC-TB-OC	472	BRK STATUS	BIN	OFF	(ON=1)	MANDC2::1:2	157		1			
FLT13-BWV-CLS	354	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	77		1			
FLT13-BWV-OC	522	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT13-BWV-OPN	348	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	76		1			
FLT13-BWV-VAL	580	CALC VALUE	ANA	0		MANDC2::1:2	49			1		
FLT13-DUR-TIM	733	DURATION TIM	ANA	0.97	HRS	MANDC2::1:2						
FLT13-EFF-FL	5	EFFLUENT FLO	ANA	4.8	MGD	MANDC2::1:2	2			1		
FLT13-EFF-FLC	86	CCC CONTROL	ANA	0	MGD	MANDC2::1:2		7				1
FLT13-EFFV-CLS	571	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	29		1			
FLT13-EFFV-OC	521	OPEN/CLOSE	BIN	INTER	(ON=4)	MANDC2::1:2						
FLT13-EFFV-OPN	301	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	28		1			
FLT13-EFFV-VAL	581	CALC VALUE	ANA	8		MANDC2::1:2	50			1		
FLT13-EFV-OR	1417	OVERRIDE	BIN	OFF	(ON=1)	MANDC2::1:2		49			1	
FLT13-FDV-CLS	342	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	65		1			
FLT13-FDV-OC	523	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT13-FDV-OPN	336	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	64		1			
FLT13-FDV-VAL	582	CALC VALUE	ANA	0		MANDC2::1:2	51			1		
FLT13-INV-CLS	318	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	41		1			
FLT13-INV-OC	524	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC2::1:2						
FLT13-INV-OPN	312	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC2::1:2	40		1			
FLT13-INV-VAL	583	CALC VALUE	ANA	4		MANDC2::1:2	52			1		
FLT13-LEV-SP	1357	AUTO CONTROL	ANA	3.32	MGD	MANDC2::1:2		1				1

WTP - Electrical Room		RTU 2 / DC 2		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
FLT13-LOH-ALM	372	HEAD ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	100		1			
FLT13-LOH-DP	11	HEAD LOSS	ANA	0.6	FT	MANDC2::1:2	8			1		
FLT13-SP-DEV	4766	DEVIATION	ANA	1.48	MGD	MANDC2::1:2						
FLT13-SWV-CLS	324	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	53		1			
FLT13-SWV-OC	525	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT13-SWV-OPN	330	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	52		1			
FLT13-SWV-VAL	584	CALC VALUE	ANA	0		MANDC2::1:2	53			1		
FLT13-TRB-HL	386	HIGH ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	114		1			
FLT13-TRB-NTU	19	TURBIDITY	ANA	0.213	NTU	MANDC2::1:2	41			1		
FLT13-TRBS-EI	380	SAMPLE SEL	BIN	EFLUNT	(ON=1)	MANDC2::1:2	108		1			
FLT13-WSTV-CLS	366	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	89		1			
FLT13-WSTV-OC	526	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT13-WSTV-OPN	360	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	88		1			
FLT13-WSTV-VAL	585	CALC VALUE	ANA	0		MANDC2::1:2	54			1		
FLT14-BWV-CLS	355	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	79		1			
FLT14-BWV-OC	527	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT14-BWV-OPN	349	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	78		1			
FLT14-BWV-VAL	586	CALC VALUE	ANA	0		MANDC2::1:2	55			1		
FLT14-DUR-TIM	734	DURATION TIM	ANA	332.62	HRS	MANDC2::1:2						
FLT14-EFF-FL	6	EFFLUENT FLO	ANA	2.79	MGD	MANDC2::1:2	3			1		
FLT14-EFF-FLC	87	CCC CONTROL	ANA	0	MGD	MANDC2::1:2		8				1
FLT14-EFFV-CLS	307	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	31		1			
FLT14-EFFV-OC	528	OPEN/CLOSE	BIN	INTER	(ON=4)	MANDC2::1:2						
FLT14-EFFV-OPN	302	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	30		1			
FLT14-EFFV-VAL	587	CALC VALUE	ANA	8		MANDC2::1:2	56			1		
FLT14-EFV-OR	1418	OVERRIDE	BIN	OFF	(ON=1)	MANDC2::1:2		50			1	
FLT14-FDV-CLS	343	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	67		1			
FLT14-FDV-OC	529	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT14-FDV-OPN	337	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	66		1			
FLT14-FDV-VAL	588	CALC VALUE	ANA	0		MANDC2::1:2	57			1		
FLT14-INV-CLS	319	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	43		1			
FLT14-INV-OC	530	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC2::1:2						
FLT14-INV-OPN	313	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC2::1:2	42		1			
FLT14-INV-VAL	589	CALC VALUE	ANA	4		MANDC2::1:2	58			1		
FLT14-LEV-SP	1358	AUTO CONTROL	ANA	3.32	MGD	MANDC2::1:2		2				1
FLT14-LOH-ALM	373	HEAD ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	101		1			
FLT14-LOH-DP	12	HEAD LOSS	ANA	0.2	FT	MANDC2::1:2	9			1		
FLT14-SP-DEV	4767	DEVIATION	ANA	-0.53	MGD	MANDC2::1:2						
FLT14-SWV-CLS	325	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	55		1			
FLT14-SWV-OC	531	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT14-SWV-OPN	331	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	54		1			
FLT14-SWV-VAL	590	CALC VALUE	ANA	0		MANDC2::1:2	59			1		
FLT14-TRB-HL	387	HIGH ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	115		1			
FLT14-TRB-NTU	20	TURBIDITY	ANA	0.168	NTU	MANDC2::1:2	17			1		
FLT14-TRBS-EI	381	SAMPLE SEL	BIN	EFLUNT	(ON=1)	MANDC2::1:2	109		1			
FLT14-WSTV-CLS	367	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	91		1			
FLT14-WSTV-OC	532	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT14-WSTV-OPN	361	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	90		1			

WTP - Electrical Room		RTU 2 / DC 2		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
FLT14-WSTV-VAL	591	CALC VALUE	ANA	0		MANDC2::1:2	60			1		
FLT15-BWV-CLS	356	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	81		1			
FLT15-BWV-OC	533	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT15-BWV-OPN	350	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	80		1			
FLT15-BWV-VAL	592	CALC VALUE	ANA	0		MANDC2::1:2	61			1		
FLT15-DLY-VAL	442	DELAY VALUE	ANA	1	X 15 SEC	MANDC2::1:2						
FLT15-DUR-TIM	735	DURATION TIM	ANA	581.97	HRS	MANDC2::1:2						
FLT15-EFF-FL	10	EFFLUENT FLO	ANA	3.7	MGD	MANDC2::1:2	4			1		
FLT15-EFF-FLC	88	CCC CONTROL	ANA	0	MGD	MANDC2::1:2		9				1
FLT15-EFFV-CLS	308	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	33		1			
FLT15-EFFV-OC	534	OPEN/CLOSE	BIN	INTER	(ON=4)	MANDC2::1:2						
FLT15-EFFV-OPN	303	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	32		1			
FLT15-EFFV-VAL	593	CALC VALUE	ANA	8		MANDC2::1:2	62			1		
FLT15-EFV-OR	1419	OVERRIDE	BIN	OFF	(ON=1)	MANDC2::1:2		51			1	
FLT15-FDV-CLS	344	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	69		1			
FLT15-FDV-OC	535	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT15-FDV-OPN	338	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	68		1			
FLT15-FDV-VAL	594	CALC VALUE	ANA	0		MANDC2::1:2	63			1		
FLT15-INV-CLS	320	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	45		1			
FLT15-INV-OC	536	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC2::1:2						
FLT15-INV-OPN	314	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC2::1:2	44		1			
FLT15-INV-VAL	595	CALC VALUE	ANA	4		MANDC2::1:2	64			1		
FLT15-LEV-SP	1359	AUTO CONTROL	ANA	3.32	MGD	MANDC2::1:2		3				1
FLT15-LOH-ALM	374	HEAD ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	102		1			
FLT15-LOH-DP	13	HEAD LOSS	ANA	0.6	FT	MANDC2::1:2	10			1		
FLT15-PRO-DP	18	PROFILE DP	ANA	0	FT	MANDC2::1:2	40			1		
FLT15-PRO1-SV	412	SAMPLE SOLV	BIN	CLOSED	(ON=1)	MANDC2::1:2		1			1	
FLT15-PRO10-SV	421	SAMPLE SOLV	BIN	CLOSED	(ON=1)	MANDC2::1:2		10			1	
FLT15-PRO2-SV	413	SAMPLE SOLV	BIN	CLOSED	(ON=1)	MANDC2::1:2		2			1	
FLT15-PRO3-SV	414	SAMPLE SOLV	BIN	CLOSED	(ON=1)	MANDC2::1:2		3			1	
FLT15-PRO4-SV	415	SAMPLE SOLV	BIN	CLOSED	(ON=1)	MANDC2::1:2		4			1	
FLT15-PRO5-SV	416	SAMPLE SOLV	BIN	CLOSED	(ON=1)	MANDC2::1:2		5			1	
FLT15-PRO6-SV	417	SAMPLE SOLV	BIN	CLOSED	(ON=1)	MANDC2::1:2		6			1	
FLT15-PRO7-SV	418	SAMPLE SOLV	BIN	CLOSED	(ON=1)	MANDC2::1:2		7			1	
FLT15-PRO8-SV	419	SAMPLE SOLV	BIN	CLOSED	(ON=1)	MANDC2::1:2		8			1	
FLT15-PRO9-SV	420	SAMPLE SOLV	BIN	CLOSED	(ON=1)	MANDC2::1:2		9			1	
FLT15-SP-DEV	4768	DEVIATION	ANA	0.39	MGD	MANDC2::1:2						
FLT15-SWV-CLS	326	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	57		1			
FLT15-SWV-OC	537	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT15-SWV-OPN	332	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	56		1			
FLT15-SWV-VAL	596	CALC VALUE	ANA	0		MANDC2::1:2	65			1		
FLT15-TRB-HL	388	HIGH ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	116		1			
FLT15-TRB-NTU	21	TURBIDITY	ANA	0.139	NTU	MANDC2::1:2	18			1		
FLT15-TRBS-EI	382	SAMPLE SEL	BIN	EFLUNT	(ON=1)	MANDC2::1:2	110		1			
FLT15-WSTV-CLS	368	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	93		1			
FLT15-WSTV-OC	538	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT15-WSTV-OPN	362	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	92		1			
FLT15-WSTV-VAL	597	CALC VALUE	ANA	0		MANDC2::1:2	66			1		

WTP - Electrical Room		RTU 2 / DC 2		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
FLT16-BWV-CLS	357	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	83		1			
FLT16-BWV-OC	539	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT16-BWV-OPN	351	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	82		1			
FLT16-BWV-VAL	598	CALC VALUE	ANA	0		MANDC2::1:2	67			1		
FLT16-DUR-TIM	736	DURATION TIM	ANA	248.28	HRS	MANDC2::1:2						
FLT16-EFF-FL	7	EFFLUENT FLO	ANA	3.28	MGD	MANDC2::1:2	5			1		
FLT16-EFF-FLC	89	CCC CONTROL	ANA	0	MGD	MANDC2::1:2		10				1
FLT16-EFFV-CLS	309	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	35		1			
FLT16-EFFV-OC	540	OPEN/CLOSE	BIN	INTER	(ON=4)	MANDC2::1:2						
FLT16-EFFV-OPN	304	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	34		1			
FLT16-EFFV-VAL	599	CALC VALUE	ANA	8		MANDC2::1:2	68			1		
FLT16-EFV-OR	1420	OVERRIDE	BIN	OFF	(ON=1)	MANDC2::1:2		52			1	
FLT16-FDV-CLS	345	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	71		1			
FLT16-FDV-OC	541	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT16-FDV-OPN	339	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	70		1			
FLT16-FDV-VAL	600	CALC VALUE	ANA	0		MANDC2::1:2	69			1		
FLT16-INV-CLS	321	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	47		1			
FLT16-INV-OC	542	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC2::1:2						
FLT16-INV-OPN	315	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC2::1:2	46		1			
FLT16-INV-VAL	601	CALC VALUE	ANA	4		MANDC2::1:2	70			1		
FLT16-LEV-SP	83	AUTO CONTROL	ANA	3.32	MGD	MANDC2::1:2		4				1
FLT16-LOH-ALM	375	HEAD ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	103		1			
FLT16-LOH-DP	14	HEAD LOSS	ANA	1.7	FT	MANDC2::1:2	11			1		
FLT16-SP-DEV	4769	DEVIATION	ANA	-0.03	MGD	MANDC2::1:2						
FLT16-SWV-CLS	327	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	59		1			
FLT16-SWV-OC	543	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT16-SWV-OPN	333	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	58		1			
FLT16-SWV-VAL	602	CALC VALUE	ANA	0		MANDC2::1:2	71			1		
FLT16-TRB-HL	389	HIGH ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	117		1			
FLT16-TRB-NTU	22	TURBIDITY	ANA	0.2	NTU	MANDC2::1:2	19			1		
FLT16-TRBS-EI	383	SAMPLE SEL	BIN	EFLUNT	(ON=1)	MANDC2::1:2	111		1			
FLT16-WSTV-CLS	369	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	95		1			
FLT16-WSTV-OC	544	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT16-WSTV-OPN	363	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	94		1			
FLT16-WSTV-VAL	603	CALC VALUE	ANA	0		MANDC2::1:2	72			1		
FLT17-BWV-CLS	358	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	85		1			
FLT17-BWV-OC	545	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT17-BWV-OPN	352	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	84		1			
FLT17-BWV-VAL	604	CALC VALUE	ANA	0		MANDC2::1:2	73			1		
FLT17-DUR-TIM	737	DURATION TIM	ANA	359.36	HRS	MANDC2::1:2						
FLT17-EFF-FL	8	EFFLUENT FLO	ANA	3.89	MGD	MANDC2::1:2	6			1		
FLT17-EFF-FLC	90	CCC CONTROL	ANA	0	MGD	MANDC2::1:2		11				1
FLT17-EFFV-CLS	310	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	37		1			
FLT17-EFFV-OC	546	OPEN/CLOSE	BIN	INTER	(ON=4)	MANDC2::1:2						
FLT17-EFFV-OPN	305	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	36		1			
FLT17-EFFV-VAL	605	CALC VALUE	ANA	8		MANDC2::1:2	74			1		
FLT17-EFV-OR	1421	OVERRIDE	BIN	OFF	(ON=1)	MANDC2::1:2		53			1	
FLT17-FDV-CLS	346	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	73		1			

WTP - Electrical Room		RTU 2 / DC 2		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
FLT17-FDV-OC	547	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT17-FDV-OPN	340	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	72		1			
FLT17-FDV-VAL	606	CALC VALUE	ANA	0		MANDC2::1:2	75			1		
FLT17-INV-CLS	322	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	49		1			
FLT17-INV-OC	548	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC2::1:2						
FLT17-INV-OPN	316	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC2::1:2	48		1			
FLT17-INV-VAL	607	CALC VALUE	ANA	4		MANDC2::1:2	76			1		
FLT17-LEV-SP	1355	AUTO CONTROL	ANA	3.32	MGD	MANDC2::1:2		5				1
FLT17-LOH-ALM	376	HEAD ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	104		1			
FLT17-LOH-DP	15	HEAD LOSS	ANA	1.1	FT	MANDC2::1:2	12			1		
FLT17-SP-DEV	4770	DEVIATION	ANA	0.58	MGD	MANDC2::1:2						
FLT17-SWV-CLS	328	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	61		1			
FLT17-SWV-OC	549	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT17-SWV-OPN	334	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	60		1			
FLT17-SWV-VAL	608	CALC VALUE	ANA	0		MANDC2::1:2	77			1		
FLT17-TRB-HL	390	HIGH ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	118		1			
FLT17-TRB-NTU	23	TURBIDITY	ANA	0.139	NTU	MANDC2::1:2	20			1		
FLT17-TRBS-EI	384	SAMPLE SEL	BIN	EFLUNT	(ON=1)	MANDC2::1:2	112		1			
FLT17-WSTV-CLS	370	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	97		1			
FLT17-WSTV-OC	550	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT17-WSTV-OPN	364	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	96		1			
FLT17-WSTV-VAL	609	CALC VALUE	ANA	0		MANDC2::1:2	78			1		
FLT18-BWV-CLS	359	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	87		1			
FLT18-BWV-OC	551	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT18-BWV-OPN	353	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	86		1			
FLT18-BWV-VAL	610	CALC VALUE	ANA	0		MANDC2::1:2	79			1		
FLT18-DUR-TIM	738	DURATION TIM	ANA	369.34	HRS	MANDC2::1:2						
FLT18-EFF-FL	9	EFFLUENT FLO	ANA	3.43	MGD	MANDC2::1:2	7			1		
FLT18-EFF-FLC	91	CCC CONTROL	ANA	0	MGD	MANDC2::1:2		12				1
FLT18-EFFV-CLS	311	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	39		1			
FLT18-EFFV-OC	552	OPEN/CLOSE	BIN	INTER	(ON=4)	MANDC2::1:2						
FLT18-EFFV-OPN	306	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	38		1			
FLT18-EFFV-VAL	611	CALC VALUE	ANA	8		MANDC2::1:2	80			1		
FLT18-EFV-OR	1422	OVERRIDE	BIN	OFF	(ON=1)	MANDC2::1:2		54			1	
FLT18-FDV-CLS	347	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	75		1			
FLT18-FDV-OC	553	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						
FLT18-FDV-OPN	341	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	74		1			
FLT18-FDV-VAL	612	CALC VALUE	ANA	0		MANDC2::1:2	81			1		
FLT18-INV-CLS	323	CLOSE STATUS	BIN		(ON=1)	MANDC2::1:2	51		1			
FLT18-INV-OC	554	OPEN/CLOSE	BIN	OPEN	(ON=4)	MANDC2::1:2						
FLT18-INV-OPN	317	OPEN STATUS	BIN	OPEN	(ON=1)	MANDC2::1:2	50		1			
FLT18-INV-VAL	613	CALC VALUE	ANA	4		MANDC2::1:2	82			1		
FLT18-LEV-SP	1356	AUTO CONTROL	ANA	3.32	MGD	MANDC2::1:2		6				1
FLT18-LOH-ALM	377	HEAD ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	105		1			
FLT18-LOH-DP	16	HEAD LOSS	ANA	0.5	FT	MANDC2::1:2	13			1		
FLT18-SP-DEV	4771	DEVIATION	ANA	0.12	MGD	MANDC2::1:2						
FLT18-SWV-CLS	329	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	63		1			
FLT18-SWV-OC	555	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2						

WTP - Electrical Room	RTU 2 / DC 2	Fiber Optic						Discrete Input	Analog Input	Discrete Output	Analog Output
FLT18-SWV-OPN	335	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	62	1			
FLT18-SWV-VAL	614	CALC VALUE	ANA	0		MANDC2::1:2	83		1		
FLT18-TRB-HL	391	HIGH ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	119	1			
FLT18-TRB-NTU	24	TURBIDITY	ANA	0.156	NTU	MANDC2::1:2	21		1		
FLT18-TRBS-EI	385	SAMPLE SEL	BIN	EFLUNT	(ON=1)	MANDC2::1:2	113	1			
FLT18-WSTV-CLS	371	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	99	1			
FLT18-WSTV-OC	556	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2					
FLT18-WSTV-OPN	365	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	98	1			
FLT18-WSTV-VAL	615	CALC VALUE	ANA	0		MANDC2::1:2	84		1		
FLTT-BW-FL	17	BAC WSH FLO	ANA	0.06	MGD	MANDC2::1:2	14		1		
FLTT-BWFC-SP	95	FLOW SETP	ANA	0	MGD	MANDC2::1:2		16			1
FLTT-BWV-CLS	379	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	107	1			
FLTT-BWV-OC	557	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC2::1:2					
FLTT-BWV-OPN	378	OPEN STATUS	BIN		(ON=1)	MANDC2::1:2	106	1			
FLTT-BWV-VAL	616	CALC VALUE	ANA	0		MANDC2::1:2	85		1		
FLTT-IN-LEV	4	TRAIN INF LV	ANA	2.62	FEET	MANDC2::1:2	1		1		
FLTT-IN-OVFL	1435	FLUME OVRFLO	BIN	NORMAL	(ON=1)	MANDC2::1:2					
FLTT-INCH-OVF	392	HIGH ALARM	BIN	NORMAL	(ON=1)	MANDC2::1:2	120	1			
FLUO-DAYT-ALM	4802	DAY TANK ALM	BIN	NORMAL	(ON=1)	MANDC2::1:2		38		1	
FREE-NH3	2925	FREE-NH3	ANA	0.005	PPM	MANDC2::1:2	44		1		
M1-BREAKER-OC	470	BRK STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	155	1			
M2-BREAKER-OC	471	BRK STATUS	BIN	CLOSED	(ON=1)	MANDC2::1:2	156	1			
MANRT02-STS	1669	DCU 2 RTU	BIN	ONLINE	(ON=1)	MANDC2::1:2					
PMC-MX1-RUN	299	RUN STATUS	BIN	ON	(ON=1)	MANDC2::1:2	26	1			
PMC-MX2-RUN	300	RUN STATUS	BIN	ON	(ON=1)	MANDC2::1:2	27	1			
PMC-PH	28	C POST MIX	ANA	7.99	PH	MANDC2::1:2	25		1		
RATIO	2927	RATIO	ANA	0	PPM	MANDC2::1:2	47		1		
RTU2-AC-FAIL	869	ON UPS	BIN	NORMAL	(ON=1)	MANDC2::1:2	24	1			
RTU2-LO-BAT	884	LOW UPS BAT	BIN	NORMAL	(ON=1)	MANDC2::1:2	23	1			
TOTAL-NH3	2926	TOTAL-NH3	ANA	0	PPM	MANDC2::1:2	42		1		

Discrete Input 24 VDC	**160**			
Analog Input 4-20 mA		**83**		
Discrete Output 24 VDC			**39**	
Analog Output 4-20 mA				**18**

Lime Thickener	DC 2 PLC Modicon	Ethernet

Insert V

POINT FILE SUMMARY 16-OCT-17 10:38:40								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
SLDG-AUTO-SEL	3936	TSP AUTO SEL	BIN	NOT-SEL	(ON=1)	MANDC2::2:2	22	
SLDG-BED-SEL	3922	PMP TO BEDS	BIN	NOT-SEL	(ON=1)	MANDC2::2:2		513
SLDG-C1C2-RUN	3945	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2		376
SLDG-DCPMP-RUN	3911	RUN STATUS	BIN	ON	(ON=1)	MANDC2::2:2	33	
SLDG-DRV-FAIL	3914	DRIVE FAIL	BIN	NORMAL	(ON=1)	MANDC2::2:2	38	
SLDG-EMER-CTL	3934	EM MODE CTRL	BIN	NOT-SEL	(ON=1)	MANDC2::2:2		503
SLDG-EMER-MOD	3935	EMERG MODE	BIN	OFF	(ON=1)	MANDC2::2:2		504
SLDG-EMER-OFF	3959	EM MODE OFF	BIN	NOT-SEL	(ON=1)	MANDC2::2:2		
SLDG-EMER-SLBD	3933	PMP TO BEDS	BIN	NOT-SEL	(ON=1)	MANDC2::2:2		507
SLDG-EMER-TKLD	3932	PMP TO TRUCK	BIN	NOT-SEL	(ON=1)	MANDC2::2:2		506
SLDG-FLOW	3852	SLUDGE FLOW	ANA	254	GPM	MANDC2::2:2	40209	
SLDG-FLOW-SP	3851	FLOW SETPT	ANA	250	GPM	MANDC2::2:2		208
SLDG-FLOW-TOT	3960	TOTALIZER	ANA	0	KGAL	MANDC2::2:2		216
SLDG-HOP-RUN	3915	RUN STATUS	BIN	ON	(ON=1)	MANDC2::2:2	39	
SLDG-MODE	3923	CONTROL MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		401
SLDG-P1A-RUN	3893	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	97	
SLDG-P1B-RUN	3894	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	98	
SLDG-P1C-RUN	3895	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	99	
SLDG-P1D-RUN	3896	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	100	
SLDG-P2A-RUN	3897	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	101	
SLDG-P2B-RUN	3898	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	102	
SLDG-P2C-RUN	3899	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	103	
SLDG-P2D-RUN	3900	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	104	
SLDG-P3A-RUN	3901	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	113	
SLDG-P3B-RUN	3902	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	114	
SLDG-P3C-RUN	3903	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	115	
SLDG-P3D-RUN	3904	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	116	
SLDG-P4A-RUN	3905	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	117	
SLDG-P4B-RUN	3906	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	118	
SLDG-P4C-RUN	3907	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	119	
SLDG-P4D-RUN	3908	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	120	
SLDG-PSI-DLY	3917	ALARM DELAY	ANA	1	SEC	MANDC2::2:2		207
SLDG-PSI-HALM	3928	HI PSI ALARM	BIN	NORMAL	(ON=1)	MANDC2::2:2		434
SLDG-PSI-HSP	3848	HI SEPOINT	ANA	50	PSI	MANDC2::2:2		205
SLDG-PSI-LALM	3929	LO PSI ALARM	BIN	NORMAL	(ON=1)	MANDC2::2:2		435
SLDG-PSI-LSP	3849	LO SETPOINT	ANA	5	PSI	MANDC2::2:2		206
SLDG-PV21-FTO	3864	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		421
SLDG-PV21-MOD	3857	PV2-1 MODE	BIN	HAND	(ON=1)	MANDC2::2:2		377
SLDG-PV21-OC	3870	OPEN/CLOSE	BIN	OPEN	(ON=1)	MANDC2::2:2	45	378
SLDG-PV21-REM	3946	REMOTE/LOCAL	BIN	LOCAL	(ON=1)	MANDC2::2:2	47	
SLDG-PV210-FTO	3890	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		430
SLDG-PV210-MOD	3867	PV2-10 MODE	BIN	HAND	(ON=1)	MANDC2::2:2		395

Discrete Input	Analog Input	Discrete Output	Analog Output
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Lime Thickener		DC 2 PLC Modicon	Ethernet						Discrete Input	Analog Input	Discrete Output	Analog Output
SLDG-PV210-OC	3879	OPEN/CLOSE	BIN	OPEN	(ON=1)	MANDC2::2:2	74	396	1		1	
SLDG-PV210-REM	3955	REMOTE/LOCAL	BIN	LOCAL	(ON=1)	MANDC2::2:2	76		1			
SLDG-PV211-FTO	3891	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		431			1	
SLDG-PV211-MOD	3868	PV2-11 MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		397			1	
SLDG-PV211-OC	3880	OPEN/CLOSE	BIN	CLOSED	(ON=1)	MANDC2::2:2	77	398	1		1	
SLDG-PV211-REM	3956	REMOTE/LOCAL	BIN	REMOTE	(ON=1)	MANDC2::2:2	79		1			
SLDG-PV212-FTO	3892	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		432			1	
SLDG-PV212-MOD	3869	PV2-12 MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		399			1	
SLDG-PV212-OC	3881	OPEN/CLOSE	BIN	CLOSED	(ON=1)	MANDC2::2:2	81	400	1		1	
SLDG-PV212-REM	3957	REMOTE/LOCAL	BIN	LOCAL	(ON=1)	MANDC2::2:2	83		1			
SLDG-PV22-FTO	3882	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		422			1	
SLDG-PV22-MOD	3858	PV2-2 MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		379			1	
SLDG-PV22-OC	3871	OPEN/CLOSE	BIN	OPEN	(ON=1)	MANDC2::2:2	48	380	1		1	
SLDG-PV22-REM	3947	REMOTE/LOCAL	BIN	REMOTE	(ON=1)	MANDC2::2:2	50		1			
SLDG-PV23-FTO	3883	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		423			1	
SLDG-PV23-MOD	3859	PV2-3 MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		381			1	
SLDG-PV23-OC	3872	OPEN/CLOSE	BIN	CLOSED	(ON=1)	MANDC2::2:2	51	382	1		1	
SLDG-PV23-REM	3948	REMOTE/LOCAL	BIN	LOCAL	(ON=1)	MANDC2::2:2	53		1			
SLDG-PV24-FTO	3884	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		424			1	
SLDG-PV24-MOD	3860	PV2-4 MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		383			1	
SLDG-PV24-OC	3873	OPEN/CLOSE	BIN	CLOSED	(ON=1)	MANDC2::2:2	54	384	1		1	
SLDG-PV24-REM	3949	REMOTE/LOCAL	BIN	LOCAL	(ON=1)	MANDC2::2:2	56		1			
SLDG-PV25-FTO	3885	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		425			1	
SLDG-PV25-MOD	3861	PV2-5 MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		385			1	
SLDG-PV25-OC	3874	OPEN/CLOSE	BIN	OPEN	(ON=1)	MANDC2::2:2	57	386	1		1	
SLDG-PV25-REM	3950	REMOTE/LOCAL	BIN	REMOTE	(ON=1)	MANDC2::2:2	59		1			
SLDG-PV26-FTO	3886	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		426			1	
SLDG-PV26-MOD	3862	PV2-6 MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		387			1	
SLDG-PV26-OC	3875	OPEN/CLOSE	BIN	CLOSED	(ON=1)	MANDC2::2:2	60	388	1		1	
SLDG-PV26-REM	3951	REMOTE/LOCAL	BIN	REMOTE	(ON=1)	MANDC2::2:2	62		1			
SLDG-PV27-FTO	3887	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		427			1	
SLDG-PV27-MOD	3863	PV2-7 MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		389			1	
SLDG-PV27-OC	3876	OPEN/CLOSE	BIN	OPEN	(ON=1)	MANDC2::2:2	65	390	1		1	
SLDG-PV27-REM	3952	REMOTE/LOCAL	BIN	REMOTE	(ON=1)	MANDC2::2:2	67		1			
SLDG-PV28-FTO	3888	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		428			1	
SLDG-PV28-MOD	3865	PV2-8 MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		391			1	
SLDG-PV28-OC	3877	OPEN/CLOSE	BIN	CLOSED	(ON=1)	MANDC2::2:2	68	392	1		1	
SLDG-PV28-REM	3953	REMOTE/LOCAL	BIN	REMOTE	(ON=1)	MANDC2::2:2	70		1			
SLDG-PV29-FTO	3889	FAIL TO OPER	BIN	NORMAL	(ON=1)	MANDC2::2:2		429			1	
SLDG-PV29-MOD	3866	PV2-9 MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		393			1	
SLDG-PV29-OC	3878	OPEN/CLOSE	BIN	CLOSED	(ON=1)	MANDC2::2:2	71	394	1		1	
SLDG-PV29-REM	3954	REMOTE/LOCAL	BIN	REMOTE	(ON=1)	MANDC2::2:2	73		1			
SLDG-PVLVS-TIM	3919	FTO TIMEOUT	ANA	50	SEC	MANDC2::2:2		213				1
SLDG-RAKE-RUN	3916	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	42		1			
SLDG-RAKE-T100	3912	100% TORQUE	BIN	NORMAL	(ON=1)	MANDC2::2:2	36		1			
SLDG-RAKE-T85	3913	85% TORQUE	BIN	NORMAL	(ON=1)	MANDC2::2:2	37		1			
SLDG-RCRC-SEL	3939	RECIRC SLDG	BIN	SELECTED	(ON=1)	MANDC2::2:2						
SLDG-RCRC-TIM	3920	RECIRC TIME	ANA	60	MIN	MANDC2::2:2		203				1

Lime Thickener		DC 2 PLC Modicon	Ethernet						Discrete Input	Analog Input	Discrete Output	Analog Output
SLDG-RTBS-SEL	3930	ROT BY START	BIN	NOT-SEL	(ON=1)	MANDC2::2:2		501			1	
SLDG-RTBT-SEL	3931	ROT BY TIME	BIN	NOT-SEL	(ON=1)	MANDC2::2:2		502			1	
SLDG-SYS-PSI	3847	SYSTEM PSI	ANA	20	PSI	MANDC2::2:2	40204			1		
SLDG-TKLD-SEL	3921	PMP TO TRUCK	BIN	NOT-SEL	(ON=1)	MANDC2::2:2		511			1	
SLDG-TSP1-ERR	3926	CTL SEQ ERR	BIN	NORMAL	(ON=1)	MANDC2::2:2		436			1	
SLDG-TSP1-MOD	3924	CONTROL MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		409			1	
SLDG-TSP1-RT	3855	TSP1 RUNTIME	ANA	4376	HRS	MANDC2::2:2		219				1
SLDG-TSP1-RUN	3909	RUN STATUS	BIN	ON	(ON=1)	MANDC2::2:2	10	411	1		1	
SLDG-TSP1-SEL	3937	TSP1 SELECT	BIN	SELECTED	(ON=1)	MANDC2::2:2	21		1			
SLDG-TSP1-SPD	3853	TSP1 SPEED	ANA	73	%	MANDC2::2:2	40210	215		1		1
SLDG-TSP2-ERR	3927	CTL SEQ ERR	BIN	NORMAL	(ON=1)	MANDC2::2:2		437			1	
SLDG-TSP2-MOD	3925	CONTROL MODE	BIN	AUTO	(ON=1)	MANDC2::2:2		410			1	
SLDG-TSP2-RT	3856	TSP2 RUNTIME	ANA	927	HRS	MANDC2::2:2		221				1
SLDG-TSP2-RUN	3910	RUN STATUS	BIN	OFF	(ON=1)	MANDC2::2:2	13	412	1		1	
SLDG-TSP2-SEL	3938	TSP2 SELECT	BIN	NOT-SEL	(ON=1)	MANDC2::2:2	23		1			
SLDG-TSP2-SPD	3854	TSP2 SPEED	ANA	0	%	MANDC2::2:2	40211	217		1		1
SLDG-TSPS-HRS	3918	ROTATE HOURS	ANA	1	HRS	MANDC2::2:2		212				1

Discrete Input 24 VDC	**51**			
Analog Input 4-20 mA		**4**		
Discrete Output 24 VDC			**54**	
Analog Output 4-20 mA				**12**

WTP - A/B Chemical Room	RTU 3 / DC 3	Fiber Optic

Insert V

POINT FILE SUMMARY 13-OCT-17 10:24:30								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
A-ALUM-IGAIN	2387	GAIN CONTROL	ANA	1	%/GPM	MANDC3::1:3		
A-ALUM-INTFL	2184	A BASIN	ANA	1.13	GAL	MANDC3::1:3		
A-POLY-DTFL	2267	A1+A2 BASIN	ANA	235	GAL	MANDC3::1:3		
A-POLY-FLO	2343	A1+A2 FLO	ANA	0.39	GPM	MANDC3::1:3		
A-POLY-HLEV	2789	HIGH LEVEL	BIN	NORMAL	(ON=1)	MANDC3::1:3	28	
A-POLY-IGAIN	2240	GAIN CONTROL	ANA	0.1	%/GPM	MANDC3::1:3		
A-POLY-INTFL	2254	A1+A2 POLY	ANA	0.39	GPM	MANDC3::1:3		
A1-POLY-ALM	1029	FLOW ALM	BIN	NORMAL	(ON=1)	MANDC3::1:3		
A1-POLY-FLO	2337	A1-POLY-0 FL	ANA	0.39	GAL/MIN	MANDC3::1:3	14	
A2-POLY-ALM	2253	A2 BASIN	BIN	NORMAL	(ON=1)	MANDC3::1:3		
A2-POLY-FLO	2166	A2-POLY-0 FL	ANA	0	GAL/MIN	MANDC3::1:3	3	
ABAS-1PMP-ALUM	2363		BIN		(ON=1)	MANDC3::1:3		
ABAS-2PMP-ALUM	2364		BIN		(ON=1)	MANDC3::1:3		
ABAS-3PMP-ALUM	2365		BIN	A BASIN	(ON=1)	MANDC3::1:3		
ABAS-4PMP-ALUM	2366		BIN		(ON=1)	MANDC3::1:3		
ABAS-ALUM-ABS	2390	ABS CHANGE	ANA	0.01	GPM	MANDC3::1:3		
ABAS-ALUM-CH	2375	SP CHANGE	ANA	0.01	%	MANDC3::1:3		
ABAS-ALUM-DB	2393	A BASIN DB	ANA	0.01	GPM	MANDC3::1:3		
ABAS-ALUM-ERR	2396	A BASIN	ANA	0.01	GPM	MANDC3::1:3		
ABAS-ALUM-FLO	2170	A ALUM FLOW	ANA	1.13	GAL/MIN	MANDC3::1:3	12	
ABAS-ALUM-SEL	2283	A BASIN	ANA	3		MANDC3::1:3		
ABAS-POLY-ABS	2257	ABS CHANGE	ANA	0.01	GPM	MANDC3::1:3		
ABAS-POLY-CH	2259	SP CHANGE	ANA	-0.0011	%	MANDC3::1:3		
ABAS-POLY-DB	2261	A BASIN	ANA	0.01	GPM	MANDC3::1:3		
ABAS-POLY-ERR	2255	A BASIN	ANA	-0.01	GPM	MANDC3::1:3		
ABAS-POLY-LL	497	A BASIN POLY	BIN	NORMAL	(ON=1)	MANDC3::1:3	37	
ABAS-POLY-RST	2793	A BASIN POLY	BIN	NORMAL	(ON=1)	MANDC3::1:3		6
ABLIME-N-ALARM	4363	ALARM	BIN	NORMAL	(ON=1)	MANDC3::1:3	88	
ABLIME-N-SPD	4366	N SLAKER	ANA	26.1	%	MANDC3::1:3	44	
ABLIME-S-ALARM	4364	ALARM	BIN	NORMAL	(ON=1)	MANDC3::1:3	87	
ABLIME-S-SPD	4365	S SLAKER	ANA	0.8	%	MANDC3::1:3	43	
ALUM-DB	2423	ALUM	ANA	0.01	GPM	MANDC3::1:3		
ALUM-FDP1-AM	2378	FDP1 ALUM	BIN	MANUAL	(ON=1)	MANDC3::1:3	79	
ALUM-FDP1-RUN	2703		BIN	ON	(ON=1)	MANDC3::1:3		
ALUM-FDP1-FAULT			BIN	ON	(ON=1)			
ALUM-FDP1-CONTROL			BIN	ON	(ON=1)			
ALUM-FDP1-SPC	2382	ALUM SPEED	ANA	30.01	%	MANDC3::1:3		3
ALUM-FDP1-SP		ALUM SPEED	ANA	0-100	%			1
ALUM-FDP2-AM	2379	FDP2 ALUM	BIN	MANUAL	(ON=1)	MANDC3::1:3	80	
ALUM-FDP2-RUN	2704		BIN	ON	(ON=1)	MANDC3::1:3		
ALUM-FDP2-FAULT			BIN	ON	(ON=1)			
ALUM-FDP2-CONTROL			BIN	ON	(ON=1)			

Discrete Input	Analog Input	Discrete Output	Analog Output
1			
	1		
	1		
1			
1			
1			
1			
	1		
	1		
	1		
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		1	
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	1		
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	1		
1			
1			
1			
		1	
			1
	1		
1			
1			
1			
		1	

WTP - A/B Chemical Room		RTU 3 / DC 3	Fiber Optic						Discrete Input	Analog Input	Discrete Output	Analog Output
ALUM-FDP2-SPC	2383	ALUM SPEED	ANA	25.01	%	MANDC3::1:3		1				1
ALUM-FDP2-SP		ALUM SPEED	ANA	0-100	%			1		1		
ALUM-FDP3-AM	2380	FDP3 ALUM	BIN	MANUAL	(ON=1)	MANDC3::1:3	81		1			
ALUM-FDP3-RUN			BIN	ON	(ON=1)	MANDC3::1:3			1			
ALUM-FDP3-FAULT			BIN	ON	(ON=1)	MANDC3::1:3			1			
ALUM-FDP3-CONTROL			BIN	ON	(ON=1)	MANDC3::1:3					1	
ALUM-FDP3-SPC	2384	ALUM SPEED	ANA	10.01	%	MANDC3::1:3		4				1
ALUM-FDP3-SP		ALUM SPEED	ANA	0-100	%	MANDC3::1:3				1		
ALUM-FDP4-AM	2381	FDP4 ALUM	BIN	MANUAL	(ON=1)	MANDC3::1:3	82		1			
ALUM-FDP4-RUN			BIN	ON	(ON=1)	MANDC3::1:3			1			
ALUM-FDP4-FAULT			BIN	ON	(ON=1)	MANDC3::1:3			1			
ALUM-FDP4-CONTROL			BIN	ON	(ON=1)	MANDC3::1:3					1	
ALUM-FDP4-SPC	2385	ALUM SPEED	ANA	0	%	MANDC3::1:3		2				1
ALUM-FDP4-SPC	2385	ALUM SPEED	ANA	0	%	MANDC3::1:3		2				1
ALUM-PMP-ALM	2329	DUPLICATE	BIN	NORMAL	(ON=0)	MANDC3::1:3						
AMMN-GAS-LEV	1441	N. AMMONIA	ANA	0.27	PPM	MANDC3::1:3	6			1		
AMMS-GAS-LEV	1442	S. AMMONIA	ANA	5.01	PPM	MANDC3::1:3	5			1		
APOLY-FL-ALM	2243	A BASIN	BIN	NORMAL	(ON=1)	MANDC3::1:3						
APOLY-LO-WATER	2790	LOW WATER	BIN	NORMAL	(ON=1)	MANDC3::1:3	38		1			
B-ALUM-IGAIN	2388	GAIN CONTROL	ANA	1	%/GPM	MANDC3::1:3						
B-ALUM-INTFL	2183	B BASIN	ANA	2.48	GAL	MANDC3::1:3						
B-POLY-ALM	1030	FLOW ALM	BIN	NORMAL	(ON=1)	MANDC3::1:3						
B-POLY-HLEV	2819	HIGH LEVEL	BIN	NORMAL	(ON=1)	MANDC3::1:3	30		1			
B-POLY-IGAIN	2241	GAIN CONTROL	ANA	1	%/GPM	MANDC3::1:3						
BBAS-1PMP-ALUM	2367		BIN	B BASIN	(ON=1)	MANDC3::1:3						
BBAS-2PMP-ALUM	2368		BIN		(ON=1)	MANDC3::1:3						
BBAS-3PMP-ALUM	2369		BIN		(ON=1)	MANDC3::1:3						
BBAS-4PMP-ALUM	2370		BIN		(ON=1)	MANDC3::1:3						
BBAS-ALUM-ABS	2391	ABS CHANGE	ANA	0.03	GPM	MANDC3::1:3						
BBAS-ALUM-CH	2376	SP CHANGE	ANA	0.03	%	MANDC3::1:3						
BBAS-ALUM-DB	2394	B BASIN DB	ANA	0.01	GPM	MANDC3::1:3						
BBAS-ALUM-ERR	2397	B BASIN	ANA	0.03	GPM	MANDC3::1:3						
BBAS-ALUM-FLO	2169	B ALUM FLOW	ANA	2.48	GAL/MIN	MANDC3::1:3	11			1		
BBAS-ALUM-SEL	2330	B BASIN	ANA	1		MANDC3::1:3						
BBAS-POLY-ABS	2271	B BASIN	ANA	0.02	GPM	MANDC3::1:3						
BBAS-POLY-CH	2260	SP CHANGE	ANA	0.018	%	MANDC3::1:3						
BBAS-POLY-DB	2262	B BASIN	ANA	0.01	GPM	MANDC3::1:3						
BBAS-POLY-ERR	2270	B BASIN	ANA	0.02	GPM	MANDC3::1:3						
BBAS-POLY-FLO	2165	B-POLY-0 FL	ANA	0.88	GAL/MIN	MANDC3::1:3	13			1		
BBAS-POLY-LL	498	B BASIN POLY	BIN	NORMAL	(ON=1)	MANDC3::1:3	40		1			
BBAS-POLY-RST	2786	B BASIN POLY	BIN	NORMAL	(ON=1)	MANDC3::1:3		5			1	
BPOLY-FL-ALM	2244	B BASIN	BIN	NORMAL	(ON=1)	MANDC3::1:3						
BPOLY-LO-WATER	2818	LOW WATER	BIN	NORMAL	(ON=1)	MANDC3::1:3	39		1			
C-ALUM-IGAIN	2389	GAIN CONTROL	ANA	0.1	%/GPM	MANDC3::1:3						
C-POLY-IGAIN	2242	GAIN CONTROL	ANA	0	%/GPM	MANDC3::1:3						
CALUM-FDP1-ABS	2428	ABS CHANGE	ANA	0	GPM	MANDC3::1:3						
CALUM-FDP2-ABS	2429	ABS CHANGE	ANA	0	GPM	MANDC3::1:3						
CALUM-FDP3-ABS	2430	ABS CHANGE	ANA	0	GPM	MANDC3::1:3						

WTP - A/B Chemical Room		RTU 3 / DC 3	Fiber Optic						Discrete Input	Analog Input	Discrete Output	Analog Output
CALUM-FDP4-ABS	2431	ABS CHANGE	ANA	0	GPM	MANDC3::1:3						
CBAS-1PMP-ALUM	2371		BIN		(ON=1)	MANDC3::1:3						
CBAS-2PMP-ALUM	2372		BIN		(ON=1)	MANDC3::1:3						
CBAS-3PMP-ALUM	2373		BIN		(ON=1)	MANDC3::1:3						
CBAS-4PMP-ALUM	2374		BIN		(ON=1)	MANDC3::1:3						
CBAS-ALUM-ABS	2392	ABS CHANGE	ANA	0	GPM	MANDC3::1:3						
CBAS-ALUM-CH	2377	SP CHANGE	ANA	0	%	MANDC3::1:3						
CBAS-ALUM-DB	2395	C BASIN DB	ANA	0.01	GPM	MANDC3::1:3						
CBAS-ALUM-ERR	2398	C BASIN	ANA	0	GPM	MANDC3::1:3						
CBAS-ALUM-FLO	2168	CBAS-ALUM-FL	ANA	0	GAL/MIN	MANDC3::1:3	10			1		
CBAS-ALUM-SEL	2331	C BASIN	ANA	0		MANDC3::1:3						
MANRT03-STS	1670	DCU 3 RTU	BIN	ONLINE	(ON=1)	MANDC3::1:3						
PHOS-ABS	2235	ABS CHANGE	ANA	0.03	GPM	MANDC3::1:3						
PHOS-AM	2201		BIN	MANUAL	(ON=1)	MANDC3::1:3	73		1			
PHOS-CH	2233	SP CHANGE	ANA	0	%	MANDC3::1:3						
PHOS-DB	2236	DEADBAND	ANA	0.05	GPM	MANDC3::1:3						
PHOS-FDP-ALM	496	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC3::1:3	26		1			
PHOS-ERR	2232	PHOS ERROR	ANA	-0.0332	GPM	MANDC3::1:3						
PHOS-FDP-ALM	496	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC3::1:3	26		1			
PHOS-FDP-RUN	493	RUN STATUS	BIN	ON	(ON=1)	MANDC3::1:3	25		1			
PHOS-FDP-SPD	2228	PHOSPHATE SP	ANA	0	%	MANDC3::1:3		10				1
PHOS-FDP-SS	2209	PHOS S/S	BIN	ON	(ON=1)	MANDC3::1:3	74	2	1		1	
PHOS-FL	2164	PHOS FLOW	ANA	2.02	GPM	MANDC3::1:3	1			1		
PHOS-FL-AVG	4800	PHOS FLOW	ANA	2.02	GPM	MANDC3::1:3						
PHOS-IGAIN	2234	GAIN CONTROL	ANA	0.23	%/GPM	MANDC3::1:3						
PHOS-INTFL	2456		ANA	2.02	GPM	MANDC3::1:3						
POLY-FDP1-ALM	2785	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC3::1:3						
POLY-FDP1-AM	2268	A BASIN	BIN	MANUAL	(ON=1)	MANDC3::1:3	78	3	1		1	
POLY-FDP1-CMP	2934	A BASIN	ANA	0	%	MANDC3::1:3						
POLY-FDP1-CONTROL		START/STOP	BIN	ON	(ON=1)	MANDC3::1:3					1	
POLY-FDP1-RUN	494	RUN STATUS	BIN	ON	(ON=1)	MANDC3::1:3	27		1			
POLY-FDP1-SPD	2310	A POLY SPD	ANA	0	%	MANDC3::1:3		9				1
POLY-FDP1-TACH	2780	A BASIN	ANA	0	%	MANDC3::1:3	17			1		
POLY-FDP2-ALM	2784	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC3::1:3						
POLY-FDP2-AM	2269	B BASIN	BIN	MANUAL	(ON=1)	MANDC3::1:3	77	4	1		1	
POLY-FDP2-CONTROL		START/STOP	BIN	MANUAL	(ON=1)	MANDC3::1:3		4			1	
POLY-FDP2-RUN	495	RUN STATUS	BIN	ON	(ON=1)	MANDC3::1:3	29		1			
POLY-FDP2-SPD	2312	B POLY SPD	ANA	0	%	MANDC3::1:3		11				1
POLY-FDP2-TACH	2781	B BASIN	ANA	0	%	MANDC3::1:3	18			1		
RTU3-AC-FAIL	918	ON UPS	BIN	NORMAL	(ON=1)	MANDC3::1:3	23		1			
RTU3-LO-BAT	920	LOW UPS BAT	BIN	NORMAL	(ON=1)	MANDC3::1:3	24		1			
SOD-ALM-STR	2935	SODIUM	BIN		(ON=1)	MANDC3::1:3						
SOD-HYP-FLOW	2923	SODIUM	ANA	2.45	GPM	MANDC3::1:3	2			1		
SOD-HYP-LEV1	3798	TANK LEVEL 1	ANA	4.06	FT	MANDC3::1:3	33			1		
SOD-HYP-LEV2	3799	TANK LEVEL 2	ANA	8.36	FT	MANDC3::1:3	34			1		
SOD-P1-SPT	3967	SODIUM HYP.	ANA	0	PERCENT	MANDC3::1:3						
SOD-P2-SPT	3968	SODIUM HYP.	ANA	100	PERCENT	MANDC3::1:3		5				1
SODH-P1	3553	SODIUM-HYP	BIN	RUNNING	(ON=1)	MANDC3::1:3	57	11	1		1	

WTP - A/B Chemical Room		RTU 3 / DC 3		Fiber Optic					Discrete Input	Analog Input	Discrete Output	Analog Output
SODH-P1-REMOTE		SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3			1			
SODH-P1-FAIL	3535	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	58		1			
SODH-P1-FLO	3961	PUMP P1	ANA	1.47	GPM	MANDC3::1:3	36			1		
SODH-P1-LK-ALM	3534	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	59		1			
SODH-P1-OFF	4671	PUMP1 OFF	BIN		(ON=1)	MANDC3::1:3						
SODH-P1-SPD	3546	PUMP P1	ANA	46	%	MANDC3::1:3	19			1		
SODH-P1-SPT	3561	SODIUM HYP.	ANA	1.35	GPM	MANDC3::1:3						
SODH-P2	3552	SODIUM-HYP	BIN	RUNNING	(ON=1)	MANDC3::1:3	60	12	1		1	
SODH-P2-FAIL	3536	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	61		1			
SODH-P2-REMOTE		SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3			1			
SODH-P2-FLO	3962	PUMP P2	ANA	0.54	GPM	MANDC3::1:3	41			1		
SODH-P2-LK-ALM	3528	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	62		1			
SODH-P2-OFF	4670	PUMP2 OFF	BIN		(ON=1)	MANDC3::1:3						
SODH-P2-SPD	3547	PUMP P2	ANA	23	%	MANDC3::1:3	22			1		
SODH-P2-SPT	3562	SODIUM HYP.	ANA	0.7	GPM	MANDC3::1:3						
SODH-P3	3555	SODIUM-HYP	BIN	RUNNING	(ON=1)	MANDC3::1:3	63	13	1		1	
SODH-P3-REMOTE		SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3			1			
SODH-P3-FAIL	3537	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	64		1			
SODH-P3-FLO	3963	PUMP P3	ANA	0.14	GPM	MANDC3::1:3	37			1		
SODH-P3-LK-ALM	3529	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	65		1			
SODH-P3-OFF	4669	PUMP3 OFF	BIN		(ON=1)	MANDC3::1:3						
SODH-P3-SPD	3548	PUMP P3	ANA	18	%	MANDC3::1:3	23			1		
SODH-P3-SPT	3563	SODIUM HYP.	ANA	3	%	MANDC3::1:3		6				1
SODH-P4	3554	SODIUM-HYP	BIN	OFF	(ON=1)	MANDC3::1:3	66	14	1		1	
SODH-P4-REMOTE		SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3			1			
SODH-P4-FAIL	3538	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	67		1			
SODH-P4-FLO	3964	PUMP P4	ANA	0	GPM	MANDC3::1:3	38			1		
SODH-P4-LK-ALM	3530	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	68		1			
SODH-P4-OFF	4668	PUMP4 OFF	BIN		(ON=1)	MANDC3::1:3						
SODH-P4-SPD	3549	PUMP P4	ANA	0	%	MANDC3::1:3	27			1		
SODH-P4-SPT	3564	SODIUM HYP.	ANA	8	%	MANDC3::1:3		7				1
SODH-P5	3556	SODIUM-HYP	BIN	RUNNING	(ON=1)	MANDC3::1:3	69	15	1		1	
SODH-P5-REMOTE		SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3			1			
SODH-P5-FAIL	3539	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	70		1			
SODH-P5-FLO	3965	PUMP P5	ANA	0.34	GPM	MANDC3::1:3	39			1		
SODH-P5-LK-ALM	3531	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	71		1			
SODH-P5-OFF	4667	PUMP5 OFF	BIN		(ON=1)	MANDC3::1:3						
SODH-P5-SPD	3550	PUMP P5	ANA	80	%	MANDC3::1:3	28			1		
SODH-P5-SPT	3565	SODIUM HYP.	ANA	0	%	MANDC3::1:3		8				1
SODH-P6	3557	SODIUM-HYP	BIN	OFF	(ON=1)	MANDC3::1:3	72	16	1		1	
SODH-P6-AM	4672	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANDC3::1:3		7			1	
SODH-P6-AMSP	4675	SPT-OUT	ANA	100		MANDC3::1:3		12				1
SODH-P6-REMOTE		SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3			1			
SODH-P6-FAIL	3558	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	85		1			
SODH-P6-FLO	3966	PUMP P6	ANA	0	GPM	MANDC3::1:3	40			1		
SODH-P6-LK-ALM	3532	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3	86		1			
SODH-P6-LOCAL	4664	RUN MODE	BIN		(ON=1)	MANDC3::1:3	85		1			
SODH-P6-OFF	4666	PUMP6 OFF	BIN		(ON=1)	MANDC3::1:3						

WTP - A/B Chemical Room		RTU 3 / DC 3	Fiber Optic						Discrete Input	Analog Input	Discrete Output	Analog Output
SODH-P6-PIDOUT	4676	REMOTE-AUTO	ANA	100	GPM	MANDC3::1:3						
SODH-P6-REMOTE	4665	RUN MODE	BIN	REMOTE	(ON=1)	MANDC3::1:3	36		1			
SODH-P6-SP-AUT	4673	REMOTE-AUTO	ANA	10.01	GPM	MANDC3::1:3						
SODH-P6-SP-MAN	4674	REMOTE-MANUA	ANA	85	%	MANDC3::1:3						
SODH-P6-SPD	3551	PUMP P6	ANA	0	%	MANDC3::1:3	26			1		
SODH-P6-SPT	3566	SPT-OUT	ANA	0	HZ	MANDC3::1:3						
SODH-P6-SS	4662	START/STOP	BIN	STOPED	(ON=1)	MANDC3::1:3		16			1	
SODH-P6-STATE	4663	RUN STATE	BIN	RUNNING	(ON=1)	MANDC3::1:3	72		1			
SODH-PMP-ALM	3545		BIN	OFF	(ON=1)	MANDC3::1:3						
SODH-SAFE-ADD1	4679	SAFE TO ADD	ANA	13802	GAL	MANDC3::1:3						
SODH-SAFE-ADD2	4680	SAFE TO ADD	ANA	2373	GAL	MANDC3::1:3						
SODH-TOTCL2-1	4677	TOTAL CL2	ANA	8498	GAL	MANDC3::1:3						
SODH-TOTCL2-2	4678	TOTAL CL2	ANA	19927	GAL	MANDC3::1:3						
TOX-GAS-ALM	3560		BIN	OFF	(ON=1)	MANDC3::1:3		1			1	
FL-P1-REMOTE		REMOTE-AUTO	BIN	ON	(ON=1)	MANDC3::1:3			1			
FL-P1-RUN		RUNNING	BIN	ON	(ON=1)	MANDC3::1:3			1			
FL-P1-FAIL		FAULT	BIN	ON	(ON=1)	MANDC3::1:3			1			
FL-P1-CONTROL		START/STOP	BIN	ON	(ON=1)	MANDC3::1:3					1	
FL-P1-SPEED REFERENCE			ANA	0-100	%							1
FL-P1-SPEED			ANA	0-100	%					1		1
FL-P2-REMOTE		REMOTE-AUTO	BIN	ON	(ON=1)	MANDC3::1:3			1			
FL-P2-RUN		RUNNING	BIN	ON	(ON=1)	MANDC3::1:3			1			
FL-P2-FAIL		FAULT	BIN	ON	(ON=1)	MANDC3::1:3			1			
FL-P2-CONTROL		START/STOP	BIN	ON	(ON=1)	MANDC3::1:3					1	
FL-P2-SPEED REFERENCE			ANA	0-100	%							1
FL-P2-SPEED			ANA	0-100	%					1		1

Discrete Input 24 VDC	**64**			
Analog Input 4-20 mA		**33**		
Discrete Output 24 VDC			**22**	
Analog Output 4-20 mA				**17**

WTP - Ground Storage Tanks	RTU 4 / DC 4	Fiber Optic

	Discrete Input	Analog Input	Discrete Output	Analog Output

Insert V

POINT FILE SUMMARY 13-OCT-17 10:24:52								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
64-WELL-HRS	4513	EQV ITERAT	ANA	0.25	NUMBER	MANDC4::1:4		
64-WELL-ITR	4505	EQV ITERAT	ANA	1	NUMBER	MANDC4::1:4		
64-WELL-LVCHG	4640	LVL CHANGE	ANA	0.73	FT. MSL	MANDC4::1:4		
64-WELL-MAX1	4627	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
64-WELL-MAX21	4625	LVL READING	ANA	13.58	FT. MSL	MANDC4::1:4		
64-WELL-MAX22	4626	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
64-WELL-MAX31	4621	LVL READING	ANA	13.58	FT. MSL	MANDC4::1:4		
64-WELL-MAX32	4622	LVL READING	ANA	13.58	FT. MSL	MANDC4::1:4		
64-WELL-MAX33	4623	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
64-WELL-MAX34	4624	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
64-WELL-MIN1	4634	LVL READING	ANA	13.4	FT. MSL	MANDC4::1:4		
64-WELL-MIN21	4632	LVL READING	ANA	13.4	FT. MSL	MANDC4::1:4		
64-WELL-MIN22	4633	LVL READING	ANA	13.95	FT. MSL	MANDC4::1:4		
64-WELL-MIN31	4628	LVL READING	ANA	13.4	FT. MSL	MANDC4::1:4		
64-WELL-MIN32	4629	LVL READING	ANA	13.4	FT. MSL	MANDC4::1:4		
64-WELL-MIN33	4630	LVL READING	ANA	13.95	FT. MSL	MANDC4::1:4		
64-WELL-MIN34	4631	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
64-WELL-READ1	4613	LVL READING	ANA	13.4	FT. MSL	MANDC4::1:4		
64-WELL-READ2	4614	LVL READING	ANA	13.58	FT. MSL	MANDC4::1:4		
64-WELL-READ3	4615	LVL READING	ANA	13.4	FT. MSL	MANDC4::1:4		
64-WELL-READ4	4616	LVL READING	ANA	13.58	FT. MSL	MANDC4::1:4		
64-WELL-READ5	4617	LVL READING	ANA	13.95	FT. MSL	MANDC4::1:4		
64-WELL-READ6	4618	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
64-WELL-READ7	4619	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
64-WELL-READ8	4620	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
A-WELL-HRS	4509	EQV ITERAT	ANA	0.5	NUMBER	MANDC4::1:4		
A-WELL-ITR	4501	EQV ITERAT	ANA	2	NUMBER	MANDC4::1:4		
A-WELL-LEV	2040	LVL MONITOR	ANA	12.84	FT. MSL	MANDC4::1:4	7	
A-WELL-LVCHG	4636	LVL CHANGE	ANA	0.78	FT. MSL	MANDC4::1:4		
A-WELL-MAX1	4561	LVL READING	ANA	13.79	FT. MSL	MANDC4::1:4		
A-WELL-MAX21	4559	LVL READING	ANA	13.13	FT. MSL	MANDC4::1:4		
A-WELL-MAX22	4560	LVL READING	ANA	13.79	FT. MSL	MANDC4::1:4		
A-WELL-MAX31	4555	LVL READING	ANA	13.09	FT. MSL	MANDC4::1:4		
A-WELL-MAX32	4556	LVL READING	ANA	13.13	FT. MSL	MANDC4::1:4		
A-WELL-MAX33	4557	LVL READING	ANA	13.51	FT. MSL	MANDC4::1:4		
A-WELL-MAX34	4558	LVL READING	ANA	13.79	FT. MSL	MANDC4::1:4		
A-WELL-MIN1	4568	LVL READING	ANA	13.01	FT. MSL	MANDC4::1:4		
A-WELL-MIN21	4566	LVL READING	ANA	13.01	FT. MSL	MANDC4::1:4		
A-WELL-MIN22	4567	LVL READING	ANA	13.26	FT. MSL	MANDC4::1:4		
A-WELL-MIN31	4562	LVL READING	ANA	13.03	FT. MSL	MANDC4::1:4		
A-WELL-MIN32	4563	LVL READING	ANA	13.01	FT. MSL	MANDC4::1:4		
A-WELL-MIN33	4564	LVL READING	ANA	13.26	FT. MSL	MANDC4::1:4		

WTP - Ground Storage Tanks		RTU 4 / DC 4	Fiber Optic					
A-WELL-MIN34	4565	LVL READING	ANA	13.68	FT. MSL	MANDC4::1:4		
A-WELL-READ1	4547	LVL READING	ANA	13.03	FT. MSL	MANDC4::1:4		
A-WELL-READ2	4548	LVL READING	ANA	13.09	FT. MSL	MANDC4::1:4		
A-WELL-READ3	4549	LVL READING	ANA	13.01	FT. MSL	MANDC4::1:4		
A-WELL-READ4	4550	LVL READING	ANA	13.13	FT. MSL	MANDC4::1:4		
A-WELL-READ5	4551	LVL READING	ANA	13.26	FT. MSL	MANDC4::1:4		
A-WELL-READ6	4552	LVL READING	ANA	13.51	FT. MSL	MANDC4::1:4		
A-WELL-READ7	4553	LVL READING	ANA	13.68	FT. MSL	MANDC4::1:4		
A-WELL-READ8	4554	LVL READING	ANA	13.79	FT. MSL	MANDC4::1:4		
ASR-WELL-HRS	4512	EQV ITERAT	ANA	0.25	NUMBER	MANDC4::1:4		
ASR-WELL-ITR	4504	EQV ITERAT	ANA	1	NUMBER	MANDC4::1:4		
ASR-WELL-LVCHG	4639	LVL CHANGE	ANA	0.85	FT. MSL	MANDC4::1:4		
ASR-WELL-MAX1	4605	LVL READING	ANA	14.98	FT. MSL	MANDC4::1:4		
ASR-WELL-MAX21	4603	LVL READING	ANA	14.36	FT. MSL	MANDC4::1:4		
ASR-WELL-MAX22	4604	LVL READING	ANA	14.98	FT. MSL	MANDC4::1:4		
ASR-WELL-MAX31	4599	LVL READING	ANA	14.2	FT. MSL	MANDC4::1:4		
ASR-WELL-MAX32	4600	LVL READING	ANA	14.36	FT. MSL	MANDC4::1:4		
ASR-WELL-MAX33	4601	LVL READING	ANA	14.75	FT. MSL	MANDC4::1:4		
ASR-WELL-MAX34	4602	LVL READING	ANA	14.98	FT. MSL	MANDC4::1:4		
ASR-WELL-MIN1	4612	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
ASR-WELL-MIN21	4610	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
ASR-WELL-MIN22	4611	LVL READING	ANA	14.51	FT. MSL	MANDC4::1:4		
ASR-WELL-MIN31	4606	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
ASR-WELL-MIN32	4607	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
ASR-WELL-MIN33	4608	LVL READING	ANA	14.51	FT. MSL	MANDC4::1:4		
ASR-WELL-MIN34	4609	LVL READING	ANA	14.82	FT. MSL	MANDC4::1:4		
ASR-WELL-READ1	4591	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
ASR-WELL-READ2	4592	LVL READING	ANA	14.2	FT. MSL	MANDC4::1:4		
ASR-WELL-READ3	4593	LVL READING	ANA	14.13	FT. MSL	MANDC4::1:4		
ASR-WELL-READ4	4594	LVL READING	ANA	14.36	FT. MSL	MANDC4::1:4		
ASR-WELL-READ5	4595	LVL READING	ANA	14.51	FT. MSL	MANDC4::1:4		
ASR-WELL-READ6	4596	LVL READING	ANA	14.75	FT. MSL	MANDC4::1:4		
ASR-WELL-READ7	4597	LVL READING	ANA	14.82	FT. MSL	MANDC4::1:4		
ASR-WELL-READ8	4598	LVL READING	ANA	14.98	FT. MSL	MANDC4::1:4		
C-WELL-HRS	4510	EQV ITERAT	ANA	0	NUMBER	MANDC4::1:4		
C1-WELL-HRS	4514	EQV ITERAT	ANA	0.5	NUMBER	MANDC4::1:4		
C1-WELL-ITR	4502	EQV ITERAT	ANA	2	NUMBER	MANDC4::1:4		
C1-WELL-LEV	4478	LVL MONITOR	ANA	-23.04	FT. MSL	MANDC4::1:4	5	
C1-WELL-LVCHG	4637	LVL CHANGE	ANA	0.38	FT. MSL	MANDC4::1:4		
C1-WELL-MAX1	4583	LVL READING	ANA	-22.87	FT. MSL	MANDC4::1:4		
C1-WELL-MAX21	4581	LVL READING	ANA	-22.89	FT. MSL	MANDC4::1:4		
C1-WELL-MAX22	4582	LVL READING	ANA	-22.87	FT. MSL	MANDC4::1:4		
C1-WELL-MAX31	4577	LVL READING	ANA	-23.11	FT. MSL	MANDC4::1:4		
C1-WELL-MAX32	4578	LVL READING	ANA	-22.89	FT. MSL	MANDC4::1:4		
C1-WELL-MAX33	4579	LVL READING	ANA	-23.13	FT. MSL	MANDC4::1:4		
C1-WELL-MAX34	4580	LVL READING	ANA	-22.87	FT. MSL	MANDC4::1:4		
C1-WELL-MIN1	4590	LVL READING	ANA	-23.25	FT. MSL	MANDC4::1:4		
C1-WELL-MIN21	4588	LVL READING	ANA	-23.19	FT. MSL	MANDC4::1:4		

Discrete Input	Analog Input	Discrete Output	Analog Output
	1		

WTP - Ground Storage Tanks		RTU 4 / DC 4	Fiber Optic						Discrete Input	Analog Input	Discrete Output	Analog Output
C1-WELL-MIN22	4589	LVL READING	ANA	-23.25	FT. MSL	MANDC4::1:4						
C1-WELL-MIN31	4584	LVL READING	ANA	-23.19	FT. MSL	MANDC4::1:4						
C1-WELL-MIN32	4585	LVL READING	ANA	-23.02	FT. MSL	MANDC4::1:4						
C1-WELL-MIN33	4586	LVL READING	ANA	-23.25	FT. MSL	MANDC4::1:4						
C1-WELL-MIN34	4587	LVL READING	ANA	-23	FT. MSL	MANDC4::1:4						
C1-WELL-READ1	4569	LVL READING	ANA	-23.19	FT. MSL	MANDC4::1:4						
C1-WELL-READ2	4570	LVL READING	ANA	-23.11	FT. MSL	MANDC4::1:4						
C1-WELL-READ3	4571	LVL READING	ANA	-23.02	FT. MSL	MANDC4::1:4						
C1-WELL-READ4	4572	LVL READING	ANA	-22.89	FT. MSL	MANDC4::1:4						
C1-WELL-READ5	4573	LVL READING	ANA	-23.25	FT. MSL	MANDC4::1:4						
C1-WELL-READ6	4574	LVL READING	ANA	-23.13	FT. MSL	MANDC4::1:4						
C1-WELL-READ7	4575	LVL READING	ANA	-23	FT. MSL	MANDC4::1:4						
C1-WELL-READ8	4576	LVL READING	ANA	-22.87	FT. MSL	MANDC4::1:4						
D-WELL-HRS	4511	EQV ITERAT	ANA	0	NUMBER	MANDC4::1:4						
D-WELL-ITR	4503	EQV ITERAT	ANA	0	NUMBER	MANDC4::1:4						
D-WELL-LEV	2041	LVL MONITOR	ANA	38.31	FT. MSL	MANDC4::1:4	8			1		
D-WELL-LVCHG	4638	LVL CHANGE	ANA	0.32	FT. MSL	MANDC4::1:4						
D-WELL-MAX1	4534	LVL READING	ANA	38.37	FT. MSL	MANDC4::1:4						
D-WELL-MAX21	4532	LVL READING	ANA	38.37	FT. MSL	MANDC4::1:4						
D-WELL-MAX22	4533	LVL READING	ANA	38.37	FT. MSL	MANDC4::1:4						
D-WELL-MAX31	4528	LVL READING	ANA	38.31	FT. MSL	MANDC4::1:4						
D-WELL-MAX32	4529	LVL READING	ANA	38.37	FT. MSL	MANDC4::1:4						
D-WELL-MAX33	4530	LVL READING	ANA	38.11	FT. MSL	MANDC4::1:4						
D-WELL-MAX34	4531	LVL READING	ANA	38.37	FT. MSL	MANDC4::1:4						
D-WELL-MIN1	4541	LVL READING	ANA	38.05	FT. MSL	MANDC4::1:4						
D-WELL-MIN21	4539	LVL READING	ANA	38.11	FT. MSL	MANDC4::1:4						
D-WELL-MIN22	4540	LVL READING	ANA	38.05	FT. MSL	MANDC4::1:4						
D-WELL-MIN31	4535	LVL READING	ANA	38.24	FT. MSL	MANDC4::1:4						
D-WELL-MIN32	4536	LVL READING	ANA	38.11	FT. MSL	MANDC4::1:4						
D-WELL-MIN33	4537	LVL READING	ANA	38.05	FT. MSL	MANDC4::1:4						
D-WELL-MIN34	4538	LVL READING	ANA	38.35	FT. MSL	MANDC4::1:4						
D-WELL-READ1	4520	LVL READING	ANA	38.24	FT. MSL	MANDC4::1:4						
D-WELL-READ2	4521	LVL READING	ANA	38.31	FT. MSL	MANDC4::1:4						
D-WELL-READ3	4522	LVL READING	ANA	38.37	FT. MSL	MANDC4::1:4						
D-WELL-READ4	4523	LVL READING	ANA	38.11	FT. MSL	MANDC4::1:4						
D-WELL-READ5	4524	LVL READING	ANA	38.05	FT. MSL	MANDC4::1:4						
D-WELL-READ6	4525	LVL READING	ANA	38.11	FT. MSL	MANDC4::1:4						
D-WELL-READ7	4526	LVL READING	ANA	38.37	FT. MSL	MANDC4::1:4						
D-WELL-READ8	4527	LVL READING	ANA	38.35	FT. MSL	MANDC4::1:4						
DCU4-TEMP-ALM	1478	DCU MELTDOWN	BIN	NORMAL	(ON=1)	MANDC4::1:4	36		1			
GS-CWV-CLS	513	CLOSE STATUS	BIN	CLOSED	(ON=1)	MANDC4::1:4	35		1			
GS-CWV-OC	511	OPEN/CLOSE	BIN	CLOSED	(ON=4)	MANDC4::1:4		4				1
GS-CWV-OPN	512	OPEN STATUS	BIN		(ON=1)	MANDC4::1:4	34		1			
GS-CWV-VAL	652	CALC VALUE	ANA	0		MANDC4::1:4	49			1		
GS-HSP-FL	3845	FINISH FLOW	ANA	13.34	MGD	MANDC4::1:4	1			1		
GS-HSP-PRS	71	HI SER PRES	ANA	61.47	PSIG	MANDC4::1:4	2			1		
GS-HSP1-ALM	514	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC4::1:4	26		1			
GS-HSP1-LS	508	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC4::1:4	27	5	1			1

WTP - Ground Storage Tanks		RTU 4 / DC 4		Fiber Optic				
GS-HSP1-RT	2512	GRD STORAGE	ANA	59835	HOURS	MANDC4::1:4		
GS-HSP1-SS	505	START/STOP	BIN	OFF	(ON=1)	MANDC4::1:4	25	1
GS-HSP2-ALM	515	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC4::1:4	29	
GS-HSP2-LS	509	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC4::1:4	30	6
GS-HSP2-RT	2513	GRD STORAGE	ANA	59586	HOURS	MANDC4::1:4		
GS-HSP2-SS	506	START/STOP	BIN	ON	(ON=1)	MANDC4::1:4	28	2
GS-HSP3-ALM	516	FAIL ALARM	BIN	NORMAL	(ON=1)	MANDC4::1:4	32	
GS-HSP3-LS	510	LOAD SHED	BIN	RESTORE	(ON=1)	MANDC4::1:4	33	7
GS-HSP3-RT	2514	GRD STORAGE	ANA	59645	HOURS	MANDC4::1:4		
GS-HSP3-SS	507	START/STOP	BIN	OFF	(ON=1)	MANDC4::1:4	31	3
GS-PUMP-LKOUT	1558	SAFETY	BIN	OFF	(ON=1)	MANDC4::1:4	37	
GS-TANK-LVL	4459	TANK LEVEL	ANA	28.49	FT	MANDC4::1:4	4	
GS-TK2-LEV	4460	TANK LEVEL	ANA	28.75	FT	MANDC4::1:4	9	
MANRT04-STS	2821	DCU 4 RTU	BIN	ONLINE	(ON=1)	MANDC4::1:4		
RTU4-AC-FAIL	919	ON UPS	BIN	NORMAL	(ON=1)	MANDC4::1:4	23	
RTU4-LO-BAT	921	LOW UPS BAT	BIN	NORMAL	(ON=1)	MANDC4::1:4	24	
RTU4-TEMP	2047	RTU4 TEMP	ANA	84.62	DEG. F	MANDC4::1:4	14	

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1		1	
	1			
	1		1	
	1		1	
	1			
	1		1	
	1			
	1		1	
	1		1	
	1			
		1		
		1		
	1			
	1			
		1		

Discrete Input 24 VDC	**15**			
Analog Input 4-20 mA		**9**		
Discrete Output 24 VDC			**7**	
Analog Output 4-20 mA				**0**

Main Control Room	RTU 5 / DC5	Ethernet

Insert V

POINT FILE SUMMARY 13-OCT-17 10:36:08								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
59ST-LF	1053	LINE FAIL	BIN	ONLINE	(ON=1)	MANDC5::1:5	87	
AB-BW-EN	4896		BIN	INHIBIT	(ON=1)	MANDC5::1:5		
AB-BW-EN-1	4895		BIN	ENABLE	(ON=1)	MANDC5::1:5		3
AB-BWSH-CTL	4477	ON/OFF	BIN	ON	(ON=1)	MANDC5::1:5	81	17
AB-BWSH-SEL	1048		BIN	EL TNK	(ON=1)	MANDC5::1:5	82	18
AB-BWSHPMP-FLT	3284	BW PMP FAULT	BIN	NORMAL	(ON=1)	MANDC5::1:5		
AB-BWSHPMP-RDY	3283	BW PMP RDY	BIN	NOTREADY	(ON=1)	MANDC5::1:5		
AB-BWSHPMP-SS	3282	BW PMP S/S	BIN	OFF	(ON=1)	MANDC5::1:5		
AB-EFF-FL-AVG	4745	EFF FLOW AVG	ANA	2.09	MGD	MANDC5::1:5		
AB-FLUME-AVG	4744	LEVEL AVG	ANA	2.11	MGD	MANDC5::1:5		
AB-RW-TOT-FL	4775	RAW WATER FL	ANA	24.51	MGD	MANDC5::1:5		
ABAS-ALUM-FL	668	FLOW STATUS	BIN	NORMAL	(ON=1)	MANDC5::1:5	47	
ABAS-AM-FL	996	AMMONIA FLOW	ANA	0	LBS/DAY	MANDC5::1:5	40	
ABAS-RM-PH	970	A RAPID MIX	ANA	6.22	PH	MANDC5::1:5	14	
ABAS-RW-ABS	1575	ABSOLUTE	ANA	0.29	MGD	MANDC5::1:5		
ABAS-RW-AM	1565	ABAS AUT/MAN	BIN	MANUAL	(ON=1)	MANDC5::1:5		
ABAS-RW-CH	1576	SP CHANGE	ANA	0	%	MANDC5::1:5		
ABAS-RW-FL	960	RAW WTR FLOW	ANA	7.24	MGD	MANDC5::1:5	4	
ABAS-RW-FLAVG	1625	FLOW AVERAGE	ANA	7.29	MGD	MANDC5::1:5		
ABAS-RW-FLC	1564	VLV CONTROL	ANA	0	%	MANDC5::1:5		2
ABAS-RW-VP	967	RWTR VLV POS	ANA	52	%	MANDC5::1:5	11	
ABAS-RWSPT-DEV	2782	RAW WTR FLOW	ANA	6	MGD	MANDC5::1:5		
ABAS-SLDG-FL	2150	SLUDGE FLOW	ANA	0	GPM	MANDC5::1:5	26	
ABAS-SP1-ALM	2727	A BASIN SLDG	BIN	NORMAL	(ON=1)	MANDC5::1:5		
ABAS-SP1-RT	2526	A BASIN	ANA	11335	HOURS	MANDC5::1:5		
ABAS-SP1-STAT	1020	STATUS	BIN	OFF	(ON=1)	MANDC5::1:5	46	
ABAS-SP2-ALM	2728	A BASIN SLDG	BIN	NORMAL	(ON=1)	MANDC5::1:5		
ABAS-SP2-RT	2527	A BASIN	ANA	11287	HOURS	MANDC5::1:5		
ABAS-SP2-STAT	1019	STATUS	BIN	OFF	(ON=1)	MANDC5::1:5	45	
ALARM-TEST	4938	TEST ALARM	BIN	NORMAL	(ON=1)	MANDC5::1:5		
AMB-NH3	1056	ALRM/NORM	BIN	NORMAL	(ON=1)	MANDC5::1:5	90	
ASP1-ALM-CONST	2731	ABASIN	ANA	240		MANDC5::1:5		
ASP2-ALM-CONST	2732	ABASIN	ANA	240		MANDC5::1:5		
B1BAS-RM-PH	2096	B1 RAPID MIX	ANA	4.53	PH	MANDC5::1:5	15	
B2BAS-RM-PH	2405	B2 RAPID MIX	ANA	6.61	PH	MANDC5::1:5	19	
BBAS-ALUM-FL	669	FLOW STATUS	BIN	NORMAL	(ON=1)	MANDC5::1:5	48	
BBAS-AM-FL	997	AMMONIA FLOW	ANA	0	LBS/DAY	MANDC5::1:5	41	
BBAS-CLAR-STAT	1046	STATUS	BIN	ON	(ON=1)	MANDC5::1:5	78	
BBAS-FLOC-AC	2031	AC FAILURE	BIN	AC ON	(ON=1)	MANDC5::1:5	42	
BBAS-PM1-SS	1057	START/STOP	BIN	OFF	(ON=1)	MANDC5::1:5	79	15
BBAS-PM2-SS	1058	START/STOP	BIN	OFF	(ON=1)	MANDC5::1:5	80	16
BBAS-RW-ABS	1562	ABSOLUTE	ANA	0.14	MGD	MANDC5::1:5		

	Discrete Input	Analog Input	Discrete Output	Analog Output
59ST-LF	1			
AB-BW-EN				
AB-BW-EN-1			1	
AB-BWSH-CTL	1		1	
AB-BWSH-SEL	1		1	
AB-BWSHPMP-FLT				
AB-BWSHPMP-RDY				
AB-BWSHPMP-SS				
AB-EFF-FL-AVG				
AB-FLUME-AVG				
AB-RW-TOT-FL				
ABAS-ALUM-FL	1			
ABAS-AM-FL		1		
ABAS-RM-PH		1		
ABAS-RW-ABS				
ABAS-RW-AM				
ABAS-RW-CH				
ABAS-RW-FL		1		
ABAS-RW-FLAVG				
ABAS-RW-FLC				1
ABAS-RW-VP		1		
ABAS-RWSPT-DEV				
ABAS-SLDG-FL		1		
ABAS-SP1-ALM				
ABAS-SP1-RT				
ABAS-SP1-STAT	1			
ABAS-SP2-ALM				
ABAS-SP2-RT				
ABAS-SP2-STAT	1			
ALARM-TEST				
AMB-NH3	1			
ASP1-ALM-CONST				
ASP2-ALM-CONST				
B1BAS-RM-PH		1		
B2BAS-RM-PH		1		
BBAS-ALUM-FL	1			
BBAS-AM-FL		1		
BBAS-CLAR-STAT	1			
BBAS-FLOC-AC	1			
BBAS-PM1-SS	1		1	
BBAS-PM2-SS	1		1	
BBAS-RW-ABS				

Main Control Room		RTU 5 / DC5	Ethernet						Discrete Input	Analog Input	Discrete Output	Analog Output
BBAS-RW-AM	1566	BBAS AUT/MAN	BIN	MANUAL	(ON=1)	MANDC5::1:5						
BBAS-RW-CH	1560	SP CHANGE	ANA	0	%	MANDC5::1:5						
BBAS-RW-FL	959	RAW WTR FLOW	ANA	17.31	MGD	MANDC5::1:5	3			1		
BBAS-RW-FLAVG	1596	FLOW AVERAGE	ANA	17.36	MGD	MANDC5::1:5						
BBAS-RW-FLC	1559	B BASIN	ANA	0	%	MANDC5::1:5		3				1
BBAS-RW-VP	968	RWTR VLV POS	ANA	0	%	MANDC5::1:5	12			1		
BBAS-RWSPT-DEV	2783	RAW WTR FLOW	ANA	16.5	MGD	MANDC5::1:5						
BBAS-SLDG-FL	2349	SLUDGE FLOW	ANA	508.97	GPM	MANDC5::1:5	46			1		
BBAS-SP1-RT	2528	B BASIN	ANA	17107	HOURS	MANDC5::1:5						
BBAS-SP1-STAT	1031	STATUS	BIN	OFF	(ON=1)	MANDC5::1:5	61		1			
BBAS-SP2-RT	2529	B BASIN	ANA	18161	HOURS	MANDC5::1:5						
BBAS-SP2-STAT	1032	STATUS	BIN	ON	(ON=1)	MANDC5::1:5	62		1			
BWR-P1-STAT	1060	STATUS	BIN	ON	(ON=1)	MANDC5::1:5	49		1			
BWR-P2-STAT	1061	STATUS	BIN	OFF	(ON=1)	MANDC5::1:5	50		1			
CWA-BWSH-FL	4507	BACWASH-FL	ANA	0	MGD	MANDC5::1:5	54			1		
CWA-BWSH-P	1050	ON/OFF	BIN	OFF	(ON=1)	MANDC5::1:5	84		1			
CWA-BWSH-P-RT	2709		ANA	28	HOURS	::						
CWA-BWSH-P1-RT	2515	CLEARWELL A	ANA	0	HOURS	MANDC5::1:5						
CWA-LEV	964	LEVEL	ANA	7.1	FEET	MANDC5::1:5	8			1		
CWA-SWSH-P	1259	SURF WSH PMP	BIN	OFF	(ON=1)	MANDC5::1:5	39		1			
CWA-TP1-RT	2501	CLEARWELL A	ANA	4271	HOURS	MANDC5::1:5						
CWA-TP1-SS	1256	START/STOP	BIN	OFF	(ON=1)	MANDC5::1:5	32	8	1		1	
CWA-TP2-RT	2502	CLEARWELL A	ANA	5784	HOURS	MANDC5::1:5						
CWA-TP2-SS	578	START/STOP	BIN	OFF	(ON=1)	MANDC5::1:5	33	9	1		1	
CWA-TP3-RT	2503	CLEARWELL A	ANA	2090	HOURS	MANDC5::1:5						
CWA-TP3-SS	579	START/STOP	BIN	ON	(ON=1)	MANDC5::1:5	34	10	1		1	
CWA-TP4-RT	2504	CLEARWELL A	ANA	22730	HOURS	MANDC5::1:5						
CWA-TP4-SS	653	START/STOP	BIN	OFF	(ON=1)	MANDC5::1:5	35	11	1		1	
CWA-TP5-RT	2505	CLEARWELL A	ANA	2799	HOURS	MANDC5::1:5						
CWA-TP5-SS	654	START/STOP	BIN	OFF	(ON=1)	MANDC5::1:5	36	12	1		1	
CWA-XFER-FL	958	FINISH FLOW	ANA	7.12	MGD	MANDC5::1:5	2			1		
CWB-LEV	2877	LEVEL	ANA	7.69	FEET	MANDC5::1:5	6			1		
CWB-TP4-SS	2820	START/STOP	BIN	ON	(ON=1)	MANDC5::1:5	40	13	1		1	
CWB-TP5-SS	659	START/STOP	BIN	OFF	(ON=1)	MANDC5::1:5	41	14	1		1	
CWB-XFER-FL	957	FINISH FLOW	ANA	7.31	MGD	MANDC5::1:5	1			1		
CWB-XFER-PSI	963	TRANSF PRESS	ANA	62.45	PSI	MANDC5::1:5	7			1		
DCU5-OUT	2573		BIN	OFF	(ON=1)	MANDC5::1:5		7			1	
DEZ-PMP-TMR-ON	2572	CYCLE TIME	ANA	10	MIN	MANDC5::1:5						
DEZUR-CONT	2568	DEZ PMP SET	BIN	EAST	(ON=1)	MANDC5::1:5						
E-DEZ-VLV	2576		BIN	ON	(ON=1)	MANDC5::1:5		1			1	
EAST-DEZUR	2569	E. DEZURICK	BIN	ON	(ON=1)	MANDC5::1:5		30			1	
EAST-DEZUR-ALM	3970	B BASIN SLDG	BIN	NORMAL	(ON=1)	MANDC5::1:5						
ECL2-EM	1028	EMERGENCY	BIN	NORMAL	(ON=1)	MANDC5::1:5	58		1			
ECL2-H2O-LT	1025	LEVEL/TEMP	BIN	NORMAL	(ON=1)	MANDC5::1:5	55		1			
ECL2-MP	1027	MANIF PRESS	BIN	NORMAL	(ON=1)	MANDC5::1:5	57		1			
ECL2-VR-ALM	1026	VAC ALARM	BIN	NORMAL	(ON=1)	MANDC5::1:5	56		1			
EP1-BS-LF	1052	LINE FAIL	BIN	ONLINE	(ON=1)	MANDC5::1:5	86		1			
ET-BWSH-FL	4506	BACWASH-FL	ANA	0	MGD	MANDC5::1:5	53			1		

Main Control Room		RTU 5 / DC5	Ethernet						Discrete Input	Analog Input	Discrete Output	Analog Output
ET-BWV-CL	4892	MAIN BW VAL	BIN	CLOSE	(ON=1)	MANDC5::1:5	25		1			
ET-BWV-OC	4897	MAIN BW VAL	BIN	CLOSE	(ON=1)	MANDC5::1:5						
ET-BWV-OP	4891	MAIN BW VAL	BIN		(ON=1)	MANDC5::1:5	26		1			
ET-CWA-BWSH-FL	4468	BACWASH-FL	ANA	0	MGD	MANDC5::1:5	47			1		
FLT1-12-LEV-SP	1916	AUTO CONTROL	ANA	2.05	MGD	MANDC5::1:5		4				1
FLT1-BW	1034	START/STOP	BIN		(ON=1)	MANDC5::1:5	66		1			
FLT1-BW-EN	4864	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT1-SP-DEV	4731	DEVIATION	ANA	-0.69	MGD	MANDC5::1:5						
FLT1-TURB	980	TURBIDITY	ANA	0.039	NTU	MANDC5::1:5	24			1		
FLT10-BW	1043	START/STOP	BIN		(ON=1)	MANDC5::1:5	75		1			
FLT10-BW-EN	4873	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT10-SP-DEV	4740	DEVIATION	ANA	-0.25	MGD	MANDC5::1:5						
FLT11-BW	1044	START/STOP	BIN		(ON=1)	MANDC5::1:5	76		1			
FLT11-BW-EN	4874	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT11-SP-DEV	4741	DEVIATION	ANA	0.45	MGD	MANDC5::1:5						
FLT12-BW	1045	START/STOP	BIN		(ON=1)	MANDC5::1:5	77		1			
FLT12-BW-EN	4875	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT12-SP-DEV	4742	DEVIATION	ANA	-0.17	MGD	MANDC5::1:5						
FLT2-BW	1035	START/STOP	BIN		(ON=1)	MANDC5::1:5	67		1			
FLT2-BW-EN	4865	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT2-SP-DEV	4732	DEVIATION	ANA	0.3	MGD	MANDC5::1:5						
FLT2-TURB	981	TURBIDITY	ANA	0.027	NTU	MANDC5::1:5	48			1		
FLT3-BW	1036	START/STOP	BIN		(ON=1)	MANDC5::1:5	68		1			
FLT3-BW-EN	4866	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT3-SP-DEV	4733	DEVIATION	ANA	0.18	MGD	MANDC5::1:5						
FLT3-TURB	931	TURBIDITY	ANA	0.03	NTU	MANDC5::1:5	36			1		
FLT4-BW	1037	START/STOP	BIN		(ON=1)	MANDC5::1:5	69		1			
FLT4-BW-EN	4867	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT4-SP-DEV	4734	DEVIATION	ANA	0.29	MGD	MANDC5::1:5						
FLT4-TURB	2621	TURBIDITY	ANA	0.045	NTU	MANDC5::1:5	37			1		
FLT5-BW	2858	START/STOP	BIN		(ON=1)	MANDC5::1:5	70		1			
FLT5-BW-EN	4868	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT5-SP-DEV	4735	DEVIATION	ANA	0.13	MGD	MANDC5::1:5						
FLT5-TURB	933	TURBIDITY	ANA	0.116	NTU	MANDC5::1:5	27			1		
FLT6-BW	2857	START/STOP	BIN		(ON=1)	MANDC5::1:5	71		1			
FLT6-BW-EN	4869	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT6-SP-DEV	4736	DEVIATION	ANA	0.01	MGD	MANDC5::1:5						
FLT6-TURB	934	TURBIDITY	ANA	0.071	NTU	MANDC5::1:5	28			1		
FLT7-BW	1040	START/STOP	BIN		(ON=1)	MANDC5::1:5	72		1			
FLT7-BW-EN	4870	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT7-SP-DEV	4737	DEVIATION	ANA	0.09	MGD	MANDC5::1:5						
FLT8-BW	1041	START/STOP	BIN		(ON=1)	MANDC5::1:5	73		1			
FLT8-BW-EN	4871	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT8-SP-DEV	4738	DEVIATION	ANA	0.15	MGD	MANDC5::1:5						
FLT9-BW	1042	START/STOP	BIN		(ON=1)	MANDC5::1:5	74		1			
FLT9-BW-EN	4872	ET BACKWSH	BIN	INHIBIT	(ON=1)	MANDC5::1:5						
FLT9-SP-DEV	4739	DEVIATION	ANA	-0.1	MGD	MANDC5::1:5						
FLTT-IN-LEVA	2855	FLUM OVRFLOW	ANA	2.11	FEET	MANDC5::1:5	13			1		

Main Control Room		RTU 5 / DC5	Ethernet						Discrete Input	Analog Input	Discrete Output	Analog Output
LIM-SLK1-RUN	672	RUN STATUS	BIN	OFF	(ON=1)	MANDC5::1:5	63		1			
LIM-SLK2-RUN	673	RUN STATUS	BIN	OFF	(ON=1)	MANDC5::1:5	64		1			
LIM-SLRMX1-RUN	1033	RUN	BIN	OFF	(ON=1)	MANDC5::1:5	65		1			
MANRT05-STS	1672	DCU 5 RTU	BIN	ONLINE	(ON=1)	MANDC5::1:5						
NCTY-30IN-FL	966	30" FLOW	ANA	5.22	MGD	MANDC5::1:5	10			1		
NCTY-30IN-POS	965	30" VLV POS	ANA	0	%	MANDC5::1:5	9			1		
NSE-RP-STAT	1017	STATUS	BIN	OFF	(ON=1)	MANDC5::1:5	43		1			
PLT-WTR-FL	979	WTR FLOW	ANA	1.2	GPM	MANDC5::1:5	23			1		
PT-PMP-ALM-DLY	4462	PORT BOOSTER	ANA	10		::						
RYE-COND	2412	RYE BRIDGE	ANA	2000	MS/CM	MANDC5::1:5	21			1		
RYE-LF	1051	LINE FAIL	BIN	ONLINE	(ON=1)	MANDC5::1:5	85		1			
SSE-RP-STAT	1018	STATUS	BIN	OFF	(ON=1)	MANDC5::1:5	44		1			
TEST-LEV	2826	PLANT ELEV.	ANA	10	FEET	MANDC5::1:5						
W-DEZ-VLV	2574		BIN	OFF	(ON=1)	MANDC5::1:5		2			1	
WCL2-EM	1024	EMER ALARM	BIN	NORMAL	(ON=1)	MANDC5::1:5	54		1			
WCL2-H2O-LT	1021	ALRM/NORM	BIN	NORMAL	(ON=1)	MANDC5::1:5	51		1			
WCL2-MP	1023	MANIF PRESS	BIN	NORMAL	(ON=1)	MANDC5::1:5	53		1			
WCL2-VR-ALM	1022	ALRM/NORM	BIN	NORMAL	(ON=1)	MANDC5::1:5	52		1			
WEST-DEZUR	2565	W. DEZURICK	BIN	OFF	(ON=1)	MANDC5::1:5		31			1	
WEST-DEZUR-ALM	3969	B BASIN SLDG	BIN	NORMAL	(ON=1)	MANDC5::1:5						
WTP-CWA-OP-CL	2439	CLEARWELL	BIN	CLOSE	(ON=1)	MANDC5::1:5	38		1			
WTP-ET-ABS	1738	ABSOLUTE	ANA	1.67	FT/HR	MANDC5::1:5						
WTP-ET-AM	1740	ET AUT/MAN	BIN	AUTO	(ON=1)	MANDC5::1:5						
WTP-ET-DB	1739	SP DEADBAND	ANA	0.5	%	MANDC5::1:5						
WTP-ET-ERR	1735	FILL ERROR	ANA	1.67	FT/HR	MANDC5::1:5						
WTP-ET-FH	1734	RATE FT/HR	ANA	0	FT/HR	MANDC5::1:5						
WTP-ET-FM	1733	RATE FT/M	ANA	0	FT/MIN	MANDC5::1:5						
WTP-ET-FSP	1732	FILL SETPNT	ANA	12	%	MANDC5::1:5		1				1
WTP-ET-LEV	961	PLANT ELEV.	ANA	28.77	FT	MANDC5::1:5	5			1		
WTP-ET-OP-CL	2437	OLD ELEVATED	BIN	CLOSE	(ON=1)	MANDC5::1:5	83		1			
WTP-ET-POS	2561	ELEVATED	ANA	10	%	MANDC5::1:5	45			1		
WTP-ET-PRAT	2438	NEW ELEVATED	BIN	OPEN	(ON=1)	MANDC5::1:5	37		1			
WTP-ET-PRAT-CL	2436	PRATT VALVE	BIN		(ON=1)	MANDC5::1:5		22			1	
WTP-ET-PRAT-OP	2435	PRATT VALVE	BIN	CLOSE	(ON=1)	MANDC5::1:5		21			1	
WTP-ET-VLV-CL	1731	CLOSE VALVE	BIN	STOP	(ON=1)	MANDC5::1:5		20			1	
WTP-ET-VLV-OP	1730	OPEN VALVE	BIN	CLOSE	(ON=1)	MANDC5::1:5		19			1	
WTP-PRAT-STR	2444	ELEVATED	BIN	OFF	(ON=1)	MANDC5::1:5	88		1			
WTP-VLV-OP-CL	2563	ELEVATED	BIN	OPEN	(ON=1)	MANDC5::1:5						

Discrete Input 24 VDC	**58**			
Analog Input 4-20 mA		**32**		
Discrete Output 24 VDC			**21**	
Analog Output 4-20 mA				**4**

Gate House PLC			**Ethernet**					

Insert V

POINT FILE SUMMARY								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
DG-EM-STOP	2557	TAINER GATE	BIN	NORM	(ON=1)			29
DG1-ALM	2558	MAN/AUTO	BIN	AUTO	(ON=1)		89	
DG1-CLOSE	2556	TAINER GATE	BIN	IDLE	(ON=1)			24
DG1-OPEN	2555	TAINER GATE	BIN	IDLE	(ON=1)			23
DG2-ALM	2559	MAN/AUTO	BIN	AUTO	(ON=1)		91	
DG2-CLOSE	2549	TAINER GATE	BIN	IDLE	(ON=1)			26
DG2-OPEN	2548	TAINER GATE	BIN	IDLE	(ON=1)			25
DG3-ALM	2560	MAN/AUTO	BIN	AUTO	(ON=1)		92	
DG3-CLOSE	2551	TAINER GATE	BIN	IDLE	(ON=1)			28
DG3-OPEN	2550	TAINER GATE	BIN	IDLE	(ON=1)			27
DG1-ANGLE	3805	GATE ANGLE	ANA	0	DEGREES	MANMVA::1:20	5	
DG1-HI-LIMIT	3802	HI LIMIT SW	BIN	NORMAL	(ON=1)	MANMVA::1:20	22	
DG2-ANGLE	3806	GATE ANGLE	ANA	0	DEGREES	MANMVA::1:20	8	
DG2-HI-LIMIT	3803	HI LIMIT SW	BIN	NORMAL	(ON=1)	MANMVA::1:20	23	
DG3-ANGLE	3807	GATE ANGLE	ANA	0	DEGREES	MANMVA::1:20	7	
DG3-HI-LIMIT	3804	HI LIMIT SW	BIN	NORMAL	(ON=1)	MANMVA::1:20	24	
IVR1-TG1-LEV	3810	LEVEL	ANA	0.1	FEET	MANMVA::1:20		
IVR2-TG1-LEV	3811	LEVEL	ANA	0	FEET	MANMVA::1:20		
IVR3-TG3-LEV	3812	LEVEL	ANA	0	FEET	MANMVA::1:20		
TG1-ALARM	3818	GATE OPEN	BIN	NORMAL	(ON=1)	MANMVA::1:20		
TG1-LEV	3770	LEVEL	ANA	0	FT	MANMVA::1:20	2	
TG2-ALARM	3819	GATE OPEN	BIN	NORMAL	(ON=1)	MANMVA::1:20		
TG2-LEV	2034	LEVEL	ANA	0.01	FT	MANMVA::1:20	3	
TG3-ALARM	3820	GATE OPEN	BIN	NORMAL	(ON=1)	MANMVA::1:20		
TG3-LEV	2035	LEVEL	ANA	0	FT	MANMVA::1:20	4	

	Discrete Input	Analog Input	Discrete Output	Analog Output
DG-EM-STOP			1	
DG1-ALM	1			
DG1-CLOSE			1	
DG1-OPEN			1	
DG2-ALM	1			
DG2-CLOSE			1	
DG2-OPEN			1	
DG3-ALM	1			
DG3-CLOSE			1	
DG3-OPEN			1	
DG1-ANGLE		1		
DG1-HI-LIMIT	1			
DG2-ANGLE		1		
DG2-HI-LIMIT	1			
DG3-ANGLE		1		
DG3-HI-LIMIT	1			
IVR1-TG1-LEV		1		
IVR2-TG1-LEV		1		
IVR3-TG3-LEV		1		
TG1-ALARM				
TG1-LEV		1		
TG2-ALARM				
TG2-LEV		1		
TG3-ALARM				
TG3-LEV		1		

Discrete Input 24 VDC	**6**			
Analog Input 4-20 mA		**9**		
Discrete Output 24 VDC			**7**	
Analog Output 4-20 mA				**0**

59th Street Elevated Tank	**RTU 11**	**Radio**

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POINT FILE SUMMARY 13-OCT-17 10:21:14								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
59ST-ET-AC	1502	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:11	7	
59ST-ET-BAT	1647	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:11	8	
59ST-ET-DS	1481	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:11	5	
59ST-ET-LEV	1278	59ST ET	ANA	28.79	FT	MANMVA::1:11	1	
59ST-LAD-ALM	3757	SEC. FAULT	BIN	NORMAL	(ON=1)	MANMVA::1:11	24	
MANRT11-STS	1626	59ST ET COMM	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Open	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Close	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve - RTU Control	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		OCA - Auto	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Opened	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Closed	BIN	ONLINE	(ON=1)	MANMVA::1:11		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
		1		
	1			
			1	
			1	
			1	
	1			
	1			
	1			

Discrete Input 24 VDC	**7**			
Analog Input 4-20 mA		**1**		
Discrete Output 24 VDC			**3**	
Analog Output 4-20 mA				**0**

North West Elevated Tank	RTU 12	Radio

Insert V

POINT FILE SUMMARY 13-OCT-17 10:20:52								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT12-STS	1627	N.W. ET COMM	BIN	ONLINE	(ON=1)	MANMVA::1:12		
NW-ET-AC	1503	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:12	7	
NW-ET-BAT	1648	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:12	8	
NW-ET-DS	1482	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:12	5	
NW-ET-LEV	1279	NW ET	ANA	20.31	FT	MANMVA::1:12	1	
NW-ET-RL	2229	N.W. EL.TNK.	BIN	REMOTE	(ON=1)	MANMVA::1:12		2
NW-ET-VLV-OC	2230	N.W. EL.TNK.	BIN	OPEN	(ON=1)	MANMVA::1:12		1

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
		1		
			1	
			1	

Discrete Input 24 VDC	**3**			
Analog Input 4-20 mA		**1**		
Discrete Output 24 VDC			**2**	
Analog Output 4-20 mA				**0**

Palmetto Elevated Tank	**RTU 13**	**Radio**

Insert V

POINT FILE SUMMARY 13-OCT-17 10:20:36								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT13-STS	1628	PAL. ET COMM	BIN	ONLINE	(ON=1)	MANMVA::1:13		
PAL-ET-AC	1504	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:13	7	
PAL-ET-BAT	1649	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:13	8	
PAL-ET-DS	1483	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:13	5	
PAL-ET-LEV	1280	PAL ET	ANA	27.55	FT	MANMVA::1:13	1	
		Valve Open	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Close	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve - RTU Control	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		OCA - Auto	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Opened	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Closed	BIN	ONLINE	(ON=1)	MANMVA::1:11		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
		1		
			1	
			1	
			1	
	1			
	1			
	1			

Discrete Input 24 VDC	**6**			
Analog Input 4-20 mA		**1**		
Discrete Output 24 VDC			**3**	
Analog Output 4-20 mA				**0**

Sarasota Meter Station	**RTU 14**	**Radio**

Insert V

POINT FILE SUMMARY 13-OCT-17 10:20:11								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT14-STS	1629	SARA MS COMM	BIN	ONLINE	(ON=1)	MANMVA::1:14		
SAR-FL	4456	SARA 30IN FL	ANA	0	MGD	MANMVA::1:14	228	
SMS-AC	1505	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:14	243	
SMS-BAT	1650	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:14	244	
SMS-DS	1484	DOOR SWITCH	BIN	CLOSED	(ON=0)	MANMVA::1:14	241	
SMS-FL	1291	SARA 30IN FL	ANA	2.14	MGD	MANMVA::1:14	231	
SMS-FL2	4448	SARA 30IN FL	ANA	2.2	MGD	MANMVA::1:14	230	
SMS-PSI	1286	SARASOTA MS	ANA	60.74	PSI	MANMVA::1:14	229	

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
		1		
		1		
		1		

Discrete Input 24 VDC	**3**			
Analog Input 4-20 mA		**4**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**0**

Ellenton Booster Station	**RTU 15**	**Radio**

Insert V

POINT FILE SUMMARY 13-OCT-17 10:19:51								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
ELNTN-BS-AC	1651	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:15	7	
ELNTN-BS-BAT	1652	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:15	8	
ELNTN-BS-DPSI	1288	DISCH. PSI	ANA	71.64	PSI	MANMVA::1:15	3	
ELNTN-BS-DS	1485	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:15	5	
ELNTN-BS-FL	1292	ELLENTON BS	ANA	0	MGD	MANMVA::1:15	1	
ELNTN-BS-P1	1294	ELLENTON BS	BIN	OFF	(ON=1)	MANMVA::1:15	21	1
ELNTN-BS-P1-RT	3837	ELLENTON BS	ANA	849	HOURS	MANMVA::1:15		
ELNTN-BS-P2	1295	ELLENTON BS	BIN	OFF	(ON=1)	MANMVA::1:15	22	2
ELNTN-BS-P2-RT	3838	ELLENTON BS	ANA	9	HOURS	MANMVA::1:15		
ELNTN-BS-SPSI	1287	ELLENTON BS	ANA	0	PSI	MANMVA::1:15	2	
ELNTN-CL2-RES	3785	RESIDUAL	ANA	0	MG/L	MANMVA::1:15	4	
ELNTN-CONDUCT	3786	CONDUCTIVITY	ANA	0.1	US	MANMVA::1:15	5	
ELNTN-MON-CNTV	3789	VOLTAGE	ANA	-1.25	V	MANMVA::1:15	8	
ELNTN-PH	3787	PH	ANA	0	PH	MANMVA::1:15	6	
ELNTN-TMP-H2O	3790	WATER TEMP	ANA	86	DEG F	MANMVA::1:15	7	
ELTN-BS-P2	3839	PUMP 2	BIN	OFF	(ON=1)	MANMVA::1:15		
MANRT15-STS	1630	ELNT BS COMM	BIN	ONLINE	(ON=1)	MANMVA::1:15		

	Discrete Input	Analog Input	Discrete Output	Analog Output
ELNTN-BS-AC	1			
ELNTN-BS-BAT	1			
ELNTN-BS-DPSI		1		
ELNTN-BS-DS	1			
ELNTN-BS-FL		1		
ELNTN-BS-P1	1		1	
ELNTN-BS-P2	1		1	
ELNTN-BS-SPSI		1		
ELNTN-CL2-RES		1		
ELNTN-CONDUCT		1		
ELNTN-MON-CNTV		1		
ELNTN-PH		1		
ELNTN-TMP-H2O		1		

Discrete Input 24 VDC	**5**			
Analog Input 4-20 mA		**8**		
Discrete Output 24 VDC			**2**	
Analog Output 4-20 mA				**0**

North County Elevated Tank	**RTU 16**	**Radio**

Insert V

POINT FILE SUMMARY 13-OCT-17 10:19:31								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT16-STS	1631	N.C. ET COMM	BIN	ONLINE	(ON=1)	MANMVA::1:16		
NCTY-CL2-RES	3486	RESIDUAL	ANA	0.38	MG/L	MANMVA::1:16	2	
NCTY-CONDUCT	3487	CONDUCTIVITY	ANA	0.1	US	MANMVA::1:16	3	
NCTY-ET-AC	1654	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:16	7	
NCTY-ET-BAT	1653	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:16	8	
NCTY-ET-DS	1486	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:16	5	
NCTY-ET-LEV	4455	NCTY-ET	ANA	0	FT	MANMVA::1:16	1	
NCTY-ET-MA	1299	MANUAL/AUTO	BIN	AUTO	(ON=1)	MANMVA::1:16	21	1
NCTY-MON-CNTV	3502	MONITOR	ANA	-1.25	V	MANMVA::1:16	6	
NCTY-PH	3488	PH	ANA	0	PH	MANMVA::1:16	4	
NCTY-TMP-H2O	3489	WATER TEMP	ANA	32	DEG F	MANMVA::1:16	5	
		Valve Open	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Close	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve - RTU Control	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		OCA - Auto	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Opened	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Closed	BIN	ONLINE	(ON=1)	MANMVA::1:11		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
		1		
	1		1	
		1		
		1		
		1		
			1	
			1	
			1	
	1			
	1			
	1			

Discrete Input 24 VDC	**7**			
Analog Input 4-20 mA		**6**		
Discrete Output 24 VDC			**4**	
Analog Output 4-20 mA				**0**

Elwood Park # 2	RTU 17	Radio

Insert V

POINT FILE SUMMARY 13-OCT-17 10:19:14								
ACRONYM	RN	NAME	REC TYP	VALUE	ENG UNITS	UNIT	IN ADD	OUT ADD
EP2-BS-AC	1693	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:17	7	
EP2-BS-BAT	1655	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:17	8	
EP2-BS-DB	2903	DEADBAND	ANA	0.5	GPM	MANMVA::1:17		
EP2-BS-DPSI	1310	DIS PRESSURE	ANA	68.39	PSI	MANMVA::1:17	2	
EP2-BS-DS	1487	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:17	5	
EP2-BS-ERR	2892	EP2 BOOSTER	ANA	0	PSI	MANMVA::1:17		
EP2-BS-FL	1293	EP2 FLOW	ANA	26	MGD	MANMVA::1:17	3	
EP2-BS-INTFL	2885	INTEGRATOR	ANA	26	GAL	MANMVA::1:17		
EP2-BS-P1-ABS	2900	ABS CHANGE	ANA	0	PSI	MANMVA::1:17		
EP2-BS-P1-SPC	2882	ELWOOD 2	ANA	0	%	MANMVA::1:17		1
EP2-BS-P1-SS	2937		BIN	OFF	(ON=1)	MANMVA::1:17	25	17
EP2-BS-P2-ABS	2901	ABS CHANGE	ANA	0	PSI	MANMVA::1:17		
EP2-BS-P2-SPC	2883	ELWOOD 2	ANA	78	%	MANMVA::1:17		2
EP2-BS-P2-SPD	3783	SPEED	ANA	0	%	MANMVA::1:17	4	
EP2-BS-P2-SS	2938		BIN	OFF	(ON=1)	MANMVA::1:17	26	18
EP2-BS-P3-ABS	2902	ABS CHANGE	ANA	0	PSI	MANMVA::1:17		
EP2-BS-P3-SPC	2884	ELWOOD 2	ANA	0	%	MANMVA::1:17		3
EP2-BS-P3-SS	2939		BIN	OFF	(ON=1)	MANMVA::1:17	27	19
EP2-BS-SPSI	1289	SUCTION PSI	ANA	0	PSI	MANMVA::1:17	1	
EP2-HFUEL-ALM	4440	HIGH FUEL	BIN	OFF	(ON=1)	MANMVA::1:17	32	
EP2-LEAK-ALM	4439	LEAK ALARM	BIN	OFF	(ON=1)	MANMVA::1:17	31	
EP2-LFUEL-ALM	4438	LOW FUEL	BIN	OFF	(ON=1)	MANMVA::1:17	30	
EP2-MIDN-TOT	2886		ANA	37388	GAL	MANMVA::1:17		
EP2-OFILL-ALM	4437	LEAK ALARM	BIN	OFF	(ON=1)	MANMVA::1:17	29	
EP2-P1-ERR	2897	EP2 BOOSTER	ANA	0	PSI	MANMVA::1:17		
EP2-P1-IGAIN	2893	GAIN CONTROL	ANA	0	%/PSI	MANMVA::1:17		
EP2-P1-RT	3830	ELWOOD 2	ANA	3889	HOURS	MANMVA::1:17		
EP2-P2-ERR	2898	EP2 BOOSTER	ANA	0	PSI	MANMVA::1:17		
EP2-P2-IGAIN	2894	GAIN CONTROL	ANA	0	%/PSI	MANMVA::1:17		
EP2-P2-RT	3831	ELWOOD 2	ANA	2164	HOURS	MANMVA::1:17		
EP2-P2-SPT	3782	EP2 BOOSTER	ANA	0	PSI	MANMVA::1:17		4
EP2-P3-ERR	2899	EP2 BOOSTER	ANA	0	PSI	MANMVA::1:17		
EP2-P3-IGAIN	2895	GAIN CONTROL	ANA	0	%/PSI	MANMVA::1:17		
EP2-P3-RT	3832	ELWOOD 2	ANA	3114	HOURS	MANMVA::1:17		
EP2-PSI-INTFL	2904	EP2 PSI	ANA	68.39	PSI	MANMVA::1:17		
EP2-PSI-SPT	2896	EP2 BOOSTER	ANA	0	PSI	MANMVA::1:17		
MANRT17-STS	1632	ELW2 BS COMM	BIN	ONLINE	(ON=1)	MANMVA::1:17		

	Discrete Input	Analog Input	Discrete Output	Analog Output
EP2-BS-AC	1			
EP2-BS-BAT	1			
EP2-BS-DPSI		1		
EP2-BS-DS	1			
EP2-BS-FL		1		
EP2-BS-P1-SPC				1
EP2-BS-P1-SS	1		1	
EP2-BS-P2-SPC				1
EP2-BS-P2-SPD		1		
EP2-BS-P2-SS	1		1	
EP2-BS-P3-SPC				1
EP2-BS-P3-SS	1		1	
EP2-BS-SPSI		1		
EP2-HFUEL-ALM	1			
EP2-LEAK-ALM	1			
EP2-LFUEL-ALM	1			
EP2-OFILL-ALM	1			
EP2-P2-SPT				1

Discrete Input 24 VDC	**10**			
Analog Input 4-20 mA		**4**		
Discrete Output 24 VDC			**3**	
Analog Output 4-20 mA				**4**

WTP - Raw Water # 2	**RTU 18**	**Radio**

Insert V

POINT FILE SUMMARY 13-OCT-17 10:18:58								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
LM-RES-LEV	3841	LAKE LEVEL	ANA	39.04	FT	MANMVA::1:18	4	
LM-RES-TEMP	2408	LAKE TEMP	ANA	32	DEG F	MANMVA::1:18		
LM-RES-TEMP-C	2409	LAKE TEMP	ANA	0	DEG C	MANMVA::1:18	5	
MANRT18-STS	1633	RW 2 PS COMM	BIN	ONLINE	(ON=1)	MANMVA::1:18		
RW2-AC	1694	AC POWER	BIN	ACFAIL	(ON=1)	MANMVA::1:18	7	
RW2-BAT	1656	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:18	8	
RW2-DS	1488	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:18	5	
RW2-P1-RT	2541	RAW WATER 1	ANA	17713	HOURS	MANMVA::1:18		
RW2-P1-SS	1274	PUMP 1	BIN	OFF	(ON=1)	MANMVA::1:18	21	1
RW2-P2-RT	2542	RAW WATER 2	ANA	19027	HOURS	MANMVA::1:18		
RW2-P2-SS	1275	PUMP 2	BIN	OFF	(ON=1)	MANMVA::1:18	22	2
RW2-P3-RT	2543	RAW WATER 3	ANA	9379	HOURS	MANMVA::1:18		
RW2-P3-SS	1276	PUMP 3	BIN	OFF	(ON=1)	MANMVA::1:18	23	3

	Discrete Input	Analog Input	Discrete Output	Analog Output
		1		
		1		
	1			
	1			
	1			
	1		1	
	1		1	
	1		1	

Discrete Input 24 VDC	**6**			
Analog Input 4-20 mA		**2**		
Discrete Output 24 VDC			**3**	
Analog Output 4-20 mA				**0**

Port Manatee Elevated Tank	RTU 19	Radio

Insert V

POINT FILE SUMMARY 13-OCT-17 10:18:40								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT19-STS	1634	PORT ET COMM	BIN	ONLINE	(ON=1)	MANMVA::1:19		
PM-ET-AC	1695	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:19	7	
PM-ET-BAT	1657	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:19	8	
PM-ET-DS	1489	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:19	5	
PM-ET-LEV	1282	PM ET	ANA	13	FT	MANMVA::1:19	4	
PM-GEN-FAIL	4785	GEN FAIL	BIN	NORMAL	(ON=1)	MANMVA::1:19	14	
PM-GEN-RUN	4784	GEN RUNING	BIN	OFF	(ON=1)	MANMVA::1:19	13	
PM-P1-ON	3821	PUMP 1	BIN	ON	(ON=1)	MANMVA::1:19	17	
PM-P1-RT	3833	PORT MANATEE	ANA	59483	HOURS	MANMVA::1:19		
PM-P2-ON	3822	PUMP 2	BIN	OFF	(ON=1)	MANMVA::1:19	18	
PM-P2-RT	3834	PORT MANATEE	ANA	54069	HOURS	MANMVA::1:19		
PM-P3-ON	3823	PUMP 3	BIN	OFF	(ON=1)	MANMVA::1:19	19	
PM-P3-RT	3835	PORT MANATEE	ANA	52313	HOURS	MANMVA::1:19		
PM-P4-ON	3824	PUMP 4	BIN	ON	(ON=1)	MANMVA::1:19	20	
PM-P4-RT	3836	PORT MANATEE	ANA	60637	HOURS	MANMVA::1:19		
PM-RESET	3825	LOGIC RESET	BIN	OFF	(ON=1)	MANMVA::1:19	24	1
PORT-ALM-COND.	3767	PUMP FAULT	BIN	NORMAL	(ON=1)	MANMVA::1:19	21	
PORT-DIS-PR	3765	PORT-DIS-PR	ANA	74.91	PSI	MANMVA::1:19	2	
PORT-FL-RATE	3764	PORT FLOW	ANA	115.38	GPM	MANMVA::1:19	1	
PORT-P-FAIL	3768	PUMP FAULT	BIN	ALARM	(ON=1)	MANMVA::1:19	22	
PORT-PMP-ALM	4463	PORT PUMP	BIN	NORMAL	(ON=1)	MANMVA::1:19		
PORT-SHUTDOWN	3769	PORT	BIN	NORMAL	(ON=1)	MANMVA::1:19	23	
PORT-SUCTION	3766	PORT-SUC-PR	ANA	1.1	PSI	MANMVA::1:19	3	
PORT-SYS-SDWN	3829	SYS.SHUTDOWN	BIN	OFF	(ON=0)	MANMVA::1:19	16	2
		Valve Open	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Close	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve - RTU Control	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		OCA - Auto	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Opened	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Closed	BIN	ONLINE	(ON=1)	MANMVA::1:11		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
		1		
	1			
	1			
	1			
	1			
	1			
	1			
	1			1
	1			
		1		
		1		
	1			
		1		
	1			
	1			1
				1
				1
				1
	1			
	1			
	1			

Discrete Input 24 VDC	**17**			
Analog Input 4-20 mA		**4**		
Discrete Output 24 VDC			**5**	
Analog Output 4-20 mA				**0**

WTP - Raw Water # 1	RTU 20	Fiber Optic

Insert V

POINT FILE SUMMARY 13-OCT-17 10:18:23								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT20-STS	1646	RW 1 PS COMM	BIN	ONLINE	(ON=1)	MANMVA::1:20		
N-TOE-DR-FL	2033	NORTH TOE	ANA	14.7	GPM	MANMVA::1:20	1	
RW1-AC	1624	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:20	7	
RW1-BAT	1679	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:20	8	
RW1-DS	1623	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:20	5	
RW1-P1-RT	2491	RAW WATER 1	ANA	20687	HOURS	MANMVA::1:20		
RW1-P1-SS	3333	START/STOP	BIN	ON	(ON=1)	MANMVA::1:20	17	8
RW1-P2-RT	2492	RAW WATER 2	ANA	34152	HOURS	MANMVA::1:20		
RW1-P2-SS	1008	START/STOP	BIN	OFF	(ON=1)	MANMVA::1:20	18	2
RW1-P3-RT	2493	RAW WATER 3	ANA	34209	HOURS	MANMVA::1:20		
RW1-P3-SS	1009	START/STOP	BIN	OFF	(ON=1)	MANMVA::1:20	19	3
RW1-P4-RT	2494	RAW WATER 4	ANA	31521	HOURS	MANMVA::1:20		
RW1-P4-SS	1010	START/STOP	BIN	ON	(ON=1)	MANMVA::1:20	20	4
RW1-P5-RT	2495	RAW WATER 5	ANA	29392	HOURS	MANMVA::1:20		
RW1-P5-SS	1011	START/STOP	BIN	ON	(ON=1)	MANMVA::1:20	21	5
RW1-P6-RT	2496	RAW WATER 6	ANA	0	HOURS	MANMVA::1:20		
RW1-P6-SS	1012	START/STOP	BIN	OFF	(ON=1)	MANMVA::1:20		6
RW1-P7-RT	2497	RAW WATER 7	ANA	0	HOURS	MANMVA::1:20		
RW1-P7-SS	3332	START/STOP	BIN	OFF	(ON=1)	MANMVA::1:20		1
S-TOE-DR-FL	4461	SOUTH TOE	ANA	17.6	GPM	MANMVA::1:20	6	

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
	1			
	1			
	1			
	1			
	1			
	1			
	1			
		1		

Discrete Input 24 VDC	**8**			
Analog Input 4-20 mA		**2**		
Discrete Output 24 VDC			**7**	
Analog Output 4-20 mA				**0**

Rain Gauge # 1	**RTU 21**	**Radio**

Insert V

POINT FILE SUMMARY 13-OCT-17 10:18:07								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT21-STS	2590	R.G. 1 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:21		
RG1-AC	2591	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:21	7	
RG1-BAT	2596	BATTERY STAT	BIN	NORMAL	(ON=1)	MANMVA::1:21	8	
RG1-DS	2594	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:21	5	
RG1-LEV	3846	RAIN GAUGE 1	COU	0	IN/M	MANMVA::1:21	6	
RG1-MIDN-TOT	2598	RAIN GAUGE 1	ANA	0	INCHES	MANMVA::1:21		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
	1			

Discrete Input 24 VDC	**4**			
Analog Input 4-20 mA		**0**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**0**

Rain Gauge # 3	**RTU 23**	**Radio**

Insert V

POINT FILE SUMMARY 13-OCT-17 10:17:50								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT23-STS	1637	R.G. 3 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:23		
RG3-AC	2587	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:23	7	
RG3-BAT	1685	BATTERY STAT	BIN	NORMAL	(ON=1)	MANMVA::1:23	8	
RG3-DS	1492	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:23	5	
RG3-LEV	1602	RAIN GAUGE 3	COU	0	IN/M	MANMVA::1:23	6	
RG3-MIDN-TOT	1788	RAIN GAUGE 3	ANA	0	INCHES	MANMVA::1:23		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
	1			

Discrete Input 24 VDC	**4**			
Analog Input 4-20 mA		**0**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**0**

Rain Gauge # 4	**RTU 24**	**Radio**

Insert V

POINT FILE SUMMARY 13-OCT-17 10:17:32								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT24-STS	1638	R.G. 4 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:24		
RG4-AC	1700	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:24	7	
RG4-BAT	1686	BATTERY STAT	BIN	NORMAL	(ON=1)	MANMVA::1:24	8	
RG4-DS	1493	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:24	5	
RG4-LEV	1603	RAIN GAUGE 4	COU	0	IN/M	MANMVA::1:24	6	
RG4-MIDN-TOT	1789	RAIN GAUGE 4	ANA	0	INCHES	MANMVA::1:24		
RG4-WS-HUMID	3722	HUMIDITY	ANA	44	%	MANMVA::1:24	4	
RG4-WS-TEMP	3721	TEMPERATURE	ANA	85.9	DEG F	MANMVA::1:24	3	
RG4-WS-WDAVG	3720	WIND DIR AVG	ANA	266	DEG	MANMVA::1:24	2	
RG4-WS-WSAVG	3719	WIND SPD AVG	ANA	5	MPH	MANMVA::1:24	1	

	Discrete Input	Analog Input	Discrete Output	Analog Output
RG4-AC	1			
RG4-BAT	1			
RG4-DS	1			
RG4-LEV	1			
RG4-WS-HUMID		1		
RG4-WS-TEMP		1		
RG4-WS-WDAVG		1		
RG4-WS-WSAVG		1		

Discrete Input 24 VDC	**4**			
Analog Input 4-20 mA		**4**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**0**

Rain Gauge # 6	**RTU 26**	**Radio**

Insert V

POINT FILE SUMMARY 13-OCT-17 10:17:13								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT26-STS	1636	R.G. 6 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:26		
RG6-AC	1698	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:26	7	
RG6-BAT	1684	BATTERY STAT	BIN	NORMAL	(ON=1)	MANMVA::1:26	8	
RG6-DS	1491	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:26	5	
RG6-LEV	1601	RAIN GAUGE 6	COU	0	IN/M	MANMVA::1:26	6	
RG6-MIDN-TOT	1787	RAIN GAUGE 6	ANA	0	INCHES	MANMVA::1:26		
TEST-AO	3781		ANA	50.01	%	MANMVA::1:26		1
TEST1	3777		ANA	3	%	MANMVA::1:26	17	
TEST2	3778		ANA	0	%	MANMVA::1:26	18	
TEST3	3779		ANA	0	%	MANMVA::1:26	19	
TEST4	3780		ANA	0	%	MANMVA::1:26	20	

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
	1			
				1
		1		
		1		
		1		
		1		

Discrete Input 24 VDC	**4**			
Analog Input 4-20 mA		**4**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**1**

Rain Gauge # 7	RTU 27	Radio

Insert V

POINT FILE SUMMARY 13-OCT-17 10:16:50								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT27-STS	1641	R.G. 7 COMM	BIN	DOWN	(ON=1)	MANMVA::1:27		
RG7-24VDC-IN	4942	24VDC INPUT	ANA	25.1	VDC	MANMVA::1:27	5	
RG7-AC	1703	SOLAR POWER	BIN	SOL ON	(ON=1)	MANMVA::1:27	7	
RG7-BAT	1689	BATTERY STAT	BIN	NORMAL	(ON=1)	MANMVA::1:27	8	
RG7-BAT-VOLT	2032	SOLAR POWER	ANA	0	VOLTS	MANMVA::1:27	1	
RG7-DS	1496	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:27	5	
RG7-LEV	1606	RAIN GAUGE 7	COU	0	IN/M	MANMVA::1:27	6	
RG7-MIDN-TOT	1792	RAIN GAUGE 7	ANA	0	INCHES	MANMVA::1:27		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
		1		
	1			
	1			

Discrete Input 24 VDC	**4**			
Analog Input 4-20 mA		**2**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**0**

Rain Gauge # 8	**RTU 28**	**Radio**

	Discrete Input	Analog Input	Discrete Output	Analog Output

Insert V

POINT FILE SUMMARY 13-OCT-17 10:16:29								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT28-STS	1642	R.G. 8 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:28		
RG8-AC	1704	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:28	7	
RG8-BAT	1690	BATTERY STAT	BIN	NORMAL	(ON=1)	MANMVA::1:28	8	
RG8-DS	1497	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:28	5	
RG8-LEV	1607	RAIN GAUGE 8	COU	0	IN/M	MANMVA::1:28	6	
RG8-MIDN-TOT	1793	RAIN GAUGE 8	ANA	0	INCHES	MANMVA::1:28		

Discrete Input 24 VDC	**4**			
Analog Input 4-20 mA		**0**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**0**

Elwood Park # 1	RTU 30	Radio

Insert V

POINT FILE SUMMARY 13-OCT-17 10:16:10								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
EP1-30IN-INTFL	1717	INTEGRATOR	ANA	2.65	GAL	MANMVA::1:30		
EP1-36IN-INTFL	1718	INTEGRATOR	ANA	0.02	GAL	MANMVA::1:30		
EP1-ATS-SWPOS	4392	ATS SW POS	BIN	ON	(ON=1)	MANMVA::1:30	60	
EP1-BS-30IN-FL	1283	EP1 30IN FL	ANA	3.86	MGD	MANMVA::1:30	1	
EP1-BS-36IN-FL	1284	EP1 36IN FL	ANA	0.02	MGD	MANMVA::1:30	2	
EP1-BS-AC	1678	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:30	7	
EP1-BS-BAT	1659	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:30	8	
EP1-BS-GS-ABS	1618	ABSOLUTE	ANA	0.92	FT/HR	MANMVA::1:30		
EP1-BS-GS-AM	1616	EP1 AUT/MAN	BIN	AUTO	(ON=1)	MANMVA::1:30		
EP1-BS-GS-DB	1617	SP DEADBAND	ANA	0.25	FT/HR	MANMVA::1:30		
EP1-BS-GS-FH	1682	RATE FT/HR	ANA	-0.92	FT/HR	MANMVA::1:30		
EP1-BS-GS-FM	1681	RATE FT/M	ANA	-0.02	FT/MIN	MANMVA::1:30		
EP1-BS-GS-FSP	1615	FILL SETPNT	ANA	0	FT/HR	MANMVA::1:30		
EP1-BS-GS-LEV	2106	GROUND STRG	ANA	18.73	FT	MANMVA::1:30	6	
EP1-BS-GSCH	1620	SP CHANGE	ANA	0.69	%	MANMVA::1:30		
EP1-BS-GSDIF	1613	LEVEL DIF.	ANA	0	FT/MIN	MANMVA::1:30		
EP1-BS-GSERR	1614	FILL RATE	ANA	0.92	FT/HR	MANMVA::1:30		
EP1-BS-GSIGAIN	1619	GAIN CTRL	ANA	0.75	%/FT/HR	MANMVA::1:30		
EP1-BS-P1-RT	2519	ELWOOD PK 1	ANA	24086	HOURS	MANMVA::1:30		
EP1-BS-P1-SS	1324	PUMP 1	BIN	OFF	(ON=0)	MANMVA::1:30	17	1
EP1-BS-P2-RT	2520	ELWOOD PK 1	ANA	470	HOURS	MANMVA::1:30		
EP1-BS-P2-SS	1325	PUMP 2	BIN	OFF	(ON=1)	MANMVA::1:30	18	2
EP1-BS-P3-RT	2521	ELWOOD PK 1	ANA	754	HOURS	MANMVA::1:30		
EP1-BS-P3-SS	1326	PUMP 3	BIN	OFF	(ON=1)	MANMVA::1:30	19	3
EP1-BS-P4-RT	2522	ELWOOD PK 1	ANA	728	HOURS	MANMVA::1:30		
EP1-BS-P4-SS	2881	PUMP 4	BIN	OFF	(ON=1)	MANMVA::1:30	20	4
EP1-BS-P5-RT	2523	ELWOOD PK 1	ANA	542	HOURS	MANMVA::1:30		
EP1-BS-P5-SS	2880	PUMP 5	BIN	OFF	(ON=1)	MANMVA::1:30	21	5
EP1-BS-P6-RT	2524	ELWOOD PK 1	ANA	26320	HOURS	MANMVA::1:30		
EP1-BS-P6-SS	1329	PUMP 6	BIN	OFF	(ON=0)	MANMVA::1:30	22	6
EP1-BS-P7-RT	2525	ELWOOD PK 1	ANA	8600	HOURS	MANMVA::1:30		
EP1-BS-P7-SS	4635	PUMP 7	BIN	ON	(ON=0)	MANMVA::1:30	23	7
EP1-BS-VLV-CTL	2907	SET POINT	ANA	0	%	MANMVA::1:30		1
EP1-BS-VLV-POS	1322	EP1 VLV POS	ANA	0	%	MANMVA::1:30	5	
EP1-BS-VLV-SPT	5015	SET OUTPUT	ANA	0	%	MANMVA::1:30		
EP1-BS30-DTFL	1577	ELWOOD #1 30	ANA	1056	KGAL	MANMVA::1:30		
EP1-BS30IN-PSI	2076	EP1 30IN PSI	ANA	66.39	PSI	MANMVA::1:30	3	
EP1-BS36-DTFL	1578	ELWOOD #1 36	ANA	4	KGAL	MANMVA::1:30		
EP1-BS36IN-PSI	1680	EP1 36IN PSI	ANA	67.19	PSI	MANMVA::1:30	4	
EP1-CL2-RES	3772	RESIDUAL	ANA	0	MG/L	MANMVA::1:30	19	
EP1-CONDUCT	3773	CONDUCTIVITY	ANA	0.1	US	MANMVA::1:30	20	
EP1-FAULT-GS	3748	SEC. FAULT	BIN	NORM	(ON=1)	MANMVA::1:30	6	

	Discrete Input	Analog Input	Discrete Output	Analog Output
EP1-30IN-INTFL				
EP1-36IN-INTFL				
EP1-ATS-SWPOS	1			
EP1-BS-30IN-FL		1		
EP1-BS-36IN-FL		1		
EP1-BS-AC	1			
EP1-BS-BAT	1			
EP1-BS-GS-ABS				
EP1-BS-GS-AM				
EP1-BS-GS-DB				
EP1-BS-GS-FH				
EP1-BS-GS-FM				
EP1-BS-GS-FSP				
EP1-BS-GS-LEV		1		
EP1-BS-GSCH				
EP1-BS-GSDIF				
EP1-BS-GSERR				
EP1-BS-GSIGAIN				
EP1-BS-P1-RT				
EP1-BS-P1-SS	1		1	
EP1-BS-P2-RT				
EP1-BS-P2-SS	1		1	
EP1-BS-P3-RT				
EP1-BS-P3-SS	1		1	
EP1-BS-P4-RT				
EP1-BS-P4-SS	1		1	
EP1-BS-P5-RT				
EP1-BS-P5-SS	1		1	
EP1-BS-P6-RT				
EP1-BS-P6-SS	1		1	
EP1-BS-P7-RT				
EP1-BS-P7-SS	1		1	
EP1-BS-VLV-CTL				1
EP1-BS-VLV-POS		1		
EP1-BS-VLV-SPT				
EP1-BS30-DTFL				
EP1-BS30IN-PSI		1		
EP1-BS36-DTFL				
EP1-BS36IN-PSI		1		
EP1-CL2-RES		1		
EP1-CONDUCT		1		
EP1-FAULT-GS	1			

Elwood Park # 1		RTU 30	Radio					
EP1-GEN-ALARM	4390	GENERATOR	BIN	OFF	(ON=1)	MANMVA::1:30	58	
EP1-GEN-RUN	4389	GEN RUN	BIN	ON	(ON=1)	MANMVA::1:30	57	
EP1-LEAK-ALARM	4391	LEAK ALARM	BIN	OFF	(ON=1)	MANMVA::1:30	59	
EP1-LLEV-ALARM	4393	LOLEV ALARM	BIN	OFF	(ON=1)	MANMVA::1:30	61	
EP1-MON-CNTV	3776	VOLTAGE	ANA	-1.25	V	MANMVA::1:30	21	
EP1-PH	3774	PH	ANA	0	PH	MANMVA::1:30	18	
EP1-TEMP	1784	EP1 RTU TEMP	ANA	71.93	DEG F	MANMVA::1:30	7	
EP1-TEMP-ALM	1716	CABINET TEMP	BIN	HI TEMP	(ON=1)	MANMVA::1:30	24	
EP1-TK1-BAT	4781	HATCH TX BAT	BIN	NORMAL	(ON=1)	MANMVA::1:30	80	
EP1-TK1-HATCH	4808	ELWOOD PK1	BIN	CLOSED	(ON=1)	MANMVA::1:30	73	
EP1-TK2-BAT	4809	HATCH TX BAT	BIN	NORMAL	(ON=1)	MANMVA::1:30	80	
EP1-TK2-HATCH	4807	ELWOOD PK1	BIN	CLOSED	(ON=1)	MANMVA::1:30	75	
EP1-TK3-BAT	4810	HATCH TX BAT	BIN	NORMAL	(ON=1)	MANMVA::1:30	80	
EP1-TK3-HATCH	4806	ELWOOD PK1	BIN	CLOSED	(ON=1)	MANMVA::1:30	77	
EP1-TMP-H20	3775	WATER TEMP	ANA	32	DEG F	MANMVA::1:30	17	
MANRT30-STS	1644	ELW1 BS COMM	BIN	ONLINE	(ON=1)	MANMVA::1:30		
SECURE-EL1-GS	3491	SEC. ALARM	BIN	HATCH-OP	(ON=1)	MANMVA::1:30	5	
		Valve Open	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Close	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve - RTU Control	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		OCA - Auto	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Opened	BIN	ONLINE	(ON=1)	MANMVA::1:11		
		Valve Closed	BIN	ONLINE	(ON=1)	MANMVA::1:11		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
	1			
	1			
		1		
		1		
		1		
	1			
	1			
	1			
	1			
	1			
	1			
	1			
		1		
	1			
			1	
			1	
			1	
	1			
	1			
	1			

Discrete Input 24 VDC	**26**			
Analog Input 4-20 mA		**12**		
Discrete Output 24 VDC			**10**	
Analog Output 4-20 mA				**1**

Cortez G.S. and Booster Station	RTU 31	Modem

Insert V

POINT FILE SUMMARY 13-OCT-17 10:15:51								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
CRTZ-BS-AC	1696	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:31	7	
CRTZ-BS-BAT	1692	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:31	8	
CRTZ-BS-DP-AVG	1760	DP AVG	ANA	78.95	PSI	MANMVA::1:31	66	
CRTZ-BS-DP-SP	1765	DP SETPNT	ANA	73.99	PSI	MANMVA::1:31		1
CRTZ-BS-DPGAIN	1770	DP GAIN	ANA	0.75	%/PSI	MANMVA::1:31		
CRTZ-BS-DPSI	1746	DISCHRGE PSI	ANA	74.08	PSI	MANMVA::1:31	3	
CRTZ-BS-DS	1710	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:31	5	
CRTZ-BS-FL	1747	CORTEZ FLOW	ANA	3.61	MGD	MANMVA::1:31	1	
CRTZ-BS-GS-AM	1777	CRTZ AUT/MAN	BIN	MANUAL	(ON=1)	MANMVA::1:31	89	100
CRTZ-BS-GS-LEV	1309	STRG LEVEL	ANA	21.58	FT	MANMVA::1:31	4	15
CRTZ-BS-P1-ALM	1861	PUMP #1	BIN	NORMAL	(ON=0)	MANMVA::1:31	20	
CRTZ-BS-P1-SPD	1741	PUMP 1 SPEED	ANA	61.94	%	MANMVA::1:31	5	
CRTZ-BS-P1-SS	1724	PUMP 1 S/S	BIN	ON	(ON=1)	MANMVA::1:31	17	1
CRTZ-BS-P2-ALM	1860	PUMP #2	BIN	NORMAL	(ON=0)	MANMVA::1:31	21	
CRTZ-BS-P2-SPD	1742	PUMP 2 SPEED	ANA	0	%	MANMVA::1:31	6	
CRTZ-BS-P2-SS	1725	PUMP 2 S/S	BIN	OFF	(ON=1)	MANMVA::1:31	18	2
CRTZ-BS-P3-ALM	1862	PUMP #3	BIN	NORMAL	(ON=0)	MANMVA::1:31	22	
CRTZ-BS-P3-SPD	1743	PUMP 3 SPEED	ANA	78.53	%	MANMVA::1:31	7	
CRTZ-BS-P3-SS	1726	PUMP 3 S/S	BIN	ON	(ON=1)	MANMVA::1:31	19	101
CRTZ-BS-SP-AVG	1749	SP AVG	ANA	54.46	PSI	MANMVA::1:31	86	
CRTZ-BS-SP-SP	1764	SP SETPNT	ANA	55.01	PSI	MANMVA::1:31		8
CRTZ-BS-SPGAIN	1771	SP GAIN	ANA	2	%/PSI	MANMVA::1:31		
CRTZ-BS-SPSI	1745	SUCTION PSI	ANA	54.73	PSI	MANMVA::1:31	2	
CRTZ-BS-VL-CTL	1729	VALVE CNTRL	ANA	0	%	MANMVA::1:31		4
CRTZ-BS-VL-POS	1744	CRTZ VLV POS	ANA	0	%	MANMVA::1:31	8	
CRTZ-BS-VL-SPT	5016	SETS OUTPUT	ANA	0	%	MANMVA::1:31		
CRTZ-BS-VL-ST	1776	VALVE STATUS	BIN	CLOSED	(ON=1)	MANMVA::1:31		
CRTZ-DTFL	2914	CORTEZ	ANA	1632	KGAL	MANMVA::1:31		
CRTZ-INTFL	2913	INTEGRATOR	ANA	2.51	GAL	MANMVA::1:31		
CRTZ-LAD-ALM	3756	SEC. FAULT	BIN	NORM	(ON=1)	MANMVA::1:31	24	
CRTZ-MIDN-TOT	1782	CORTEZ BS	ANA	3368	KGAL	MANMVA::1:31		
CRTZ-P1-RT	3826	P1-RT	ANA	72417	HOURS	MANMVA::1:31		
CRTZ-P2-RT	3827	P2-RT	ANA	46209	HOURS	MANMVA::1:31		
CRTZ-P3-RT	3828	P3-RT	ANA	21909	HOURS	MANMVA::1:31		
FAULT-CTZ-GS	3747	SEC. FAULT	BIN	FAULT	(ON=1)	MANMVA::1:31	6	
MANRT31-STS	1645	CRTZ BS COMM	BIN	ONLINE	(ON=1)	MANMVA::1:31		
SECURE-CTZ-GS	3492	SEC. ALARM	BIN	HATCH-CL	(ON=1)	MANMVA::1:31	23	

	Discrete Input	Analog Input	Discrete Output	Analog Output
CRTZ-BS-AC	1			
CRTZ-BS-BAT	1			
CRTZ-BS-DP-AVG		1		
CRTZ-BS-DP-SP				1
CRTZ-BS-DPGAIN				
CRTZ-BS-DPSI		1		
CRTZ-BS-DS	1			
CRTZ-BS-FL		1		
CRTZ-BS-GS-AM	1		1	
CRTZ-BS-GS-LEV		1		1
CRTZ-BS-P1-ALM	1			
CRTZ-BS-P1-SPD		1		
CRTZ-BS-P1-SS	1		1	
CRTZ-BS-P2-ALM	1			
CRTZ-BS-P2-SPD		1		
CRTZ-BS-P2-SS	1		1	
CRTZ-BS-P3-ALM	1			
CRTZ-BS-P3-SPD		1		
CRTZ-BS-P3-SS	1		1	
CRTZ-BS-SP-AVG		1		
CRTZ-BS-SP-SP				1
CRTZ-BS-SPGAIN				
CRTZ-BS-SPSI		1		
CRTZ-BS-VL-CTL				1
CRTZ-BS-VL-POS		1		
CRTZ-BS-VL-SPT				
CRTZ-BS-VL-ST				
CRTZ-DTFL				
CRTZ-INTFL				
CRTZ-LAD-ALM	1			
CRTZ-MIDN-TOT				
CRTZ-P1-RT				
CRTZ-P2-RT				
CRTZ-P3-RT				
FAULT-CTZ-GS	1			
MANRT31-STS				
SECURE-CTZ-GS	1			

Discrete Input 24 VDC	**13**			
Analog Input 4-20 mA		**10**		
Discrete Output 24 VDC			**4**	
Analog Output 4-20 mA				**4**

WTP - Carbon Silo	RTU 32	Fiber Optic

Insert V

POINT FILE SUMMARY 13-OCT-17 10:15:35								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
CARB-DCDP-HI	2765	DUST COLL	BIN	OFF	(ON=1)	MANMVA::1:32	14	
CARB-HPAC-HI	2761	PAC HOPPER	BIN	ON	(ON=1)	MANMVA::1:32	9	
CARB-HPAC-LO	2762	PAC HOPPER	BIN	OFF	(ON=1)	MANMVA::1:32	10	
CARB-LMFL-ALM	2755	LOW FLOW	BIN	OFF	(ON=1)	MANMVA::1:32	1	
CARB-LWFL-ALM	2756	LOW WASH FLW	BIN	OFF	(ON=1)	MANMVA::1:32	2	
CARB-NLWFL-ALM	2771	NORTH RETRO	BIN	OFF	(ON=1)	MANMVA::1:32	23	
CARB-NNFL-ALM	2770	NORTH RETRO	BIN	OFF	(ON=1)	MANMVA::1:32	22	
CARB-NRI-VLV	2788	NORTH RETRO	BIN	OPEN	(ON=1)	MANMVA::1:32	21	
CARB-NWCHL-ALM	2772	NORTH RETRO	BIN	OFF	(ON=1)	MANMVA::1:32	24	
CARB-P1-SS	2822	START/STOP	BIN	OFF	(ON=1)	MANMVA::1:32		2
CARB-P2-SS	2823	START/STOP	BIN	OFF	(ON=1)	MANMVA::1:32		3
CARB-P7-SS	2824	START/STOP	BIN	OFF	(ON=1)	MANMVA::1:32		7
CARB-RMT-SS	2777	REMOTE S/S	BIN	REMOTE	(ON=1)	MANMVA::1:32		1
CARB-SILO-AC	2752	AC DOWN	BIN	AC ON	(ON=1)	MANMVA::1:32	243	
CARB-SILO-BAT	2750	BAT VOLTS	ANA	22.61	VOLTS	MANMVA::1:32	232	
CARB-SILO-DCOL	2775	REMOTE SILO	BIN	OK	(ON=1)	MANMVA::1:32	29	
CARB-SILO-DS	2751	DOOR ALARM	BIN	CLOSED	(ON=1)	MANMVA::1:32	241	
CARB-SILO-FEED	2794	SILO LBS/MIN	ANA	3.214	LBS/MIN	MANMVA::1:32		1
CARB-SILO-FILL	2773	REMOTE SILO	BIN	OK	(ON=0)	MANMVA::1:32	27	
CARB-SILO-FLN	2774	REMOTE SILO	BIN	OPEN	(ON=1)	MANMVA::1:32	28	
CARB-SILO-HI	2758	SILO HI LEV	BIN	OFF	(ON=1)	MANMVA::1:32	4	
CARB-SILO-LBS	2754	SILO LBS/MIN	ANA	0	LBS/MIN	MANMVA::1:32	225	
CARB-SILO-LEV	2753	SILO LEVEL	ANA	88.46	PERCENT	MANMVA::1:32	226	
CARB-SILO-LL	2760	SILO LO LO	BIN	OFF	(ON=1)	MANMVA::1:32	7	
CARB-SILO-LO	2759	SILO LO LEV	BIN	OFF	(ON=1)	MANMVA::1:32	6	
CARB-SILO-RV	2763	SILO ROTARY	BIN	OFF	(ON=1)	MANMVA::1:32	12	
CARB-SLFL-ALM	2767	SOUTH RETRO	BIN	OFF	(ON=1)	MANMVA::1:32	18	
CARB-SLSP-ALM	2764	SILO LO	BIN	OFF	(ON=1)	MANMVA::1:32	13	
CARB-SLWFL-ALM	2768	SOUTH RETRO	BIN	OFF	(ON=1)	MANMVA::1:32	19	
CARB-SRI-VLV	2766	SOUTH RETRO	BIN	CLOSE	(ON=1)	MANMVA::1:32	17	
CARB-SWCHL-ALM	2769	SOUTH-RETRO	BIN	OFF	(ON=1)	MANMVA::1:32	20	
CARB-WCHL-ALM	2757	WET CONE HI	BIN	OFF	(ON=1)	MANMVA::1:32	3	
MANRT32-STS	2791	C SILO COMM	BIN	ONLINE	(ON=1)	MANMVA::1:32		
OLD-CARB-LEV	2908	LEVEL OF	ANA	81.59	%	MANMVA::1:32	227	
RW1-CBFL	3448	RW1-CARB-FL	ANA	2.32	GPM	MANMVA::1:32	230	
RW2-CBFL	3449	RW2-CARB-FL	ANA	0.12	GPM	MANMVA::1:32	228	

	Discrete Input	Analog Input	Discrete Output	Analog Output
CARB-DCDP-HI	1			
CARB-HPAC-HI	1			
CARB-HPAC-LO	1			
CARB-LMFL-ALM	1			
CARB-LWFL-ALM	1			
CARB-NLWFL-ALM	1			
CARB-NNFL-ALM	1			
CARB-NRI-VLV	1			
CARB-NWCHL-ALM	1			
CARB-P1-SS			1	
CARB-P2-SS			1	
CARB-P7-SS			1	
CARB-RMT-SS			1	
CARB-SILO-AC	1			
CARB-SILO-BAT		1		
CARB-SILO-DCOL	1			
CARB-SILO-DS	1			
CARB-SILO-FEED				1
CARB-SILO-FILL	1			
CARB-SILO-FLN	1			
CARB-SILO-HI	1			
CARB-SILO-LBS		1		
CARB-SILO-LEV		1		
CARB-SILO-LL	1			
CARB-SILO-LO	1			
CARB-SILO-RV	1			
CARB-SLFL-ALM	1			
CARB-SLSP-ALM	1			
CARB-SLWFL-ALM	1			
CARB-SRI-VLV	1			
CARB-SWCHL-ALM	1			
CARB-WCHL-ALM	1			
MANRT32-STS				
OLD-CARB-LEV		1		
RW1-CBFL		1		
RW2-CBFL		1		

Discrete Input 24 VDC	**24**			
Analog Input 4-20 mA		**6**		
Discrete Output 24 VDC			**4**	
Analog Output 4-20 mA				**1**

Monitoring Wells 50, 51, 52, 53	RTU 40	Radio

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1	1	1	1

Insert V

POINT FILE SUMMARY 13-OCT-17 10:10:43								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
ECS54-MXL-MTMP	4850	TIME MIN	ANA	0	MIN	MANMVA::1:40		
ECW-BIN-PORT	4709	ECW TEST BIN	BIN	OFF	(ON=1)	MANMVA::1:40	5	
ECW50-ABS-LEV	4933	N. SURFICIAL	ANA	196.15	FT	MANMVA::1:40		
ECW50-LEV	1863	N. SURFICIAL	ANA	116.01	FT. MSL	MANMVA::1:40	4	
ECW50-MAX-LEV	2154	MON WELL 50	ANA	116.12	FT. MSL	MANMVA::1:40		
ECW50-MIN-LEV	2155	MON WELL 50	ANA	115.99	FT. MSL	MANMVA::1:40		
ECW50-MXL-DLY	4813	DAILY MAX LV	ANA	116.24	FT. MSL	MANMVA::1:40		
ECW50-MXL-HRS	4831	TIME HOURS	ANA	3	HRS	MANMVA::1:40		
ECW50-MXL-HTMP	4841	TIME HOURS	ANA	1	HRS	MANMVA::1:40		
ECW50-MXL-MIN	4836	TIME VAR	ANA	30	MIN	MANMVA::1:40		
ECW50-MXL-MTMP	4846	TIME MIN	ANA	42	MIN	MANMVA::1:40		
ECW50-MXL-RST	4822	MAX LV RST	BIN	NORMAL	(ON=1)	MANMVA::1:40		
ECW50-MXL-TMP	4812	TEMP MAX LVL	ANA	116.12	FT. MSL	MANMVA::1:40		
ECW51-ABS-LEV	4934	UPPER FLO	ANA	667.08	FT	MANMVA::1:40		
ECW51-LEV	1864	UPPER FLORID	ANA	34.88	FT. MSL	MANMVA::1:40	1	
ECW51-MAX-LEV	2156	MON WELL 51	ANA	34.94	FT. MSL	MANMVA::1:40		
ECW51-MIN-LEV	2157	MON WELL 51	ANA	34.64	FT. MSL	MANMVA::1:40		
ECW51-MXL-DLY	4818	DAILY MAX LV	ANA	35.47	FT. MSL	MANMVA::1:40		
ECW51-MXL-HRS	4832	TIME HOURS	ANA	8	HRS	MANMVA::1:40		
ECW51-MXL-HTMP	4842	TIME HOURS	ANA	7	HRS	MANMVA::1:40		
ECW51-MXL-MIN	4837	TIME VAR	ANA	0	MIN	MANMVA::1:40		
ECW51-MXL-MTMP	4847	TIME MIN	ANA	44	MIN	MANMVA::1:40		
ECW51-MXL-RST	4823	MAX LV RST	BIN	NORMAL	(ON=1)	MANMVA::1:40		
ECW51-MXL-TMP	4814	TEMP MAX LEV	ANA	34.94	FT. MSL	MANMVA::1:40		
ECW52-ABS-LEV	4935	INTERMEDIATE	ANA	238.25	FT	MANMVA::1:40		
ECW52-LEV	1865	INTERMEDIATE	ANA	108.05	FT. MSL	MANMVA::1:40	2	
ECW52-MAX-LEV	2158	MON WELL 52	ANA	108.13	FT. MSL	MANMVA::1:40		
ECW52-MIN-LEV	2159	MON WELL 52	ANA	107.96	FT. MSL	MANMVA::1:40		
ECW52-MXL-DLY	4819	DAILY MAX LV	ANA	108.26	FT. MSL	MANMVA::1:40		
ECW52-MXL-HRS	4833	TIME HOURS	ANA	8	HRS	MANMVA::1:40		
ECW52-MXL-HTMP	4843	TIME HOURS	ANA	8	HRS	MANMVA::1:40		
ECW52-MXL-MIN	4838	TIME VAR	ANA	23	MIN	MANMVA::1:40		
ECW52-MXL-MTMP	4848	TIME MIN	ANA	30	MIN	MANMVA::1:40		
ECW52-MXL-RST	4824	MAX LV RST	BIN	NORMAL	(ON=1)	MANMVA::1:40		
ECW52-MXL-TMP	4815	TEMP MAX LEV	ANA	108.13	FT. MSL	MANMVA::1:40		
ECW53-ABS-LEV	4936	LOWER FLORID	ANA	1225.12	FT	MANMVA::1:40		
ECW53-LEV	1866	LOWER FLORID	ANA	33.12	FT. MSL	MANMVA::1:40	3	
ECW53-MAX-LEV	2161	MON WELL 53	ANA	33.48	FT. MSL	MANMVA::1:40		
ECW53-MIN-LEV	2160	MON WELL 53	ANA	32.98	FT. MSL	MANMVA::1:40		
ECW53-MXL-DLY	4820	DAILY MAX LV	ANA	34.18	FT. MSL	MANMVA::1:40		
ECW53-MXL-HRS	4834	TIME HOURS	ANA	7	HRS	MANMVA::1:40		
ECW53-MXL-HTMP	4844	TIME HOURS	ANA	7	HRS	MANMVA::1:40		

Monitoring Wells 50, 51, 52, 53		RTU 40		Radio				

ECW53-MXL-MIN	4839	TIME VAR	ANA	45	MIN	MANMVA::1:40		
ECW53-MXL-MTMP	4849	TIME MIN	ANA	15	MIN	MANMVA::1:40		
ECW53-MXL-RST	4825	MAX LV RST	BIN	NORMAL	(ON=1)	MANMVA::1:40		
ECW53-MXL-TMP	4816	TEMP MAX LEV	ANA	33.48	FT. MSL	MANMVA::1:40		
ECW54-ABS-LEV	4937	S. SURFICIAL	ANA	197.67	FT	MANMVA::1:40		
ECW54-MXL-DLY	4821	DAILY MAX LV	ANA	111.6	FT. MSL	MANMVA::1:40		
ECW54-MXL-HRS	4835	TIME HOURS	ANA	5	HRS	MANMVA::1:40		
ECW54-MXL-HTMP	4845	TIME HOURS	ANA	1	HRS	MANMVA::1:40		
ECW54-MXL-MIN	4840	TIME VAR	ANA	14	MIN	MANMVA::1:40		
ECW54-MXL-MTMP	4851	TIME MIN	ANA	44	MIN	MANMVA::1:40		
ECW54-MXL-RST	4826	MAX LV RST	BIN	NORMAL	(ON=1)	MANMVA::1:40		
ECW54-MXL-TMP	4817	TEMP MAX LEV	ANA	111.49	FT. MSL	MANMVA::1:40		
EVD-TIME	4827	TIME VAR	ANA	610.52	MIN	MANMVA::1:40		
EVD-TIME-HRS	4828	TIME VAR	ANA	10	HRS	MANMVA::1:40		
EVD-TIME-MIN	4829	TIME VAR	ANA	10	MIN	MANMVA::1:40		
EVD-TIME-SEC	4830	TIME VAR	ANA	31	SEC	MANMVA::1:40		
MANRT40-STS	1871	ECMW COMM	BIN	ONLINE	(ON=1)	MANMVA::1:40		

	Discrete Input	Analog Input	Discrete Output	Analog Output
Discrete Input 24 VDC	**1**			
Analog Input 4-20 mA		**4**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**0**

East County Well # 1 & RG # 5	RTU 41	Radio

POINT FILE SUMMARY 11-OCT-17 13:48:29

ACRONYM	RN	NAME	REC TYP	VALUE	ENG UNITS	UNIT	IN ADD	OUT ADD
ECW-TOTAL-FL	4730	ECW FIELD	ANA	17.06	MGD	MANMVA::1:41		
ECW-TOTAL-FLO	4889	ECW FIELD	ANA	0	MGD	MANMVA::1:41		
ECW1-AC	1835	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:41	7	
ECW1-BAT	1840	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:41	8	
ECW1-BLD-SS	3400	WELL #1	BIN	OFF	(ON=1)	MANMVA::1:41		2
ECW1-BUB-LEV	2153	WELL 1 LEVEL	ANA	2.3	FT. MSL	MANMVA::1:41	6	
ECW1-DS	1830	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:41	4	
ECW1-FL	1820	WELL #1 FLOW	ANA	0	MGD	MANMVA::1:41	1	
ECW1-LEV	1845	WELL 1 LEVEL	ANA	-53.53	FT. MSL	MANMVA::1:41	3	
ECW1-P1-ALM	1855	PUMP ALARM	BIN	NORMAL	(ON=1)	MANMVA::1:41	22	
ECW1-P1-RT	2536	EC WELL 1	ANA	54383	HOURS	MANMVA::1:41		
ECW1-P1-SS	1850	WELL #1 PUMP	BIN	OFF	(ON=1)	MANMVA::1:41	21	1
ECW1-PSI	1825	WELL #1 PSI	ANA	30.91	PSI	MANMVA::1:41	2	
IMC-CALC-FLO	4776	ECW FIELD	ANA	1.26	MGD	MANMVA::1:41		
MANRT41-STS	1815	ECW 1 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:41		
RG5-LEV	1604	RAIN GAUGE 5	COU	0	IN/M	MANMVA::1:41	6	
RG5-MIDN-TOT	1790	RAIN GAUGE 5	ANA	0.03	INCHES	MANMVA::1:41		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
			1	
		1		
	1			
		1		
		1		
	1			
	1		1	
		1		
	1			
	1			

Discrete Input 24 VDC	**6**			
Analog Input 4-20 mA		**4**		
Discrete Output 24 VDC			**2**	
Analog Output 4-20 mA				**0**

East County Well # 2	RTU 42	Radio

POINT FILE SUMMARY 11-OCT-17 13:49:03

ACRONYM	RN	NAME	REC TYP	VALUE	ENG UNITS	UNIT	IN ADD	OUT ADD
ECW2-AC	1836	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:42	7	
ECW2-BAT	1841	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:42	8	
ECW2-BLD-SS	3445	WELL #2	BIN	OFF	(ON=1)	MANMVA::1:42		2
ECW2-DS	1831	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:42	4	
ECW2-FL	1821	WELL #2 FLOW	ANA	4.49	MGD	MANMVA::1:42	1	
ECW2-LEV	1846	WELL 2 LEVEL	ANA	-58.11	FT. MSL	MANMVA::1:42	3	
ECW2-P1-ALM	1856	PUMP ALARM	BIN	NORMAL	(ON=1)	MANMVA::1:42	22	
ECW2-P1-RT	2537	EC WELL 2	ANA	53446	HOURS	MANMVA::1:42		
ECW2-P1-SS	1851	WELL #2 PUMP	BIN	ON	(ON=1)	MANMVA::1:42	21	3
ECW2-PSI	1826	WELL #2 PSI	ANA	34.2	PSI	MANMVA::1:42	2	
MANRT42-STS	1816	ECW 2 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:42		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
			1	
	1			
		1		
		1		
	1			
	1		1	
		1		

Discrete Input 24 VDC	**5**			
Analog Input 4-20 mA		**3**		
Discrete Output 24 VDC			**2**	
Analog Output 4-20 mA				**0**

East County Well # 3	RTU 43	Radio

POINT FILE SUMMARY 11-OCT-17 13:49:26

ACRONYM	RN	NAME	REC TYP	VALUE	ENG UNITS	UNIT	IN ADD	OUT ADD
ECW3-AC	1837	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:43	7	
ECW3-BAT	1842	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:43	8	
ECW3-BLD-SS	3444	WELL #3	BIN	OFF	(ON=1)	MANMVA::1:43		2
ECW3-DS	1832	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:43	4	
ECW3-FL	2910	WELL #3 FLOW	ANA	4.6	MGD	MANMVA::1:43	1	
ECW3-LEV	1848	WELL 3 LEVEL	ANA	-54.97	FT. MSL	MANMVA::1:43	3	
ECW3-P1-ALM	1857	PUMP ALARM	BIN	NORMAL	(ON=1)	MANMVA::1:43	22	
ECW3-P1-RT	2538	EC WELL 3	ANA	51773	HOURS	MANMVA::1:43		
ECW3-P1-SS	1852	WELL #3 PUMP	BIN	ON	(ON=1)	MANMVA::1:43	21	1
ECW3-PSI	1827	WELL #3 PSI	ANA	32.92	PSI	MANMVA::1:43	2	
MANRT43-STS	1817	ECW 3 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:43		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
			1	
	1			
		1		
		1		
	1			
	1		1	
		1		

Discrete Input 24 VDC	**5**			
Analog Input 4-20 mA		**3**		
Discrete Output 24 VDC			**2**	
Analog Output 4-20 mA				**0**

East County Well # 4	RTU 44	Radio

POINT FILE SUMMARY 11-OCT-17 13:49:42								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
ECW4-AC	1838	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:44	7	
ECW4-BAT	1843	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:44	8	
ECW4-BLD-SS	3446	WELL #4	BIN	OFF	(ON=1)	MANMVA::1:44		2
ECW4-DS	1833	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:44	4	
ECW4-FL	2778	WELL #4 FLOW	ANA	0.04	MGD	MANMVA::1:44	1	
ECW4-LEV	1847	WELL 4 LEVEL	ANA	-61.87	FT. MSL	MANMVA::1:44	3	
ECW4-P1-ALM	1858	PUMP ALARM	BIN	NORMAL	(ON=1)	MANMVA::1:44	22	
ECW4-P1-RT	2539	EC WELL 4	ANA	50986	HOURS	MANMVA::1:44		
ECW4-P1-SS	1853	WELL #4 PUMP	BIN	OFF	(ON=1)	MANMVA::1:44	21	1
ECW4-PSI	1828	WELL #4 PSI	ANA	33.65	PSI	MANMVA::1:44	2	
MANRT44-STS	2779	ECW 4 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:44		

	Discrete Input	Analog Input	Discrete Output	Analog Output
ECW4-AC	1			
ECW4-BAT	1			
ECW4-BLD-SS			1	
ECW4-DS	1			
ECW4-FL		1		
ECW4-LEV		1		
ECW4-P1-ALM	1			
ECW4-P1-RT				
ECW4-P1-SS	1		1	
ECW4-PSI		1		
MANRT44-STS				

Discrete Input 24 VDC	**5**			
Analog Input 4-20 mA		**3**		
Discrete Output 24 VDC			**2**	
Analog Output 4-20 mA				**0**

East County Well # 5	**RTU 45**	**Radio**

POINT FILE SUMMARY 11-OCT-17 13:50:05								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
ECW5-AC	1839	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:45	7	
ECW5-BAT	1844	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:45	8	
ECW5-BLD-SS	3447	WELL #5	BIN	OFF	(ON=1)	MANMVA::1:45		2
ECW5-DS	1834	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:45	4	
ECW5-FL	1824	WELL #5 FLOW	ANA	3.83	MGD	MANMVA::1:45	1	
ECW5-LEV	1849	WELL 5 LEVEL	ANA	-59.14	FT. MSL	MANMVA::1:45	3	
ECW5-P1-ALM	1859	PUMP ALARM	BIN	NORMAL	(ON=1)	MANMVA::1:45	22	
ECW5-P1-RT	2540	EC WELL 5	ANA	45051	HOURS	MANMVA::1:45		
ECW5-P1-SS	1854	WELL #5 PUMP	BIN	ON	(ON=1)	MANMVA::1:45	21	3
ECW5-PSI	1829	WELL #5 PSI	ANA	32.88	PSI	MANMVA::1:45	2	
ECW54-LEV	1927	S. SURFICIAL	ANA	111.48	FT. MSL	MANMVA::1:45	5	
MANRT45-STS	1819	ECW 5 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:45		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
			1	
	1			
		1		
		1		
	1			
	1		1	
		1		
		1		

Discrete Input 24 VDC	**5**			
Analog Input 4-20 mA		**4**		
Discrete Output 24 VDC			**2**	
Analog Output 4-20 mA				**0**

North West Ground Storage	RTU 46	Modem

Insert V

POINT FILE SUMMARY 13-OCT-17 10:12:02								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT46-STS	3732	NW GRND COMM	BIN	ONLINE	(ON=1)	MANMVA::1:46		
N.W.SUCT.-PR	3843	N.W.SUCT.PR	ANA	59.75	PSI	MANMVA::1:46	16	
NW-GS-DIS-FLO	3607	DISCH FLOW	ANA	1018.63	GPM	MANMVA::1:46	7	
NW-GS-DIS-PRS	3608	DISCH PRESS	ANA	75.55	PSI	MANMVA::1:46	9	
NW-GS-FCOF-DLY	3609	FL CUTOFF DL	ANA	600	SECONDS	MANMVA::1:46		32
NW-GS-FLLPMP	3610	PM FILLD TNK	BIN		(ON=1)	MANMVA::1:46	153	62
NW-GS-FLLPMPX	3611	PM FILLD TNK	BIN		(ON=1)	MANMVA::1:46	175	74
NW-GS-FLLPMPZ	3726	PM FILLD TNK	BIN		(ON=1)	MANMVA::1:46	194	80
NW-GS-FLPMPVFD	3612	FLLPMP SPD	ANA	50	PERCENT	MANMVA::1:46		37
NW-GS-FLW-ALM	3613	HIGH FLW ALM	BIN	NORMAL	(ON=1)	MANMVA::1:46	183	
NW-GS-FLW1TK	3614	FROM SYS/TNK	BIN	SYS/TANK	(ON=1)	MANMVA::1:46	152	61
NW-GS-FLW1TKX	3615	FROM SYS/TNK	BIN		(ON=1)	MANMVA::1:46	174	73
NW-GS-FLW1TKZ	3727	PM FILLD TNK	BIN		(ON=1)	MANMVA::1:46	193	79
NW-GS-FLWCOFSP	3616	HIGH FLOW SP	ANA	6001.22	GPM	MANMVA::1:46		38
NW-GS-FLWSYS	3617	FL FROM DIS	BIN		(ON=1)	MANMVA::1:46	150	59
NW-GS-FLWSYSX	3618	FL FROM DIS	BIN		(ON=1)	MANMVA::1:46	172	71
NW-GS-FLWSYSZ	3728	PM FILLD TNK	BIN		(ON=1)	MANMVA::1:46	191	77
NW-GS-FLWTNK	3619	FL FROM TANK	BIN		(ON=1)	MANMVA::1:46	151	60
NW-GS-FLWTNKX	3620	FL FROM TANK	BIN		(ON=1)	MANMVA::1:46	173	72
NW-GS-FLWTNKZ	3729	PM FILLD TNK	BIN		(ON=1)	MANMVA::1:46	192	78
NW-GS-HATCH-AL	3816	SEC. ALARM	BIN	NORMAL	(ON=1)	MANMVA::1:46	30	
NW-GS-LD-FCOF	3621	FLOW CUTOFF	ANA	201	GPM	MANMVA::1:46		31
NW-GS-LG1-FCOF	3622	FLOW CUTOFF	ANA	201	GPM	MANMVA::1:46		29
NW-GS-LG2-FCOF	3623	FLOW CUTOFF	ANA	201	GPM	MANMVA::1:46		30
NW-GS-LLVL-COF	3624	LO LV CUTOFF	ANA	6	FEET	MANMVA::1:46		13
NW-GS-LVL-HISP	3625	LVL HIGH STP	ANA	15	FEET	MANMVA::1:46		24
NW-GS-LVL-LOSP	3626	LVL LOW STP	ANA	6	FEET	MANMVA::1:46		23
NW-GS-MAX-SPD	3627	MAX PUMP SPD	ANA	99	PERCENT	MANMVA::1:46		26
NW-GS-MIN-SPD	3628	MIN PUMP SPD	ANA	5	PERCENT	MANMVA::1:46		25
NW-GS-MVLVAM	3629	MOT VLV AM	BIN	AUTO	(ON=1)	MANMVA::1:46		54
NW-GS-NORMOD	3630	NORMAL OPER	BIN		(ON=1)	MANMVA::1:46	149	58
NW-GS-NORMODX	3631	NORMAL OPER	BIN		(ON=1)	MANMVA::1:46	171	70
NW-GS-NORMODZ	3730	PM FILLD TNK	BIN		(ON=1)	MANMVA::1:46	190	76
NW-GS-NUMPCMD	3632	PUMPS CMDED	ANA	3		MANMVA::1:46	38	36
NW-GS-P1-AM	3633	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANMVA::1:46		55
NW-GS-P1-FAIL	3634	PUMP FAULT	BIN	NORMAL	(ON=1)	MANMVA::1:46	2	
NW-GS-P1-FSTR	3635	FAIL TO STR	BIN	NORMAL	(ON=1)	MANMVA::1:46	117	
NW-GS-P1-HOA	3636	PUMP IN AUTO	BIN	AUTO	(ON=1)	MANMVA::1:46	128	
NW-GS-P1-MSPD	3638	MANUAL SPEED	ANA	40	%	MANMVA::1:46		33
NW-GS-P1-RT	4464	NORTH WEST	ANA	13803	HOURS	MANMVA::1:46		
NW-GS-P1-SEQ	3640	PMP1 SEQ NUM	ANA	3		MANMVA::1:46	47	7
NW-GS-P1-SRVC	3641	P1 IN SERVIC	BIN	INSERV	(ON=1)	MANMVA::1:46	146	51

Discrete Input	Analog Input	Discrete Output	Analog Output
	1		
	1		
	1		
			1
1		1	
1		1	
1		1	
			1
1			
1		1	
1		1	
1		1	
			1
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1		1	
1		1	
1		1	
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1			
			1
			1
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			1
			1
		1	
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1		1	
1		1	
	1		1
		1	
1			
1			
1			
			1
	1		1
1		1	

North West Ground Storage		RTU 46		Modem					Discrete Input	Analog Input	Discrete Output	Analog Output
NW-GS-P1-SS	3642	PUMP S/S	BIN	OFF	(ON=1)	MANMVA::1:46	1	47	1		1	
NW-GS-P1CS-SS	3643	VFD BYP S/S	BIN	OFF	(ON=1)	MANMVA::1:46	3	2	1		1	
NW-GS-P1V-OC	3645	VALVE OP/CL	BIN	CLOSE	(ON=1)	MANMVA::1:46	131		1			
NW-GS-P1VF-AMP	3646	VFD CURRENT	ANA	300	AMPS	MANMVA::1:46	1			1		
NW-GS-P1VF-SPD	3647	VFD SPEED	ANA	2	%	MANMVA::1:46	2			1		
NW-GS-P2-AM	3648	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANMVA::1:46		56			1	
NW-GS-P2-FAIL	3649	PUMP FAULT	BIN	NORMAL	(ON=1)	MANMVA::1:46	9		1			
NW-GS-P2-FSTR	3650	FAIL TO STR	BIN	NORMAL	(ON=1)	MANMVA::1:46	118		1			
NW-GS-P2-HOA	3651	PUMP IN AUTO	BIN	AUTO	(ON=1)	MANMVA::1:46	129		1			
NW-GS-P2-MSPD	3653	MANUAL SPEED	ANA	49	%	MANMVA::1:46		34				1
NW-GS-P2-RT	4465	NORTH WEST	ANA	13667	HOURS	MANMVA::1:46						
NW-GS-P2-SEQ	3655	PMP2 SEQ NUM	ANA	1		MANMVA::1:46	48	8		1		1
NW-GS-P2-SRVC	3656	P2 IN SERVIC	BIN	INSERV	(ON=1)	MANMVA::1:46	147	52	1		1	
NW-GS-P2-SS	3657	PUMP S/S	BIN	OFF	(ON=1)	MANMVA::1:46	8	48	1		1	
NW-GS-P2CS-SS	3658	VFD BYP S/S	BIN	OFF	(ON=1)	MANMVA::1:46	10	4	1		1	
NW-GS-P2V-OC	3660	VALVE OP/CL	BIN	CLOSE	(ON=1)	MANMVA::1:46	132		1			
NW-GS-P2VF-AMP	3661	VFD CURRENT	ANA	0	AMPS	MANMVA::1:46	3			1		
NW-GS-P2VF-SPD	3662	VFD SPEED	ANA	0	%	MANMVA::1:46	4			1		
NW-GS-P3-AM	3663	AUTO/MANUAL	BIN	MANUAL	(ON=1)	MANMVA::1:46		57			1	
NW-GS-P3-FAIL	3664	PUMP FAULT	BIN	NORMAL	(ON=1)	MANMVA::1:46	18		1			
NW-GS-P3-FSTR	3665	FAIL TO STR	BIN	NORMAL	(ON=1)	MANMVA::1:46	119		1			
NW-GS-P3-HOA	3666	PUMP IN AUTO	BIN	AUTO	(ON=1)	MANMVA::1:46	130		1			
NW-GS-P3-MSPD	3668	MANUAL SPEED	ANA	86	%	MANMVA::1:46		35				1
NW-GS-P3-RT	4466	NORTH WEST	ANA	21349	HOURS	MANMVA::1:46						
NW-GS-P3-SEQ	3670	PMP3 SEQ NUM	ANA	2		MANMVA::1:46	49	9		1		1
NW-GS-P3-SRVC	3671	P3 IN SERVIC	BIN	INSERV	(ON=1)	MANMVA::1:46	148	53	1		1	
NW-GS-P3-SS	3672	PUMP S/S	BIN	ON	(ON=1)	MANMVA::1:46	17	49	1		1	
NW-GS-P3CS-SS	3673	VFD BYP S/S	BIN	OFF	(ON=1)	MANMVA::1:46	19	6	1		1	
NW-GS-P3V-OC	3675	VALVE OP/CL	BIN	OPEN	(ON=1)	MANMVA::1:46	133		1			
NW-GS-P3VF-AMP	3676	VFD CURRENT	ANA	73	AMPS	MANMVA::1:46	5			1		
NW-GS-P3VF-SPD	3677	VFD SPEED	ANA	84	%	MANMVA::1:46	6			1		
NW-GS-PCOF-ALM	3678	CUTOF SUM AL	BIN	NORMAL	(ON=1)	MANMVA::1:46	185		1			
NW-GS-PFL-DLY	3679	PMP FAIL DLY	ANA	0		MANMVA::1:46		6				1
NW-GS-PID-IGN	3680	PID INTGR GN	ANA	3		MANMVA::1:46		28				1
NW-GS-PID-PGN	3681	PID PROP GN	ANA	3		MANMVA::1:46		27				1
NW-GS-PID-PRS	3682	PID PRS STP	ANA	80	PSI	MANMVA::1:46		20				1
NW-GS-PIDOUT	3740	PID RESET	ANA	10	PERCENT	MANMVA::1:46		39				1
NW-GS-PMPS-USD	3683	# PMPS USED	ANA	1		MANMVA::1:46		10				1
NW-GS-PNXT-DLY	3718	PMP ADD DLY	ANA	20	SECONDS	MANMVA::1:46		18				1
NW-GS-PRS-ALM	3684	HIGH PRS ALM	BIN	NORMAL	(ON=1)	MANMVA::1:46	99		1			
NW-GS-PRS-COF	3685	PRS CUT OFF	ANA	90	PSI	MANMVA::1:46		11				1
NW-GS-PSTR-DLY	3717	PMP STR DLY	ANA	20	SECONDS	MANMVA::1:46		17				1
NW-GS-SEQ-ALM	3686	SEQ INCONSIS	BIN	NORMAL	(ON=1)	MANMVA::1:46	101		1			
NW-GS-SPD-STP	3687	SPD SP STOP	ANA	25	%	MANMVA::1:46		5				1
NW-GS-SPD-STR	3688	SPD SP START	ANA	30	%	MANMVA::1:46		4				1
NW-GS-STBYPS	3689	TNK/PS BYPSD	BIN		(ON=1)	MANMVA::1:46	154	63	1		1	
NW-GS-STBYPSX	3690	TNK/PS BYPSD	BIN		(ON=1)	MANMVA::1:46	176	75	1		1	
NW-GS-STP-PRS	3691	STOP PRS SP	ANA	90	PSI	MANMVA::1:46		15				1

North West Ground Storage	RTU 46	Modem							Discrete Input	Analog Input	Discrete Output	Analog Output
NW-GS-STR-PRS	3692	START PRS SP	ANA	50	PSI	MANMVA::1:46		14				1
NW-GS-SV112-OC	3693	SOL VLV OP/C	BIN	CLOSED	(ON=1)	MANMVA::1:46	32	21	1		1	
NW-GS-SVLVAM	3695	MOT VLV AM	BIN	MANUAL	(ON=1)	MANMVA::1:46		46			1	
NW-GS-TANK-LVL	3696	TANK LEVEL	ANA	12.65	FT	MANMVA::1:46	8			1		
NW-GS-TOTW	4650		ANA	0.744	MG	MANMVA::1:46						
NW-GS-V107-HOA	3697	VLV IN AUTO	BIN	AUTO	(ON=1)	MANMVA::1:46	134		1			
NW-GS-V107-OC	3698	VLV OPN/CLS	BIN	OPEN	(ON=1)	MANMVA::1:46	135	9	1		1	
NW-GS-V108-HOA	3700	VLV IN AUTO	BIN	AUTO	(ON=1)	MANMVA::1:46	136		1			
NW-GS-V108-OC	3701	VLV OPN/CLS	BIN	OPEN	(ON=1)	MANMVA::1:46	137	11	1		1	
NW-GS-V109-HOA	3703	VLV IN AUTO	BIN	AUTO	(ON=1)	MANMVA::1:46	138		1			
NW-GS-V109-OC	3704	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANMVA::1:46	139	13	1		1	
NW-GS-V110-HOA	3706	VLV IN AUTO	BIN	AUTO	(ON=1)	MANMVA::1:46	140		1			
NW-GS-V110-OC	3707	VLV OPN/CLS	BIN	OPEN	(ON=1)	MANMVA::1:46	141	15	1		1	
NW-GS-V111-HOA	3709	VLV IN AUTO	BIN	AUTO	(ON=1)	MANMVA::1:46	142		1			
NW-GS-V111-OC	3710	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANMVA::1:46	143	17	1		1	
NW-GS-V112-HOA	3712	MOT VLV HOA	BIN	AUTO	(ON=1)	MANMVA::1:46	144		1			
NW-GS-V112-OC	3713	MOT VLV OP/C	BIN	OPEN	(ON=1)	MANMVA::1:46	145	19	1		1	
		Valve Open	BIN	ONLINE	(ON=1)	MANMVA::1:11					1	
		Valve Close	BIN	ONLINE	(ON=1)	MANMVA::1:11					1	
		Valve - RTU Control	BIN	ONLINE	(ON=1)	MANMVA::1:11					1	
		OCA - Auto	BIN	ONLINE	(ON=1)	MANMVA::1:11			1			
		Valve Opened	BIN	ONLINE	(ON=1)	MANMVA::1:11			1			
		Valve Closed	BIN	ONLINE	(ON=1)	MANMVA::1:11			1			

Discrete Input 24 VDC	**56**			
Analog Input 4-20 mA		**14**		
Discrete Output 24 VDC			**38**	
Analog Output 4-20 mA				**31**

Longboat Key Meter Station	RTU 47	Radio

Discrete Input	Analog Input	Discrete Output	Analog Output

Insert V

POINT FILE SUMMARY 13-OCT-17 10:12:22								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
DAY01	4987	DAY OF MONTH	BIN	1	(ON=1)	MANMVA::1:47		
DAY02	4988	DAY OF MONTH	BIN	2	(ON=1)	MANMVA::1:47		
DAY03	4989	DAY OF MONTH	BIN	3	(ON=1)	MANMVA::1:47		
DAY04	4990	DAY OF MONTH	BIN	4	(ON=1)	MANMVA::1:47		
DAY05	4991	DAY OF MONTH	BIN	5	(ON=1)	MANMVA::1:47		
DAY06	4992	DAY OF MONTH	BIN	6	(ON=1)	MANMVA::1:47		
DAY07	4993	DAY OF MONTH	BIN	7	(ON=1)	MANMVA::1:47		
DAY08	4994	DAY OF MONTH	BIN	8	(ON=1)	MANMVA::1:47		
DAY09	4995	DAY OF MONTH	BIN	9	(ON=1)	MANMVA::1:47		
DAY10	4996	DAY OF MONTH	BIN	10	(ON=1)	MANMVA::1:47		
LBK-15SEC-FL	4695	LONGBOATKEY	ANA	6.11	MGD	MANMVA::1:47		
LBK-BINARY	4682	ON OFF	BIN	OFF	(ON=1)	MANMVA::1:47		
LBK-C0UNTER-60	4687	COUNTER	COU	0	CNTS/S	MANMVA::1:47		
LBK-COUNTER	4685	LONGBOATKEY	ANA	11	KGAL	MANMVA::1:47		
LBK-DAY01-TOT	4954	LBK KEY	ANA	1344	KGAL	MANMVA::1:47		
LBK-DAY02-TOT	4955	LBK KEY	ANA	1703	KGAL	MANMVA::1:47		
LBK-DAY03-TOT	4956	LBK KEY	ANA	1673	KGAL	MANMVA::1:47		
LBK-DAY04-TOT	4957	LBK KEY	ANA	1602	KGAL	MANMVA::1:47		
LBK-DAY05-TOT	4958	LBK KEY	ANA	1727	KGAL	MANMVA::1:47		
LBK-DAY06-TOT	4959	LBK KEY	ANA	1714	KGAL	MANMVA::1:47		
LBK-DAY07-TOT	4960	LBK KEY	ANA	1860	KGAL	MANMVA::1:47		
LBK-DAY08-TOT	4961	LBK KEY	ANA	1602	KGAL	MANMVA::1:47		
LBK-DAY09-TOT	4962	LBK KEY	ANA	1934	KGAL	MANMVA::1:47		
LBK-DAY10-TOT	4963	LBK KEY	ANA	2024	KGAL	MANMVA::1:47		
LBK-DAY11-TOT	4964	LBK KEY	ANA	1752	KGAL	MANMVA::1:47		
LBK-DAY12-TOT	4965	LBK KEY	ANA	1750	KGAL	MANMVA::1:47		
LBK-DAY13-TOT	4966	LBK KEY	ANA	808	KGAL	MANMVA::1:47		
LBK-DAY14-TOT	4967	LBK KEY	ANA	1679	KGAL	MANMVA::1:47		
LBK-DAY15-TOT	4968	LBK KEY	ANA	1567	KGAL	MANMVA::1:47		
LBK-DAY16-TOT	4969	LBK KEY	ANA	1593	KGAL	MANMVA::1:47		
LBK-DAY17-TOT	4970	LBK KEY	ANA	1397	KGAL	MANMVA::1:47		
LBK-DAY18-TOT	4971	LBK KEY	ANA	1722	KGAL	MANMVA::1:47		
LBK-DAY19-TOT	4972	LBK KEY	ANA	1897	KGAL	MANMVA::1:47		
LBK-DAY20-TOT	4973	LBK KEY	ANA	1686	KGAL	MANMVA::1:47		
LBK-DAY21-TOT	4974	LBK KEY	ANA	1728	KGAL	MANMVA::1:47		
LBK-DAY22-TOT	4975	LBK KEY	ANA	1735	KGAL	MANMVA::1:47		
LBK-DAY23-TOT	4976	LBK KEY	ANA	1810	KGAL	MANMVA::1:47		
LBK-DAY24-TOT	4977	LBK KEY	ANA	1385	KGAL	MANMVA::1:47		
LBK-DAY25-TOT	4978	LBK KEY	ANA	1673	KGAL	MANMVA::1:47		
LBK-DAY26-TOT	4979	LBK KEY	ANA	1808	KGAL	MANMVA::1:47		
LBK-DAY27-TOT	4980	LBK KEY	ANA	1692	KGAL	MANMVA::1:47		
LBK-DAY28-TOT	4981	LBK KEY	ANA	1653	KGAL	MANMVA::1:47		

Longboat Key Meter Station		**RTU 47**		**Radio**				
LBK-DAY29-TOT	4982	LBK KEY	ANA	1608	KGAL	MANMVA::1:47		
LBK-DAY30-TOT	4983	LBK KEY	ANA	1481	KGAL	MANMVA::1:47		
LBK-DAY31-TOT	4984	LBK KEY	ANA	1634	KGAL	MANMVA::1:47		
LBK-DEC-COUNT	4688	LONGBOATKEY	ANA	3	KGAL	MANMVA::1:47		
LBK-DTFL	4660	LBK KEY	ANA	1477305	KGAL	MANMVA::1:47		
LBK-FLAG	4691	ON OFF	BIN	OFF	(ON=1)	MANMVA::1:47		
LBK-FLOW	4646	LONGBOATKEY	ANA	2.02	MGD	MANMVA::1:47	226	
LBK-FLOW-ACC-2	4689	LONGBOATKEY	ANA	1.41	KGAL	MANMVA::1:47		
LBK-FLOW-ACCUM	4684	LONGBOATKEY	ANA	36.59	KGAL	MANMVA::1:47		
LBK-LAST	4693	ON OFF	BIN	OFF	(ON=1)	MANMVA::1:47		
LBK-PRESENT	4694	ON OFF	BIN	OFF	(ON=1)	MANMVA::1:47		
LBK-PSI	4647	LONGBOAT KEY	ANA	67.64	PSI	MANMVA::1:47	225	
LBK-PSI-AVG	4939	LONGBOAT KEY	ANA	67.64	PSI	MANMVA::1:47		
LBK-TOGGLE	4692	ON OFF	BIN	OFF	(ON=1)	MANMVA::1:47		
LBK-TOT-FLOW-2	4690	LONGBOATKEY	ANA	1966375	KGAL	MANMVA::1:47		
LBK-TOTAL-FLOW	4686	LONGBOATKEY	ANA	0	KGAL	MANMVA::1:47		
LBK-TRIGGER	4683	ON OFF	BIN	ON	(ON=1)	MANMVA::1:47		
LBKMS-AC	4645	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:47	243	
LBKMS-BAT	4648	BATTERY LOW	BIN	NORMAL	(ON=1)	MANMVA::1:47	244	
LBKMS-DS	4649	DOOR SWITCH	BIN	CLOSED	(ON=0)	MANMVA::1:47	241	
MANRT47-STS	4644	LONGBOAT KEY	BIN	ONLINE	(ON=1)	MANMVA::1:47		

	Discrete Input	Analog Input	Discrete Output	Analog Output
LBK-DAY29-TOT				
LBK-DAY30-TOT				
LBK-DAY31-TOT				
LBK-DEC-COUNT				
LBK-DTFL				
LBK-FLAG				
LBK-FLOW		1		
LBK-FLOW-ACC-2				
LBK-FLOW-ACCUM				
LBK-LAST				
LBK-PRESENT				
LBK-PSI		1		
LBK-PSI-AVG				
LBK-TOGGLE				
LBK-TOT-FLOW-2				
LBK-TOTAL-FLOW				
LBK-TRIGGER				
LBKMS-AC	1			
LBKMS-BAT	1			
LBKMS-DS	1			
MANRT47-STS				

Discrete Input 24 VDC	**3**			
Analog Input 4-20 mA		**2**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**0**

WTP - A Basin Gallery	RTU 50	Modem

Insert V

POINT FILE SUMMARY 13-OCT-17 10:13:05								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
A1BAS-PM-PH	972	A1 POST MIX	ANA	6.68	PH	MANMVA::1:50	14	
A1BAS-PM-PH-AVG	5778	A1 PM PH AVG	ANA	6.68	PH	MANMVA::1:50		
A2BAS-PM-PH	973	A2 POST MIX	ANA	7.79	PH	MANMVA::1:50	15	
BBAS-PM-PH	974	B POST MIX	ANA	7.3	PH	MANMVA::1:50	16	
C-FLTS-EFF-TOT	4777	EFFLUENT FLO	ANA	21.2	MGD	MANMVA::1:50		
CHIP-TEST	2488		ANA	20	MA	MANMVA::1:50		3
FLT1-12-EF-TOT	4774	EFFLUENT FLO	ANA	26.56	MGD	MANMVA::1:50		
FLT1-BWV-OC	1958	BACKWSH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:50	25	
FLT1-EFF-FL	1945	EFFLUENT FLO	ANA	1.36	MGD	MANMVA::1:50	1	
FLT1-EFFV-OC	1962	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:50	30	
FLT1-FDV-OC	1959	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	27	
FLT1-INV-OC	1957	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:50	26	
FLT1-LOH-ALM	2090	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:50		1
FLT1-LOH-DP	1933	HEAD LOSS	ANA	0	FT	MANMVA::1:50	2	
FLT1-SWV-OC	1960	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	28	
FLT1-WST-INH	2126	#1 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:50		13
FLT1-WSTV-OC	2123	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	29	7
FLT2-BWV-OC	1965	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:50	31	
FLT2-EFF-FL	1946	EFFLUENT FLO	ANA	2.35	MGD	MANMVA::1:50	3	
FLT2-EFFV-OC	1966	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:50	36	
FLT2-FDV-OC	1968	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	33	
FLT2-INV-OC	1967	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:50	32	
FLT2-LOH-ALM	2091	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:50		2
FLT2-LOH-DP	1934	HEAD LOSS	ANA	0.8	FT	MANMVA::1:50	4	
FLT2-SWV-OC	1969	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	34	
FLT2-WST-INH	2127	#2 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:50		14
FLT2-WSTV-OC	1970	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	35	8
FLT3-BWV-OC	1971	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:50	37	
FLT3-EFF-FL	1947	EFFLUENT FLO	ANA	3	MGD	MANMVA::1:50	5	
FLT3-EFFV-OC	1976	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:50	42	
FLT3-FDV-OC	1973	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	39	
FLT3-INV-OC	1972	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:50	38	
FLT3-LOH-ALM	2092	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:50		3
FLT3-LOH-DP	1935	HEAD LOSS	ANA	1.3	FT	MANMVA::1:50	6	
FLT3-SWV-OC	1974	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	40	
FLT3-WST-INH	2128	#3 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:50		15
FLT3-WSTV-OC	1975	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	41	9
FLT4-BWV-OC	1977	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:50	43	
FLT4-EFF-FL	1948	EFFLUENT FLO	ANA	2.34	MGD	MANMVA::1:50	7	
FLT4-EFFV-OC	1982	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:50	48	
FLT4-FDV-OC	1979	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	45	
FLT4-INV-OC	1978	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:50	44	

Discrete Input	Analog Input	Discrete Output	Analog Output
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WTP - A Basin Gallery		RTU 50	Modem						Discrete Input	Analog Input	Discrete Output	Analog Output
FLT4-LOH-ALM	2094	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:50		4			1	
FLT4-LOH-DP	1936	HEAD LOSS	ANA	1.2	FT	MANMVA::1:50	8			1		
FLT4-SWV-OC	1980	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	46		1			
FLT4-WST-INH	2129	#4 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:50		16			1	
FLT4-WSTV-OC	1981	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	47	10	1		1	
FLT5-BWV-OC	1983	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:50	49		1			
FLT5-EFF-FL	1949	EFFLUENT FLO	ANA	2.18	MGD	MANMVA::1:50	9			1		
FLT5-EFFV-OC	1988	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:50	54		1			
FLT5-FDV-OC	1985	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	51		1			
FLT5-INV-OC	1984	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:50	50		1			
FLT5-LOH-ALM	2095	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:50		5			1	
FLT5-LOH-DP	1937	HEAD LOSS	ANA	1.2	FT	MANMVA::1:50	10			1		
FLT5-SWV-OC	1986	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	52		1			
FLT5-WST-INH	2125	#5 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:50		17			1	
FLT5-WSTV-OC	1987	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	53	11	1		1	
FLT6-BWV-OC	1989	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:50	55		1			
FLT6-EFF-FL	1950	EFFLUENT FLO	ANA	2.06	MGD	MANMVA::1:50	11			1		
FLT6-EFFV-OC	1994	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:50	60		1			
FLT6-FDV-OC	1991	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	57		1			
FLT6-INV-OC	1990	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:50	56		1			
FLT6-LOH-ALM	2093	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:50		6			1	
FLT6-LOH-DP	1938	HEAD LOSS	ANA	1	FT	MANMVA::1:50	12			1		
FLT6-SWV-OC	1992	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	58		1			
FLT6-WST-INH	2130	#6 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:50		18			1	
FLT6-WSTV-OC	1993	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:50	59	12	1		1	
FLTA-AC	2042	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:50	7		1			
FLTA-BAT	2045	REMOTE RTU	BIN	NORMAL	(ON=1)	MANMVA::1:50	8		1			
MANRT50-STS	1963	A FLT COMM.	BIN	ONLINE	(ON=1)	MANMVA::1:50						
PART-COUNT-1	2600	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	17			1		
PART-COUNT-10	2609	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	18			1		
PART-COUNT-11	2610	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	19			1		
PART-COUNT-12	2611	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	20			1		
PART-COUNT-2	2601	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	21			1		
PART-COUNT-3	2602	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	22			1		
PART-COUNT-4	2603	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	23			1		
PART-COUNT-5	2604	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	24			1		
PART-COUNT-6	2605	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	25			1		
PART-COUNT-7	2606	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	26			1		
PART-COUNT-8	2607	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	27			1		
PART-COUNT-9	2608	PARTICLES	ANA	0	2-12 U'S	MANMVA::1:50	28			1		

Discrete Input 24 VDC	**38**			
Analog Input 4-20 mA		**27**		
Discrete Output 24 VDC			**18**	
Analog Output 4-20 mA				**1**

WTP - B Basin Gallery	RTU 51	Modem

Insert V

POINT FILE SUMMARY 13-OCT-17 10:13:27								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
FLT10-BWV-OC	2020	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:51	43	
FLT10-EFF-FL	1954	EFFLUENT FLO	ANA	1.8	MGD	MANMVA::1:51	7	
FLT10-EFFV-OC	2022	EFFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:51	48	
FLT10-FDV-OC	2005	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	45	
FLT10-INV-OC	2021	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:51	44	
FLT10-LOH-ALM	2101	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:51		4
FLT10-LOH-DP	1942	HEAD LOSS	ANA	0.3	FT	MANMVA::1:51	8	
FLT10-SWV-OC	2010	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	46	
FLT10-TURB	3784	TURBIDITY	ANA	0.02	NTU	MANMVA::1:51	19	
FLT10-WST-INH	2134	#10 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:51		16
FLT10-WSTV-OC	2015	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	47	10
FLT11-BWV-OC	2023	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:51	49	
FLT11-EFF-FL	1955	EFFLUENT FLO	ANA	2.42	MGD	MANMVA::1:51	9	
FLT11-EFFV-OC	2026	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:51	54	
FLT11-FDV-OC	2006	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	51	
FLT11-INV-OC	2024	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:51	50	
FLT11-LOH-ALM	2102	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:51		5
FLT11-LOH-DP	1943	HEAD LOSS	ANA	0.9	FT	MANMVA::1:51	10	
FLT11-SWV-OC	2011	SWASH	BIN	CLOSED	(ON=1)	MANMVA::1:51	52	
FLT11-TURB	2486	TURBIDITY	ANA	0.032	NTU	MANMVA::1:51	17	
FLT11-WST-INH	2135	#11 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:51		17
FLT11-WSTV-OC	2025	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	53	11
FLT12-BWV-OC	2027	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:51	55	
FLT12-EFF-FL	2915	EFFLUENT FLO	ANA	1.88	MGD	MANMVA::1:51	11	
FLT12-EFFV-OC	2030	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:51	60	
FLT12-FDV-OC	2007	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	57	
FLT12-INV-OC	2028	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:51	56	
FLT12-LOH-ALM	2103	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:51		6
FLT12-LOH-DP	1944	HEAD LOSS	ANA	1.6	FT	MANMVA::1:51	12	
FLT12-SWV-OC	2012	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	58	
FLT12-TURB	2487	TURBIDITY	ANA	0.022	NTU	MANMVA::1:51	18	
FLT12-WST-INH	2136	#12 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:51		19
FLT12-WSTV-OC	2029	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	59	12
FLT7-BWV-OC	1995	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:51	25	
FLT7-EFF-FL	1951	EFFLUENT FLO	ANA	2.15	MGD	MANMVA::1:51	1	
FLT7-EFFV-OC	2000	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:51	30	
FLT7-FDV-OC	1997	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	27	
FLT7-INV-OC	1996	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:51	26	
FLT7-LOH-ALM	2098	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:51		1
FLT7-LOH-DP	1939	HEAD LOSS	ANA	0.3	FT	MANMVA::1:51	2	
FLT7-SWV-OC	1998	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	28	
FLT7-TURB	2482	TURBIDITY	ANA	0.029	NTU	MANMVA::1:51	13	

Discrete Input	Analog Input	Discrete Output	Analog Output
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WTP - B Basin Gallery		RTU 51		Modem					Discrete Input	Analog Input	Discrete Output	Analog Output
FLT7-WST-INH	2131	#7 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:51		13			1	
FLT7-WSTV-OC	1999	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	29	7	1		1	
FLT8-BWV-OC	2001	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:51	31		1			
FLT8-EFF-FL	1952	EFFLUENT FLO	ANA	2.21	MGD	MANMVA::1:51	3			1		
FLT8-EFFV-OC	2016	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:51	36		1			
FLT8-FDV-OC	2003	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	33		1			
FLT8-INV-OC	2002	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:51	32		1			
FLT8-LOH-ALM	2099	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:51		2			1	
FLT8-LOH-DP	1940	HEAD LOSS	ANA	1.4	FT	MANMVA::1:51	4			1		
FLT8-SWV-OC	2008	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	34		1			
FLT8-TURB	2483	TURBIDITY	ANA	0.107	NTU	MANMVA::1:51	14			1		
FLT8-WST-INH	2132	#8 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:51		14			1	
FLT8-WSTV-OC	2013	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	35	8	1		1	
FLT9-BWV-OC	2017	BACKWASH VLV	BIN	CLOSED	(ON=1)	MANMVA::1:51	37		1			
FLT9-EFF-FL	1953	EFFLUENT FLO	ANA	2.5	MGD	MANMVA::1:51	5			1		
FLT9-EFFV-OC	2019	EFFL VALVE	BIN	OPEN	(ON=1)	MANMVA::1:51	42		1			
FLT9-FDV-OC	2004	DRAIN VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	39		1			
FLT9-INV-OC	2018	INFLUENT VLV	BIN	OPEN	(ON=1)	MANMVA::1:51	38		1			
FLT9-LOH-ALM	2100	LOH ALM LITE	BIN	OFF	(ON=1)	MANMVA::1:51		3			1	
FLT9-LOH-DP	1941	HEAD LOSS	ANA	0.9	FT	MANMVA::1:51	6			1		
FLT9-SWV-OC	2009	SWASH VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	40		1			
FLT9-TURB	2484	TURBIDITY	ANA	0.024	NTU	MANMVA::1:51	15			1		
FLT9-WST-INH	2133	#9 EFFLUENT	BIN	ENABLE	(ON=1)	MANMVA::1:51		15			1	
FLT9-WSTV-OC	2014	WASTE VALVE	BIN	CLOSED	(ON=1)	MANMVA::1:51	41	9	1		1	
FLTB-AC	2043	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:51	7		1			
FLTB-BAT	2046	REMOTE RTU	BIN	NORMAL	(ON=1)	MANMVA::1:51	8		1			
MANRT51-STS	1964	B FLT COMM.	BIN	ONLINE	(ON=1)	MANMVA::1:51						

Discrete Input 24 VDC	**38**			
Analog Input 4-20 mA		**18**		
Discrete Output 24 VDC			**18**	
Analog Output 4-20 mA				**0**

Rye Bridge Conductivity Mon.	**RTU 52**	**Radio**

	Discrete Input	Analog Input	Discrete Output	Analog Output
		1		

Insert V

POINT FILE SUMMARY 13-OCT-17 10:13:47								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
MANRT52-STS	4476	CONDUCTIVITY	BIN	ONLINE	(ON=1)	MANMVA::1:52		
RYE-COND-LVL	4475	CONDUCTIV	ANA	125.15	MS/CM	MANMVA::1:52	16	

Discrete Input 24 VDC	**0**			
Analog Input 4-20 mA		**1**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**0**

ASR Wells	RTU 53	Radio

Insert V

POINT FILE SUMMARY 13-OCT-17 10:14:17								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
ASR-RTU-AC	3068	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:53	243	
ASR-RTU-BAT	3070	BAT VOLTS	ANA	23.89	VOLTS	MANMVA::1:53	232	
ASR-RTU-DS	3069	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:53	241	
ASR-RTU-ERR	4441	ERRORS	ANA	0	ERRORS	MANMVA::1:53		
ASR-RTU-STS	3072	ASR COMM	BIN	ONLINE	(ON=1)	MANMVA::1:53		
ASR-WELL-LEV	4479	LVL MONITOR	ANA	14.05	FT. MSL	MANMVA::1:53	26	
ASR2-BLOREC-ED	3218	BLO INIT REC	BIN	DISABLED	(ON=1)	MANMVA::1:53		
ASR2-BLOSTO-ED	3224	BLO INIT STO	BIN	DISABLED	(ON=1)	MANMVA::1:53		
ASR2-RCH-FLCTL	3077	FLO CTL LOOP	BIN	DISABLE	(ON=1)	MANMVA::1:53		
ASR2-RCH-FLWSP	3083	FLOW SETPT	ANA	0	MGD	MANMVA::1:53		9
ASR2-RCH-V1FED	3236	RCH V1FL ED	BIN	DISABLED	(ON=1)	MANMVA::1:53	109	72
ASR2-RCH-V1MIN	3230	RCH V1 MIN P	ANA	0	%	MANMVA::1:53		12
ASR2-RECHAR-FL	2945	RECHARG FLOW	ANA	0	MGD	MANMVA::1:53	2	
ASR2-RECOV-FL	2951	RECOVER FLOW	ANA	0.5	MGD	MANMVA::1:53	1	
ASR2-RSVPOS-ED	3212	REC/ST PIDED	BIN	DISABLED	(ON=1)	MANMVA::1:53	108	71
ASR2-RSVPOS-SP	3206	REC/ST POSSP	ANA	0	%	MANMVA::1:53		5
ASR2-TRICKL-FL	2956	TRICKLE FLOW	ANA	0	GPM	MANMVA::1:53	4	
ASR2-V1-POS	2941	VLV POSITION	ANA	-0.6	%	MANMVA::1:53	3	
ASR2-V1-POSSP	3089	POSITION SPT	ANA	0	% OPEN	MANMVA::1:53		1
ASR2-V1-RDY	2966	VLV RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	1	
ASR2-V1FL-BIAS	3515	V1FLOW BIAS	ANA	2048		MANMVA::1:53		72
ASR2-V1FL-IG	3260	V1FLOW IGAIN	ANA	1		MANMVA::1:53		11
ASR2-V1FL-PG	3255	V1FLOW PGAIN	ANA	0		MANMVA::1:53		10
ASR2-V1PAU-IG	3250	V1P AU IGAIN	ANA	0		MANMVA::1:53		7
ASR2-V1PAU-PG	3285	V1P AU PGAIN	ANA	0		MANMVA::1:53		6
ASR2-V1POP-IG	3292	V1P OP IGAIN	ANA	2		MANMVA::1:53		3
ASR2-V1POP-PG	3241	V1P OP PGAIN	ANA	2		MANMVA::1:53		2
ASR2-V1POS-ED	3139	POS CONTROL	BIN	DISABLED	(ON=1)	MANMVA::1:53	107	70
ASR2-V3-CLS	2976	VALVE CLOSED	BIN	CLOSED	(ON=1)	MANMVA::1:53	3	
ASR2-V3-OC	3006	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANMVA::1:53	97	1
ASR2-V3-OPN	2971	VALVE OPEN	BIN		(ON=1)	MANMVA::1:53	2	
ASR2-V3-RDY	2981	VLV RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	4	
ASR2-WELL-AM	3062	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANMVA::1:53	102	65
ASR2-WELL-APRS	3741	WELL PRESS	ANA	0	PSI	MANMVA::1:53	21	
ASR2-WELL-LVL	2961	WELL LEVEL	ANA	-71.6	FEET	MANMVA::1:53		
ASR2-WLOW-SP	4474	WELL LEVEL	ANA	-75	FEET	MANMVA::1:53		
ASR2-WP1-MFLT	3001	MOTOR FAIL	BIN	NORMAL	(ON=1)	MANMVA::1:53	8	
ASR2-WP1-PFLT	2996	WP FAILURE	BIN	NORMAL	(ON=1)	MANMVA::1:53	7	
ASR2-WP1-RDY	2991	WP RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	6	
ASR2-WP1-SS	2986	WP STR/STP	BIN	OFF	(ON=1)	MANMVA::1:53	5	3
ASR3-BLOREC-ED	3219	BLO INIT REC	BIN	DISABLED	(ON=1)	MANMVA::1:53		
ASR3-RCH-FLCTL	3078	FLO CTL LOOP	BIN	DISABLE	(ON=1)	MANMVA::1:53		

Discrete Input	Analog Input	Discrete Output	Analog Output
1			
	1		
1			
	1		
			1
1		1	
			1
	1		
	1		
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1		1	
1			
1		1	
1			
1			
1		1	
	1		
1			
1			
1			
1		1	

ASR Wells		RTU 53	Radio						Discrete Input	Analog Input	Discrete Output	Analog Output
ASR3-RCH-FLWSP	3084	FLOW SETPT	ANA	0	MGD	MANMVA::1:53		21				1
ASR3-RCH-V1FED	3237	RCH V1FL ED	BIN	DISABLED	(ON=1)	MANMVA::1:53	112	75	1		1	
ASR3-RCH-V1MIN	3231	RCH V1 MIN P	ANA	0	%	MANMVA::1:53		24				1
ASR3-RECHAR-FL	2946	RECHARG FLOW	ANA	0	MGD	MANMVA::1:53	6			1		
ASR3-RECOV-FL	2952	RECOVER FLOW	ANA	0	MGD	MANMVA::1:53	5			1		
ASR3-RSVPOS-ED	3213	REC/ST PIDED	BIN	DISABLED	(ON=1)	MANMVA::1:53	111	74	1		1	
ASR3-RSVPOS-SP	3207	REC/ST POSSP	ANA	0	%	MANMVA::1:53		17				1
ASR3-TRICKL-FL	2957	TRICKLE FLOW	ANA	0	GPM	MANMVA::1:53	8			1		
ASR3-V1-POS	2942	VLV POSITION	ANA	-1	%	MANMVA::1:53	7			1		
ASR3-V1-POSSP	3090	POSITION SPT	ANA	0	% OPEN	MANMVA::1:53		13				1
ASR3-V1-RDY	2967	VLV RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	9		1			
ASR3-V1FL-BIAS	3513	V1FLOW BIAS	ANA	2048		MANMVA::1:53		73				1
ASR3-V1FL-IG	3261	V1FLOW IGAIN	ANA	1		MANMVA::1:53		23				1
ASR3-V1FL-PG	3256	V1FLOW PGAIN	ANA	0		MANMVA::1:53		22				1
ASR3-V1PAU-IG	3251	V1P AU IGAIN	ANA	0		MANMVA::1:53		19				1
ASR3-V1PAU-PG	3286	V1P AU PGAIN	ANA	0		MANMVA::1:53		18				1
ASR3-V1POP-IG	3293	V1P OP IGAIN	ANA	2		MANMVA::1:53		15				1
ASR3-V1POP-PG	3242	V1P OP PGAIN	ANA	2		MANMVA::1:53		14				1
ASR3-V1POS-ED	3140	POS CONTROL	BIN	DISABLED	(ON=1)	MANMVA::1:53	110	73	1		1	
ASR3-V3-CLS	2977	VALVE CLOSED	BIN	CLOSED	(ON=1)	MANMVA::1:53	11		1			
ASR3-V3-OC	3007	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANMVA::1:53	98	4	1		1	
ASR3-V3-OPN	2972	VALVE OPEN	BIN		(ON=1)	MANMVA::1:53	10		1			
ASR3-V3-RDY	2982	VLV RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	12		1			
ASR3-WELL-AM	3063	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANMVA::1:53	103	66	1		1	
ASR3-WELL-APRS	3742	WELL PRESS	ANA	0.4	PSI	MANMVA::1:53	22			1		
ASR3-WELL-LVL	2962	WELL LEVEL	ANA	-123	FEET	MANMVA::1:53						
ASR3-WP1-MFLT	3002	MOTOR FAIL	BIN	NORMAL	(ON=1)	MANMVA::1:53	16		1			
ASR3-WP1-PFLT	2997	WP FAILURE	BIN	NORMAL	(ON=1)	MANMVA::1:53	15		1			
ASR3-WP1-RDY	2992	WP RY IND	BIN	READY	(ON=1)	MANMVA::1:53	14		1			
ASR3-WP1-SS	2987	WP STR/STP	BIN	OFF	(ON=1)	MANMVA::1:53	13	6	1		1	
ASR4-BLOREC-ED	3220	BLO INIT REC	BIN	DISABLED	(ON=1)	MANMVA::1:53						
ASR4-BLOSTO-ED	3225	BLO INIT STO	BIN	DISABLED	(ON=1)	MANMVA::1:53						
ASR4-RCH-FLCTL	3079	FLO CTL LOOP	BIN	DISABLE	(ON=1)	MANMVA::1:53						
ASR4-RCH-FLWSP	3085	FLOW SETPT	ANA	0	MGD	MANMVA::1:53		33				1
ASR4-RCH-V1FED	3238	RCH V1FL ED	BIN	DISABLED	(ON=1)	MANMVA::1:53	115	78	1		1	
ASR4-RCH-V1MIN	3232	RCH V1 MIN P	ANA	0	%	MANMVA::1:53		37				1
ASR4-RECHAR-FL	2947	RECHARG FLOW	ANA	0	MGD	MANMVA::1:53	10			1		
ASR4-RECOV-FL	2953	RECOVER FLOW	ANA	0	MGD	MANMVA::1:53	9			1		
ASR4-RSVPOS-ED	3214	REC/ST PIDED	BIN	DISABLED	(ON=1)	MANMVA::1:53	114	77	1		1	
ASR4-RSVPOS-SP	3208	REC/ST POSSP	ANA	0	%	MANMVA::1:53		29				1
ASR4-TRICKL-FL	2958	TRICKLE FLOW	ANA	0	GPM	MANMVA::1:53	12			1		
ASR4-V1-POS	2943	VLV POSITION	ANA	-0.6	%	MANMVA::1:53	11			1		
ASR4-V1-POSSP	3091	POSITION SPT	ANA	0	% OPEN	MANMVA::1:53		25				1
ASR4-V1-RDY	2968	VLV RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	17		1			
ASR4-V1FL-BIAS	3516	V1FLOW BIAS	ANA	2048		MANMVA::1:53		74				1
ASR4-V1FL-IG	3262	V1FLOW IGAIN	ANA	1		MANMVA::1:53		35				1
ASR4-V1FL-PG	3257	V1FLOW PGAIN	ANA	0		MANMVA::1:53		34				1
ASR4-V1PAU-IG	3252	V1P AU IGAIN	ANA	0		MANMVA::1:53		31				1

ASR Wells		RTU 53	Radio						Discrete Input	Analog Input	Discrete Output	Analog Output
ASR4-V1PAU-PG	3287	V1P AU PGAIN	ANA	0		MANMVA::1:53		30				1
ASR4-V1POP-IG	3294	V1P OP IGAIN	ANA	2		MANMVA::1:53		27				1
ASR4-V1POP-PG	3243	V1P OP PGAIN	ANA	2		MANMVA::1:53		26				1
ASR4-V1POS-ED	3141	POS CONTROL	BIN	DISABLED	(ON=1)	MANMVA::1:53	113	76	1		1	
ASR4-V3-CLS	2978	VALVE CLOSED	BIN	CLOSED	(ON=1)	MANMVA::1:53	19		1			
ASR4-V3-OC	3008	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANMVA::1:53	99	7	1		1	
ASR4-V3-OPN	2973	VALVE OPEN	BIN		(ON=1)	MANMVA::1:53	18		1			
ASR4-V3-RDY	2983	VLV RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	20		1			
ASR4-WELL-AM	3064	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANMVA::1:53	104	67	1		1	
ASR4-WELL-APRS	3743	WELL PRESS	ANA	0.4	PSI	MANMVA::1:53	23			1		
ASR4-WELL-LVL	2963	WELL LEVEL	ANA	-56	FEET	MANMVA::1:53						
ASR4-WP1-MFLT	3003	MOTOR FAIL	BIN	NORMAL	(ON=1)	MANMVA::1:53	24		1			
ASR4-WP1-PFLT	2998	WP FAILURE	BIN	NORMAL	(ON=1)	MANMVA::1:53	23		1			
ASR4-WP1-RDY	2993	WP RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	22		1			
ASR4-WP1-SS	2988	WP STR/STP	BIN	OFF	(ON=1)	MANMVA::1:53	21	9	1		1	
ASR5-BLOREC-ED	3221	BLO INIT REC	BIN	DISABLED	(ON=1)	MANMVA::1:53						
ASR5-BLOSTO-ED	3226	BLO INIT STO	BIN	DISABLED	(ON=1)	MANMVA::1:53						
ASR5-RCH-FLCTL	3080	FLO CTL LOOP	BIN	DISABLE	(ON=1)	MANMVA::1:53						
ASR5-RCH-FLWSP	3086	FLOW SETPT	ANA	0	MGD	MANMVA::1:53		46				1
ASR5-RCH-V1FED	3239	RCH V1FL ED	BIN	DISABLED	(ON=1)	MANMVA::1:53	118	81	1		1	
ASR5-RCH-V1MIN	3233	RCH V1 MIN P	ANA	0	%	MANMVA::1:53		50				1
ASR5-RECHAR-FL	2948	RECHARG FLOW	ANA	0.5	MGD	MANMVA::1:53	14			1		
ASR5-RECOV-FL	2954	RECOVER FLOW	ANA	0.3	MGD	MANMVA::1:53	13			1		
ASR5-RSVPOS-ED	3215	REC/ST PIDED	BIN	DISABLED	(ON=1)	MANMVA::1:53	117	80	1		1	
ASR5-RSVPOS-SP	3209	REC/ST POSSP	ANA	0	%	MANMVA::1:53		42				1
ASR5-TRICKL-FL	2959	TRICKLE FLOW	ANA	0	GPM	MANMVA::1:53	16			1		
ASR5-V1-AO4	3494	POSITION SPT	ANA	0	% OPEN	MANMVA::1:53		4				1
ASR5-V1-POS	2944	VLV POSITION	ANA	-0.7	%	MANMVA::1:53	15			1		
ASR5-V1-POSSP	3092	POSITION SPT	ANA	0	% OPEN	MANMVA::1:53		38				1
ASR5-V1-RDY	2969	VLV RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	25		1			
ASR5-V1FL-BIAS	3514	V1FLOW BIAS	ANA	2048		MANMVA::1:53		75				1
ASR5-V1FL-IG	3263	V1FLOW IGAIN	ANA	1		MANMVA::1:53		48				1
ASR5-V1FL-PG	3258	V1FLOW PGAIN	ANA	0		MANMVA::1:53		47				1
ASR5-V1PAU-IG	3253	V1P AU IGAIN	ANA	0		MANMVA::1:53		44				1
ASR5-V1PAU-PG	3288	V1P AU PGAIN	ANA	0		MANMVA::1:53		43				1
ASR5-V1POP-IG	3295	V1P OP IGAIN	ANA	2		MANMVA::1:53		40				1
ASR5-V1POP-PG	3244	V1P OP PGAIN	ANA	2		MANMVA::1:53		39				1
ASR5-V1POS-ED	3142	POS CONTROL	BIN	DISABLED	(ON=1)	MANMVA::1:53	116	79	1		1	
ASR5-V3-CLS	2979	VALVE CLOSED	BIN	CLOSED	(ON=1)	MANMVA::1:53	27		1			
ASR5-V3-OC	3009	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANMVA::1:53	100	10	1		1	
ASR5-V3-OPN	2974	VALVE OPEN	BIN		(ON=1)	MANMVA::1:53	26		1			
ASR5-V3-RDY	2984	VLV RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	28		1			
ASR5-WELL-AM	3065	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANMVA::1:53	105	68	1		1	
ASR5-WELL-APRS	3744	WELL PRESS	ANA	1.7	PSI	MANMVA::1:53	24			1		
ASR5-WELL-LVL	2964	WELL LEVEL	ANA	-56	FEET	MANMVA::1:53						
ASR5-WP1-MFLT	3004	MOTOR FAIL	BIN	NORMAL	(ON=1)	MANMVA::1:53	32		1			
ASR5-WP1-PFLT	2999	WP FAILURE	BIN	NORMAL	(ON=1)	MANMVA::1:53	31		1			
ASR5-WP1-RDY	2994	WP RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	30		1			

ASR Wells		RTU 53	Radio						Discrete Input	Analog Input	Discrete Output	Analog Output
ASR5-WP1-SS	2989	WP STR/STP	BIN	OFF	(ON=1)	MANMVA::1:53	29	12	1		1	
ASR6-BLOREC-ED	3222	BLO INIT REC	BIN	DISABLED	(ON=1)	MANMVA::1:53						
ASR6-BLOSTO-ED	3227	BLO INIT STO	BIN	DISABLED	(ON=1)	MANMVA::1:53						
ASR6-RCH-FLCTL	3081	FLO CTL LOOP	BIN	DISABLE	(ON=1)	MANMVA::1:53						
ASR6-RCH-FLWSP	3087	FLOW SETPT	ANA	0	MGD	MANMVA::1:53		59				1
ASR6-RCH-V1FED	3240	RCH V1FL ED	BIN	DISABLED	(ON=1)	MANMVA::1:53	121	84	1		1	
ASR6-RCH-V1MIN	3234	RCH V1 MIN P	ANA	0	%	MANMVA::1:53		63				1
ASR6-RECHAR-FL	2949	RECHARG FLOW	ANA	0	MGD	MANMVA::1:53	18			1		
ASR6-RECOV-FL	2955	RECOVER FLOW	ANA	0	MGD	MANMVA::1:53	17			1		
ASR6-RSVPOS-ED	3216	REC/ST PIDED	BIN	DISABLED	(ON=1)	MANMVA::1:53	120	83	1		1	
ASR6-RSVPOS-SP	3210	REC/ST POSSP	ANA	0	%	MANMVA::1:53		55				1
ASR6-TRICKL-FL	2960	TRICKLE FLOW	ANA	0	GPM	MANMVA::1:53	20			1		
ASR6-V1-AO5	3493	POSITION SPT	ANA	0	% OPEN	MANMVA::1:53		5				1
ASR6-V1-POS	2950	VLV POSITION	ANA	-1.1	%	MANMVA::1:53	19			1		
ASR6-V1-POSSP	3093	POSITION SPT	ANA	0	% OPEN	MANMVA::1:53		51				1
ASR6-V1-RDY	2970	VLV RDY IND	BIN	READY	(ON=1)	MANMVA::1:53	33		1			
ASR6-V1FL-BIAS	3517	V1FLOW BIAS	ANA	2048		MANMVA::1:53		76				1
ASR6-V1FL-IG	3264	V1FLOW IGAIN	ANA	1		MANMVA::1:53		61				1
ASR6-V1FL-PG	3259	V1FLOW PGAIN	ANA	0		MANMVA::1:53		60				1
ASR6-V1PAU-IG	3254	V1P AU IGAIN	ANA	0		MANMVA::1:53		57				1
ASR6-V1PAU-PG	3289	V1P AU PGAIN	ANA	0		MANMVA::1:53		56				1
ASR6-V1POP-IG	3296	V1P OP IGAIN	ANA	2		MANMVA::1:53		53				1
ASR6-V1POP-PG	3245	V1P OP PGAIN	ANA	2		MANMVA::1:53		52				1
ASR6-V1POS-ED	3143	POS CONTROL	BIN	DISABLED	(ON=1)	MANMVA::1:53	119	82	1		1	
ASR6-V3-CLS	2980	VALVE CLOSED	BIN	CLOSED	(ON=1)	MANMVA::1:53	35		1			
ASR6-V3-OC	3010	VLV OPN/CLS	BIN	CLOSED	(ON=1)	MANMVA::1:53	101	13	1		1	
ASR6-V3-OPN	2975	VALVE OPEN	BIN		(ON=1)	MANMVA::1:53	34		1			
ASR6-V3-RDY	2985	VLV RDY IND	BIN	NOTREADY	(ON=1)	MANMVA::1:53	36		1			
ASR6-WELL-AM	3066	AUTO/MANUAL	BIN	AUTO	(ON=1)	MANMVA::1:53	106	69	1		1	
ASR6-WELL-APRS	3745	WELL PRESS	ANA	0	PSI	MANMVA::1:53	25			1		
ASR6-WELL-LVL	2965	WELL LEVEL	ANA	-88	FEET	MANMVA::1:53						
ASR6-WP1-MFLT	3005	MOTOR FAIL	BIN	NORMAL	(ON=1)	MANMVA::1:53	40		1			
ASR6-WP1-PFLT	3000	WP FAILURE	BIN	NORMAL	(ON=1)	MANMVA::1:53	39		1			
ASR6-WP1-RDY	2995	WP RY IND	BIN	READY	(ON=1)	MANMVA::1:53	38		1			
ASR6-WP1-SS	2990	WP STR/STP	BIN	OFF	(ON=1)	MANMVA::1:53	37	15	1		1	
GS-WS-HUMID	3319	HUMIDITY	ANA	0	%	MANMVA::1:53	31			1		
GS-WS-TEMP	3318	TEMP	ANA	85.3	DEG F	MANMVA::1:53	30			1		
GS-WS-WDAVG	3330	WIND DIR AVG	ANA	237	DEG	MANMVA::1:53	32			1		
GS-WS-WSAVG	3329	WIND SPD AVG	ANA	8	MPH	MANMVA::1:53	29			1		

Discrete Input 24 VDC	**67**			
Analog Input 4-20 mA		**31**		
Discrete Output 24 VDC			**30**	
Analog Output 4-20 mA				**57**

64 State Road Monitoring Well	**RTU 54**	**Radio**

Insert V

POINT FILE SUMMARY 13-OCT-17 10:14:45								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
64-WELL-LEV	3071	WELL LEVEL	ANA	13.21	FEET	MANMVA::1:54	229	
ASR-RTUMON-AC	3073	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:54	243	
ASR-RTUMON-BAT	3074	BAT VOLTS	ANA	27.53	VOLTS	MANMVA::1:54	232	
ASR-RTUMON-DS	3075	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:54	241	
ASR-RTUMON-ERR	4442	ERRORS	ANA	876	ERRORS	MANMVA::1:54		
ASR-RTUMON-STS	3061	ASR COMM	BIN	ONLINE	(ON=1)	MANMVA::1:54		

	Discrete Input	Analog Input	Discrete Output	Analog Output
		1		
	1			
		1		
	1			

Discrete Input 24 VDC	**2**			
Analog Input 4-20 mA		**2**		
Discrete Output 24 VDC			**0**	
Analog Output 4-20 mA				**0**

East County Well # 6	RTU 56	Radio

POINT FILE SUMMARY 11-OCT-17 13:50:23

ACRONYM	RN	NAME	REC TYP	VALUE	ENG UNITS	UNIT	IN ADD	OUT ADD
ECW6-AC	4432	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:56	243	
ECW6-CAP	4412	WELL 6 SPCAP	ANA	0	GAL/FT	MANMVA::1:56		
ECW6-FL	4408	WELL #6 FLOW	ANA	4.17	MGD	MANMVA::1:56	226	
ECW6-FUEL-LVL	4419	GEN FUEL LVL	ANA	1988.1	GAL	MANMVA::1:56	229	
ECW6-GAS-LEAK	4421	FUEL LEAK	BIN	NORMAL	(ON=1)	MANMVA::1:56	6	
ECW6-LEV	4407	LEVEL	ANA	0	FT. MSL	MANMVA::1:56	225	
ECW6-P1-ALM	4398	PUMP ALARM	BIN	NORMAL	(ON=1)	MANMVA::1:56	2	
ECW6-P1-NOFLOW	4399	PUMP NO FLOW	BIN	NORMAL	(ON=1)	MANMVA::1:56	3	
ECW6-P1-RT	4414	EC WELL 6	ANA	21180	HOURS	MANMVA::1:56		
ECW6-P1-SS	4397	WELL #6 PUMP	BIN	ON	(ON=1)	MANMVA::1:56	1	1
ECW6-PSI	4410	WELL #6 PSI	ANA	32.01	PSI	MANMVA::1:56	227	
ECW6-RTU-BAT	4433	BAT VOLTS	ANA	28.83	VOLTS	MANMVA::1:56	232	
ECW6-RTU-DS	4435	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:56	241	
ECW6-TS-EMERG	4401	XFER SW EMER	BIN		(ON=1)	MANMVA::1:56	5	
ECW6-TS-NORMAL	4400	XFER SW NORM	BIN	NORMAL	(ON=1)	MANMVA::1:56	4	
MANRT56-STS	4417	ECW 6 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:56		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
		1		
		1		
	1			
		1		
	1			
	1			
	1		1	
		1		
		1		
	1			
	1			
	1			

Discrete Input 24 VDC	**8**			
Analog Input 4-20 mA		**5**		
Discrete Output 24 VDC			**1**	
Analog Output 4-20 mA				**0**

East County Well # 7	RTU 57	Radio

POINT FILE SUMMARY 11-OCT-17 13:50:40

ACRONYM	RN	NAME	REC TYP	VALUE	ENG UNITS	UNIT	IN ADD	OUT ADD
ECW7-AC	4431	AC POWER	BIN	AC ON	(ON=1)	MANMVA::1:57	243	
ECW7-CAP	4413	WELL 7 SPCAP	ANA	0	GAL/FT	MANMVA::1:57		
ECW7-FL	4409	WELL #7 FLOW	ANA	0	MGD	MANMVA::1:57	226	
ECW7-FUEL-LVL	4420	GEN FUEL LVL	ANA	0	GAL	MANMVA::1:57	229	
ECW7-GAS-LEAK	4422	FUEL LEAK	BIN	NO LEAK	(ON=1)	MANMVA::1:57	6	
ECW7-LEV	4416	LEVEL	ANA	0	FT. MSL	MANMVA::1:57	225	
ECW7-P1-ALM	4403	PUMP ALARM	BIN	NORMAL	(ON=1)	MANMVA::1:57	2	
ECW7-P1-NOFLOW	4404	PUMP NO FLOW	BIN	NORMAL	(ON=1)	MANMVA::1:57	3	
ECW7-P1-RT	4415	EC WELL 7	ANA	23493	HOURS	MANMVA::1:57		
ECW7-P1-SS	4402	WELL #7 PUMP	BIN	OFF	(ON=1)	MANMVA::1:57	1	1
ECW7-PSI	4411	WELL #7 PSI	ANA	30.63	PSI	MANMVA::1:57	227	
ECW7-RTU-BAT	4434	BAT VOLTS	ANA	25.48	VOLTS	MANMVA::1:57	232	
ECW7-RTU-DS	4436	DOOR SWITCH	BIN	CLOSED	(ON=1)	MANMVA::1:57	241	
ECW7-TS-EMERG	4406	XFER SW EMER	BIN		(ON=1)	MANMVA::1:57	5	
ECW7-TS-NORMAL	4405	XFER SW NORM	BIN	NORMAL	(ON=1)	MANMVA::1:57	4	
MANRT57-STS	4418	ECW 7 COMM	BIN	ONLINE	(ON=1)	MANMVA::1:57		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
		1		
		1		
	1			
		1		
	1			
	1			
	1		1	
		1		
		1		
	1			
	1			
	1			

Discrete Input 24 VDC	**8**			
Analog Input 4-20 mA		**5**		
Discrete Output 24 VDC			**1**	
Analog Output 4-20 mA				**0**

WTP - Fluoride	RTU 60	Fiber

Insert V

POINT FILE SUMMARY								
ACRONYM	RN	NAME	REC	VALUE	ENG	UNIT	IN	OUT
			TYP		UNITS		ADD	ADD
RTU60-AC-FAIL	918	ON UPS	BIN	NORMAL	(ON=1)	MANDC3::	23	
RTU60-UPS FAIL	920	LOW UPS BAT	BIN	NORMAL	(ON=1)	MANDC3::	24	
FLUORIDE ALM-STR	2935	SODIUM	BIN		(ON=1)	MANDC3::		
FLUORIDE-HYP-FLOW	2923	SODIUM	ANA	2.45	GPM	MANDC3::	2	
FLUORIDE-HYP-LEV1	3798	TANK LEVEL 1	ANA	4.06	FT	MANDC3::	33	
FLUORIDE-HYP-LEV2	3799	TANK LEVEL 2	ANA	8.36	FT	MANDC3::	34	
FLUORIDE-P1-SPT	3967	SODIUM HYP.	ANA	0	PERCENT	MANDC3::		
FLUORIDE-P2-SPT	3968	SODIUM HYP.	ANA	100	PERCENT	MANDC3::		5
FLUORIDEH-P1	3553	SODIUM-HYP	BIN	RUNNING	(ON=1)	MANDC3::	57	11
FLUORIDEH-P1-REMOTE		SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3		
FLUORIDEH-P1-FAIL	3535	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::	58	
FLUORIDEH-P1-FLO	3961	PUMP P1	ANA	1.47	GPM	MANDC3::	36	
FLUORIDEH-P1-LK-ALM	3534	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::	59	
FLUORIDEH-P1-OFF	4671	PUMP1 OFF	BIN		(ON=1)	MANDC3::		
FLUORIDEH-P1-SPD	3546	PUMP P1	ANA	46	%	MANDC3::	19	
FLUORIDEH-P1-SPT	3561	SODIUM HYP.	ANA	1.35	GPM	MANDC3::		
FLUORIDEH-P2	3552	SODIUM-HYP	BIN	RUNNING	(ON=1)	MANDC3::	60	12
FLUORIDEH-P2-FAIL	3536	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::	61	
FLUORIDEH-P2-REMOTE		SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::1:3		
FLUORIDEH-P2-FLO	3962	PUMP P2	ANA	0.54	GPM	MANDC3::	41	
FLUORIDEH-P2-LK-ALM	3528	SODIUM-HYP	BIN	NORM	(ON=1)	MANDC3::	62	
FLUORIDEH-P2-OFF	4670	PUMP2 OFF	BIN		(ON=1)	MANDC3::		
FLUORIDEH-P2-SPD	3547	PUMP P2	ANA	23	%	MANDC3::	22	
FLUORIDEH-P2-SPT	3562	SODIUM HYP.	ANA	0.7	GPM	MANDC3::		

	Discrete Input	Analog Input	Discrete Output	Analog Output
	1			
	1			
		1		
		1		
		1		
				1
				1
	1		1	
	1			
	1			
		1		
	1			
		1		
	1		1	
	1			
	1			
		1		
	1			
		1		

Discrete Input 24 VDC	**10**			
Analog Input 4-20 mA		**7**		
Discrete Output 24 VDC			**2**	
Analog Output 4-20 mA				**2**

WTP - EQ Backwash	RTU 61	Fiber

Insert V

POINT FILE SUMMARY									Discrete Input	Analog Input	Discrete Output	Analog Output
ACRONYM	RN	NAME	REC TYP	VALUE	ENG UNITS	UNIT	IN ADD	OUT ADD				
RTU61-AC-FAIL	918	ON UPS	BIN	NORMAL	(ON=1)	MANDC3::	23		1			
RTU61-UPS FAIL	920	LOW UPS BAT	BIN	NORMAL	(ON=1)	MANDC3::	24		1			
Return Pump 1 Run	2935	Run	BIN	NORMAL	(ON=1)	MANDC3::			1			
Return Pump 1 Fail	2923	Fail	BIN	NORMAL	(ON=1)	MANDC3::	2		1			
Return Pump 1 No Flow	3798	No Flow	BIN	NORMAL	(ON=1)	MANDC3::	33		1			
Return Pump 2 Run	3799	Run	BIN	NORMAL	(ON=1)	MANDC3::	34		1			
Return Pump 2 Fail	3967	Fail	BIN	NORMAL	(ON=1)	MANDC3::			1			
Return Pump 2 No Flow	3968	No Flow	BIN	NORMAL	(ON=1)	MANDC3::		5	1			
Return Pump 3 Run	3553	Run	BIN	NORMAL	(ON=1)	MANDC3::	57	11	1			
Return Pump 3 Fail		Fail	BIN	NORMAL	(ON=1)	MANDC3::1:3			1			
Return Pump 3 No Flow	3535	No Flow	BIN	NORMAL	(ON=1)	MANDC3::	58		1			
Return Pump 4 Run	3961	Run	BIN	NORMAL	(ON=1)	MANDC3::	36		1			
Return Pump 4 Fail	3534	Fail	BIN	NORMAL	(ON=1)	MANDC3::	59		1			
Return Pump 4 No Flow	4671	No Flow	BIN	NORMAL	(ON=1)	MANDC3::			1			
Jet Mix Pump 1 Run	3546	Run	BIN	NORMAL	(ON=1)	MANDC3::	19		1			
Jet Mix Pump 1 Fail	3561	Fail	BIN	NORMAL	(ON=1)	MANDC3::			1			
Jet Mix Pump 2 Run	3552	Run	BIN	NORMAL	(ON=1)	MANDC3::	60	12	1			
Jet Mix Pump 2 Fail	3536	Fail	BIN	NORMAL	(ON=1)	MANDC3::	61		1			
EQ Tank 1 Inlet Valve Remote		Status	BIN	NORMAL	(ON=1)	MANDC3::1:3			1			
EQ Tank 1 Inlet Valve Closed	3962	Status	BIN	NORMAL	(ON=1)	MANDC3::	41		1			
EQ Tank 1 Inlet Valve Opened	3528	Status	BIN	NORMAL	(ON=1)	MANDC3::	62		1			
EQ Tank 1 Inlet Valve Failed	4670	Status	BIN	NORMAL	(ON=1)	MANDC3::			1			
EQ Tank 2 Inlet Valve Remote		Status	BIN	NORMAL	(ON=1)	MANDC3::1:3			1			
EQ Tank 2 Inlet Valve Closed	3962	Status	BIN	NORMAL	(ON=1)	MANDC3::	41		1			
EQ Tank 2 Inlet Valve Opened	3528	Status	BIN	NORMAL	(ON=1)	MANDC3::	62		1			
EQ Tank 2 Inlet Valve Failed	4670	Status	BIN	NORMAL	(ON=1)	MANDC3::			1			
EQ Tank 1 Inlet Valve Open Command	3547	PUMP P2	BIN	NORMAL	(ON=1)	MANDC3::	22				1	
EQ Tank 1 Inlet Valve Closed Command	3562	SODIUM HYP.	BIN	NORMAL	(ON=1)	MANDC3::					1	
EQ Tank 2 Inlet Valve Open Command	3547	PUMP P2	BIN	NORMAL	(ON=1)	MANDC3::	22				1	
EQ Tank 2 Inlet Valve Closed Command	3562	SODIUM HYP.	BIN	NORMAL	(ON=1)	MANDC3::					1	
EQ Tank 1 Level	3562		ANA	NORMAL		MANDC3::				1		
EQ Tank 2 Level	3547	PUMP P2	ANA	NORMAL		MANDC3::	22			1		
EQ Tank Flow	3562	SODIUM HYP.	ANA	NORMAL		MANDC3::				1		

Discrete Input 24 VDC	**26**			
Analog Input 4-20 mA		**3**		
Discrete Output 24 VDC			**4**	
Analog Output 4-20 mA				**0**

SECTION 17950

TESTING, CALIBRATION, AND COMMISSIONING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Testing requirements that apply to process control and instrumentation systems for the entire Project.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Electronics Industries Alliance (EIA).

C. Telecommunications Industry Association (TIA).

1.03 DEFINITIONS

A. As specified in Sections 01756 - Commissioning and 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. General:
   1. Reference additional detailed test submittal scheduling and prerequisite requirements as specified in the Sequencing article of Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Overall test plan:
   1. Develop the PCIS system test submittals in consultation and cooperation with all applicable subcontractors.
   2. Develop and submit an overall testing plan for the PCIS. The overall test plan to be reviewed and approved by the Engineer before detailed test plans, procedures, and forms will be reviewed.
   3. Describe the test phases as they apply specifically to this Project and each process system.
   4. Provide a preliminary testing schedule to show the sequence of tests and commissioning as they apply to each process system and each PLC.
   5. Provide a description of factory tests. Describe what equipment will be included, what testing equipment will be used, and the simulator that will be used.
   6. Provide examples of proposed forms and checklists.

D. Test procedures:
   1. Develop and submit detailed test procedures to show that the integrated SCADA system hardware and software is fully operational and in compliance with the requirements specified in the Contract Documents.
   2. Provide a statement of test objectives for each test.
   3. Prepare specific procedures for each process system.
   4. Describe sequentially the steps to be followed in verifying the correct operation of each process system, including all features described in the loop descriptions, control strategies, and shown in the P&IDs. Implied or generic test procedures are not acceptable.
   5. Specify who will perform the tests, specifically what testing equipment will be used (including serial numbers and NIST-traceable calibration), and how the testing equipment will be used.
   6. Describe the expected role of the Engineer, as well as any requirements for assistance from Owner's staff.
   7. Provide the forms and checklists to be used.

E. Test forms:
   1. Provide test and calibration forms and checklists for each of the following:
      a. Calibration.
      b. Factory acceptance tests (FAT).
      c. Loop validation tests.
      d. Installation tests.
      e. Functional tests.
      f. Instrumentation Fine-Tuning.
      g. Communication Testing including all digital bus and all forms of Ethernet.
   2. Test forms shall include the detailed test procedures, or shall include clear references to separate pages containing the complete test procedure applicable to each form. If references to procedures are used, the complete procedure shall be included with each test binder.
   3. Every page of each test form shall include project name, date, time, name of person conducting the test, signature of person conducting the test, and for witnessed tests, place for signature of person (Engineer and Owner) witnessing the test.
   4. Some sample test forms are included at the end of this Section. These test forms show the minimum required test form content. They are not complete, and have not been customized for this Project. The Contractor is to develop and submit test forms customized for the Project and meeting all of the specified test and submittal requirements.

F. Testing binders:
   1. Sub-system to be tested, provide and submit a test binder containing all test procedures and individual test forms for the test. References to other documents for test procedures and requirements are not acceptable.
   2. Fill out in advance headings and all other information known before the test.
   3. Include applicable test plan information, as well as a list of all test prerequisites, test personnel, and equipment.
   4. Include or list reference material and provide separately at the time of the test.
   5. Record test results and verify that all test requirements and conditions have been met.

G. FAT procedure additional minimal requirements:

1. Prepare and submit a FAT procedure which includes:
    a. Control system testing block diagram.
    b. Estimated test duration.
    c. Details on the simulator construction, components, and operation.

H. Test reports:
1. At the conclusion of each test, submit a complete test report, including all test results and certifications.
2. Include all completed test binders, forms, and checklists.
3. Submission, review, and acceptance of each test report is required before the start of the sub-system.

1.06 QUALITY ASSURANCE

A. Test personnel:
1. Furnish qualified technical personnel to perform all calibration, testing, and verification. The test personnel are required to be familiar with this Project and the equipment, software, and systems before being assigned to the test program.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.11 WARRANTY (NOT USED)

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS (NOT USED)

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Source testing:
   1. Provide manufacturer services as specified in the table below.

Section Number	Section Title	Source Testing (Witnessed or Non-Witnessed)
17100 - Control Strategies	Control Strategies	Witnessed
17101 - Specific Control Strategies	Specific Control Strategies	Witnessed
17710 - Control Systems - Panels, Enclosures, and Panel Components.	Control Systems - Panels, Enclosures, and Panel Components	Witnessed
17950 - Testing, Calibration, and Commissioning	Testing, Calibration, and Commissioning	Witnessed

2. FAT - general:
   a. Performed during the Commissioning Phase, source testing activity.
   b. Before shipment to the Project Site, the complete PCIS system including all operator stations, servers, approved HMI graphics (Local and SCADA), network equipment, printers, PCMs, PLCs, RTUs, LCPs, CCS, peripherals, communications equipment, and other SCADA equipment, shall be assembled, connected, and all software loaded for a fully functional FAT of the integrated system.
   c. Perform tests to show that the integrated system hardware and software is fully operational and in compliance with the requirements specified in the Contract Documents.
   d. Additional factory tests are specified in other sections of the Instrumentation and Control Specifications.
   e. For systems that contain RTUs or remote communications with other devices, the complete communications system must be factory tested, including actual interfacing with telephone company equipment and/or the actual radios used for radio based telemetry systems**.**
   f. The FAT will be witnessed.
   g. The Contractor shall fabricate, prepare and test all control panels, servers, network equipment and all appurtenances prior to performing the

Witnessed Factory Test. This includes network operation, electrical power testing of each control panel, and factory loop verification (I/O) testing. Contractor shall certify the above items are complete and ready for Witness Factory Testing prior to scheduling the Witness Factory Test.

h. Right of observation: The Owner and/or Engineer retains the right to observe all factory test activities including any and all subsystem preparation, pretests, troubleshooting, retests, warm-up, and software modification and/or update.
i. The Owner reserves the right to test any specified function, whether or not explicitly stated in the test submittal.
j. Correction of deficiencies: Any deficiencies observed during the test shall be corrected and retested before completion of the test.
k. Any changes and/or corrections shall be noted on the test forms. Engineer shall witness the revisions and/or corrections prior to leaving the test site.
l. If the corrections and/or revisions are too extensive to be made while the Engineer is scheduled to be at the FAT test site, the FAT shall be, at the Engineer's sole discretion, considered failed, and the test shall be restarted at a later date. All costs for the re-test shall be borne by the Contractor.

3. Testing simulation:
   a. The FAT shall make use of hardware simulators that contain switches, pilot lights, variable analog signal generators, and analog signal level displays, which shall be connected to the I/O points within the SCADA system. All inputs and outputs shall be simulated and proper control and system operation shall be validated.
   b. The use of jumper wires, terminal block mounted pilot lights, and loose meters to act as or supply the functionality of a simulator shall not be allowed.
   c. The hardware simulator may consist of a PLC, operating under a SCADA software package, or other approved software that has its I/O points wired to PLC's I/O points. Software operating on a PC may then act as the switches, pilot lights, variable analog signal generators, and analog signal level displays.
4. Preliminary FAT:
   a. A complete preliminary FAT (pre-FAT) shall be conducted utilizing test procedures approved by the Engineer. The pre-FAT test procedure shall be a subset of the full FAT.
   b. The purpose of the pre-FAT is to provide assurance to the Engineer that the SCADA system is ready for the full, witnessed FAT, in terms of both stability and functionality. Debugging of software and troubleshooting of hardware shall occur during and before the pre-FAT, not during the FAT. The Contractor shall fully test the SCADA system and fix all deficiencies found before the full FAT.
   c. The Owner shall have the right to witness any or all of the pre-FAT testing and shall be notified in writing 20 days before the start of the pre-FAT.
   d. The pre-FAT test results submittal shall include a letter, signed by the Contractor's project manager or company officer, certifying that the system is complete, has been tested successfully, and is fully ready for the full, witnessed FAT. The submittal shall include completed pre-FAT test forms, signed by the Contractor's staff, and shall be submitted for review before the start of the FAT.
5. Panel inspections:

a. The Engineer will inspect each control panel for completeness, workmanship, fit and finish, and compliance with the Contract Documents and the accepted shop drawings.
b. Provide panel inspection forms as part of the FAT procedures submittal.
c. Inspection to include, as a minimum: Layout, mounting, wire and data cable routing, wire tags, power supply, components and wiring, I/O components layout (including terminals, wiring and relays), device layout on doors and front panels, and proper ventilation operation.
d. A sample FAT control panel form has been provided at the end of this Section.

6. I/O test:
   a. Verify that I/O is properly wired to field terminals and is properly mapped into the PLC and the rest of the SCADA system, including all operator interface devices.
   b. Test methodology:
      1) Discrete inputs: Apply appropriate input from simulator at panel terminal, observe input card indicator, observe data value at each indicated data address, observe data received on all operator interface displays (SCADA workstations and local operator interface (LOI) displays).
      2) Discrete outputs: Issue commands from operator interface screen, verify output card indicator light and measure response at field wiring terminals
      3) Analog inputs: Apply appropriate analog input signal at panel terminals, observe data value at each indicated data address, and observe data properly received at each operator screen. Check each point at 0 percent, 50 percent, and 100 percent of scale.
      4) Analog outputs: Enter scaled values in the output buffer file, observe the output data file value, and measure appropriate response at panel wiring terminals
   c. Test forms to include, but not be limited to:
      1) PLC and panel number.
      2) I/O type.
      3) I/O tag name.
      4) Panel terminal block numbers.
      5) Rack/slot/number of I/O point.
      6) Check-off for correct response for each I/O point.
      7) Space for comments.
      8) Initials of individual performing test.
      9) Date test was performed.
      10) Witness' signature lines.
7. System configuration test:
   a. Demonstrate and test the setup and configuration of all operator stations, servers, development stations, and peripherals.
   b. Demonstrate all utility software and functions, such as virus protection, backup, optical drive burning, network monitoring, etc.
   c. Demonstrate the proper operation of all peripheral hardware.
   d. Demonstrate all general SCADA functions.
   e. Demonstrate proper operation of log-on and other access security functions.
   f. Demonstrate the proper operation of all historical data storage, trend, display, backup, and report functions.

g. Test automatic fail over of redundant equipment.
h. Demonstrate the proper operation of the alarm display and acknowledgement functions.
i. Test forms:
    1) For each test, list the specification page and paragraph of the function demonstrated, and provide a description of the function.
    2) List the specific tests and steps to be conducted.
    3) For each function, list all of the different sub-functions or ways the function can be used, and provide a test check-off for each:
        a) Include signature and date lines.

8. Control logic test:
    a. The purpose of this test is to verify that all software functions and logic work as specified, along with any hardwired logic or functions in the tested control panels.
    b. Testing requirements:
        1) Demonstrate each function described in Section 17100 - Control Strategies. Demonstrate in detail how each function operates under a variety of operating scenarios. Test to verify the application of each general control strategy function to each specific control strategy or loop description.
        2) Demonstrate the proper operation of the programming and configuration for each control strategy or loop description. Test each strategy or loop description on a sentence by sentence and function by function basis. Loops with similar or identical logic must each be tested individually.
        3) Demonstrate the proper operation of all digital communication links and networks. Verify each digital communication I/O point.
        4) Failure testing: In addition to demonstrating correct operation of all specified features, special effort shall be made to demonstrate how the system responds to and recovers from abnormal conditions including, but not limited to: equipment failure, operator error, communications subsystem error, communications failures, simulated/forced software lockups, power failure (both utility power and power to SCADA hardware), process equipment failure, and high system loading conditions.
    c. Test forms:
        1) Include the fully revised and approved control strategy for the loop being tested.
        2) Identify the cause and effect as each I/O point is toggled through the simulator. Check boxes shall be provided to track proper and/or improper operation of the loop.
        3) Any deficiencies or operational changes shall be noted on the forms for correction and documentation:
            a) Include signature and date lines.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Installation supervision:
   1. Provide as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. Owner training:
   1. Complete Owner training as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Installation testing:
   1. General:
      a. The Owner reserves the right to test any specified function, whether or not explicitly stated in the test submittals.
      b. Failure testing:
         1) In addition to demonstrating correct operation of all specified features, demonstrate how the system reacts and recovers from abnormal conditions including, but not limited to:
            a) Equipment failure.
            b) Operator error.
            c) Communications sub-system error.
            d) Power failure.
            e) Process equipment failure.
            f) High system loading conditions.
      c. Conduct testing Monday through Friday during normal working hours for no more than 8 hours per day.
         1) Testing at other times requires approval of the Engineer.
   2. Sequencing:
      a. See additional requirements specified in the Sequencing article of Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
   3. Calibration:
      a. After installation but before starting other tests, calibrate and adjust all instruments, devices, valves, and systems, in conformance with the component manufacturer's instructions and as specified in these Contract Documents.
      b. Components having adjustable features are to be set carefully for the specific conditions and applications of this installation. Test and verify that components and/or systems are within the specified limits of accuracy.
      c. Replace either individually or within a system, defective elements that cannot achieve proper calibration or accuracy.
      d. Calibration points:

1) Calibrate each analog instrument at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span, using test instruments with accuracies traceable to NIST.

e. Field verify calibration of instruments that have been factory-calibrated to determine whether any of the calibrations are in need of adjustment.

f. Analyzer calibration:
   1) Calibrate and test each analyzer system as a workable system after installation. Follow the testing procedures directed by the manufacturers' technical representatives.

g. Complete instrument calibration sheets for every field instrument and analyzer.

h. Calibration tags:
   1) Attach a calibration and testing tag to each instrument, piece of equipment, or system.
   2) Sign the tag when calibration is complete.

4. LAN cable post-testing:
   a. After installing the cable and connectors, test all cables using the LAN certification to confirm the installation meets the requirements of the specification.
   b. Provide test documentation that includes the cable number, total length of cable, a permanent hard copy, as well as a-USB or CD copy of all traces.
      1) After installing connectors:
      2) Perform cable end-to-end testing on all installed cables from both ends of the cable. Test shall include cable system performance tests and confirm the absence of wiring errors.
      3) Submit a signed test report presenting the results of the cable testing.
      4) Repair or replace any portions of the system not meeting ANSI/TIA/EIA standards for a Category 6 installation. Repaired sections shall be retested.
   c. Submit 3 copies of all final documentation (including traces), using the approved test form, to the Engineer upon successful completion of the testing.
5. Industrial network testing:
   a. Network operation may be interrupted for inspection and testing.
   b. Test equipment:
      1) The following test equipment will be utilized in the execution of the described qualification and testing procedures.
         a) Oscilloscope, Fluke Scopemeter Series 190 or equivalent.
         b) Digital VOM, Fluke 87 Multimeter or equivalent.
         c) Network bus monitor, ProfiTrace v1.6.
         d) Fluke DSX Cable Analyzer.
   c. Installation qualification and test procedures:
      1) Visual and mechanical inspection:
         a) Compare network devices nameplate data with drawings and specifications.
         b) Confirm network components are PTO compliant.
         c) Verify labeling of all trunk cables.
         d) Confirm minimum cable distance between nodes.
         e) Verify the presence/absence of stub lines.
         f) Verify network terminators are in place.

g) Verify power supply source and connections for active terminations.
h) Verify total network node count.
i) Verify power supply specifications including quantity, ratings, locations, and configuration. Verify power supply source of supply location, conductor size, and rating.
j) Inspect accessible network cabling for adherence to specified installation practices:
(1) Cable installed in conduit or protective raceway.
(2) Cable proximity to high voltage wiring.
(3) Exposure to extreme temperatures, shock, vibration, chemicals, or moisture.
(4) Bend radius.
k) Inspect cable and conductor terminations for adherence to specified installation practices.
l) Check all accessible components for evidence of physical damage.
m) Check grounding techniques including ground conductor sizes and termination points.
n) Non-permissible cable length.
o) Wrong cable type.
p) Signal reflections.

d. Electrical tests:
1) Measure network resistance.
2) Measure network cable length.
3) Line analysis for the following conditions:
a) Short circuit between signal lines A and B.
b) Short circuit between signal lines A and B and the cable shield.
4) Shield continuity.
5) Cross-wired signals lines.
6) Terminator installed in wrong position.
7) Poor transmission or reception levels.
8) Non-permissible stub line.

e. Generate slave list.

f. Measure power supply voltage at active terminations.

g. Evaluation:
1) Confirm the network cable topology (length and configuration) does not exceed data rate limitations.
2) Confirm total stub length (if required by design) does not exceed data rate limitations.
3) Calculate spare trunk length for the specified data rate.

h. Operations qualifications and test procedures:
1) Electrical tests:
a) Examine the data traffic between the master and each slave device.
b) Verify baud rate.
c) Confirm signal level.
d) Verify network cycle time.
e) Generate “live” slave list.
f) Verify and record scanner diagnostic data including node status and error codes.
g) Monitor and capture network waveform.

i. Evaluation:
    1) Confirm all specified slave devices appear on the live list.
    2) Evaluate data traffic between master and each slave to confirm proper slave configuration and performance.
    3) Inspect waveform capture for evidence of excessive noise.
    4) Evaluate and report any failed or questionable network tests.
    5) Evaluate and report network error codes and related symptoms.

6. Loop check/validation:
    a. Check all control loops under simulated operating conditions by causing a range of input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the SCADA system. Issue commands from the SCADA system and verify proper responses of field devices. Use actual process inputs wherever available.
    b. Provide “end-to-end” tests:
        1) Test SCADA system inputs from field device to SCADA system operator workstations.
        2) Test SCADA system outputs from SCADA operator workstations to field devices and equipment.
        3) Observe and record responses at all intermediate devices.
        4) Test and record operator commands and signal readouts to each operator device where there is more than one operator interface point.
        5) For each signal, perform separate tests for SCADA computer screens, local operator interface (LOI) screens, and local control panels.
    c. Retest any loop following any necessary corrections.
    d. Apply simulated sensor inputs corresponding to 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span for networks that incorporate analog elements, and monitor the resulting outputs to verify compliance to accuracy tolerance requirements.
    e. Apply continuously variable up and down analog inputs to verify the proper operation and setting of discrete devices (signal trips, etc.).
    f. Apply provisional settings on controllers and alarm setpoints.
    g. Record all analog loop test data on test forms.
    h. Exercise each field device requiring an analog command signal, through the SCADA system. Vary, during the validation process, the output from the PLC SCADA system and measure the end device position, speed, etc. to confirm the proper operation of the device for the supplied analog signal. Manually set the output from the SCADA screen at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent and measure the response at the final device and at any intermediate devices.
    i. Exercise each field device providing a discrete input to the SCADA system in the field and observe the proper operation shall be observed at the operator workstation:
        1) Test limit switches, set limits mechanically, and observe proper operation at the operator workstation.
        2) Exercise starters, relay contacts, switch contacts, and observe proper operation.
        3) Calibrate and test instruments supplying discrete inputs, and observe proper operation.

j. Test each device accepting a discrete output signal from the SCADA. Perform the appropriate operator action at the SCADA operator stations (including LOIs, if present) and confirm the proper operation of the field device:
   1) Stroke valves through outputs from the SCADA system, and confirm proper directional operation. Confirm travel limits and any feedback signals to the SCADA system.
   2) Exercise motors starters from the SCADA system and verify proper operation through direct field observation.
   3) Exercise solenoids and other field devices from the SCADA system and verify proper operation through direct field observation.

k. Include in the test forms:
   1) Analog input devices:
      a) Calibration range.
      b) Calibration data: Input, output, and error at each test value.
      c) Analog input associated PLC register address.
      d) Value in PLC register at each test point.
      e) Value displayed at each operator interface station (local operator interface displays and SCADA workstations).
   2) Analog output devices:
      a) Calibration range.
      b) Test value at each test point.
      c) Analog output associated PLC register address.
      d) Control variable value at field device at each test point.
      e) Physical device response at each test point:
         (1) Response to be actual valve position, or motor speed, etc.
   3) Discrete instrument input devices:
      a) Switch setting, contact action, and dead band.
      b) Valve position switches:
         (1) Response in the PLC as the valve is stroked from the PLC.
         (2) Field observed actual valve position, and valve indicator position as the valve is stroked from the PLC.
      c) Operator interface switches (control stations and other pilot devices) and associated response.
      d) Starter and drive auxiliary device contact response.
      e) Response of all other discrete inputs to the PLC.
   4) Discrete output devices:
      a) Observed response of field device to the discrete output from the PLC.
      b) Observe the proper operation of Open, Close, Start, Stop, On, Off, etc.
   5) Test equipment used and associated serial numbers.
   6) Perform contractor field loop check/validation testing prior to testing with the Programmer. Submit certified test results for review prior to scheduling programmer loop check/validation testing. Contractor shall perform field loop check/validation testing separately, one set of field loop check/validation tests prior to submitting certified test results. Then the final loop check/validation test with the Programmer.

C. Functional Testing:
   1. General:

a. Commence Functional tests after completion of all loop check/validation tests:
    1) As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems, Sequencing and Scheduling article.
b. Complete functional test of each new RTU/PLC prior to demolition/installation of next RTU/PLC.
c. Functional to demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.
d. Additional tests are specified in other Instrumentation and Control Sections.
e. Follow approved detailed test procedures and check lists for Functional Test activities.

2. Control logic operational validation:
    a. The purpose of control logic validation is to field test the operation of the complete control system, including all parts of the SCADA system, all control panels (including vendor control panels), all control circuits, all control stations, all monitored/controlled equipment, and final control elements.
    b. Demonstrate all control functionality shown on the P&IDs, control schematics, and other drawings, and specified in the loop descriptions, control strategies, Electrical Specifications, and Mechanical Equipment Specifications.
    c. Test in detail on a function-by-function and sentence-by-sentence basis.
    d. Thoroughly test all hardware and software functions:
        1) Including all hardwired and software control circuit interlocks and alarms.
    e. Test final control elements, controlled equipment, control panels, and ancillary equipment under startup, shut down, and steady-state operating conditions to verify all logic and control is achieved.
    f. Control logic validation tests to include, but not limited to: a repeat of all control logic tests from the FAT, modified and expanded to include all field instruments, control panels, circuits, and equipment.
3. Loop tuning:
    a. Optimally tune all electronic control stations and software control logic incorporating proportional, integral, or derivative control. Apply control signal disturbances at various process variable levels and adjusting the gain, reset, or rate settings as required to achieve proper response.
    b. Verify the transient stability of final control elements operating over the full range of operating conditions, by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates. As a minimum, achieve 1/4-wave amplitude decay ratio damping (subsidence ratio of 4) under the full range of operating conditions.
    c. If excessive oscillations or system instability occur, as determined by the Engineer, continue tuning and parameter adjustments, or develop and implement any additional control algorithms needed to achieve satisfactory control loop operation.
4. Functional validation sheets:
    a. Document each Functional test on an approved test form.

b. Document loop tuning with a report for each loop, including two-pen chart recordings showing the responses to step disturbance at a minimum of 3 setpoints or process rates approved by the Engineer. Show tuning parameters on the charts, along with time, date, and sign-off by Contractor and Engineer.
c. Include on the form, functions which can be demonstrated on a loop-by-loop basis:
    1) Loop number and P&ID number.
    2) Control strategy, or reference to specification tested.
    3) Test procedures: Where applicable, use the FAT function-by-function, sentence-by-sentence loop test checklist forms modified to meet the requirements of the Functional test. Otherwise, create new forms.
d. For functions that cannot be demonstrated on a loop-by-loop basis (such as overall plant power failure), include on the test form a listing of the specific steps and tests to be conducted. Include with each test description the following information:
    1) Specification page and paragraph of function demonstrated.
    2) Description of function and/or text from specification.
    3) Test procedures: use the FAT loop test checklist forms modified to meet the specific testing conditions of the Functional test.

5. Functional certification:
    a. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.
        1) Including all test forms with test data entered, submitted to the Engineer with a clear and unequivocal statement that all Functional test requirements have been satisfied.

D. Instrumentation Fine-Tuning:
1. After the Process Operational Period, test PCIS system for additional 30 days as specified in this Section to identify issues and make corrections, as needed.
2. General:
    a. The performance test is part of the Work that must be completed as a condition of substantial completion and final completion for the entire Project.
    b. The complete PLC control and SCADA system must run continuously for the duration of the performance test.
    c. Test and use the entire process control system under standard operating conditions.
    d. Exercise all system functions.
    e. Log failure, any system interruption and accompanying component, subsystem, or program failure including time of occurrence, duration of each failure, failure classification, and cause:
        1) Provide a competently trained technician or programmer on call for the Project Site during all normal working days and hours from the start of the performance test until final acceptance of the system.
            a) Response time to the Project Site: 24 hours or less, for a major failure.
3. SCADA system testing:
    a. Exercise each system function, e.g., status report, alarms, logs, and displays several times at a minimum, and in a manner that approximates "normal" system operation.

b. Failure of the SCADA system during testing shall be considered as indicating that the programs and operating system do not meet the requirements of the specifications.
    1) Corrective action is required before restarting the performance test.

4. Failures:
    a. Classify failures as either major or minor:
        1) Minor failure:
            a) A small and non-critical component failure or software problem that can be corrected by the Owner's operators.
            b) Log this occurrence but this is not a reason for stopping the test and is not grounds for non-acceptance.
            c) Should the same or similar component failure occur repeatedly, this may be considered as grounds for non-acceptance.
            d) Failure of one printer or operator station is considered a minor failure providing all functions can be provided by backup equipment, i.e., alternate printers and operator station, and repairs can be made and equipment returned to service within 3 working days.
        2) Major failure:
            a) Considered to have occurred when a component, subsystem, software control, or program fault causes a halt in or improper operation of the system and/or when a technician's work is required to make a repair or to re-initiate operation of the system.
            b) Cause termination of the performance test.
            c) Start a new acceptance test when the causes of a major failure have been corrected.
            d) A failure is also considered major when failure of any control system that results in an overflow, underflow, overdose, or underdose condition occurs.

5. Technician report:
    a. Each time a technician is required to respond to a system malfunction, they must complete a report, which includes details concerning the nature of the complaint or malfunction and the resulting repair action required and taken.
    b. If a malfunction occurs which clears itself or which the operator on duty is able to correct, no report is required or logged as specified above.
    c. If a technician has performed work but no report is written, then a major failure is considered to have occurred.
    d. Each report shall be submitted within 24 hours to the Engineer and the Owner, or its representative.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES

A. Example test forms:
   1. Example test forms are attached at the end of this Section. They may be used as a starting point for the development of Project-specific test forms for this Project.
   2. The example test forms are not intended to be complete or comprehensive. Edit and supplement the forms to meet the requirements for testing and test forms specified in this Section and other Contract Documents.

END OF SECTION

	FACTORY ACCEPTANCE TEST - CONTROL PANELS	

1. GENERAL INSPECTION

A. Structural Inspection

- ☐ Verify Lifting Lugs Installed
- ☐ Verity enclosure has lock and lock is functional
- ☐ Confirm that seismic bracing components are provided per manufacturer's installation instructions

B. Exterior Inspection

- ☐ Cabinet exterior is clean, scratch, and dent free
- ☐ Inspect externally for corrosion and damage
- ☐ Verify enclosure door opens and closes easily
- ☐ Verify enclosure has a 3-point latch
- ☐ Verify enclosure has a flange mounted disconnect (where voltages greater than 120 VAC enter the cabinet)
- ☐ Verify enclosure has the appropriate NEMA rating (1, 1G, 12, 3R, 4, 4X, etc.)
- ☐ Verify enclosure is the appropriate size (not grossly larger than design, and will still fit in the plant)

Nameplates

- ☐ Cabinet has identification nameplate
- ☐ All door labels are straight, spelled correctly, and match the tagging defined in the Contract
- ☐ Cabinet has a nameplate that includes the following:
  - ☐ Power source(s)
  - ☐ Integrator's Logo
  - ☐ Circuit ID(s)
  - ☐ Short Circuit KAIC ratings
- ☐ If labels are screwed to door, silicone was utilized to cover screw holes (Labels screwed to the door of a NEMA 4/4X panel technically violates the NEMA rating.)

Door Devices

- ☐ All devices penetrating the outside of panel have gaskets, silicone or both
- ☐ All door devices are installed (HMIs, Pilot Devices, etc.)
- ☐ Door mounted equipment is mounted straight and square
- ☐ All exterior or door mounted equipment present and accounted for, installed and securely fastened
- ☐ NEMA classification has not been violated due to penetrations
- ☐ Door mounted equipment has the same NEMA rating as the panel
- ☐ All door mounted equipment installed at the correct height
- ☐ All door mounted equipment installed in the correct positions and order (layout of door mounted equipment is grouped properly and in a logical manner)
- ☐ Doors with multiple penetrations have adequate bracing (if needed)
- ☐ Visually check condition of indicators , controllers and annunciators
- ☐ Check that pilot lights illuminate correctly
- ☐ Check the Push-To-Test function
- ☐ Ensure correct pilot light color

Peripheral Devices

- ☐ Horn / Beacon is installed (where required)
- ☐ Silence and Reset pushbutton

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1. GENERAL INSPECTION (continued)

C. Interior Inspection

- ☐ Cabinet is cleaned of marks and dirt.
- ☐ Inspect internally for corrosion and damage.
- ☐ Back panel is clean of marks and dirt.
- ☐ Interior of panel vacuumed and shall be free of all debris.
- ☐ Check that the panel roof is clean and clear of foreign materials.
- ☐ Bottom of panel has been cut out (where bottom entry is required), with angle iron welded around the bottom perimeter. Re-painting has been performed.
- ☐ If internal light door limit switch is provided, ensure the light automatically turns "on" when the doors are open.
- ☐ Intrusion alarms (where required).

Interior Labeling

- ☐ All panel mounted equipment has identification labeling, by using either a Brothers or Phenolic type tags.
- ☐ Verify that door mounted components are mounted square and symmetrical.
- ☐ Verify that nameplates are straight, legible, and spelled correctly.
- ☐ All terminal blocks are identified/labeled with permanent labels including tight end blocks and caps.
- ☐ All wiring shrink labeled and or phased correctly to the specifications.
- ☐ All wire labels shrunk completely rotated and aligned alike for easy identification.
- ☐ All fuses and circuit breakers are labeled with ID and current rating.
- ☐ System Integrator's label or labels installed on door.
- ☐ Panel manufacturer model/serial number tag is present.
- ☐ All required safety/warning tags installed and straight.
- ☐ Correct UL (typically UL 508) or cUL tag installed and registered and all other associated tags installed and straight (the UL tag might not be installed in the panel at the factory test. If the panel is modified due to changes during the factory test or a punch list generated from the factory test, the UL labeling would need to be re-applied. Some UL shops do not apply the UL label until the panel is released to be shipped.).

Wireways

- ☐ Plastic wire way covers installed properly.
- ☐ Plastic wireways have no sharp edges.
- ☐ No wire Ties inside the wireways.
- ☐ No sharp edges on wire ties.
- ☐ Separation: White duct is used for DC voltages, Gray duct is used for AC voltages.
- ☐ Ensure wiring duct is not over-full, includes provision for 20% more wiring and the cover may easily be installed. Panduit recommends 50% duct fill, but 40% is a better practice.

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	FACTORY ACCEPTANCE TEST - CONTROL PANELS	

1. GENERAL INSPECTION (continued)

C. Interior Inspection (continued)

Wiring

- ☐ Visually check terminals and condition of internal wirings
- ☐ Verify that the control panel has been assembled and wired as designed
- ☐ Verify that all components are operational and perform the functions intended
- ☐ Verify that all components are sized appropriately for the application
- ☐ Verify that equipment control circuits function as intended
- ☐ Back of door wiring is labeled and neatly formed
- ☐ Back panel to door wiring has sufficient bending radius with spiral wrap
- ☐ Wire connection has been verified wired to correct points within the panel
- ☐ Individual wires have been given a pull test to verify a good terminal connection
- ☐ Wire and cable minimum bending radius have not been violated
- ☐ All equipment installed straight and square to back panel
- ☐ Wire colors are correct:
  - ☐ Black and White > AC hot and neutral, respectively
  - ☐ Red > AC control signals
  - ☐ Blue > DC power and control (Blue w/White stripe for DC ground)
  - ☐ Yellow > Foreign voltages (those still present when panel power is disconnected)
  - ☐ Green > AC equipment ground
  - ☐ Black > TSP (+)
  - ☐ White> TSP(-)
- ☐ Analog wiring shields are continuous (connected by a dedicated terminal block for such shields)
- ☐ Analog shield wires are grounded within the panel, where not otherwise grounded at the transmitter itself
- ☐ Discrete inputs are separately fused or protected by a circuit breaker on a “per loop” basis
- ☐ Intrinsic Safety Wiring
  - ☐ Ensure wiring associated with intrinsic safety circuits or intrinsic safety barriers is kept away from all other wiring by UL minimum distances or by a physical (grounded metal) barrier preventing non-intrinsically safe wiring from coming in contact with intrinsically safe circuits or wiring
- ☐ Verify all spare terminals are installed according to the percentage listed in the specifications

Grounding

- ☐ Equipped with “Blackburn” or other grounding type lug
- ☐ Lug is securely fastened to the panel structure
- ☐ Verify Grounding bar is installed
- ☐ Verify Isolated ground bar is installed

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2. POWER TEST

A. AC Power

- ☐ AC Power is routed correctly within the panel, and is isolated from DC and network wiring.
- ☐ All fuses are installed and sized properly.
- ☐ All breakers are installed and sized properly.
- ☐ 24 VDC Power Supplies are functional.
- ☐ 24 VDC Power fail contacts are functional.
- ☐ 24 VDC power supplies are redundant, and have diode modules enabling the hot swap-over between supplies.
  - ☐ 24 VDC supplies are equipped with dry contact failure alarms, wired as PLC inputs to signal failure of any DC power supply. Such alarm inputs to the PLC have been tested as being functional.
- ☐ Dedicated receptacle is wired to receive a dedicated AC supply.
- ☐ Verify continuity for all DC commons, ground and AC neutrals.
- ☐ Verify that the CP temporary input power is connected correctly and is the correct voltage.
- ☐ Close the CP main circuit breaker(s).
- ☐ Verify that voltages at subsequent circuit breakers are correct.
- ☐ Close circuit breakers.
- ☐ Verify that power feeding interruptible and uninterruptible power supplies is correct.
- ☐ Turn on power supplies if they are not already on.
- ☐ Verify that voltages at distribution terminals are correct.
- ☐ Energize any remaining hardware such as the PLC.

B. Uninterruptible Power Supply (UPS)

- ☐ Mounted appropriately within the cabinet, on a dedicated shelf, or rear of a swing-out sub panel.
- ☐ Is equipped with maintenance bypass switch (or at least plug/receptacle means for bypassing the unit).
- ☐ Test all UPS alarms (on inverter, failure, battery failure etc.)
- ☐ Turn off the AC power supply and verify that the UPS will be switched on to supply the designated vital loads in the control panel.

3. CONTROLS & AUXILIARY DEVICES TEST

- ☐ Verify all interposing and auxiliary relays are functioning.
- ☐ Verify panel lights are functioning.

Ventilation and Heating

- ☐ If ventilation fans are fitted, check the fans operate correctly any associated air filters are clean and not blocked.
- ☐ Verify components are installed in the correct orientation for proper air flow.

4. HARDWIRED INTERLOCK AND SAFETY TEST

- ☐ Verify that hardwired interlocks through the control panel as shown on schematic drawings are functioning. For example, outlet high pressure switch interlock to a pump.
- ☐ Verify that all hardwired safety devices through the control panel is functioning. For example, the pull cord emergency stops of conveyors.

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5. PLC TEST

A. Components

☐ PLC interior High Temperature alarm is installed, wired to the PLC, and is shown to be functional.

☐ Relays have transient suppression across their coils. This is particularly important for DC coil relays, where diodes in reverse polarity are often used.

☐ TVSS is installed across the main incoming 120 VAC.

PLC and PLC Rack

- ☐ Verify all cards are securely seated.
- ☐ Ensure clearance around PLC rack has been met, such that convective heat transfer is not impeded by devices erroneously mounted in the “no encroachment” area. Confirm with manufacturer clearance recommendations.

B. PLC I/O Test

☐ Furnish **I/O test forms** and test all the listed input and output points as follows:

- ☐ Discrete Inputs: Simulate a field contact closure by “shorting” across the appropriate terminal blocks. Observe the transition between a logical “0” and “1” in the PLC software.
- ☐ Discrete Outputs: Force the output bit to toggle between logical “0” and logical “1” using the PLC software. Measure contact resistance at the wired terminal blocks using a digital meter selected for the “ohms” setting.
- ☐ Analog Inputs: Connect a signal generator to the appropriate terminal blocks. Tailor the connection depending on whether a 2-wire or 4-wire simulation is required. Modulate the 4-20mA signal. Observe the associated PLC internal memory register to transition between 0-65535 or if scaled in engineering units, between 0 and the maximum scaled engineering unit. The latter method is preferred.
- ☐ Analog Outputs: Force the output register to a value between 0-65535 or 0-100%, if the scaling block can be manipulated. Observe the measured 4-20mA value increment and decrement using a digital ammeter.

C. Redundant Controllers (where required) Test

☐ Remove Communication cable from PLC-1 to verify switching to PLC-1A

☐ Remove Communication cable from PLC-1A to verify switching back to PLC-1

☐ Remove Power from PLC-1 to verify switching to PLC-1A

☐ Remove Power from PLC-1A to verify switching to PLC-1

☐ Remove Communication cable from PLC-1 to I/O rack and verify switching to PLC-1A

☐ Remove Communication cable from PLC -1A to I/O rack and verify switching to PLC-1

D. PLC Control Logic Verification

☐ The PLC control strategy is verified by following the Control Logic Verification Form based on the specifications. Each control strategy will be verified by simulating the process and checking the state or value of PLC outputs. The results of equipment status and alarms and process instrument values and trends shall also be verified on the Plant SCADA graphic screens stored in a temporary SCADA computer. Since all PLC input and output wiring has been verified and some field devices are not available during Factory Acceptance Testing, certain inputs will be simulated either by means of additional hardware and/or software as described below.

- ☐ DI states are either simulated by hardwired switches or forced inputs using a programming terminal.
- ☐ For example, when starters and drives are not provided as part of the contract, jumpers may be installed from the output call relays to the running confirmation inputs to simulate the running state of the motors.
- ☐ AI values are either simulated by an external source or within software using a programming terminal.
- ☐ For example, when a level transducer is not provided as part of the contract the level transducer loop current may be simulated with a loop powered potentiometer and adjusted manually for the level input.

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5. PLC TEST (continued)

D. PLC Control Logic Verification (continued)

Typical Fault Logic

- ☐ If the fault input is high and the disable (if applicable) for the fault is not high and the common disable (if applicable) is not high begin timing. If any of these conditions changes, stop timing and reset the timer. If the timer reaches its preset, activate the alarm output. If the fault alarm is a shutdown alarm stop the associated motor and latch the alarm so that it remains present even if the condition clears.
- ☐ The fault condition must return to normal and the alarm must be reset for a latched alarm to clear.

Typical Fail to Start Logic

- ☐ If the motor is called to run (call output high) and no running feedback is received (running input is low) and the fail to start and common alarm disables (if applicable) are not high start timing. If any of these conditions changes, stop timing and reset the timer. If the timer reaches its preset, activate the alarm output, stop calling the motor and latch the alarm.

6. HMI OR OIT TEST

HMI / OIT Functionality

- ☐ Communication with PLC
- ☐ Screen Layouts
- ☐ Screen Navigation
- ☐ Set Point Entry
- ☐ Animation
- ☐ Color Correctness (Green=Run, Red=Off, Amber=Alarm, or the agreed upon convention)
- ☐ Alarms
- ☐ Acknowledge and Reset
- ☐ Security / Access Levels / Passwords

7. NETWORK COMMUNICATION TEST

A. Network Components

- ☐ Fiber optic cabling terminates in a patch panel
- ☐ Media converters are installed and functional
- ☐ Terminating resistors have been installed for trunk/tap topologies or where required
- ☐ Wire and cable bending limitations have not been violated

B. Networking Functions

- ☐ Verify data transfer via the network to different PLCs as shown on the Network Block Diagrams
- ☐ Verify network traffic rate and error margin is acceptable

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8. FAT DOCUMENTATION AND RECORD

Panel Documentation

- ☐ As-built panel drawings showing actual panel construction and devices arrangement and c/w Bill of Material.
- ☐ Panel schematic and interconnection drawings.
- ☐ P&ID drawings and schematic drawings for the process area controlled by the panel that is to be tested.
- ☐ I/O list test forms of the process area to be tested.
- ☐ FAT procedure of the process area to be tested.
- ☐ Test record forms of the process area to be tested. Forms shall include area for signature of responsible test personnel.
- ☐ Hard copy of the PLC application program of the process area to be tested.
- ☐ Hard copy of the HMI/OIT graphic screens of the process area to be tested.

9. FAT TOOLS AND SOFTWARE

- ☐ Simulation software if required
- ☐ Digital volt meter Fluke 87
- ☐ Process meter Fluke 787
- ☐ Laptop computer with PLC application program
- ☐ Temporary SCADA computer with HMI software and applicable graphic screens
- ☐ Jumper wires

PROJECT NAME: _____ TEST DATE: _____

FACILITY NAME: _____ TESTED BY: _____

PROCESS AREA: _____ COMPANY: _____

NETWORK ID: PAGE:

WITNESSED BY: SIGNATURE:

	INSTALLATION AND CERTIFICATION CHECKLIST DOCUMENTATION	

INSTRUMENT LOOP NO. _____

SERVICE DESCRIPTION _____

A COPY OF LATEST ISSUE OF THE FOLLOWING DOCUMENTS ARE INCLUDED IN THIS INSTRUMENT INSTALLATION CERTIFICATION FILE:

☐ INSTRUMENT SPECIFICATION SHEETS (FOR ALL INSTRUMENTS IN THE LOOP)

☐ INSTRUMENT INSTALLATION DETAILS (FOR ALL INSTRUMENTS IN THE LOOP)

☐ INSTRUMENT LOOP WIRING DIAGRAMS

☐ INSTRUMENT INSTALLATION CERTIFICATION CHECKLIST

☐ SIZING CALCULATIONS

☐ INSTRUMENT INSTALLATION SCHEDULE (APPLICABLE PART)

☐ NAMEPLATE SCHEDULE (APPLICABLE PART)

☐ VENDOR LITERATURE CALIBRATION INFORMATION

	☐ No	☐ Yes
INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS?		

REMARKS: _____

CHECKED BY (COMPANY) _____ ACCEPTED BY (COMPANY) _____

SIGNATURE _____ SIGNATURE _____

DATE _____ DATE _____

	SWITCHES INSTALLATION AND CALIBRATION CHECKLIST	

INSTRUMENT LOOP NO. _____

SERVICE DESCRIPTION _____

CHECK BELOW, WHEN COMPLETED:

☐ BENCH CALIBRATED PER SPECIFICATION SHEET NO. _____

☐ VERIFIED PER P&ID NO. _____

☐ CORRESPONDS TO SPECIFICATION SHEET NO. _____

☐ WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. _____

☐ INSTALLATION CORRECT PER DETAIL NO. _____

☐ ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED

☐ INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL

☐ ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED

	☐ No	☐ Yes
INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS?		

FIELD CALIBRATION CHECK

CONTACT NO.	FUNCTION	FOR SIGNAL	CONTACT IS TO	AT SPECIFIED VALUE FOR	ACTUAL TRIP POINT WAS
1	☐ ALARM	☐ INCR	☐ OPEN	SET PT = _____	SET PT = _____
	☐ S/D PERM	☐ DECR	☐ CLOSE	RESET = _____	RESET = _____
2	☐ ALARM	☐ INCR	☐ OPEN	SET PT = _____	SET PT = _____
	☐ S/D PERM	☐ DECR	☐ CLOSE	RESET = _____	RESET = _____
3	☐ ALARM	☐ INCR	☐ OPEN	SET PT = _____	SET PT = _____
	☐ S/D PERM	☐ DECR	☐ CLOSE	RESET = _____	RESET = _____
4	☐ ALARM	☐ INCR	☐ OPEN	SET PT = _____	SET PT = _____
	☐ S/D PERM	☐ DECR	☐ CLOSE	RESET = _____	RESET = _____

NOTE: PERM IS ABBREVIATION FOR PERMISSIVE

	SWITCHES INSTALLATION AND CALIBRATION CHECKLIST	

REMARKS: _____

CHECKED BY (COMPANY) _____ ACCEPTED BY (COMPANY) _____

SIGNATURE _____ SIGNATURE _____

DATE _____ DATE _____

	TRANSMITTER/CONTROLLER/INDICATOR INSTALLATION AND CALIBRATION CHECKLIST	

☐ ☐

INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS? No Yes

INSTRUMENT TYPE ☐ TRANSMITTER ☐ CONTROLLER ☐ INDICATOR

☐ OTHER DESCRIPTION _____

INSTRUMENT TAG NO. _____ SERIAL NO. _____

SERVICE DESCRIPTION _____

BENCH CALIBRATION CHECK

INPUT RANGE = _____ OUTPUT RANGE = _____

HEAD CORRECTION = _____ ☐ LINEAR

CALIBRATED SPAN = _____ ☐ SQUARE ROOT

% CALIB SPAN	DESIRED VALUE	ACTUAL VALUE	EXPECTED VALUE	ACTUAL VALUE
0				
50				
100				

CHECK BELOW, WHEN COMPLETED:

☐ BENCH CALIBRATED PER SPECIFICATION SHEET NO. _____

☐ VERIFIED PER P&ID NO. _____

☐ CORRESPONDS TO SPECIFICATION SHEET NO. _____

☐ WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. _____

☐ INSTALLATION CORRECT PER DETAIL NO. _____

☐ ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED

☐ INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL

☐ ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED

FIELD CALIBRATION CHECK

INPUT RANGE = _____ OUTPUT RANGE = _____

% CALIB SPAN	DESIRED VALUE	ACTUAL VALUE	EXPECTED VALUE	ACTUAL VALUE
0				
50				
100				

	TRANSMITTER/CONTROLLER/INDICATOR INSTALLATION AND CALIBRATION CHECKLIST	

☐ DIRECT ☐ REVERSE

☐ ACTION VERIFIED AT 50% SPAN

☐ ACTION VERIFIED AT _____ SPAN

CONTROLLER SETTINGS								
SETTING	**GAIN**	**PB**	**RESET (INTEGRAL)**	**DERIV. (RATE)**	**HIGH LIMIT**	**LOW LIMIT**	**ELEV. ZERO**	**ZERO SUPP**
PRE-TUNE								
POST-TUNE								

PRE-TUNE SETTINGS					
	GAIN	**PB**	**RESET (REPEAT/MIN)**	**RESET (MIN/REPEAT)**	**DERIVATION (MINUTES)**
FLOW	1.0	100	10	0.1	N/A
LEVEL	1.0	100	MIN.	MAX.	N/A
PRESSURE	2.0	50	2.0	0.5	N/A
TEMP.	4.0	25	0.1	10	OFF

REMARKS _____

CHECKED BY (COMPANY) _____ ACCEPTED BY (COMPANY) _____

SIGNATURE _____ SIGNATURE _____

DATE _____ DATE _____

	ANALYZERS **INSTALLATION AND CALIBRATION CHECKLIST**	

☐ No ☐ Yes

INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS?

TYPE OF INSTRUMENT _____

INSTRUMENT TAG NO. _____ SERIAL NO. _____

SERVICE DESCRIPTION _____

CHECK BELOW, IF TRUE

☐ BENCH CALIBRATED PER SPECIFICATION SHEET NO. _____

☐ VERIFIED PER P&ID NO. _____

☐ CORRESPONDS TO SPECIFICATION SHEET NO. _____

☐ WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. _____

☐ INSTALLATION CORRECT PER DETAIL NO. _____

☐ ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED

☐ INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL

☐ ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED

REMARKS _____

CHECKED BY (COMPANY) _____ ACCEPTED BY (COMPANY) _____

SIGNATURE _____ SIGNATURE _____

DATE _____ DATE _____

	CONTROL VALVES INSTALLATION AND CALIBRATION CHECKLIST	

☐ ☐

INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS? No Yes

☐ VALVE TAG NO. _____ SERIAL NO. _____

☐ TRANSDUCER TAG NO. _____ SERIAL NO. _____

☐ SOLENOID TAG NO. _____ SERIAL NO. _____

☐ VOLUME BOOSTER TAG NO. _____ SERIAL NO. _____

☐ POSITIONER _____ SERIAL NO. _____

SERVICE DESCRIPTION _____

TRANSDUCER CHECK					
INPUT RANGE =			OUTPUT RANGE =		
CALIBRATED SPAN =			CALIBRATED SPAN =		
BENCH					
SPAN	DESIRED	ACTUAL	SPAN	EXPECTED	ACTUAL
0%			0%		
50%			50%		
100%			100%		
FIELD					
SPAN	DESIRED	ACTUAL	SPAN	EXPECTED	ACTUAL
0%			0%		
50%			50%		
100%			100%		

CHECK BELOW, IF TRUE:

☐ BENCH CALIBRATED PER ABOVE _____

☐ VERIFIED PER P&ID NO. _____

☐ CORRESPONDS TO SPECIFICATION SHEET NO. _____

- ☐ VALVE SPECIFICATION NO. _____
- ☐ TRANSDUCER SPECIFICATION NO. _____
- ☐ SOLENOID SPECIFICATION NO. _____

☐ WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. _____

☐ INSTALLATION CORRECT PER INSTRUMENT INSTALLATION DETAILS _____

- ☐ VALVE DETAIL NO. _____
- ☐ TRANSDUCER DETAIL NO. _____
- ☐ SOLENOID DETAIL NO. _____

	CONTROL VALVES INSTALLATION AND CALIBRATION CHECKLIST	

☐ ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED

☐ INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL

☐ ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED

VALVE CHECK			
FLOW CHECK	☐ PROCESS FLOW DIRECTION THROUGH THE VALVE IS CORRECT		
SAFETY CHECK	ON LOSS OF AIR VALVE FAILS ☐ OPEN ☐ CLOSE	ON LOSS OF POWER SOLENOID FAILS ☐ TO VENT ☐ TO VALVE	
TRAVEL CHECK	FULL OPEN AT _____ PSI	FULL CLOSED AT _____ PSI	MEASURED TRAVEL _____ INCHES
SEATING CHECK	☐ ON BENCH ☐ IN-LINE	RESULTS	ACTUATOR BENCH SET
POSITIONER CHECK			
VALVE FULL OPEN AT _____ PSI TO POSITIONER			
VALVE FULL CLOSED AT _____ PSI TO POSITIONER			
VOLUME BOOSTER CHECK			
BYPASS VALVE (GAIN) ADJUSTING SCREW BACKED OUT _____ TURNS FROM CLOSED TO ENSURE QUICK BUT STABLE OPERATION (TYPICALLY 1-1/2 TO 2 TURNS)			

REMARKS _____

CHECKED BY (COMPANY) _____ ACCEPTED BY (COMPANY) _____

SIGNATURE _____ SIGNATURE _____

DATE _____ DATE _____

	DEVICENET INSTALLATION TESTING	

DeviceNet Network _____

Network Installation Characteristics

Architecture	Baud Rate	Trunk Media	Drop Media
☐ Single Master	☐ 125 kBaud	☐ Thick Round	☐ Thick Round, Unshielded
or			
☐ Multi Master	☐ 250 kBaud	☐ Thin Round	☐ Thin Round, Shielded
☐ Redundant Power Supplies	☐ 500 kBaud		☐ Thick Round, Shielded

☐ Per Network

Installed Node List

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15
☐ 16 ☐ 17 ☐ 18 ☐ 19 ☐ 20 ☐ 21 ☐ 22 ☐ 23 ☐ 24 ☐ 25 ☐ 26 ☐ 27 ☐ 28 ☐ 29 ☐ 30 ☐ 31
☐ 32 ☐ 33 ☐ 34 ☐ 35 ☐ 36 ☐ 37 ☐ 38 ☐ 39 ☐ 40 ☐ 41 ☐ 42 ☐ 43 ☐ 44 ☐ 45 ☐ 46 ☐ 47
☐ 48 ☐ 49 ☐ 50 ☐ 51 ☐ 52 ☐ 53 ☐ 54 ☐ 55 ☐ 56 ☐ 57 ☐ 58 ☐ 59 ☐ 60 ☐ 61 ☐ 62 ☐ 63

☐ All nodes present and in accordance with network drawings/specifications

☐ ODVA approved devices

☐ Nodes/devices accessible for inspection and maintenance

☐ Nodes/devices properly addressed

Comments: _____

Media Inspection

Trunk Cable	Drop Cable	Installation
☐ ODVA approved	☐ ODVA approved	☐ No evidence of physical damage
☐ Labeling complete	☐ Labeling complete	☐ Installed in protective raceway
☐ Cable/conductor terminations	☐ Cable/conductor terminations	☐ Bending radius not exceeded
☐ Terminating resistors at ends	☐ Maximum drop length < 20'	☐ Cable supports in place
		☐ V- and shield are grounded
		☐ Clearance from high temperature/voltage sources
		☐ No installation subject to vibration

Comments: _____

Network Power Supplies

Power Supply Equipment	Supply Source (120 VAC)	Network Power Tap (24 VDC)
☐ ODVA compliant	☐ Overcurrent protection	☐ Overcurrent protection
☐ Quantity and ratings	☐ Conductor size	☐ Conductor size

Comments: _____

CHECKED BY (COMPANY)	ACCEPTED BY (COMPANY)
SIGNATURE	SIGNATURE
DATE	DATE

PROFIBUS
INSTALLATION QUALIFICATION AND TESTING

General Network Description

The Profibus network serves the RO pretreatment, blended water, and concentrate processes and consists of both DP and PA slave devices. The master is located in programmable logic controller, PLC-900. Profibus DP repeaters are deployed in the network to essentially support a radial network topology from each process control panel.

Network Design Characteristics

ARCHITECTURE			BAUD RATE (kbits/sec)		
MASTER	☐ SINGLE	☐ REDUNDANT	☐ 9.6	☐ 187.5	☐ 3,000
TOTAL NODE COUNT ≤ 126	☐		☐ 19.2	☐ 50	☐ 6,000
REPEATER COUNT	_____		☐ 93.75	☐ 1,500	☐ 12,000
CASCADED REPEATER COUNT <9	_____				
NODE COUNT PER DP SEGMENT <32	☐				
DP/PA SEGMENT COUPLERS	_____				
REDUNDANCY (DP/PA COUPLERS	_____				
ACTIVE TERMINATORS	☐				
PROFIBUS DIAGNOSTICS	☐ PA ONLY	☐ DP & PA			
SURGE PROTECTION FOR SLAVES LOCATED OUTSIDE			☐		
SURGE PROTECTION FOR MEDIA ENTERING THE CONTROLLER CABINET			☐		
INTRINSIC SAFETY WIRING: REQUIRED FOR ANY PA NETWORK			☐		

INSTALLED NODE LIST

☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	☐ 8	☐ 9	☐ 10	☐ 11	☐ 12	☐ 13	☐ 14	☐ 15									
☐ 16	☐ 17	☐ 18	☐ 19	☐ 20	☐ 21	☐ 22	☐ 23	☐ 24	☐ 25	☐ 26	☐ 27	☐ 28	☐ 29	☐ 30	☐ 31									
☐ 32	☐ 33	☐ 34	☐ 35	☐ 36	☐ 37	☐ 38	☐ 39	☐ 40	☐ 41	☐ 42	☐ 43	☐ 44	☐ 45	☐ 46	☐ 47									
☐ 48	☐ 49	☐ 50	☐ 51	☐ 52	☐ 53	☐ 54	☐ 55	☐ 56	☐ 57	☐ 58	☐ 59	☐ 60	☐ 61	☐ 62	☐ 63									
☐ 64	☐ 65	☐ 66	☐ 67	☐ 68	☐ 69	☐ 70	☐ 71	☐ 72	☐ 73	☐ 74	☐ 75	☐ 76	☐ 77	☐ 78	☐ 79									
☐ 80	☐ 81	☐ 82	☐ 83	☐ 84	☐ 85	☐ 86	☐ 87	☐ 88	☐ 89	☐ 90	☐ 91	☐ 92	☐ 93	☐ 94	☐ 95									
☐ 96	☐ 97	☐ 98	☐ 99	☐ 100	☐ 101	☐ 102	☐ 103	☐ 104	☐ 105	☐ 106	☐ 107	☐ 108	☐ 109	☐ 110	☐ 111									
☐ 112	☐ 113	☐ 114	☐ 115	☐ 116	☐ 117	☐ 118	☐ 119	☐ 120	☐ 121	☐ 122	☐ 123	☐ 124	☐ 125	R 126	R 127									

☐ ALL NODES PRESENT IN ACCORDANCE WITH NETWORK DESIGN DOCUMENTS.

LEGEND

- **M** MASTER NODE PRESENT AT THIS ADDRESS
- **D** PROFIBUS DP NODE PRESENT AT THIS ADDRESS
- **P** PROFIBUS PA NODE PRESENT AT THIS ADDRESS
- **R** RESERVED ADDRESS
- ☐ NO DEVICE PRESENT AT THIS ADDRESS

COMMENTS *(Comments referenced by number. Refer to the Comments, Observations, and Recommendations Summary.)*

PROJECT NAME: _____ TEST DATE: _____

FACILITY NAME: _____ TESTED BY: _____

PROCESS AREA: _____ COMPANY: _____

NETWORK ID: _____ PAGE: _____

WITNESSED BY: _____ SIGNATURE: _____

PROFIBUS
INSTALLATION QUALIFICATION AND TESTING

Media Inspection

CABLING	DP NETWORK	PA NETWORK SEGMENTS			
PI COMPLIANT	☐	☐	☐	☐	☐
LABELING COMPLETE	☐	☐	☐	☐	☐
GROUNDING	☐	☐	☐	☐	☐
CABLE AND CONDUCTOR TERMINATIONS	☐	☐	☐	☐	☐
NO STUB LINES (DP ONLY)	☐	☐	☐	☐	☐
TERMINATING RESISTORS (IN PLACE)	☐	☐	☐	☐	☐
DEDICATED DIAGNOSTICS BUS	☐	☐	☐	☐	☐
INSTALLATION					
NO EVIDENCE OF PHYSICAL DAMAGE	☐	☐	☐	☐	☐
INSTALLATION IN PROTECTIVE RACEWAY	☐	☐	☐	☐	☐
CLEARANCES FROM HIGH TEMPERATURE SOURCES	☐	☐	☐	☐	☐
CLEARANCES FROM HIGH VOLTAGE SOURCES	☐	☐	☐	☐	☐
BEND RADIUS	☐	☐	☐	☐	☐
NO INSTALLATION SUBJECT TO VIBRATION, SHOCK, HIGH FLEX, CHEMICALS, OR MOISTURE	☐	☐	☐	☐	☐
TERMINATING RESISTORS TURNED ON AT CORRECT LOCATION	☐	☐	☐	☐	☐

COMMENTS *(Comments referenced by number. Refer to the Comments, Observations, and Recommendations Summary.)*

Device Inspection

DEVICE QUANTITY/TYPE	INSTALLATION
☐ TOTAL SLAVE COUNT	☐ NO EVIDENCE OF PHYSICAL DAMAGE
☐ MOST UPDATED DEVICE DRIVER INSTALLED?	☐ ACCESSIBLE FOR INSPECTION AND MAINTENANCE
☐ INSTALLED DEVICES COMPLY WITH DRAWINGS AND SPECIFICATIONS	☐ FDT COMPLIANT DEVICES
☐ PI COMPLIANCE DEVICES	
☐ DIAGNOSTICS MODULE INSTALLED	

COMMENTS *(Comments referenced by number. Refer to the Comments, Observations, and Recommendations Summary.)*

Power Supplies

ACTIVE TERMINATIONS	COUPLERS	REPEATERS
☐ SOURCE LOCATION	☐ SOURCE LOCATION	☐ SOURCE LOCATION
☐ OVERCURRENT PROTECTION	☐ OVERCURRENT PROTECTION	☐ OVERCURRENT PROTECTION
☐ CONDUCTOR SIZE	☐ CONDUCTOR SIZE	☐ CONDUCTOR SIZE
☐ GROUNDING	☐ GROUNDING	☐ GROUNDING

COMMENTS *(Comments referenced by number. Refer to the Comments, Observations, and Recommendations Summary.)*

PROJECT NAME: _____ TEST DATE: _____

FACILITY NAME: _____ TESTED BY: _____

PROCESS AREA: _____ COMPANY: _____

NETWORK ID: PAGE:

WITNESSED BY: SIGNATURE:

PROFIBUS
INSTALLATION QUALIFICATION AND TESTING

DP Network Media Testing

DESCRIPTION	SEGMENT ID					
TRUNK LENGTH (feet)						
ALLOWABLE TRUNK LENGTH AT SPECIFIED DATA RATE:						
MEASURED TRUNK LENGTH:						
SPARE TRUNK LENGTH						
RESISTANCE MEASUREMENTS (ohms)						
NETWORK CABLE: NO TERMINATIONS						
ONE TERMINATION						
TWO TERMINATIONS						
POWER SUPPLY VOLTAGE (volts DC)						
ACTIVE TERMINATOR						
REPEATER CP1100-RPT1						
REPEATER CP1000-RPT1						
REPEATER CP1000-RPT2						
REPEATER CP2700-RPT1						

CABLE TESTS	PASS	FAIL	PASS	FAIL	PASS	FAIL	PASS	FAIL	PASS	FAIL	PASS	FAIL
TESTED FOR SHORT CIRCUIT BETWEEN SIGNAL LINES	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
TESTED FOR SHORT CIRCUIT BETWEEN SIGNAL LINES AND SHIELD	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
TESTED FOR SHIELD CONTINUITY	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
TESTED FOR OPEN SIGNAL LINES	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
TESTED FOR CROSSED SIGNAL LINES	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
TESTED FOR CORRECT TERMINATOR POSITION	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
CORRECT CABLE TYPE AND LENGTH	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
TESTED FOR SECURE AND TIGHT CONNECTORS	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

COMMENTS *(Comments referenced by number. Refer to the Comments, Observations, and Recommendations Summary.)*

PROJECT NAME: _____ TEST DATE: _____

FACILITY NAME: _____ TESTED BY: _____

PROCESS AREA: _____ COMPANY: _____

NETWORK ID: PAGE:

WITNESSED BY: SIGNATURE:

Bid Attachment 3, PLAN SET / DRAWINGS

NOTE - This attachment is uploaded as a separate document on the Procurement page of the County website with the solicitation document and available for download.

BID ATTACHMENT 4, FCC RADIO TOWER HEIGHT(S)

BID ATTACHMENT 4
FCC RADIO TOWER HEIGHT(S)

FCC **FRN # 4203022**
460.025 MHz

Callsign	Loc No.	RTU #	Name	Emission Designator	Output Power (watts)	ERP (watts)	Antenna HT./ Tp meters	AMSL	Antenna AAT meters
WQLX500	1	42	EAST COUNTY WELL #2	9K30F1D	25.000	75.000	16.0	114.8	102.8
	2	41	EAST COUNTY WELL #1 <-- R.G. #5	9K30F1D	25.000	75.000	16.0	118.1	105.6
	3	21	RAIN GAUGE #1	9K30F1D	25.000	75.000	5.0	52.5	44.2
	4	10	INSTRUMENTATION SHOP, TEST BENCH	9K30F1D	25.000	75.000	6.0	55.8	48.7
	5	11	59TH STREET ELEVATED TANK	9K30F1D	25.000	75.000	40.0	19.7	57.7
	6		WTP ELEVATED TANK	9K30F1D	25.000	75.000	53.0	52.5	92.8
WQLX502	1	53	ASR WELLS	9K30F1D	25.000	75.000	5.0	55.8	47.5
	2	56	EAST COUNTY WELL #6	9K30F1D	25.000	75.000	16.0	98.4	87.2
	3	57	EAST COUNTY WELL #7	9K30F1D	25.000	75.000	16.0	95.1	84.6
	4	45	EAST COUNTY WELL #5	9K30F1D	25.000	75.000	16.0	111.6	100.3
	5	44	EAST COUNTY WELL #4	9K30F1D	25.000	75.000	16.0	108.3	96.1
	6	43	EAST COUNTY WELL #3	9K30F1D	25.000	75.000	16.0	118.1	105.4
WQLX504	1	12	NORHT WEST ELEVATED TANK	9K30F1D	25.000	75.000	54.0	23.0	75.7
	2	13	PALMETTO ELEVATED TANK	9K30F1D	25.000	75.000	55.0	16.4	68.6
	3	14	SARASOTA METER STATION	9K30F1D	25.000	75.000	5.0	32.8	32.3
	4	15	ELLENTON BOOSTER STATION	9K30F1D	25.000	75.000	10.0	0.0	7.4
	5	16	NORTH COUNTY ELEVATED TANK	9K30F1D	25.000	75.000	58.0	32.8	86.5
	6	54	64 STATE ROAD MONITORING WELL	9K30F1D	25.000	75.000	5.0	65.6	57.4
WQLX506	1	28	RAIN GAUGE #8	9K30F1D	25.000	75.000	15.0	72.2	69.0
	2		RAIN GAUGE #9 **NOT USED**	~~9K30F1D~~	~~25.000~~	~~75.000~~	~~15.0~~	~~75.5~~	~~72.3~~
	3	30	ELWOOD PARK #1	9K30F1D	25.000	75.000	9.0	9.0	12.8
	4	17	ELWOOD PARK #2	9K30F1D	25.000	75.000	9.0	13.1	17.2
	5	18	WTP - RAW WATER #2	9K30F1D	25.000	75.000	7.0	36.1	29.7
	6	19	PORT MANATEE ELEVATED TANK	9K30F1D	25.000	75.000	12.0	9.8	19.5
WQLX508	1	31	CORTEZ G.S. AND BOOSTER **NOT USED**	~~9K30F1D~~	~~25.000~~	~~75.000~~	~~15.0~~	~~3.3~~	~~17.0~~
	3	23	RAIN GAUGE #3	9K30F1D	25.000	75.000	15.0	39.4	37.5

BID ATTACHMENT 4
FCC RADIO TOWER HEIGHT(S)

FCC

FRN # 4203022
460.025 MHz

Callsign	Loc No.	RTU #	Name	Emission Designator	Output Power (watts)	ERP (watts)	Antenna HT./ Tp meters	AMSL	Antenna AAT meters
	4	24	RAIN GAUGE #4	9K30F1D	25.000	75.000	15.0	85.3	79.4
	5	26	RAIN GAUGE #6	9K30F1D	25.000	75.000	15.0	121.4	39.9
	6	27	RAIN GAUGE #7	9K30F1D	25.000	75.000	15.0	124.7	116.0
WQQL843	1	40	EAST COUNTY MONITORING WELLS	9K30F1D	25.000	75.000	16.0	98.4	81.9
	2	52	RYE BRIDGE - CONDUCTIVITY MON	9K30F1D	25.000	75.000	10.0	3.2	-1.8
	3	47	LONG BOAT KEY METER STATION	9K30F1D	25.000	75.000	7.6	5.0	11.7

Section D, Sample Construction Agreement with General Conditions of the Construction Agreement And Agreement Exhibits

CONSTRUCTION AGREEMENT

for

STIPULATED SUM

between

MANATEE COUNTY (AS OWNER)

and

<CONTRACTOR NAME> (AS CONTRACTOR)

CONSTRUCTION AGREEMENT FOR
STIPULATED SUM
[PROJECT NAME]

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

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

WHEREAS, in response to Owner's Invitation for Bid _____ (the "IFB"), Contractor has submitted its Bid (the "Contractor's Bid") to provide the aforementioned construction services.

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

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

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

3. Date of Commencement and Substantial Completion.

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

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

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

Portion of Work	Substantial Completion Date

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

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

4. Contract Sum.

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

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

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

5. Payments.

A. Progress Payments.

(1) Based upon Applications for Payment submitted to the Architect/Engineer by the Contractor and Certificates for Payment issued by the Architect/Engineer, the Owner shall make progress payments on account

of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

(2) The period covered by each Application for Payment shall be one calendar month ending on the last day of the month.

(3) Payments shall be made by Owner in accordance with the requirements of Section 218.735, Florida Statutes.

(4) Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form and supported by such data to substantiate its accuracy as the Architect/Engineer may require. This schedule, unless objected to by the Owner or Architect/Engineer, shall be used as a basis for reviewing the Contractor's Applications for Payment.

(5) Applications for Payment shall indicate the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

(6) Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

i. Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of ten percent (10.00%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 3.3.B. of the General Conditions;

ii. Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), supported by paid receipts, less retainage of ten percent (10.00%);

iii. Subtract the aggregate of previous payments made by the Owner; and

iv. Subtract amounts, if any, for which the Architect/Engineer has withheld or nullified an Application for Payment, in whole or in part as provided in Section 3.3.C. of the General Conditions.

(7) The progress payment amount determined in accordance with Section 5.A(6) shall be further modified under the following circumstances:

i. Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect/Engineer shall determine for incomplete Work, retainage applicable to such work and unsettled claims.

ii. Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.2.B. of the General Conditions.

(8) Reduction or limitation of retainage, if any, shall be as follows:

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

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

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

(1) The Contractor has fully performed the Work except for the Contractor's responsibility to correct Work as provided in Section 2.4.C. of the General Conditions, and to satisfy other requirements, if any, which extend beyond final payment; and

(2) A final Application for Payment has been approved by the Architect/Engineer.

6. Termination or Suspension.

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

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

7. Other Provisions.

A. Substantial Completion Defined. Substantial Completion shall be defined as provided in Article I of the General Conditions. In the event a temporary certificate of

occupancy or completion is issued establishing Substantial Completion, the Contractor shall diligently pursue the issuance of a permanent certificate of occupancy or completion.

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

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

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

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

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

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

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

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

8. Insurance and Bonding. If and to the extent required by the Invitation for Bid documents, the Contractor shall furnish insurance coverage for (but not necessarily limited to)

workers' compensation, commercial general liability, auto liability, excess liability, and builder's risk. The Contractor shall furnish to the Owner all appropriate policies and Certificate(s) of Insurance. The Contractor shall also post a Payment and Performance Bond for the Contract Sum, within ten (__) days following notification of intent to award, and otherwise in accordance with the Invitation for Bid documents.

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

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

11. Amendments; Waivers; Assignment.

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

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

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

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

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

14. Disclaimer of Third-Party Beneficiaries; Successors and Assigns. This Agreement is solely for the benefit of the parties hereto, and no right, privilege, or cause of action shall by reason hereof accrue upon, to, or for the benefit of any third party. Nothing in this Agreement is intended or shall be construed to confer upon or give any person, corporation,

partnership, trust, private entity, agency, or other governmental entity any right, privilege, remedy, or claim under or by reason of this Agreement or any provisions or conditions hereof. This Agreement shall be binding upon, and its benefits and advantages shall inure to, the successors and assigns of the parties hereto.

15. Construction.

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

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

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

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

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

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

To the Owner: Manatee County,
Attn:
Address
City/State/Zip
Email:

To the Contractor:
Name.
Attn:
Address
City/State/Zip
Email:

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

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

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

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE CHAPTER 119, FLORIDA STATUTES, TO THE

CONTRACTOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS AGREEMENT, CONTACT THE OWNER'S CUSTODIAN OF PUBLIC RECORDS AT 941-748-4501, EXT. 5845; DEBBIE.SCACCIANOCE@MYMANATEE.ORG; POST OFFICE BOX 1000, BRADENTON, FLORIDA 34206.

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

Exhibit A—Title(s) of Drawings

Exhibit B—Title(s) of Specifications

Exhibit C—Affidavit of No Conflict

Exhibit D—Certificate(s) of Insurance

Exhibit E—Payment and Performance Bond

Exhibit F—Standard Forms
1—Application for Payment
2—Certificate of Substantial Completion
3—Final Reconciliation / Warranty / Affidavit
4—Change Order

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

NAME OF CONTRACTOR

By: _____

Printed Name: _____

Title: _____

Date: _____

MANATEE COUNTY, a political subdivision of the State of Florida

By: _____

Printed Name:

Title:

Date: _____

GENERAL CONDITIONS

of the

CONSTRUCTION AGREEMENT

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GENERAL CONDITIONS
ARTICLE I
DEFINITIONS

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

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

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

C. Architect/Engineer: <Name>, a corporation, registered and licensed to do business in the State of Florida with _____ as the primary qualifying agent OR an employee of Manatee County Government

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

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

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

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

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

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

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

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

L. Defective: When modifying the term "Work", referring to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents, or that does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or that has been damaged prior to Owner's approval of final payment (unless responsibility for the protection thereof has been assumed by Owner).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

KK. Substantial Completion and Substantially Complete: The stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use; provided, however, that as a condition precedent to Substantial Completion, the Owner has received all certificates of occupancy or completion and other permits, approvals, licenses, and other documents from any governmental authority which are necessary for the beneficial occupancy of the Project or any designated portion thereof.

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

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

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

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

PP. Work Directive Change: A written directive to Contractor, issued on or after the effective date of the Agreement pursuant to Section 5.8 and signed by Owner's Project

Representative, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed or responding to emergencies.

ARTICLE II
RELATIONSHIP AND RESPONSIBILITIES

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

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

B. Construction Team. The Contractor, Owner and Architect/Engineer shall be called the "Construction Team" and shall work together as a team commencing upon full execution of the Contract Documents through Substantial Completion. As provided in Section 2.2, the Contractor and Architect/Engineer shall work jointly through completion and shall be available thereafter should additional services be required. The Contractor shall provide leadership to the Construction Team on all matters relating to construction. The Contractor understands, acknowledges and agrees that the Architect/Engineer shall provide leadership to the Construction Team on all matters relating to design.

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

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

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

the Work shall be fully qualified and shall be authorized or permitted under law to perform such services.

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

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

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

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

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

A. The Project Schedule shall show a breakdown of all tasks to be performed, and their relationship in achieving the completion of each phase of Work, subject to review of Owner and Architect/Engineer and approval or rejection by Owner. The Project Schedule shall show, at a minimum, the

approximate dates on which each segment of the Work is expected to be started and finished, the proposed traffic flows during each month, the anticipated earnings by the Contractor for each month and the approximate number of crews and equipment to be used. The Project Schedule shall include all phases of procurement, approval of shop drawings, proposed Change Orders in progress, schedules for Change Orders, and performance testing requirements. The Project Schedule shall include a construction commencement date and Project Substantial Completion Date, which dates shall accommodate known or reasonably anticipated geographic, atmospheric and weather conditions.

B. The Project Schedule shall serve as the framework for the subsequent development of all detailed schedules. The Project Schedule shall be used to verify Contractor performance and to allow the Owner's Project Representative to monitor the Contractor's efforts.

C. The Project Schedule may be adjusted by the Contractor pursuant to Article V. The Owner shall have the right to reschedule Work provided such rescheduling is in accordance with the remainder of terms of the Contract Documents.

D. The Contractor shall prepare a submittal schedule, promptly after being awarded the Agreement and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect/Engineer's approval. The Architect/Engineer's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect/Engineer reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

E. The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect/Engineer.

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

A. Construction of Project. The Contractor shall work from the receipt of a Notice to Proceed through the Substantial Completion of the Project in accordance with the terms of the Contract Documents to manage the construction of the Project. The Construction Services provided by the Contractor to construct the Project shall include without limitation (1) all services necessary and commensurate with established construction standards, and (2) all services described in the Invitation for Bid (or Request for Proposal) and the Bid (or Guaranteed Maximum Price Addendum).

B. Notice to Proceed. A Notice to Proceed may be given at any time within thirty (30) days after the effective date of the Agreement. Contractor shall start to perform the

Work on the date specified in the Notice to Proceed, but no Work shall be done at the site prior to the issuance of the Notice to Proceed.

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

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

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

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

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

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

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

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

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

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

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

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

M. Cleanliness. The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the

Contractor's tools, construction equipment, machinery and surplus materials from and about the Project Site. Contractor shall restore to original conditions all property not designated for alteration by the Contract Documents If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from Contractor.

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

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

(1) All employees on the Work and other persons and organizations who may be affected thereby;

(2) All the Work and materials and equipment to be incorporated therein, whether in storage on or off the Project Site; and

(3) Other property at the Project Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities not designated for removal, relocation or replacement during construction.

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

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

Q. Substitutes. For Substitutes not included with the Bid (or Guaranteed Maximum Price Addendum), but submitted after the effective date of the Agreement (or Guaranteed Maximum Price Addendum), Contractor shall make written application to

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

(1) Architect/Engineer will be allowed a reasonable time within which to evaluate each proposed Substitute. Architect/Engineer will be the sole judge of acceptability and no Substitute will be ordered, installed or utilized without Architect/Engineer's prior written acceptance which will be evidenced by either a Change Order or an approved shop drawing. Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any Substitute.

(2) Contractor shall reimburse Owner for the charges of Architect/Engineer and Architect/Engineer's Consultants for evaluating each proposed Substitute submitted after the effective date of the Agreement and all costs resulting from any delay in the Work while the Substitute was undergoing review.

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

S. Suitability of Project Site. The Contractor has, by careful examination, satisfied itself as to the nature and location of the Work and all other matters which can in any way affect the Work, including, but not limited to details pertaining to borings, as shown on the drawings. Such boring information is not guaranteed to be more than a general indication of the materials likely to be found adjacent to holes bored at the Project Site, approximately at the locations indicated. The Contractor has examined boring data, where available, made its own interpretation of the subsurface conditions and other preliminary data, and has based its Bid (or

Guaranteed Maximum Price Addendum) on its own opinion of the conditions likely to be encountered. Except as specifically provided in Sections 2.4.U., 5.4 and 5.5, no extra compensation or extension of time will be considered for any Project Site conditions that existed at the time of bidding (or at the time of execution of the Guaranteed Maximum Price Addendum). No verbal agreement or conversation with any officer, agent or employee of the Owner, before or after the execution of the Agreement, shall affect or modify any of the terms or obligations herein contained.

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

U. Remediation of Contamination: Owner and Contractor recognize that remediation of subsurface conditions may be necessary due to potential hazardous materials contamination. Because the presence or extent of any contamination is not known, Contractor shall include no cost in the Contract Sum, and no time in the Project Schedule, for cost or delays that might result from any necessary remediation. The Project Schedule shall provide a period of time between demolition activities and the start of the next activity to commence any remediation if needed. Contractor shall use all reasonable efforts in scheduling the Project to minimize the likelihood that remediation delays construction. Any hazardous materials remediation Work which Contractor agrees to perform shall be done pursuant to a Change Order or amendment consistent with the following:

(1) The dates of Substantial Completion shall be equitably adjusted based on delays, if any, incurred in connection with remediation efforts.

(2) Contractor and any Subcontractors which have mobilized on the Project Site shall be paid for demonstrated costs of overhead operations at the Project Site during any period of delay of more than seven (7) days, except to the extent that Work proceeds concurrently with remediation. The categories of costs to be reimbursed are limited to those reasonably incurred at the jobsite during the delay period (such as trailers or offices, telephones, faxes, and the like); equipment dedicated to the Project and located at the Project Site; salaries and associated costs of personnel dedicated to the Project to the extent that they do not perform work on other projects; and other jobsite costs that are reasonable and which are incurred during the delay period. Subcontractors and suppliers which have not mobilized are limited to the costs set forth in Section 2.4.U(3).

(3) Contractor and any Subcontractor or supplier on the Project who is eligible for compensation shall be paid any demonstrated costs of escalation in materials or labor, and reasonable costs of off-site storage of materials identified to the Project, arising because of any delay of more than seven (7) days. Such Contractor, Subcontractors and suppliers are obligated to take all reasonable steps to mitigate escalation costs, such as through early purchase of materials.

(4) Contractor, for itself and all Subcontractors and suppliers on the Project, hereby agrees that the extension of time for delays under Section 2.4.U(1), and payment of the costs identified in Sections 2.4.U(2) and/or Section 2.4.U(3), are the sole remedies for costs and delays described in this Section, and waives all claims and demands for extended home office overhead (including, but not limited to, "Eichleay" claims), lost profit or lost opportunities, and any special, indirect, or consequential damages arising as a result of delays described in this Section. The Contract Sum shall be adjusted to reflect payment of allowable costs.

(5) If any delay described in this section causes the time or cost for the Project to exceed the Contract Time or the Contact Sum, then the Owner may terminate the Agreement pursuant to Section [illegible].

(6) Contractor and any Subcontractor or supplier seeking additional costs under this Section 2.4.U. shall promptly submit estimates for any costs as requested by Owner, and detailed back-up for all costs when payment is sought or whenever reasonably requested by Owner. All costs are auditable, at Owner's discretion. Bid, estimate and pricing information reasonably related to any request for additional compensation will be provided promptly upon request.

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

V. Interfacing.

(1) The Contractor shall take such measures as are necessary to ensure proper coordination and delivery of the Project, including but not limited to providing that all procurement of long-lead items, the separate construction Subcontractors, and the general conditions items are performed without duplication or overlap to maintain completion of all Work on schedule. Particular attention shall be given to provide that each Subcontractor bid package clearly identifies the Work included in that particular separate subcontract, its scheduling for start and completion, and its relationship to other separate contractors.

(2) Without assuming any design responsibilities of the Architect/Engineer, the Contractor shall include in the Progress Reports required under this Section 2.4 comments on overlap with any other separate subcontracts, omissions, lack of correlation between drawings, and any other deficiencies noted, in order that the Architect/Engineer may arrange for necessary corrections.

W. Job Site Facilities. The Contractor shall arrange for all job site facilities required and necessary to enable the Contractor and Architect/Engineer to perform their

respective duties and to accommodate any representatives of the Owner which the Owner may choose to have present on the Project Site.

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

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

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

(1) Building Permit. The Owner and Architect/Engineer shall provide such information to any Permitting Authority as is necessary to obtain approval from the Permitting Authority to commence construction prior to beginning construction. The Contractor shall pull any required building permit, and shall be responsible for delivering and posting the building permit at the Project Site prior to the commencement of construction. The cost of the building permit is included in the Contract Sum. The Owner and Architect/Engineer shall fully cooperate with the Contractor when and where necessary.

(2) Code Inspections. The Project requires detailed code compliance inspection during construction in disciplines determined by any Permitting Authority. These disciplines normally include, but are not necessarily limited to, structural, mechanical, electrical, plumbing, general building and fire. The Contractor shall notify the appropriate inspector(s) and the Architect/Engineer, no less than 24 hours in advance, when the Work is ready for inspection and before the Work is covered up. All inspections shall be made for conformance with the applicable ordinances and building codes. Costs for all re-inspections of Work found defective and subsequently repaired shall not be included as Project Costs and shall be

borne by the Contractor or as provided in the contract between Contractor and Subcontractor.

(3) Contractor's Personnel. The Contractor shall maintain sufficient off-site support staff and competent full-time staff at the Project Site authorized to act on behalf of the Contractor to coordinate, inspect, and provide general direction of the Work and progress of the Subcontractors. At all times during the performance of the Work, the Owner shall have the right to demand replacement of Contractor Personnel to whom the Owner has reasonable objection, without liability to the Contractor.

(4) Lines of Authority. To provide general direction of the Work, the Contractor shall establish and maintain lines of authority for its personnel and shall provide this information to the Owner and all other affected parties, such as the code inspectors of any Permitting Authority, the Subcontractors, and the Architect/Engineer. The Owner and Architect/Engineer may attend meetings between the Contractor and his Subcontractors; however, such attendance is optional and shall not diminish either the authority or responsibility of the Contractor to administer the subcontracts.

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

BB. Management of Subcontractors. All Subcontractors shall be compensated in accordance with Article IV. The Contractor shall solely control the Subcontractors. The Contractor shall negotiate all Change Orders and Field Orders with all affected Subcontractors and shall review the costs and advise the Owner and Architect/Engineer of their validity and reasonableness, acting in the Owner's best interest. When there is an imminent threat to health and safety, and Owner's Project Representative concurrence is impractical, the Contractor shall act immediately to remove the threats to health and safety and shall subsequently fully inform Owner of all such action taken. The Contractor shall also carefully review all shop drawings and then forward the same to the Architect/Engineer for review and actions. The Architect/Engineer will transmit them back to the Contractor, who will then issue the shop drawings to the affected Subcontractor for fabrication or revision. The Contractor shall maintain a suspense control system to promote expeditious handling. The Contractor shall request the Architect/Engineer to make interpretations of the drawings or specifications requested of him by the Subcontractors and shall maintain a business system to promote timely response. The Contractor shall inform

the Architect/Engineer which shop drawings or requests for clarification have the greatest urgency, to enable the Architect/Engineer to prioritize requests coming from the Contractor. The Contractor shall advise the Owner and Architect/Engineer when timely response is not occurring on any of the above.

CC. Job Requirements.

(1) The Contractor shall provide each of the following as a part of its services hereunder:

(a) Maintain a log of daily activities, including manpower records, equipment on site, weather, delays, major decisions, etc;

(b) Maintain a roster of companies on the Project with names and telephone numbers of key personnel;

(c) Establish and enforce job rules governing parking, clean-up, use of facilities, and worker discipline;

(d) Provide labor relations management and equal opportunity employment for a harmonious, productive Project;

(e) Provide and administer a safety program for the Project and monitor for subcontractor compliance without relieving them of responsibilities to perform Work in accordance with best accepted practices;

(f) Provide a quality control program as provided under Section 2.4.C above;

(g) Provide miscellaneous office supplies that support the construction efforts which are consumed by its own forces;

(h) Provide for travel to and from its home office to the Project Site and to those other places within Manatee County as required by the Project;

(i) Verify that tests, equipment, and system start-ups and operating and maintenance instructions are conducted as required and in the presence of the required personnel and provide adequate records of same to the Architect/Engineer;

(j) Maintain at the job site orderly files for correspondence, reports of job conferences, shop drawings and sample submissions, reproductions of original Contract Documents including all addenda, change orders, field orders, additional drawings issued after execution of the Agreement, Owner/Architect/Engineer's clarifications and interpretations of the Contract Documents,

progress reports, as-built drawings, and other project related documents;

(k) Keep a diary or log book, recording hours on the job site, weather conditions, data relative to questions of extras or deductions; list of visiting officials and representatives or manufacturers, fabricators, suppliers and distributors; daily activities, decisions, observations in general and specific observations in more detail as in the case of observing test procedures, and provide copies of same to Owner/Architect/Engineer;

(l) Record names, addresses and telephone numbers of all Contractors, Subcontractors and major suppliers of materials and equipment;

(m) Furnish Owner/Architect/Engineer periodic reports, as required, of progress of the Work and Contractor's compliance with the approved progress schedule and schedule of shop drawing submissions;

(n) Consult with Owner/Architect/Engineer in advance of scheduling major tests, inspections or start of important phases of the Work;

(o) Verify, during the course of the Work, that certificates, maintenance and operations manuals and other data required to be assembled and furnished are applicable to the items actually installed and deliver same to Owner/Architect/Engineer for review prior to final Acceptance of the Work; and

(p) Cooperate with Owner in the administration of grants.

(2) The Contractor shall provide personnel and equipment, or shall arrange for separate Subcontractors to provide each of the following as a Project Cost:

(a) Services of independent testing laboratories, and provide the necessary testing of materials to ensure conformance to contract requirements; and

(b) Printing and distribution of all required bidding documents and shop drawings, including the sets required by Permitting Authority inspectors.

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

Architect/Engineer. Final as-built drawings shall be signed and sealed by a registered Florida surveyor.

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

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

(1) Contractor shall use its best efforts and due diligence to ensure that during the warranty period, those entities or individuals who have provided direct warranties to the Owner as required by the Contract Documents perform all required warranty work in a timely manner and at the sole cost and expense of such warranty providers. Any such cost or expense not paid by the warranty providers shall be paid by the Contractor, to include any costs and attorney's fees incurred in warranty-related litigation between Contractor and any Subcontractors.

(2) The Contractor shall secure guarantees and warranties of Subcontractors, equipment suppliers and materialmen, and assemble and deliver same to the Owner in a manner that will facilitate their maximum enforcement and assure their meaningful implementation. The Contractor shall collect and deliver to the Owner any specific written guaranties or warranties given by others as required by subcontracts.

(3) At the Owner's request, the Contractor shall conduct, jointly with the Owner and the Architect/Engineer, no more than two (2) warranty inspections within three (3) years after the Substantial Completion Date.

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

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

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

ARTICLE III
COMPENSATION

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

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

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

(1) In the case of Unit Price Work, in accordance with Section 3.1.C, below; or

(2) By mutual acceptance of a lump sum; or

(3) On the basis of the cost of the Work, plus a negotiated Contractor's fee for overhead and profit. Contractor shall submit an itemized cost breakdown together with supporting data.

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

(1) If the total cost of a particular item of Unit Price Work amounts to 5% or more of the Contract Sum and the variation in the quantity of the particular item of Unit Price Work performed by Contractor differs by more than 15% from the estimated quantity of such item indicated in the Agreement; and

(2) If there is no corresponding adjustment with respect to any other item of Work; and

(i) If Contractor believes that it has incurred additional expense as a result thereof; or

(ii) If Owner believes that the quantity variation entitles it to an adjustment in the unit price; or

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

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

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

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

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

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

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

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

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

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

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

ARTICLE IV
SUBCONTRACTORS

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

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

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

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

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

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

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

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

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

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

relieve Contractor from any liability or responsibility to Owner, or obligate Owner to the payment of any compensation to the Subcontractor or additional compensation to the Contractor.

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

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

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

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

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

(1) assignment is effective only after termination of the Contract by the Owner for cause pursuant to Article XIV and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and

(2) assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Agreement.

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

ARTICLE V
CHANGES IN WORK

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

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

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

5.4 Concealed Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect/Engineer before conditions are disturbed and in no event later than ten (10) days after first observance of the conditions. The

Architect/Engineer will promptly investigate such conditions and, if the Architect/Engineer determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect/Engineer determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect/Engineer shall promptly notify the Owner and Contractor in writing, stating the reasons. If the Contractor disputes the Architect/Engineer's determination or recommendation, the Contractor may proceed as provided in Article VIII. If the Owner disputes the Architect/Engineer's determination or recommendation, the Owner may appeal directly to the Purchasing Official and shall thereafter follow the process set forth in Section 8.5.

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

5.6 Change Orders; Adjustments to Contract Sum.

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

(1) By mutual acceptance of a lump sum amount properly itemized and supported by sufficient substantiating data, to permit evaluation by the Architect/Engineer and Owner; or

(2) By unit prices stated in the Agreement or subsequently agreed upon; or

(3) By any other method mutually agreeable to Owner and Contractor.

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

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

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

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

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

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

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

5.12 Changes to Contract Time. The Contract Time may only be changed pursuant to a Change Order or a written amendment to the Contract Documents. Any claim for an

extension or shortening of the Contract Time shall be based on written notice delivered by the party making the claim to the other party. Notice of the extent of the claim with supporting data shall be delivered within fifteen (15) days from detection or beginning of such occurrence and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled to because of the occurrence of said event. The Contract time will be extended in an amount equal to time lost due to delays beyond the control of Contractor. Such delays shall include, but not be limited to, acts or neglect by Owner or others performing additional Work; or to fires, floods, epidemics, abnormal weather conditions or acts of God. Failure to deliver a written notice of claim within the requisite 15-day period shall constitute a waiver of the right to pursue said claim.

ARTICLE VI
ROLE OF ARCHITECT/ENGINEER

6.1 General.

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

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

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

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

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

in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

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

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

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

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

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

ARTICLE VII
OWNER'S RIGHTS AND RESPONSIBILITIES

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

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

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

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

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

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

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

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

(2) The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the drawings and specifications provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Project Plans and Specifications or other instruments of service. The Contractor, Subcontractors, Sub-

subcontractors, and material or equipment suppliers may not use the drawings or specifications on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect/Engineer and the Architect/Engineer's consultants.

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

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

(1) Attend preconstruction conferences, arrange a schedule of progress meetings and other job conferences as required in consultation with Owner/Architect/Engineer and notify those expected to attend in advance; and attend meetings and maintain and circulate copies of minutes thereof;

(2) Serve as Owner/Architect/Engineer's liaison with Contractor, working principally through Contractor's superintendent, to assist in understanding the intent of the Contract Documents. As requested by Owner/Architect/Engineer, assist in obtaining additional details or information when required at the job site for proper execution of the Work;

(3) Report to Owner/Architect/Engineer whenever he believes that any Work is unsatisfactory, faulty or defective or does not conform to the Contract Documents;

(4) Accompany any visiting inspectors representing public or other agencies having jurisdiction over the project; record the outcome of these inspections and report to Owner/Architect/Engineer;

(5) Review applications for payment with Contractor for compliance with the established procedure for their submission and forward them with recommendations to Owner/Architect/Engineer; and

(6) Perform those duties as set forth elsewhere within the Contract Documents.

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

(1) Authorize any deviation from the Contract Documents or approve any substitute materials or equipment;

(2) Exceed limitations on Owner/Architect/Engineer's authority as set forth in the Contract Documents;

(3) Undertake any of the responsibilities of Contractor, Subcontractors or Contractor's superintendent, or expedite the Work;

(4) Advise on or issue directions relative to any aspect of the means, methods, techniques, sequences or procedures of construction unless such is specifically called for in the Contract Documents;

(5) Advise on or issue directions as to safety precautions and programs in connection with the Work;

(6) Authorize Owner to occupy the project in whole or in part; or

(7) Participate in specialized field or laboratory tests.

ARTICLE VIII
RESOLUTION OF DISAGREEMENTS; CLAIMS FOR COMPENSATION

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

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

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

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

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

(2) The Contractor must submit a notice of claim to Owner's Project Representative and to the Architect/Engineer within fifteen (15) days of when the Contractor was or should have been aware of the fact that an occurrence was likely to cause delay or increased costs. Failure to submit a claim within the requisite 15-day period shall constitute a waiver of the right to pursue said claim.

(3) Within twenty (20) days of submitting its notice of claim, the Contractor shall submit to the Owner's Project Representative its request for Change Order, which shall include a written statement of all details of the claim, including a description of the Work affected.

(4) After receipt of a request for Change Order, the Owner's Project Representative, in consultation with the Architect/Engineer, shall deliver to the Contractor, within twenty (20) days after receipt of request, its written response to the claim.

(5) In the event the Owner and Contractor are unable to agree on the terms of a Change Order, the Owner shall have the option to instruct the Contractor to proceed with the Work. In that event, the Owner shall pay for those parts of the Work, the scope and price of which are not in dispute. The balance of the disputed items in the order to proceed will be resolved after completion of the Work, based upon completed actual cost.

(6) The rendering of a decision by Owner with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment) will be a condition precedent to any exercise by Owner or Contractor of such right or remedies as either may otherwise have under the Contract Documents or by laws or regulations in respect of any such claim, dispute or other matter.

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

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

(1) damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of

management or employee productivity or of the services of such persons, unless any of such damages or losses are covered by insurance placed by the Contractor; and

(2) damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

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

ARTICLE IX
INDEMNITY

9.1 Indemnity.

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

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

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

ARTICLE X
ACCOUNTING RECORDS; OWNERSHIP OF DOCUMENTS

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

10.2 Inspection and Audit. The Contractor's records shall be open to inspection and subject to examination, audit, and/or reproduction during normal working hours by the Owner's agent or authorized representative to the extent necessary to adequately permit evaluation and verification of any invoices, payments or claims submitted by the Contractor or any of its payees during the performance of the Work. These records shall include, but not be limited to, accounting records, written policies and procedures, Subcontractor files (including proposals of successful and unsuccessful bidders), original estimates, estimating worksheets, correspondence, Change Order files (including documentation covering negotiated settlements), and any other supporting evidence necessary to substantiate charges related to the Contract Documents. They shall also include, but not be limited to, those records necessary to evaluate and verify direct and indirect costs (including overhead allocations) as they may apply to costs associated with the Contract Documents. For such audits, inspections, examinations and evaluations, the Owner's agent or authorized representative shall have access to said records from the effective date of the Contract Documents, for the duration of Work, and until three (3) years after the date of final payment by the Owner to the Contractor pursuant to the Contract Documents.

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

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

ARTICLE XI
PUBLIC CONTRACT LAWS

11.1 Equal Opportunity Employment.

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

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

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

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

A. No Interest in Business Activity. In accepting award of this Agreement, the Contractor, which shall include its directors, officers and employees, represents that it presently has no interest in and shall acquire no interest in any business or activity which would conflict in any manner with the performance of services required hereunder, including without limitation as described in the Contractor's own professional ethical requirements. An interest in a business or activity which shall be deemed a conflict includes but is not limited to direct financial interest in any of the material and equipment manufacturers, suppliers, distributors, or contractors who will be eligible to supply material and equipment for the Project for which the Contractor is furnishing its services required hereunder.

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

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

11.5 Public Entity Crimes. The Contractor is directed to the Florida Public Entity Crimes Act, Section 287.133, Florida Statutes, specifically section 2(a), and the Owner's

requirement that the Contractor comply with it in all respects prior to and during the term of the Agreement.

ARTICLE XII
FORCE MAJEURE, FIRE OR OTHER CASUALTY

12.1 Force Majeure.

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

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

C. Notice; Mitigation. The party seeking excuse for nonperformance based on Force Majeure shall give written notice to the Owner, if with respect to the Contractor, or to the Contractor if with respect to the Owner, specifying its actual or anticipated duration. Each party seeking excuse from nonperformance based on Force Majeure shall use its best efforts to rectify any condition causing the delay and will cooperate with the other party, except that neither party shall be obligated to incur any unreasonable additional costs and expenses to overcome any loss of time thereby resulted.

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

(1) Receipt by the Owner or the trustee of the proceeds derived from collection of all valid claims against insurers or others based upon such damage or destruction, and receipt of other sums from any source such that the funds necessary to pay the Project Cost and any additions to the Project Cost necessitated for repair or reconstruction are available;

(2) Written agreement executed by the Contractor and the Owner, by amendment to the Contract Documents or otherwise, authorizing and approving the repair or reconstruction and any additions to the Project Cost necessitated thereby, including any required adjustment to the Contract Sum; and

(3) Final approval by the Owner of the Project Plans and Specifications for such repair or reconstruction and issuance of any required building permit.

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

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

ARTICLE XIII
REPRESENTATIONS, WARRANTIES AND COVENANTS

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

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

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

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

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

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

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

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

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

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

J. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective, and that Owner, representatives of Owner, and governmental agencies with jurisdictional interests will have

access to the Work at reasonable times for their observation, inspecting and testing. Contractor shall give Architect/Engineer timely notice of readiness of the Work for all required approvals and shall assume full responsibility, including costs, in obtaining required tests, inspections, and approval certifications and/or acceptance, unless otherwise stated by Owner.

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

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

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

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

any other provisions of the Contract Documents to the contrary, Owner shall have the right to bring a direct action in the Circuit Court to recover such costs.

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

A. The Owner is a validly existing political subdivision of the State of Florida.

B. The Owner has all requisite corporate or governmental power and authority to carry on its business as now conducted and to perform its obligations under the Contract Documents and each Contract Document contemplated hereunder to which it is or will be a party.

C. The Contract Documents and each Contract Document contemplated hereby to which the Owner is or will be a party has been duly authorized by all necessary action on the part of, and has been or will be duly executed and delivered by, the Owner, and neither the execution and delivery thereof nor compliance with the terms and provisions thereof or hereof: (a) requires the approval and consent of any other person or party, except such as have been duly obtained or as are specifically noted herein; (b) contravenes any existing law, judgment, governmental rule, regulation or order applicable to or binding on the Owner; or (c) contravenes or results in any breach of, default under or result in the creation of any lien or encumbrance upon the Owner under any indenture, mortgage, deed of trust, bank loan, or credit agreement, the charter, ordinances, resolutions, or any other agreement or instrument to which the Owner is a party, specifically including all covenants of any bonds, notes, or other forms of indebtedness of the Owner outstanding on the date of the Contract Documents.

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

E. There are no pending or, to the knowledge of the Owner, threatened actions or proceedings before any court or administrative agency against the Owner which question the validity of the Contract Documents or any document contemplated hereunder, or which are likely in any case or in the aggregate to materially adversely affect the consummation of the transactions contemplated hereunder or the financial or corporate condition of the Owner.

F. The Owner shall use due diligence to timely fulfill or cause to be fulfilled all of the conditions expressed in the Contract Documents which are within the control of the Owner or which are the responsibility of the Owner to fulfill.

G. During the pendency of the Work and while the obligations of the Owner under the Contract Documents shall be in effect, the Owner shall cause to occur and to continue to be in effect and take such action as may be necessary to enforce those instruments,

documents, certificates and events contemplated by the Contract Documents that are applicable to and the responsibility of the Owner.

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

ARTICLE XIV
TERMINATION AND SUSPENSION

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

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

B. Insolvency. If the Contractor is adjudged bankrupt, or if it makes a general assignment for the benefit of its creditors, or if a receiver is appointed because its insolvency, then the Owner may, without prejudice to any other right or remedy, and after giving the Contractor and its surety, if any, fourteen (14) days written notice, and during which period the Contractor fails to cure the violation, terminate the Agreement. In such case, the Contractor shall not be entitled to receive any further payment. Owner shall be entitled to recover all costs and

damages arising because of failure of Contractor to perform as provided in the Contract Documents, as well as reasonable termination expenses, and costs and damages incurred by the Owner may be deducted from any payments left owing the Contractor.

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

D. Rights of Owner. The Owner may, after giving Contractor (and the Surety, if there is one) seven (7) days written notice, terminate the services of Contractor for cause; exclude Contractor from the Project Site and take possession of the Work and of all Contractor's tools, construction equipment and machinery at the Project Site and use the same to the full extent they could be used (without liability to Contractor for trespass or conversion); incorporate in the Work all materials and equipment stored at the Project Site or for which Owner has paid Contractor but which are stored elsewhere, and finish the Work as Owner may deem expedient. In such case, Contractor shall not be entitled to receive any further payment beyond an amount equal to the value of material and equipment not incorporated in the Work, but delivered and suitably stored, less the aggregate of payments previously made. If the direct and indirect costs of completing the Work exceed the unpaid balance of the Contract Sum, Contractor shall pay the difference to Owner. Such costs incurred by Owner shall be verified by Owner in writing; but in finishing the Work, Owner shall not be required to obtain the lowest quote for the Work performed. Contractor's obligation to pay the difference between such costs and such unpaid balance shall survive termination of the Agreement. In such event and notwithstanding any other provisions of the Contract Documents to the contrary, Owner shall be entitled to bring a direct action in the Circuit Court to recover such costs.

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

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

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

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

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

14.5 Vacation of Project Site; Delivery of Documents. Upon termination by Owner pursuant to Section 14.2 or 14.4, Contractor shall withdraw its employees and its equipment, if any, from the Project Site on the effective date of the termination as specified in the notice of termination (which effective date shall not be less than two (2) working days after the date of delivery of the notice), regardless of any claim the Contractor may or may not have against the Owner. Upon termination, the Contractor shall deliver to the Owner all original papers, records, documents, drawings, models and other material set forth and described in the Contract Documents.

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

Exhibit A
Title(s) of Drawings

Exhibit B
Title(s) of Specifications

Exhibit C
Affidavit of No Conflict

Exhibit D
Contractor's Certificate(s) of Insurance

Exhibit E
Contractor's Payment and Performance Bond

MANATEE COUNTY GOVERNMENT
PUBLIC CONSTRUCTION BOND
NUMBER _____

BY THIS BOND, We_____, located at_____, as
(Name of Contractor) (Address)

Principal and _____, a corporation, whose address is
(Name of Surety)

_____

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

THE CONDITIONS OF THIS BOND is that if Principal:

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

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

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

DATED ON _____

CONTRACTOR AS PRINCIPAL	**SURETY**
Company Name	Company Name
Signature	Signature
Print Name & Title	Print Name and Title
(Corporate Seal)	(Corporate Seal)

AGENT OR BROKER

Company Name

Address

Telephone

Licensed Florida Insurance Agent? ☐ Yes ☐ No

License #:

State of:

County of:

City of:

Exhibit F
Standard Forms

APPLICATION FOR PAYMENT

Request No.: ____ Project No.: _____
Purchase Order No.: _____
Project: _____ County Bid No.: _____
From: _____ To: _____ Consultant: _____

CONTRACT PAYMENT SUMMARY

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

CONTRACTOR'S AFFIDAVIT OF NOTICE

CERTIFICATE: The undersigned CONTRACTOR certifies that all items and amounts shown on this Application for Payment are on account of work performed, materials supplied and/or materials stored on site and paid for by Contractor in accordance with the Contract Documents with due consideration for previous Payment(s), if any, received by the Contractor from the County, and that the Amount Due this Payment shown is now due.

NOTARY: **CONTRACTOR:**

State of Florida, County of _____ _____
Name of person authorized to sign Affidavit of Notice

Sworn to (or affirmed) and subscribed before me
this _____ day of _____ _____
TITLE

_____
(Name of person giving notice)

Contractor name, address and telephone no.:

_____
(Signature of Notary Public - State of Florida)
Print, Type or Stamp Commissioned Name of Notary Public:

Personally Known ____ or Produced Identification ____
Type of Identification Produced: _____

VERIFICATION, RECOMMENDATION, CONCURRENCES AND APPROVALS

	(Signatures)	(Date)
Quantities verified by:		
Consultant/Engineer:		
Project Management:		
Department Head:		
Payment approved by the Board of County Commissioners:		
Attested to by the Clerk of Circuit Court:		

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

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

(USE CONTINUATION SHEETS IF NECESSARY)

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

Contractor Signature	Date	Engineer's Approval	Date
Printed Name and Title		Printed Name and Title	

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

ATTACH THE INSPECTOR'S FINAL WALKTHROUGH LIST OF DEFICIENCIES.

FINAL RECONCILIATION, WARRANTY PERIOD DECLARATION AND CONTRACTOR'S AFFIDAVIT

Project Title:	Date Submitted:
Contractor Data: Name: Address: City/State/Zip:	Project No: Warranty (months):

This Final Reconciliation is for the work performed for Manatee County by the above named contractor, hereinafter called CONTRACTOR, pursuant to the contract dated _____ as amended, and acts as an addendum thereto.

It is agreed that all quantities and prices in the attached Final Pay Estimate No. _____ are correct and that the amount of $_____ including retainage is due to the CONTRACTOR, that no claims are outstanding as between the parties, and that the above stated sum represents the entirety of monies owed the CONTRACTOR.

It is further agreed that the warranty period for CONTRACTOR'S work pursuant to the Contract is from _____ to _____

As (title) _____ for CONTRACTOR, I have authority to bind said CONTRACTOR, and as such make this final reconciliation, declaration and affidavit for the purpose of inducing Manatee County to make final payment to CONTRACTOR for work done at/upon _____ under said contract:

CONTRACTOR has paid all social security and withholding taxes accrued in connection with the construction project.

CONTRACTOR has paid all workers' compensation and other insurance premiums incurred in connection with this construction project.

CONTRACTOR has paid for all required permits in connection with this construction project.

All laborers, material, men, suppliers, subcontractors and service professionals who worked for and/or supplied materials, equipment and/or services to the CONTRACTOR under this construction contract have been paid in full.

_____
(Affiant Signature)

NOTARY:
State of Florida, County of _____ , Sworn to (or affirmed) and subscribed before me this _____ day of _____ , ____, by _____ (person giving notice).

Signature of Notary Public - State of Florida: _____
Print, Type or Stamp Commissioned Name of Notary Public:

Personally Known ☐ or Produced Identification ☐
Type of Identification Produced _____

CONTRACT CHANGE ORDER

(for Total Contract Adjusted Amount Greater than $1,000,000)

PROJECT:

Change Order No.:

Contract Amount (Present Value)

Project Number:

NO. OF ITEM	DESCRIPTION OF ITEM AND CHANGE	DECREASE	INCREASE
	BY EXECUTION OF THIS CHANGE ORDER THE CONTRACTOR AGREES THAT ALL CLAIMS FOR ADDITIONAL CONTRACT TIME AND FEES FOR THE ITEMS IN THIS CHANGE ORDER HAVE BEEN SATISFIED.		
		TOTAL DECREASE:	**TOTAL INCREASE:**

Contractor: _____
Address: _____
City / State: _____

Contractor Signature: _____ Date: _____

THE NET CHANGE OF

ADJUSTS THE CURRENT CONTRACT AMOUNT FROM

TO

____ CALENDAR DAYS ARE ADDED TO THE SCHEDULE WHICH CHANGES THE FINAL COMPLETION DATE TO MONTH DAY, YEAR

RECOMMENDATION, CONCURRENCES AND APPROVALS

	SIGNATURES	DATE
Consultant / Engineer:	_____	_____
Project Manager:	_____	_____
Division Manager:	_____	_____
	Project Management Division Manager	
Manatee County Purchasing:	_____	_____
	Purchasing Official	

Authority to execute this contract per Manatee County Code, Chapter 2-26, and per the delegation by the County Administrator effective 1/26/2009

JUSTIFICATION FOR CHANGE	Change Order No : Project Number:

1. NECESSITY FOR CHANGE:

2. Is change an alternate bid? (If yes, expla

3. Does change su tantial hysical size of the project? (If yes, explain)

4 Effect of this change on other "Prime" contractors?

5 Has the Surety and insurance company been notified, if applicable? CONTRACTOR RESPONSIBILITY