

**PACKAGED PUMP STATION AND CONTROLS BID
(Equipment Only)**

for the
North Lakeshore Sanitary Sewer Improvement Project

(This is a Non-Installation Bid Package)



BID #: ITB WS 10-19

BID OPENS: December 19, 2018 @ 3:15 P.M.

CONTENTS

Pages

Invitation to Bid & Respondent's Acknowledgement	
Notice to Respondents	
Bid Requirements	
General Services Bid Conditions	GSC-1
Special Bid Conditions	
Standard Terms and Conditions	
Drug-Free Workplace Certification	Form A
Conflict of Interest Disclosure Form	Form B
Federal E-Verify Compliance Certification	Form C
Indemnification and Hold Harmless	Form D
Lobbying	Form E
Cone of Silence	Form F
Company Data	Form G
Addendum Acknowledgement	Form H
Equipment Owner's Data Sheet	Form I
Bid Sheet	Form J
Notice of Award	
General Conditions	
Supplementary Conditions	
Work Summary	01010-1
Submittals	01330-1
Shop Drawing Procedures	01332-1
Quality Requirements	01400-1
Substitution Procedures	01630-1
Manufacturer Services	01640-1
Facility Startup	01650-1
Operations & Maintenance	01782-1
Pump, Wetwell, & Manhole	11145-1
Grounding and Bonding	16060-1
Electrical Support	16072-1
Electrical Identification	16075-1
Conductors and Cables	16120-1
Wiring Devices	16140-1
Enclosed Switches and Circuit Breakers	16410-1
Motor Control Centers	16443-1
Instrumentation and Controls	16900-1



INVITATION TO BID (ITB) & RESPONDENT'S ACKNOWLEDGEMENT

ITB TITLE:
Packaged Pump Station & Controls for the North Lakeshore
Sanitary Sewer Improvement Project

ITB NUMBER:
ITB WS 10-19

ISSUE DATE: November 19, 2018 8:00 A.M. CST
LAST DAY FOR QUESTIONS: December 3, 2018 3:00 P.M. CST
ITB OPENING DATE & TIME: December 19, 2018 3:15 P.M. CST

NOTE: BIDS RECEIVED AFTER THE BID OPENING DATE & TIME WILL NOT BE CONSIDERED.

Okaloosa County, Florida solicits your company to submit a bid on the above referenced goods or services. All terms, specifications and conditions set forth in this ITB are incorporated into your response. A bid will not be accepted unless all conditions have been met. All bids must have an authorized signature in the space provided below. All bids must be sealed and received by the Okaloosa County Clerk of Court by the "ITB Opening Date & Time" referenced above. The official clock for the purpose of receiving bids is located in the Clerk of Court, Brackin Building Conference & Training Room, #305 located at 302 N. Wilson St, Crestview, FL 32536. All envelopes containing sealed bids must reference the "ITB Title", "ITB Number" and the "ITB Opening Date & Time". All bids being submitted prior to the opening must be submitted at Okaloosa County Purchasing Department, 5479A Old Bethel Rd., Crestview, FL 32536. Okaloosa County is not responsible for lost or late delivery of bids by the U.S. Postal Service or other delivery services used by the respondent. Neither faxed nor electronically submitted bids will be accepted. Bids may not be withdrawn for a period of ninety (90) days after the bid opening unless otherwise specified.

RESPONDENT ACKNOWLEDGEMENT FORM BELOW MUST BE COMPLETED, SIGNED, AND RETURNED AS PART OF YOUR BID. BIDS WILL NOT BE ACCEPTED WITHOUT THIS FORM, SIGNED BY AN AUTHORIZED AGENT OF THE RESPONDENT.

COMPANY NAME
MAILING ADDRESS
CITY, STATE, ZIP

FEDERAL EMPLOYER'S IDENTIFICATION NUMBER (FEIN):

TELEPHONE NUMBER: EXT: FAX:
EMAIL:

I CERTIFY THAT THIS BID IS MADE WITHOUT PRIOR UNDERSTANDING, AGREEMENT, OR CONNECTION WITH ANY OTHER RESPONDENT SUBMITTING A BID FOR THE SAME MATERIALS, SUPPLIES, EQUIPMENT OR SERVICES, AND IS IN ALL RESPECTS FAIR AND WITHOUT COLLUSION OR FRAUD. I AGREE TO ABIDE BY ALL TERMS AND CONDITIONS OF THIS BID AND CERTIFY THAT I AM AUTHORIZED TO SIGN THIS BID FOR THE RESPONDENT.

AUTHORIZED SIGNATURE: PRINTED NAME:
TITLE: DATE:

NOTICE TO RESPONDENTS
ITB WS 10-19

Notice is hereby given that the Board of County Commissioners of Okaloosa County, FL, will accept sealed bids until **December 19, 2018, 3:15 p.m. (CST)** 3:, for **Packaged Pump Station and Controls**.

Interested respondents desiring consideration shall provide an original and two (2) copies (total three (3)) of their Invitation to Bids (ITB) response with the respondent's areas of expertise identified. Submissions shall be portrait orientation, unbound, and 8 ½" x 11" where practical. **All originals must have original signatures in blue ink.**

The Bid Documents can be viewed at <https://www.bidnetdirect.com/florida> or at <http://www.myokaloosa.com/purchasing/home> then accessing the link "View Current Solicitations"

BID DOCUMENTS are available for electronic download from **CONSTANTINE ENGINEERING, INC.**, under the project name at the following web address: <http://www.tcginfo.com/Documents/>.

At **3:15 p.m. (CST), December 19, 2018**, all bids will be opened and read aloud. All bids must be in sealed envelopes reflecting on the outside thereof the Respondent's name and "**Packaged Pump Station and Controls**". The Board of County Commissioners will consider all bids properly submitted at its scheduled bid opening in the **Conference & Training Room #305 – (old First National Bank Bldg.)** located at 302 N. Wilson St, Crestview, FL 32536. Bids may be submitted to the Okaloosa County Purchasing Department, 5479A Old Bethel Rd, Crestview, FL 32536 prior to the opening. **NOTE: Crestview, FL is not a next day guaranteed delivery location by most delivery services.** Respondents using mail or delivery services assume all risks of late or non-delivery.

The County reserves the right to award the bid to the lowest responsive respondent and to waive any irregularity or technicality in bids received. Okaloosa County shall be the sole judge of the bid and the resulting negotiated agreement that is in its best interest and its decision shall be final.

Any Respondent failing to mark outside of the envelope as set forth herein may not be entitled to have their bid considered.

All bids should be addressed as follows:

Packaged Pump Station and Controls

Okaloosa County Purchasing
Dept.
5479A Old Bethel Rd.
Crestview FL 32536

Jeff Hyde
Purchasing Manager

Date

OKALOOSA COUNTY
BOARD OF COUNTY COMMISSIONERS
Graham W. Fountain, Chairman

BID REQUIREMENTS

BID #: ITB WS 10-19

BID ITEM: Packaged Pump Station and Controls for the North Lakeshore Sanitary Sewer Improvement Project

SCOPE

Equipment covered by this bid includes the manufacture, deliver and start-up services for **Packaged Pump Station and Controls** specified herein. All materials shall be manufactured within the continental United States. No substitutions will be accepted unless approved by the Purchasing and the Water & Sewer Departments. **Note: Evaluation of bid will be based on “TOTAL BASE BID AMOUNT” for each Alternative listed. All bids shall include itemized unit cost for each identified items.**

Price shall be guaranteed for 90 days after the bids are read and received. Price shall include delivery of all equipment and appurtenances to the following location:

1804 LEWIS TURNER BLVD. FORT WALTON BEACH, FL. 32547

OWNER Delivery Contact:

Mark Griffin, Okaloosa County Water & Sewer
850-651-7176 or mgriffin@myokaloosa.com

Vendor is required to coordinate fabrication and shipping with the installation Contractor once a construction contract has been executed between the County and a Contractor.

THE FOLLOWING MUST BE SUBMITTED WITH THE PROPOSAL:

- A list of any and all exceptions to the Bid and Contract Documents.
- Dimensional and weight information on components and assemblies.
- Catalog information and cuts.
- Manufacturer's specifications, including materials description and paint system. Also a list of any requested exceptions to the Bid and Contract Documents.
- Performance data and pump curves, as applicable. Horsepower of all motors supplied.
- Outside utility requirements for each component, such as water, power, air, etc.
- Addresses and phone numbers of nearest service center and a listing of the manufacturers or manufacturer's representatives' services available at this location.
- Addresses and phone numbers for the nearest parts warehouse capable of providing mil parts replacement and/or repair service.
- A list of the three most recent installations where similar equipment by the manufacturer or manufacturer's representative is currently in service; include contact name, telephone number, mailing address, and the names of the Engineer, Owner, and installation contractor; if three installations do not exist, the list shall include all that do exist, if any.
- Description of structural, electrical, mechanical, and all other changes or modifications necessary to adapt the equipment or system to the arrangement shown and/or functions described on the Drawings and in the Technical Specifications.
- Any additional information requested by the OWNER.

THE FOLLOWING SHALL BE SUPPLIED PRIOR TO CONTRACT AWARD

- A SUPPLY BOND in the amount at least equal to 5% of the Base Bid Amount.

GENERAL BID CONDITIONS

PRE-BID ACTIVITY -

Except as provided in this section, respondents are prohibited from contacting or lobbying the County, County Administrator, Commissioners, County staff, and Review Committee members, or any other person authorized on behalf of the County related or involved with the solicitation. All inquiries on the scope of work, specifications, additional requirements, attachments, terms and general conditions or instructions, or any issue must be directed in writing, by US mail or email to:

Okaloosa County Purchasing Department
5479A Old Bethel Road
Crestview, FL 32536
Email: dmason@myokaloosa.com
(850) 689-5960

All questions or inquiries must be received no later than the last day for questions (reference ITB & Respondent's Acknowledgement form). Any addenda or other modification to the bid documents will be issued by the County five (5) days prior to the date and time of bid closing, as written addenda, and will be posted to and the Okaloosa County website at <https://www.myokaloosa.com> and the Bidnet website at <https://www.bidnetdirect.com/florida>.

Such written addenda or modification shall be part of the bid documents and shall be binding upon each respondent. Each respondent is required to acknowledge receipt of any and all addenda in writing and submit with their bid. No respondent may rely upon any verbal modification or interpretation.

PREPARATION OF BID – The bid form is included with the bid documents. Additional copies may be obtained from the County. The respondent shall submit bids in accordance with the public notice.

All blanks in the bid documents shall be completed by printing in ink or by typewriter in both words and numbers with the amounts extended, totaled and the bid signed. A bid price shall be indicated for each section, bid item, alternative, adjustment unit price item, and unit price item listed therein, or the words “No Bid”, “No Change”, or “Not Applicable” entered. No changes shall be made to the phraseology of the form or in the items mentioned therein. In case of any discrepancy between the written amount and the numerical figures, the written amount shall govern. Any bid which contains any omissions, erasures, alterations, additions, irregularities of any kind, or items not called for which shall in any manner fail to conform to the conditions of public notice inviting bids may be rejected.

A bid submitted by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature). The official address of the partnership shall be shown below the signature.

A bid submitted by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown below the signature.

A bid submitted by an individual shall show the respondent's name and official address.

A bid submitted by a joint venture shall be executed by each joint venture in the manner indicated on the bid form. The official address of the joint venture must be shown below the signature. It is preferred that all signatures be in blue ink with the names type or printed below the signature. Okaloosa County does not accept electronic signatures.

The bid shall contain an acknowledgement of receipt of all Addenda, the numbers of which shall be filled in on the form. The address and telephone # for communications regarding the bid shall be shown.

If the respondent is an out-of-state corporation, the bid shall contain evidence of respondent's authority and qualification to do business as an out-of-state corporation in the State of Florida. A state contractor license # for the State of Florida shall also be included on the bid form. Respondent shall be licensed in accordance with the requirements of Chapter 489, Florida Statutes.

INTEGRITY OF BID DOCUMENTS - Respondents shall use the original Bid documents provided by the Purchasing Department and enter information only in the spaces where a response is requested. Respondents may use an attachment as an addendum to the Bid documents if sufficient space is not available. Any modifications or alterations to the original bid documents by the respondent, whether intentional or otherwise, will constitute grounds for rejection of a bid. Any such modification or alteration that a respondent wish to propose must be clearly stated in the respondent's response in the form of an addendum to the original bid documents.

SUBMITTAL OF BID – A bid shall be submitted no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in an opaque sealed envelope plainly marked with the project title (and, if applicable, the designated portion of the project for which the bid is submitted), the name and address of the respondent, and shall be accompanied by the bid security and other required documents. It is the respondent's responsibility to assure that its bid is delivered at the proper time and place. Offers by telegram, facsimile, or telephone will **NOT** be accepted.

Note: Crestview is not a next day delivery site for overnight carriers.

MODIFICATION & WITHDRAWAL OF BID - A bid may be modified or withdrawn by an appropriate document duly executed in the manner that a bid must be executed and delivered to the place where bids are to be submitted prior to the date and time for the opening of bids.

If within 24 hours after bids are opened any respondent files a duly signed written notice with the County and promptly thereafter demonstrates to the reasonable satisfaction of the County that there was a material substantial mistake in the preparation of its bid, that respondent may withdraw its bid, and the bid security may be returned. Thereafter, if the work is rebid, that respondent will be disqualified from 1) further bidding on the work, and 2) doing any work on the contract, either as a subcontractor or in any other capacity.

BIDS TO REMAIN SUBJECT TO ACCEPTANCE – All bids will remain subject to acceptance or rejection for ninety (90) calendar days after the day of the bid opening, but the County may, in its sole discretion, release any bid and return the bid security prior to the end of this period.

IDENTICAL TIE BIDS - – In cases of identical procurement responses, the award shall be determined either by lot or on the basis of factors deemed to serve the best interest of the County. In the case of the latter, there must be adequate documentation to support such a decision.

CONDITIONAL & INCOMPLETE BIDS - Okaloosa County specifically reserves the right to reject any conditional bid and bids which make it impossible to determine the true amount of the bid.

PRICING – The bid price shall include all equipment, labor, materials, freight, taxes etc. Okaloosa County reserves the right to select that bid most responsive to our needs.

ADDITION/DELETION OF ITEM – The County reserves the right to add or delete any item from this bid or resulting contract when deemed to be in the County’s best interest.

SPECIFICATION EXCEPTIONS – Specifications are based on the most current literature available. Respondent shall clearly list any change in the manufacturer’s specifications which conflict with the bid specifications. Respondent must also explain any deviation from the bid specification in writing, as a foot note on the applicable bid page and enclose a copy of the manufacturer’s specifications data detailing the changed item(s) with their bid. Failure of the respondent to comply with these provisions will result in respondents being held responsible for all costs required to bring the equipment in compliance with bid specifications.

APPLICABLE LAWS & REGULATIONS – All applicable Federal and State laws, County and municipal ordinances, orders, rules and regulations of all authorities having jurisdiction over the project shall apply to the bid throughout, and they will be deemed to be included in the contract the same as though they were written in full therein.

DISQUALIFICATION OF RESPONDENTS - Any of the following reasons may be considered as sufficient for the disqualification of a respondent and the rejection of its bid:

Submission of more than one proposal for the same work from an individual, firm or corporation under the same or different name.

Evidence that the respondent has a financial interest in the firm of another respondent for the same work.

Evidence of collusion among respondents. Participants in such collusion will receive no recognition as respondents for any future work of the County until such participant has been reinstated as a qualified respondent.

Uncompleted work which in the judgment of the County might hinder or prevent the prompt completion of additional work if awarded.

Failure to pay or satisfactorily settle all bills due for labor and material on former contracts in force at the time of advertisement of proposals.

Default under previous contract.

Listing of the respondent by any Local, State or Federal Government on its barred/suspended vendor list.

AWARD OF BID

Okaloosa County Review - Okaloosa County designated Staff will review all bids and will participate in the Recommendation to Award.

The County will award the bid to the responsive and responsible vendor(s) with the lowest responsive bid(s), and the County reserves the right to award the bid to the respondent submitting a responsive bid with a resulting negotiated agreement which is most advantageous and in the best interest of the County, and to reject any and all bids or to waive any irregularity or technicality in bids received. Okaloosa County shall be the sole judge of the bid and the resulting negotiated agreement that is in its best interest and its decision shall be final.

Okaloosa County reserves the right to waive any informalities or reject any and all bids, in whole or part, to utilize any applicable state contracts in lieu of or in addition to this bid and to accept the bid that in its judgment will best serve the interest of the County.

Okaloosa County specifically reserves the right to reject any conditional bids and will normally reject those which made it impossible to determine the true amount of the bid. Each item must be bid separately and no attempt is to be made to tie any item or items to any other item or items.

DISCRIMINATION - An entity or affiliate who has been placed on the discriminatory vendor list may not submit a bid on a contract to provide goods or services to a public entity, may not submit a bid on a contract 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 award or perform work as a contractor, supplier, subcontractor, or consultant under contract with any public entity, and may not transact business with any public entity.

PUBLIC ENTITY CRIME INFORMATION - Pursuant to Florida Statute 287.133, a respondent may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity; and may not transact business with any public entity in excess of the threshold amount provided in s. [287.017](#) for CATEGORY TWO for a period of 36 months following the date of being placed on the convicted vendor list.

CONE OF SILENCE CLAUSE - The Okaloosa County Board of County Commissioners has established a solicitation silence policy (**Cone of Silence Clause**) that prohibits oral and written communication regarding all formal solicitations for goods and services (formal bids, Request for Proposals, Requests for Qualifications) issued by the Board through the County Purchasing Department. The period commences from the date of advertisement until award of contract.

All communications shall be directed to the Purchasing Department.

Note: For respondent's convenience, this certification form is enclosed and is made a part of the bid package.

REORGANIZATION OR BANKRUPTCY PROCEEDINGS – Bids will not be considered from respondents who are currently involved in official financial reorganization or bankruptcy proceedings.

INVESTIGATION OF RESPONDENT – The County may make such investigations, as it deems necessary to determine the stability of the respondent to perform the work and that there is no conflict of interest as it relates to the project. The respondent shall furnish to the Owner any additional information and financial data for this purpose as the County may request.

Note: For respondent’s convenience, this certification form is enclosed and is made a part of the bid package.

REVIEW OF PROCUREMENT DOCUMENTS - Per Florida Statute 119.071 (2) 2 sealed bids, proposals, or replies received by the County pursuant to a competitive solicitation are exempt from public disclosure until such time as the County provides notice of an intended decision or until 30 days after opening the bids, proposals, or final replies, whichever is earlier.

COMPLIANCE WITH FLORIDA STATUTE 119.0701 - The Respondent shall comply with all the provisions of section 119.0701, Florida Statutes relating to the public records which requires, among other things, that the Respondent: (a) Keep and maintain public records; (b) Provide the public with access to public records on the same terms and conditions that the public agency would provide the records; (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; and (d) Meet all requirements for retaining public records and transfer, at no cost, to the public agency all public records in possession of the respondent upon termination of the contract.

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR’S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS AT OKALOOSA COUNTY RISK MANAGEMENT DEPARTMENT 5479 OLD BETHEL ROAD CRESTVIEW, FL 32536 PHONE: (850) 689-5977 riskinfo@co.okaloosa.fl.us.

PROTECTION OF RESIDENT WORKERS – The Okaloosa County Board of County Commissioners actively supports the Immigration and Nationality Act (INA) which includes provisions addressing employment eligibility, employment verifications, and nondiscrimination. Under the INA, employers may hire only persons who may legally work in the United States (i.e., citizens and nationals of the U.S.) and aliens authorized to work in the U.S. The employer must verify the identity and employment eligibility of anyone to be hired, which includes completing the Employment Eligibility Verifications. The respondent shall establish appropriate procedures and controls so no services or products under the Contract Documents will be performed or manufactured by any worker who is not legally eligible to perform such services or employment. Okaloosa County reserves the right to request documentation showing compliance with the requirements.

Respondents doing construction business with Okaloosa County are required to use the Federal Government Department of Homeland Security's website and use the E-Verify Employment Eligibility Verifications System to confirm eligibility of all employees to work in the United States.

SUSPENSION OR TERMINATION FOR CONVENIENCE - The County may, at any time, without cause, order Respondent in writing to suspend, delay or interrupt the work in whole or in part for such period of time as the County may determine, or to terminate all or a portion of the Contract for the County's convenience. Upon such termination, the Contract Price earned to the date of termination shall be paid to Respondent, but Respondent waives any claim for damages, including loss of profits arising out of or related to the early termination. Those Contract provisions which by their nature survive final acceptance shall remain in full force and effect. If the County orders a suspension, the Contract price and Contract time may be adjusted for increases in the cost and time caused by suspension, delay or interruption. No adjustment shall be made to the extent that performance is, was or would have been so suspended, delayed or interrupted by reason for which Respondent is responsible; or that an equitable adjustment is made or denied under another provision of this Contract.

FAILURE OF PERFORMANCE/DELIVERY - In case of default by the respondent, the County after due notice (oral or written) may procure the necessary supplies or services from other sources and hold the respondent responsible for difference in cost incurred. Continuous instances of default shall result in cancellation of the award and removal of the respondent from the bid list for duration of one (1) year, at the option of the County.

AUDIT - If requested, respondent shall permit the County or an authorized, independent audit agency to inspect all data and records of respondent relating to its performance and its subcontracts under this bid from the date of the award through three (3) years after the expiration of contract.

EQUAL EMPLOYMENT OPPORTUNITY; NON DISCRIMINATION – Respondent will not discriminate against any employee or an applicant for employment because of race, color, religion, gender, sexual orientation, national origin, age, familial status or handicap.

NON-COLLUSION – Respondent certifies that it has entered into no agreement to commit a fraudulent, deceitful, unlawful or wrongful act, or any act which may result in an unfair advantage over other respondents. See Florida Statute 838.22.

UNAUTHORIZED ALIENS/PATRIOT'S ACT – The knowing employment by respondent or its subcontractors of any alien not authorized to work by the immigration laws is prohibited and shall be a default of the contract. In the event that the respondent is notified or becomes aware of such default, the respondent shall take steps as are necessary to terminate said employment with 24 hours of notification or actual knowledge that an alien is being employed. Respondent's failure to take such steps as are necessary to terminate the employment of any said alien within 24 hours of notification or actual knowledge that an alien is being employed shall be grounds for immediate termination of the contract. Respondent shall take all commercially reasonable precautions to ensure that it and its subcontractors do not employ persons who are not authorized to work by the immigration laws.

The following documents are to be submitted with the proposal packet. Failure to submit all required forms might result in your submittal being deemed non-responsive:

- A. Exhibit "B" General Grant Funding Special Provisions
- B. Standard Additional Clauses "Exhibit C"
- C. Drug-Free Workplace Certification Form
- D. Conflict of Interest
- E. Federal E-Verify
- F. Cone of Silence
- G. Indemnification and Hold Harmless
- H. Company Data/Sam Form
- I. Addendum Acknowledgement
- J. Certification Regarding Lobbying Proposal Sheet
- K. Governmental Debarment & Suspension
- L. Equipment Owner's Data Sheet
- M. Bid Sheet/Anti-Collusion

SPECIAL BID CONDITIONS

1. **Equipment Acceptance** - Delivery of material to Okaloosa Board of County Commissioners does not constitute acceptance for the purpose of payment. Final acceptance and authorization of payment shall be given only after a thorough inspection indicates that the material meets contract specifications and conditions as listed. Should the delivered material differ in any respect from specifications, payment will be withheld until such time as the supplier takes necessary corrective action. The Purchasing Department shall be notified of the deviation in writing within 10 days and the provisions of the delivery paragraph shall prevail. If the proposed corrective action is not acceptable to Okaloosa County, the final acceptance of the material shall remain the property of the supplier and the county shall not be liable for payment for any portion thereof.

2. **Right to Waive and Reject**
 - A. The Board, in its absolute discretion, may reject any bid of a bidder that has failed, in the opinion of the Board, to complete or perform an Okaloosa County contracted project in a timely fashion or has failed in any other way, in the opinion of the Board, to perform a prior contract in a satisfactory manner and has directed the Okaloosa County Purchasing Director to emphasize this condition to potential bidders.

 - B. The County will award the bid to the lowest and most responsive bidder, and the County reserves the right to award the bid to the bidder submitting a responsive bid with a resulting negotiated agreement which is most advantageous and in the best interest of the County, and to reject any and all bids or to waive any irregularity or technicality in bids received. Okaloosa County shall be the sole judge of the bid and the resulting negotiated agreement that is in its best interest and its decision shall be final

 - C. The Board of County Commissioners reserves the right to waive any informalities or reject any and all bids, in whole or part, and to utilize any applicable state contracts in lieu of or in addition to this bid.

 - D. The Board of County Commissioners specifically reserves the right to reject any conditional bid and will normally reject those that make it impossible to determine the true amount of the bid. Each item must be bid separately and no attempt is to be made to tie any item or items to any other item or items.

3. **Terms and Conditions** – All bidders shall review the Terms and Conditions attached hereto and if the Board accepts their bid and executes a contract, the bidder awarded the contract (Seller) shall agree to the Terms and Conditions, completely, and agree to furnish the materials and services specified herein in accordance with the Specifications and Terms and Conditions herein.

4. **Delivery Schedule** - Submittal data to be delivered for approval with the Bid.
Operation & Maintenance manuals to be delivered for approval no later than 30 calendar days prior to start-up and after receipt of Approved or Approved as Noted submittal data.
Delivery of on-site Equipment/Materials shall be no later than calendar days identified on the Bid, after receipt of Purchase Order and shall be coordinated with the on-site installation Contractor.

5. **Terms of Sale** - FOB Job Site

6. **Sales Tax** – Is excluded from the Lump Sum amount of this order.

7. **Supply Bond**

- A. Seller shall furnish to Buyer a Supply Bond in an amount at least equal to 5% of the Contract Price, as security for the faithful and timely delivery of all procured items covered by this procurement agreement. The bond shall remain in effect until 1) inspection by Buyer of satisfaction of delivery based on visual inspection, or 2) twenty days after receipt of all procured items, whichever is later. Seller shall also furnish such other bonds as are required by the Contract Documents.
- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.
- C. If the surety on any bond furnished by Seller is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Contract, Seller shall promptly notify Buyer and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements.

STANDARD TERMS AND CONDITIONS

1. **AGREEMENT.** The executed agreement (Order) between the Board and the Seller for materials and services, including the terms and conditions herein and any attachments or specifications hereto, contains the complete agreement between the Board and the Seller and supersedes all prior agreements.
2. **TIME.** Time is of the essence in the performance of this Order.
3. **SELLERS CONDITIONS.** By acceptance of this Order and/or commencement of performance hereunder, Seller agrees to comply fully with the terms and conditions set forth in this document. Acceptance of this Order is expressly limited to the terms and conditions of this Order and none of the Seller's terms and conditions shall apply in acknowledging this Order or in the acceptance of this Order. Acceptance by the Board of the goods, equipment and/or services ("goods") delivered under this Order shall not constitute acceptance of the Seller's terms and conditions.
4. **DEFINITIONS.** As used herein, the term "goods" shall mean and includes all supplies, materials, work, services, equipment, training, start-up services, operation and maintenance manuals or other items whatsoever to be furnished by Seller under this Order.
5. **INSPECTION.** Notwithstanding any prior inspection or test, payment or receiving document, goods are subject to final inspection and acceptance at the destination for delivery stated herein. Payment for goods shall not constitute acceptance.
6. **WARRANTIES.** (a) Notwithstanding inspection and acceptance by the Board of goods furnished under this Order, Seller warrants that all goods furnished will be of merchantable quality, and will be free from defects in material, workmanship and design, and conform in all aspects with the specifications and requirements of this Order. (b) Seller further warrants that all goods furnished will be of the highest workmanlike quality. (c) All Warranties hereunder shall be for a period of one (1) year from the date of delivery or the beneficial use of the goods, or as indicated otherwise in this Order, whichever is later, and shall be warranties of future performance for each warranty year. (d) In the event of a breach of warranty hereunder, the Board may, at no increase in Order price or other cost to the Board, either: (1) require the prompt correction or replacement of defective or otherwise nonconforming goods or parts thereof, along with such new or revised data as is associated with the corrective action taken; or (2) retain such goods, whereupon the price thereof shall be reduced by an amount equitable under the circumstances; or (3) correct or replace such goods with similar goods, by contract or otherwise, and charge Seller for all additional costs caused thereby. (e) Any goods or parts thereof corrected or furnished in replacement pursuant to this clause shall be subject to all the provisions of this clause to the same extent as goods initially delivered. The warranty with respect to such goods or parts thereof shall be equal in duration to the initial warranty period and shall run from the date of delivery or placement in service of such corrected or replaced goods, whichever is later. (f) the Board's or its agents approval of Seller-generated designs drawings or other technical documents shall in no way relieve Seller of its obligations under this or any other clause of this Order.

7. **SCHEDULE & EXPEDITING.** Seller shall keep the Board informed as the status of the goods hereunder and Seller's schedule of activities to assure delivery by the time required herein. Without any responsibility to do so, the Board reserves the right to take steps to expedite acquisition, production and/or shipment of the goods, if, in the Board's sole judgment, delivery of the completed goods by the date required becomes doubtful. Seller shall reimburse the Board for all costs it may incur in expediting acquisition, production or shipment of the goods.
8. **CHANGES.** The Board reserves the right at any time prior to delivery, by written order, to cancel, suspends, revise or change the goods or quantity of goods to be furnished by Seller hereunder, and in no event shall the Board be responsible for loss of anticipated profits or consequential damages. In the event of a revision to this Order by the Board, the Board shall be responsible only for the price of the goods accepted. Any increase in the price of the goods resulting from a revision is subject to the approval of the Board. Failure to agree to any adjustment shall be a dispute within the meaning of the "Disputes" clause hereof. Pending resolution of the dispute, the Seller shall not be excused from proceeding with the order as changed.
9. **BANKRUPTCY.** The Board may terminate this Order in whole or in part by written notice: (a) if the Seller shall become insolvent or make a general assignment for the benefit of creditors; or (b) if a petition under any bankruptcy act or similar statute is filed by or against the Seller and is not vacated within ten (10) days after it is filed.
10. **PRICES.** Seller warrants that the prices of the goods covered by this Order are not in excess of prices charged by Seller for similar goods to Seller's most favored customers.
11. **INVOICING AND PAYMENT.** Unless otherwise specified, a separate invoice shall be issued for each shipment. Unless otherwise specified, an invoice shall not be issued prior to shipment of goods and payment will not be made prior to receipt and acceptance of both the goods and a correct invoice. Credit and discount periods as identified on the face of this Order (if any) shall be computed from the date of receipt of the correct invoice to the date Board's check is mailed. Discount shall be taken on full amount of invoice.
12. **ASSIGNMENT.** Neither this Order nor any interest herein nor claim thereunder shall be assigned or transferred by Seller, except as expressly authorized in writing by the Board.
13. **ADVERTISING AND PUBLICITY.** Seller shall not, without prior written consent of the Board, publish the fact that the Board has placed this Order with Seller, or release any information relative thereto. Seller shall not use the name of Seller or Engineer, or affiliates (hereinafter collectively referred to as Engineer) in any advertising or promotional literature without the prior written consent of the Board and Engineer.
14. **PATENT, COPYRIGHT OR TRADEMARK INFRINGEMENT.** Seller agrees to indemnify, defend and hold harmless Owner, the Board, Engineer and their officers, agents, employees, successors and assigns against loss, damage or liability, including costs, expenses and attorneys' fees on account of any suit, claim, judgment or demand involving the alleged infringement of any patent, copyright, trademark, or trade name by reason of the manufacture, use, sale or disposition of any item or material supplied hereunder. If so requested by the

Board or Engineer, Seller shall, at its expense, appear in and assume the defense of any litigation to which Owner, the Board and Engineer has been made a party which relates to any such infringement. If a final injunction against Owner or the Board's use of the goods results from such claim (or if the Board reasonably believes such a claim is likely), Seller shall, at its own expense and at the Board's request, obtain for Owner and the Board the right to continue using the goods or replace or modify (or any part thereof) so that it becomes non-infringing but functionally equivalent.

15. **INDEMNITY.** (a) Seller agrees to indemnify and hold harmless and upon request, defend the Board and Engineer and their agents and employees and persons claiming through the Board or Engineer from and against all claims, losses, damages, expenses for (1) damages to persons or property caused in whole or in part by any act, omission or default of Seller, its contractors, subcontractors, sub-subcontractors, material men, or agents of any tier or their respective employees except for claims of or damages resulting from the gross negligence, or willful, wanton or intentional misconduct of the Board, or Engineer, their officers, directors, agents or employees; and (2) statutory or punitive damages caused by or result from the acts or omissions of the Seller, its contractors, subcontractors, sub-subcontractors, material men, or agents of any tier or their respective employees. The indemnity provided by this Section 15 (a) shall be limited to the dollar amount of insurance specified in Section 25. (b) Seller further agrees to indemnify and hold harmless and upon request defend the Board and Engineer and persons claiming through the Board or Engineer and their agents and employees from liabilities, damages, losses and costs, including but not limited to attorneys' fees, to the extent caused by the negligence, recklessness, or intentional wrongful misconduct of the Seller and persons employed or utilized by Seller in the performance of the work. The indemnity provided by this herein shall in no way be limited by any insurance coverage provided by Seller.
16. **CONSEQUENTIAL DAMAGES.** Notwithstanding any other provision herein, the Board shall under no circumstances be responsible to Seller for any consequential, indirect or special damages.
17. **DELIVERY.** Delivery shall be to the project site Free on Board (F.O.B.) unless otherwise designated in this Order.
18. **TITLE AND RISK OF LOSS.** Title to and risk of loss on all goods shipped by Seller to the Board shall not pass to the Board until the Board inspects and accepts such goods at the location designated by the Board.
19. **TAXES.** The Board is a tax exempt public entity and the prices herein should not include Federal, state or local taxes for the goods purchased herein.
20. **DISPUTE RESOLUTION.** In the event of any dispute between the parties arising out of or in connection with the Order or the services or work contemplated herein; the parties agree to first make a good faith effort to resolve the dispute informally. Negotiations shall take place between the designated principals of each party. If the parties are unable to resolve the dispute informally, then either party may submit the controversy to a court of competent jurisdiction. Each party shall be responsible for its own costs and expenses including attorneys' fees and court costs incurred in the course of any dispute, mediation, or legal proceeding.
21. **COMPLIANCE WITH LAWS.** Seller agrees to comply with all applicable local, state and Federal laws and executive orders and a regulation issued pursuant

- thereto and agrees to indemnify the Board and Engineer against any liability, loss, cost, damage, or expense incurred by reason of Seller's violation of this provision.
22. **GOVERNING LAW AND VENUE.** This Order shall be governed by the laws of the State of Florida. Venue for any legal proceedings arising out of this Order shall be in Okaloosa County, Florida.
 23. **SEVERABILITY.** If any provision of this Order, or any part thereof, shall be invalid or unenforceable, such provision or part shall be deemed severed, and the remainder hereof shall be given full force and effect.
 24. **INSURANCE REQUIREMENTS.** Seller shall maintain products liability and completed operations insurance which provides, under the terms of the primary policy or by contractual liability endorsement if necessary, coverage in respect of claims involving bodily injury or property damage arising out of or in connection with the goods. Such insurance shall be in such minimum amounts of 1 million, and shall declare the Board, Engineer and Owner as an additional insured. Seller shall also maintain workers compensation and employer's liability insurance. All policies of insurance shall not be cancelable except upon ten (10) days' written notice to the Board, shall include a waiver of subrogation in favor of the Board and Engineer. Seller shall furnish proof of such insurance to the Board.
 25. **PUBLIC RECORDS.** Seller shall allow public access to all documents, records and other materials, subject to the provisions of Chapter 119, Florida Statutes, prepared or received by Seller in conjunction with this Order.
 26. **AUDIT.** The Board shall have the right from time to time at its sole expense to audit the compliance by the Seller with the terms, conditions, obligations, limitations, restrictions and requirements of this Order and such right shall extend for a period of three (3) years after termination of this Order.

EXHIBIT B

GENERAL GRANT FUNDING SPECIAL PROPOSAL CONDITIONS

Either this solicitation is fully or partially Grant funded. Respondents shall comply with the clauses as enumerated below.

1. **Drug Free Workplace Requirements:** Drug-free workplace requirements in accordance with Drug Free Workplace Act of 1988 (Pub l 100-690, Title V, Subtitle D) All contractors entering into Federal funded contracts over \$100,000 must comply with Federal Drug Free workplace requirements as Drug Free Workplace Act of 1988.
2. **Contractor Compliance:** The contractor shall comply with all uniform administrative requirements, cost principles, and audit requirements for federal awards.
3. **Conflict of Interest:** The contractor must disclose in writing any potential conflict of interest to the County or pass-through entity in accordance with applicable Federal policy.
4. **Mandatory Disclosures:** The contractor must disclose in writing all violations of Federal criminal law involving fraud, bribery, or gratuity violations potentially affecting the Federal award.
5. **Utilization of Minority and Women Firms (M/WBE):** The contractor must take all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible, in accordance with 2CFR 200.321. If subcontracts are to be let, prime contractor will require compliance by all sub-contractors. Prior to contract award, the contractor shall document efforts to utilize M/WBE firms including what firms were solicited as suppliers and/or subcontractors as applicable and submit this information with their bid submittal. Information regarding certified M/WBE firms can be obtained from:

Florida Department of Management Services (Office of Supplier Diversity)

Florida Department of Transportation

Minority Business Development Center in most large cities and

Local Government M/DBE programs in many large counties and cities
6. **Equal Employment Opportunity:** (As per Executive Order 11246) The contractor may not discriminate against any employee or applicant for employment because of age, race, color, creed, sex, disability or national origin. The contractor agrees to take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their age, race, color, creed, sex, disability or national origin. Such action shall include but not be limited to the following: employment, upgrading, demotion or transfer, recruitment advertising, layoff or termination, rates of pay or other forms of compensation and selection for training including apprenticeship.
7. **Davis-Bacon Act:** If applicable to this contract, the contractor agrees to comply with all provisions of the Davis Bacon Act as amended (40 U.S.C. 3141-3148). Contractors are required to pay wages to laborers and mechanics at a rate not less than the prevailing

wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. If the grant award contains Davis Bacon provisions, the County will place a copy of the current prevailing wage determination issued by the Department of Labor in the solicitation document. The decision to award a contract shall be conditioned upon the acceptance of the wage determination.

8. **Copeland Anti Kick Back Act**: If applicable to this contract, contractors shall comply with all the requirements of 18 U.S.C. § 874, 40 U.S.C. § 3145, 29 CFR Part 3 which are incorporated by reference to this contract. Contractors are prohibited from inducing by any means any person employed in the construction, completion or repair of public work to give up any part of the compensation to which he or she is otherwise entitled.
9. **Contract Work Hours and Safety Standards Act** (40 U.S.C. 3701–3708): Where applicable, all contracts awarded in excess of \$100,000 that involve the employment of mechanics or laborers must be in compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor is required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.
10. **Clean Air Act (42 U.S.C. 7401–7671q.)** and the Federal Water Pollution Control Act (33 U.S.C. 1251–1387): as amended—The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401–7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251–1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).
11. **Debarment and Suspension** (Executive Orders 12549 and 12689): A contract award (see 2 CFR 180.220) must not be made to parties listed on the government wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), “Debarment and Suspension. SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549. The contractor shall certify compliance. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions and subcontracts.

12. **Byrd Anti-Lobbying Amendment** (31 U.S.C. 1352): Contractors that apply or bid for an award exceeding \$100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award. The contractor shall certify compliance.
13. **Rights to Inventions Made Under a Contract or Agreement:** If the Federal award meets the definition of “funding agreement” under 37 CFR § 401.2 (a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that “funding agreement,” the recipient or subrecipient must comply with the requirements of 37 CFR Part 401, “Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements,” and any implementing regulations issued by the awarding agency.
14. **Procurement of Recovered Materials:** Contractors must comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds \$10,000 or the value of the quantity acquired during the preceding fiscal year exceeded \$10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.
15. **Access to Records and Reports:**

Contractor will make available to the County’s granting agency, the granting agency’s Office of Inspector General, the Government Accountability Office, the Comptroller General of the United States, Okaloosa County, Okaloosa County Clerk of Court’s Inspector General, or any of their duly authorized representatives any books, documents, papers or other records, including electronic records, of the contractor that are pertinent to the County’s grant award, in order to make audits, investigations, examinations, excerpts, transcripts, and copies of such documents. The right also includes timely and reasonable access to the contractor’s personnel during normal business hours for the purpose of interview and discussion related to such documents. This right of access shall continue as long as records are retained.

16. **Record Retention:**

Contractor will retain of all required records pertinent to this contract for a period of three years, beginning on a date as described in 2 C.F.R. §200.333 and retained in compliance with 2 C.F.R. §200.333.

17. **Federal Changes:** Contractor shall comply with all applicable Federal agency regulations, policies, procedures and directives, including without limitation those listed directly or by reference, as they may be amended or promulgated from time to time during the term of the contract.

18. **Termination for Default (Breach or Cause):**

Contracts in excess of \$10,000 – If Contractor does not deliver supplies in accordance with the contract delivery schedule, or, if the contract is for services, the Contractor fails to perform in the manner called for in the contract, or if the Contractor fails to comply with any other provisions of the contract, the County may terminate the contract for default. Termination shall be effected by serving a notice of termination on the contractor setting forth the manner in which the Contractor is in default. The contractor will only be paid the contract price for supplies delivered and accepted, or services performed in accordance with the manner of performance set forth in the contract.

19. **Safeguarding Personal Identifiable Information**

Contractor will take reasonable measures to safeguard protected personally identifiable information and other information designated as sensitive by the awarding agency or is considered sensitive consistent with applicable Federal, state and/or local laws regarding privacy and obligations of confidentiality.

20. **Prohibition on utilization of cost plus a percentage of cost contracts:** The County will not award contracts containing Federal funding on a cost plus percentage of cost basis.

21. **Prohibition on utilization of time and material type contracts:** The County will not award contracts based on a time and material basis if the contract contains Federal funding.

22. **Disputes:** Any dispute arising under this Agreement which is not settled by Agreement of the parties may be settled by mediation, arbitration, or other appropriate legal proceedings. Pending any decision, appeal or judgment in such proceedings or the settlement of any dispute arising under this Agreement, shall proceed diligently with the performance of this Agreement in accordance with the decision of the County. This Agreement shall be construed under the laws of the State of Florida, and venue for any actions arising out of this Agreement shall be in the Circuit Court of Okaloosa County.

23. **Energy Policy and Conservation Act (43 U.S.C. §6201)**

All contracts except micro-purchases (\$3000 or less, except for construction contracts over \$2000). Contracts shall comply with mandatory standards and policies relating to energy efficiency, stating in the state energy conservation plan issued in compliance with the Energy Policy and Conservation act. (Pub. L. 94-163, 89 Stat. 871) [53 FR 8078, 8087, Mar. 11, 1988, as amended at 60 FR 19639, 19645, Apr. 19, 1995].

As the person authorized to sign this statement, I certify that this company complies/will comply fully with the above requirements.

DATE: _____

SIGNATURE: _____

COMPANY: _____

NAME: _____

ADDRESS: _____

TITLE: _____

E-MAIL: _____

PHONE NO.: _____

Exhibit “C”

Standard Contract Clauses

Title VI Clauses for Compliance with Nondiscrimination Requirements

Compliance with Nondiscrimination Requirements

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “contractor”) agrees as follows:

1. **Compliance with Regulations:** The contractor (hereinafter includes consultants) will comply with the Title VI List of Pertinent Nondiscrimination Acts And Authorities, as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.
2. **Non-discrimination:** The contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor will not participate directly or indirectly in the discrimination prohibited by the Nondiscrimination Acts and Authorities, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR part 21.
3. **Solicitations for Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the contractor of the contractor’s obligations under this contract and the Nondiscrimination Acts And Authorities on the grounds of race, color, or national origin.
4. **Information and Reports:** The contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the sponsor or the Federal Aviation Administration to be pertinent to ascertain compliance with such Nondiscrimination Acts And Authorities and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the contractor will so certify to the sponsor or the Federal Aviation Administration, as appropriate, and will set forth what efforts it has made to obtain the information.
5. **Sanctions for Noncompliance:** In the event of a contractor’s noncompliance with the Non-discrimination provisions of this contract, the sponsor will impose such

contract sanctions as it or the Federal Aviation Administration may determine to be appropriate, including, but not limited to:

- a. Withholding payments to the contractor under the contract until the contractor complies; and/or
 - b. Cancelling, terminating, or suspending a contract, in whole or in part.
6. **Incorporation of Provisions:** The contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The contractor will take action with respect to any subcontract or procurement as the sponsor or the Federal Aviation Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request the sponsor to enter into any litigation to protect the interests of the sponsor. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

Title VI List of Pertinent Nondiscrimination Acts and Authorities

Title VI List of Pertinent Nondiscrimination Acts and Authorities

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the “contractor”) agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d *et seq.*, 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin);
- 49 CFR part 21 (Non-discrimination In Federally-Assisted Programs of The Department of Transportation—Effectuation of Title VI of The Civil Rights Act of 1964);
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 *et seq.*), as amended, (prohibits discrimination on the basis of disability); and 49 CFR part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 *et seq.*), (prohibits discrimination on the basis of age);

- Airport and Airway Improvement Act of 1982, (49 USC § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms “programs or activities” to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act of 1990, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131 – 12189) as implemented by Department of Transportation regulations at 49 CFR parts 37 and 38;
- The Federal Aviation Administration’s Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures non-discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).

FEDERAL FAIR LABOR STANDARDS ACT (FEDERAL MINIMUM WAGE)

All contracts and subcontracts that result from this solicitation incorporate by reference the provisions of 29 CFR part 201, the Federal Fair Labor Standards Act (FLSA), with the same force and effect as if given in full text. The FLSA sets minimum wage, overtime pay, recordkeeping, and child labor standards for full and part time workers.

The [*contractor / consultant*] has full responsibility to monitor compliance to the referenced statute or regulation. The [*contractor / consultant*] must address any claims or disputes that arise from this requirement directly with the U.S. Department of Labor – Wage and Hour Division

OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

All contracts and subcontracts that result from this solicitation incorporate by reference the requirements of 29 CFR Part 1910 with the same force and effect as if given in full text. Contractor must provide a work environment that is free from recognized hazards that may cause death or serious physical harm to the employee. The Contractor retains full responsibility to monitor its compliance and their subcontractor's compliance with the applicable requirements of the Occupational Safety and Health Act of 1970 (20 CFR Part 1910). Contractor must address any claims or disputes that pertain to a referenced requirement directly with the U.S. Department of Labor – Occupational Safety and Health Administration.

E-VERIFY

Enrollment and verification requirements.

- (1) If the Contractor is not enrolled as a Federal Contractor in E-Verify at time of contract award, the Contractor shall-
 - a. Enroll. Enroll as a Federal Contractor in the E-Verify Program within thirty (30) calendar days of contract award;
 - b. Verify all new employees. Within ninety (90) calendar days of enrollment in the E-Verify program, begin to use E-Verify to initiate verification of employment eligibility of all new hires of the Contractor, who are working in the United States, whether or not assigned to the contract, within three (3) business days after the date of hire (but see paragraph (b)(3) of this section); and,
 - c. Verify employees assigned to the contract. For each employee assigned to the contract, initiate verification within ninety (90) calendar days after date of enrollment or within thirty (30) calendar days of the employee's assignment to the contract, whichever date is later (but see paragraph (b)(4) of this section.)
- (2) If the Contractor is enrolled as a Federal Contractor in E-Verify at time of contract award, the Contractor shall use E-Verify to initiate verification of employment eligibility of
 - a. All new employees.
 - i. Enrolled ninety (90) calendar days or more. The Contractor shall initiate verification of all new hires of the Contractor, who are working in the United States, whether or not assigned to the contract, within three (3) business days after the date of hire (but see paragraph (b)(3) of this section); or

- b. Enrolled less than ninety (90) calendar days. Within ninety (90) calendar days after enrollment as a Federal Contractor in E-Verify, the Contractor shall initiate verification of all new hires of the contractor, who are working in the United States, whether or not assigned to the contract, within three (3) business days after the date of hire (but see paragraph (b)(3) of this section; or
 - ii. Employees assigned to the contract. For each employee assigned to the contract, the Contractor shall initiate verification within ninety (90) calendar days after date of contract award or within thirty (30) days after assignment to the contract, whichever date is later (but see paragraph (b)(4) of this section.)
- (3) If the Contractor is an institution of higher education (as defined at 20 U.S.C. 1001(a)); a State of local government or the government of a Federally recognized Indian tribe, or a surety performing under a takeover agreement entered into with a Federal agency pursuant to a performance bond, the Contractor may choose to verify only employees assigned to the contract, whether existing employees or new hires. The Contractor shall follow the applicable verification requirements of (b)(1) or (b)(2), respectively, except that any requirement for verification of new employees applies only to new employees assigned to the contract.
- (4) Option to verify employment eligibility of all employees. The Contractor may elect to verify all existing employees hired after November 6, 1986 (after November 27, 2009, in the Commonwealth of the Northern Mariana Islands), rather than just those employees assigned to the contract. The Contractor shall initiate verification for each existing employee working in the United States who was hired after November 6, 1986 (after November 27, 2009, in the Commonwealth of the Northern Mariana Islands), within one hundred eighty (180) calendar days of-
- i. Enrollment in the E-Verify program; or
 - ii. Notification to E-Verify Operations of the Contractor's decision to exercise this option, using the contract information provided in the E-Verify program Memorandum of Understanding (MOU)
- (5) The Contractor shall comply, for the period of performance of this contract, with the requirements of the E-Verify program MOU.
- i. The Department of Homeland Security (DHS) or the Social Security Administration (SSA) may terminate the Contractor's MOU and deny access to the E-Verify system in accordance with the terms of the MOU.

In such case, the Contractor, will be referred to a suspension or debarment official.

ii. During the period between termination of the MOU and a decision by the suspension or debarment official whether to suspend or debar, the contractor is excused from its obligations under paragraph (b) of this clause. If the suspension or debarment official determines not to suspend or debar the Contractor, then the Contractor must reenroll in E-Verify.

iii. Web site. Information on registration for and use of the E-Verify program can be obtained via the Internet at the Department of Homeland Security Web site: <http://www.dhs.gov/E-Verify>.

Individuals previously verified. The Contractor is not required by this clause to perform additional employment verification using E-Verify for any employee-

- (a) Whose employment eligibility was previously verified by the Contractor through the E-Verify program;
- (b) Who has been granted and holds an active U.S. Government security clearance for access to confidential, secret, or top secret information in accordance with the National Industrial Security Program Operating Manual; or
- (c) Who has undergone a completed background investigation and been issued credentials pursuant to Homeland Security Presidential Directive (HSPD)-12. Policy for a Common Identification Standard for Federal Employees and Contractors.

Subcontracts. The Contractor shall include the requirements of this clause, including this paragraph €(appropriately modified for identification of the parties in each subcontract that-

- (1) Is for-(i) Commercial and noncommercial services (except for commercial services that are part of the purchase of a COTS item (or an item that would be a COTS item, but for minor modifications), performed by the COTS provider, and are normally provided for that COTS item); or
- (ii) Construction;
- (2) Has a value of more than \$3,500; and
- (3) Includes work performed in the United States.

DRUG-FREE WORKPLACE CERTIFICATION

THE BELOW SIGNED RESPONDENT CERTIFIES that it has implemented a drug-free workplace program. In order to have a drug-free workplace program, a business shall:

1. Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.
2. Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.
3. Give each employee engaged in providing the commodities or contractual services that are under quote a copy of the statement specified in subsection 1.
4. In the statement specified in subsection 1, notify the employees that, as a condition of working on the commodities or contractual services that are under quote, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, any violation of Chapter 893, Florida Statutes, or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.
5. Impose a sanction on, or require the satisfactory participation in, drug abuse assistance or rehabilitation program if such is available in employee's community, by any employee who is convicted.
6. Make a good faith effort to continue to maintain a drug-free workplace through implementation of this section.

As the person authorized to sign this statement, I certify that this firm complies fully with the above requirements.

DATE: _____

SIGNATURE: _____

COMPANY: _____

NAME: _____

(Typed or Printed)

ADDRESS: _____

TITLE: _____

E-MAIL: _____

PHONE NO.: _____

CONFLICT OF INTEREST DISCLOSURE FORM

For purposes of determining any possible conflict of interest, all respondents, must disclose if any Okaloosa Board of County Commissioner, employee(s), elected officials(s), or if any of its agencies is also an owner, corporate officer, agency, employee, etc., of their business.

Indicate either “yes” (a county employee, elected official, or agency is also associated with your business), or “no”. If yes, give person(s) name(s) and position(s) with your business.

YES _____

NO _____

NAME(S)

POSITION(S)

FIRM NAME: _____

BY (PRINTED): _____

BY (SIGNATURE): _____

TITLE: _____

ADDRESS: _____

PHONE NO. _____

E-MAIL _____

DATE _____

FEDERAL E-VERIFY COMPLIANCE CERTIFICATION

In accordance with Okaloosa County Policy and Executive Order Number 11-116 from the office of the Governor of the State of Florida, Respondent hereby certifies that the U.S. Department of Homeland Security's E-Verify system will be used to verify the employment eligibility of all new employees hired by the respondent during the contract term, and shall expressly require any subcontractors performing work or providing services pursuant to the contract to likewise utilize the U.S. Department of Homeland Securities E-Verify system to verify the employment eligibility of all new employees hired by the subcontractor during the contract term; and shall provide documentation such verification to the COUNTY upon request.

As the person authorized to sign this statement, I certify that this company complies/will comply fully with the above requirements.

DATE: _____
SIGNATURE: _____

COMPANY: _____
NAME: _____

ADDRESS: _____
TITLE: _____

E-MAIL: _____

PHONE NO.: _____

INDEMNIFICATION AND HOLD HARMLESS

Respondent shall indemnify and hold harmless the County, its officers and employees from liabilities, damages, losses, and costs including but not limited to reasonable attorney fees, to the extent caused by the negligence, recklessness, or intentional wrongful conduct of the Respondent and other persons employed or utilized by the Respondent in the performance of this Agreement.

Respondent's Company Name

Authorized Signature – Manual

Physical Address

Authorized Signature – Typed

Mailing Address

Title

Phone Number

FAX Number

Cellular Number

After-Hours Number(s)

Date

Email

LOBBYING - 31 U.S.C. 1352, 49 CFR Part 19, 49 CFR Part 20

APPENDIX A, 49 CFR PART 20--CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements

(To be submitted with each bid or offer exceeding \$100,000)

The undersigned [Contractor] certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form--LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions [as amended by "Government wide Guidance for New Restrictions on Lobbying," 61 Fed. Reg. 1413 (1/19/96). Note: Language in paragraph (2) herein has been modified in accordance with Section 10 of the Lobbying Disclosure Act of 1995 (P.L. 104-65, to be codified at 2 U.S.C. 1601, *et seq.*)]
3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31, U.S.C. § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

[Note: Pursuant to 31 U.S.C. § 1352(c)(1)-(2)(A), any person who makes a prohibited expenditure or fails to file or amend a required certification or disclosure form shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such expenditure or failure.]

The Contractor, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. A 3801, *et seq.*, apply to this certification and disclosure, if any.

_____ Signature of Contractor's Authorized Official

_____ Name and Title of Contractor's Authorized Official

_____ Date

CONE OF SILENCE

The Board of County Commissioners have established a solicitation silence policy (**Cone of Silence**) that prohibits oral and written communication regarding all formal solicitations for goods and services (ITB, RFP, ITQ, ITN, and RFQ) or other competitive solicitation between the bidder (or its agents or representatives) or other entity with the potential for a financial interest in the award (or their respective agents or representatives) regarding such competitive solicitation, and any County Commissioner or County employee, selection committee member or other persons authorized to act on behalf of the Board including the County’s Architect, Engineer or their subconsultants, or anyone designated to provide a recommendation to award a particular contract, other than the Purchasing Department Staff..

The period commences from the time of advertisement until contract award.

Any information thought to affect the committee or staff recommendation submitted after bids are due, should be directed to the Purchasing Manager or an appointed representative. It shall be the Purchasing Manager’s decision whether to consider this information in the decision process.

Any violation of this policy shall be grounds to disqualify the respondent from consideration during the selection process.

All respondents must agree to comply with this policy by signing the following statement and including it with their submittal.

I _____ representing _____
Signature Company Name

On day of _____ 2018 hereby agree to abide by the County’s “**Cone of Silence Clause**” and understand violation of this policy shall result in disqualification of my proposal/submittal.

COMPANY DATA

Respondent's Company Name: _____

Physical Address & Phone #: _____

Contact Person (Typed-Printed): _____

Phone #: _____

Cell #: _____

Federal ID or SS #: _____

DUNNS/SAM #: _____

Respondent's License #: _____

Fax #: _____

Emergency #'s After Hours,
Weekends & Holidays: _____

System for Award Management (Oct 2016)

(a) Definitions. As used in this provision.

“Electronic Funds Transfer (EFT) indicator” means a four-character suffix to the unique entity identifier. The suffix is assigned at the discretion of the commercial, nonprofit, or Government entity to establish additional System for Award Management records for identifying alternative EFT accounts (see [subpart 32.11](#)) for the same entity.

“Registered in the System for Award Management (SAM) database” means that:

(1) The Offeror has entered all mandatory information, including the unique entity identifier and the EFT indicator, if applicable, the Commercial and Government Entity (CAGE) code, as well as data required by the Federal Funding Accountability and Transparency Act of 2006 (see [subpart 4.14](#)) into the SAM database;

(2) The offeror has completed the Core, Assertions, and Representations and Certifications, and Points of Contact sections of the registration in the SAM database;

(3) The Government has validated all mandatory data fields, to include validation of the Taxpayer Identification Number (TIN) with the Internal Revenue Service (IRS). The offeror will be required to provide consent for TIN validation to the Government as a part of the SAM registration process; and

(4) The Government has marked the record “Active”.

“Unique entity identifier” means a number or other identifier used to identify a specific commercial, nonprofit, or Government entity. See www.sam.gov for the designated entity for establishing unique entity identifiers.

(b)(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee shall be registered in the SAM database prior to award, during performance, and through final payment of any contract, basic agreement, basic ordering agreement, or blanket purchasing agreement resulting from this solicitation.

(2) The Offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation “Unique Entity Identifier” followed by the unique entity identifier that identifies the Offeror’s name and address exactly as stated in the offer. The Offeror also shall enter its EFT indicator, if applicable. The unique entity identifier will be used by the Contracting Officer to verify that the Offeror is registered in the SAM database.

(c) If the Offeror does not have a unique entity identifier, it should contact the entity designated at www.sam.gov for establishment of the unique entity identifier directly to obtain one. The Offeror should be prepared to provide the following information:

(1) Company legal business name.

(2) Tradestyle, doing business, or other name by which your entity is commonly recognized.

(3) Company Physical Street Address, City, State, and Zip Code.

(4) Company Mailing Address, City, State and Zip Code (if separate from physical).

(5) Company telephone number.

(6) Date the company was started.

(7) Number of employees at your location.

(8) Chief executive officer/key manager.

(9) Line of business (industry).

(10) Company Headquarters name and address (reporting relationship within your entity).

(d) If the Offeror does not become registered in the SAM database in timely manner, the Contracting Officer may proceed to award to the next otherwise successful registered Offeror.

(e) Processing time, which normally takes 48 hours, should be taken into consideration when registering. Offerors who are not registered should consider applying for registration immediately upon receipt of this solicitation.

(f) Offerors may obtain information on registration at <https://www.acquisition.gov> .

Offerors SAM information:

Entity Name: _____

Entity Address: _____

Duns Number: _____

CAGE Code: _____

ADDENDUM ACKNOWLEDGEMENT
ITB WS 10-19

Acknowledgment is hereby made of the following addenda (identified by number) received since issuance of solicitation:

<u>ADDENDUM NO.</u>	<u>DATE</u>

NOTE: Prior to submitting the response to this solicitation, it is the responsibility of the respondent to confirm if any addenda have been issued. If such addenda have been issued, acknowledge receipt by noting number(s) and date(s) above.

EQUIPMENT OWNER'S DATA SHEET

NAME OF OWNER _____
ADDRESS _____
PHONE NUMBER _____
PERSON TO CONTACT _____

NAME OF OWNER _____
ADDRESS _____
PHONE NUMBER _____
PERSON TO CONTACT _____

NAME OF OWNER _____
ADDRESS _____
PHONE NUMBER _____
PERSON TO CONTACT _____

NAME OF OWNER _____
ADDRESS _____
PHONE NUMBER _____
PERSON TO CONTACT _____

NAME OF OWNER _____
ADDRESS _____
PHONE NUMBER _____
PERSON TO CONTACT _____

BID SHEET

BID #: ITB WS 10-19

BASE BID (Items 1-2) - NORTH LAKESHORE SANITARY SEWER IMPROVEMENT PROJECT – PACKAGED PUMP STATION AND CONTROLS

ITEM	QTY		DESCRIPTION	UNIT PRICE	EXT. PRICE
1	1	EA	Submersible Pumping Station , with 8' x 21' RFP Wetwell & SS Internal Discharge Piping, Two (2) – 10 HP Non-Clog Pumps and secondary level monitoring hardware. One complete electrical control system including programmable PLC, HMI screen and motor control center for a duplex pumping station.		
2	1		Pre-Assembled Valve Vault , complete with all internal piping, valves, seals, drain piping and access hatch.		
3	2	LS	5'0" Diameter FRP Manhole , with booted pipe openings, H2O rated 30"x30" alum access hatch		
	1	Lot	Specific Specification Sections (01330, 01332, 01782, 11145) Drawings: All Submittals: Include with this bid the following: Shop Drawings, Product Data, & Calculations (6 Copies w/Electronic PDF). Preliminary O&M Manuals, and Final O&M Manuals Warranty: Warranty shall be in accordance with the attached specifications Payment: List Freight and Manufacturer Services as a separate non taxable item when submitting invoices	Cost associated with these requirements shall be included in the associated unit price shown for the specified equipment in Item 1	N/A
	1	Lot	Manufacturer Services as detailed in Specification Section 01640, and as required providing a fully operational and functioning system per the scope of this contract.		N/A
	1	Lot	Spare Parts and Tools: As specified in Equipment Sections		N/A

	TOTAL BASE BID (ITEM 1-3)	\$
--	----------------------------------	----

DELIVERY TIME: _____ MAXIMUM* DAYS FROM RECEIPT OF PURCHASE ORDER

*Max Days is defined as calendar days to deliver all equipment to the site as specified, including submittals, manufacturing and testing. Time will be from date of receipt of purchase agreement from OWNER. Allow a max 10 working days for initial submittal review and each resubmit required by ENGINEER / OWNER.

LUMP SUM BASE BID AMOUNT IS WRITTEN AS:

_____ Dollars and _____
Cents,

\$ _____, To Be Fully Tested, Shipped and

Delivered to the Project Site within _____ Calendar Days from Receipt of Official Purchase Order.

ANTI-COLLUSION STATEMENT: The below signed bidder has not divulged to, discussed or compared his bid with other bidders and has not colluded with any other bidder or parties to bid whatever. (Note: No premiums, rebates, or gratuities permitted either with, prior to, or after any delivery of materials. Any such violation will result in the cancellation and/or return of material (as applicable) and the removal from bid list(s).

Bidder's Company Name

Authorized Signature – Manual

Authorized Signature – Typed

Address

Title

Phone #

Fax #

Federal ID # or SS #

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General Description of Project
- B. CONTRACTOR - Responsibility
- C. OWNER - Responsibility
- D. Contractor's Use of Site and Equipment Offload

1.2 GENERAL DESCRIPTION OF PROJECT

- A. Supply a new complete sanitary sewer pumping station. Bid shall include 2-15 HP recessed impeller submersible sewer pumps, 8' diameter FRP wetwell, stainless steel discharge piping, pre-assembled valve vault, 5' diameter FRP manholes; and all other appurtenances and related work required to complete the Work.
- B. Contracting Method: Direct Bid (MATERIAL ONLY).

1.3 MATERIAL CONTRACTOR RESPONSIBILITY

A. The following items are intended to identify the general materials and deliverables to be included in the Material Contractor's bid proposal.

1. Furnish the following pumps and pump components and appurtenances.
 - a. A 8' diameter single molded FRP wetwell in accordance with the Contract Drawings and Specification. Wetwell shall be delivered to the site fully assembled and ready for operation. The wetwell shall include hatch covers, pumps, guiderails systems, piping supports, fasteners, influent drop structure, floats and level transducer, discharge piping, wall penetration sleeves and seals as noted on drawings.
 - b. A 89"x89"x65" concrete or single molded FRP valve vault in accordance with the Contract Drawings and Specification. The Vault shall be delivered to the site fully assembled and ready for operation. The Vault shall include hatch covers, valves, piping supports, fasteners, gauges, floor drain, discharge piping, wall penetration sleeves and seals as noted on drawings.
 - c. Note: The stainless steel wetwell discharge piping shall be extended 60" from outer wall of wetwell and shall include 125 lb flange fitting for connection to the valve vault piping.
 - d. Cut openings and field fabricate sleeves for large diameter pipe penetration and electrical pump leads. Coordinate with OWNER on final location and elevation. Provide mechanical seal between carrier pipe and sleeve after installation and testing.
 - e. Provide minimum 60 ft pump electrical leads for each pump and floats. Leads shall be capable of being extended for termination by Owner into Disconnect Switch and Junction Box. The Level Transducer shall be supplied with a minimum 100 ft lead, to provide uninterrupted

connectivity to the control system.

- f. Deliver and offload at project site location in accordance with Section 13125, and shall include all necessary material and labor to secure structure as a permanent fixture. Coordinate with the OWNER a minimum 3 weeks in advance of delivery.

1.4 OWNER RESPONSIBILITY

A. OWNER will perform certain activities in connection with the Work as follows:

1. Furnish and Install the following components and appurtenances.
 - a. All below ground discharge piping, valves and fittings outside the valve box (See Contract Drawings for Owner Responsibility)
 - b. AR valves, taps and pressure gauges.
 - c. 10" influent piping (Material Contractor to field fabricated sleeves after installation of wetwell)
 - d. Below ground electrical and control wiring and conduits
 - e. Control Panel mounting material and foundation, including electrical stub-ups
 - f. Wetwell and Valve Box installation, including connecting piping; annual space fill and concrete pads.
 - g. 4 - NEMA 4x Disconnect Switches, conduit and supporting structures.

1.5 MATERIAL CONTRACTOR'S USE OF SITE

A. CONTRACTOR'S use of the Site shall be confined to the areas shown.

B. CONTRACTOR shall:

1. Contractor shall coordinate with the OWNER and assume full responsibility for delivery of equipment to the project site and the associated labor, material and equipment required to fully offload the specified equipment at the OWNERS specified location.
2. Obtain and pay for all additional storage or work areas required for its operations and testing, prior to schedule delivery.

END OF SECTION

SUBMITTALS**PART 1 - GENERAL**

1.1 DESCRIPTION

- A. Submittals are required prior to, during, and at the end of the installation period. The submittals shall conform to the requirements described in this Section and all referenced Sections or Articles.

1.2 PROCEDURE

- A. Submit the following items within five days after the Contract is executed.
1. Shop Drawings, Product Data and Samples: Submit Shop Drawings, product data and samples in accordance with Section 01332, Shop Drawing Procedures, and as required in applicable Sections of the Contract Documents.
 2. Request for Information: Submit a Request for Information (RFI), when any of the following are required: an interpretation of the Specifications; additional details; information not shown on the Drawings or in the Specifications; or clarification of discrepancies is required. Manufacturer shall retain one copy and submit one copy to the ENGINEER for response.
 3. Operation and Maintenance Manuals and Lesson Plans: Submit Equipment Operation and Maintenance Manuals for approval, by the ENGINEER, within 30 days after approval of Equipment Shop Drawing. Submit Equipment Training Lesson Plans for approval, by the ENGINEER, 60 days prior to commencement of training. Submit Operation and Maintenance Data and Lesson Plans in accordance with Section 01782, Operation and Maintenance Data.
- B. Submittal At Final Completion: Submit the following items in the proper form as a condition of Final Acceptance of the Work:
1. Guarantees, Warranties, and Bonds: Submit as listed in various Sections of the Specifications.
 2. Operations and Maintenance Data: Submit all remaining product data and manuals as specified in various Sections of the Specifications.

PART 2 - PRODUCTS (NOT USED)**PART 3 - EXECUTION (NOT USED)****END OF SECTION**

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SECTION 01332

SHOP DRAWING PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The submittal of Shop Drawings shall conform to requirements in this Section. A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required.
- B. The term "Shop Drawings" as used herein shall be understood to include detailed design calculations, fabrication and installation drawings, lists, graphs, test data, operating instructions, and other items which shall include, but are not necessarily limited to:
 - 1. Drawings and catalog information and cuts.
 - 2. Specifications, parts list, suggested spare parts lists, and equipment drawings.
 - 3. Wiring diagrams of systems and equipment.
 - 4. Complete lubrication, maintenance and operation instructions, including initial startup instructions.
 - 5. Applicable certifications.
 - 6. Anchor bolt templates, mounting instructions, and mounting design calculations as required.
 - 7. Required maintenance operations to allow all installed equipment to remain idle for a period of time not to exceed 24 months.
 - 8. Other technical, installation, and maintenance data as applicable.
 - 9. Unloading and handling methods and storage requirements.
 - 10. Note, highlight, and explain proposed changes to the Contract Documents.
 - 11. Paint submittal showing type of paint and the mils thickness of coating system used.
 - 12. Drawings showing Installation Contractor field verifications illustrating all field dimensions. Installation Contractor shall field verify all dimensions and existing materials shown on the Drawings. Any modifications required shall be at Installation Contractor's expense.

1.2 PROCEDURE

- A. Submit Shop Drawings to ENGINEER.
- B. A letter of transmittal shall accompany each submittal. If data for more than one Section of the Specifications is submitted, a separate transmittal letter shall accompany the data submitted for each Section.
- C. All letters of transmittal shall be submitted in duplicate.

SECTION 01332

- D. At the beginning of each letter of transmittal, provide a reference heading indicating the following:
 - 1. OWNER'S Name: _____
 - 2. Project Name: _____
 - 3. Contract No.: _____
 - 4. Transmittal No.: _____
 - 5. Section No.: _____

- E. If a Shop Drawing deviates from the requirements of the Contract Documents, Manufacturer shall specifically note each variation in his letter of transmittal.

- F. All Shop Drawings submitted for approval shall have a title block with complete identifying information satisfactory to ENGINEER.

- G. All Shop Drawings submitted shall bear the stamp of approval and signature of Manufacturer as evidence that they have been reviewed and verified to the completeness of the submittal by Manufacturer. Submittal without this stamp of approval will not be reviewed by ENGINEER and will be returned to Manufacturer. Manufacturer's stamp shall contain the following minimum information:

Project Name: _____

Manufacturer's Name: _____

Date: _____

-----Reference-----

Item: _____

Specifications:

Section: _____

Page No.: _____

Page No.: _____

Drawing No.: _____ of _____

Location: _____

Submittal No.: _____

Approved By: _____

- H. Manufacturer shall utilize the submittal identification numbering system as follows:
 - 1. The Submittal Number shall be a separate and unique number correlating to each individual submittal that is required to be tracked as a separate and unique item. The Submittal Number shall be a two part, eight character, alpha/numeric number assigned by Manufacturer in the following manner:

- a. The first part of the Submittal Number shall consist of five characters that pertain to the applicable Specification Section number.
 - b. The second part of the Submittal Number shall consist of three digits (numbers 001 to 999) to number each separate and unique submittal submitted under each Specification Section.
 - c. A dash shall separate the two parts of the Submittal Number.
 - d. A typical Submittal Number for the third Working Drawing submitted under Section 15101, Ductile Iron Pipe, would be 15101-003.
2. The Review Cycle shall be a three-digit number indicating the initial submission or resubmission of the same submittal. For example:

- 001 = First (initial) submission.
- 002 = Second submission (first resubmission).
- 003 = Third submission (second resubmission).

3. An example of the typical submittal identification numbers for the first submission of the third submittal submitted under Section 15051, Buried Piping Installation is:

<u>Submittal Number</u>	<u>Review Cycle</u>
15051-003	001

An example of the typical submittal identification numbers for the second submission of the third submittal submitted under Section 15051, Buried Piping Installation is:

<u>Submittal Number</u>	<u>Review Cycle</u>
15051-003	002

- I. Manufacturer shall initially submit to ENGINEER a minimum of five copies of all submittals that are on 11-inch by 17-inch or smaller sheets, and one unfolded reproducible and three prints made from that reproducible for all submittal on sheets larger than 11-inch by 17-inch.
- J. After ENGINEER completes his review, Shop Drawings will be affixed with a stamp and marked with one of the following notations:
 1. Approved.
 2. Approved as Corrected.
 3. Approved as Corrected, Resubmit.
 4. Revise and Resubmit.
 5. Not Approved.
 6. Not Reviewed.
 7. For Information Only.

SHOP DRAWING PROCEDURES

- K. If a submittal is acceptable, it will be marked "Approved" or "Approved as Corrected." Three prints or copies of the submittal will be returned to Manufacturer.
- L. Upon return of a submittal marked "Approved" or "Approved as Corrected," Manufacturer may order, ship or fabricate the materials included on the submittal, provided it is in accordance with the corrections indicated.
- M. If a Shop Drawing marked "Approved as Corrected" has extensive corrections or corrections affecting other Shop Drawings or Work, ENGINEER may require that Manufacturer make the corrections indicated thereon and resubmit the Shop Drawings for record purposes. Such Shop Drawings will have the notation, "Approved as Corrected - Resubmit." The corrected Shop Drawing shall be a pre-condition for payment for the work item of the Shop Drawing.
- N. If a submittal is unacceptable, two copies will be returned to Manufacturer with one of the following notations:
 - 1. "Revise and Resubmit."
 - 2. "Not Approved."
- O. Upon return of a submittal marked "Revise and Resubmit", Manufacturer shall make the corrections indicated and repeat the initial approval procedure. The "Not Approved" notation is used to indicate material or equipment that is not acceptable. Upon return of a submittal so marked, Manufacturer shall repeat the initial approval procedure utilizing acceptable material or equipment.
- P. Shop Drawings shall be submitted well in advance of the need for the material or equipment for construction and with ample allowance for the time required to make delivery of material or equipment after data covering such is approved. Manufacturer and Installation Contractor shall assume the risk for all Work, materials or equipment that are fabricated, delivered or installed prior to the approval of Shop Drawings. Materials or equipment will not be included in periodic progress payments until approval thereof has been obtained in the specified manner.
- Q. ENGINEER will review and process all submittals promptly; a reasonable time shall be allowed for this, for the Shop Drawings being revised and resubmitted, and for time required to return the approved Shop Drawings to Manufacturer.
- R. Manufacturer shall furnish required submittals with complete information and accuracy in order to achieve required approval of an item within two submittals.
- S. Mark each page of a submittal and each individual component submitted with the specification number, paragraph, and subparagraph. Arrange submittal information presentation to appear in the sequence in the Specification Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01400 QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve CONTRACTOR of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit CONTRACTOR's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for CONTRACTOR to provide quality-assurance and -control services required by ENGINEER, OWNER, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See Divisions 2 through 16 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by ENGINEER.
- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. Installer/Applicator/Erector: CONTRACTOR or another entity engaged by CONTRACTOR as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to ENGINEER for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to ENGINEER for a decision before proceeding.

1.4 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Reports: Prepare and submit certified written reports that include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- C. Permits, Licenses, and Certificates: For OWNER's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by ENGINEER.
 2. Notify ENGINEER seven days in advance of dates and times when mockups will be constructed.
 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 4. Obtain ENGINEER's approval of mockups before starting work, fabrication, or construction.
 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 6. Demolish and remove mockups when directed, unless otherwise indicated.

- J. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 2 through 16.

1.6 QUALITY CONTROL

- A. OWNER Responsibilities: Where quality-control services are indicated as OWNER's responsibility, OWNER will engage a qualified testing agency to perform these services.
 - 1. OWNER will furnish CONTRACTOR with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to CONTRACTOR, and the Contract Sum will be adjusted by Change Order.
- B. Tests and inspections not explicitly assigned to OWNER are CONTRACTOR's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of CONTRACTOR by authorities having jurisdiction, whether specified or not.
 - 1. Where services are indicated as CONTRACTOR's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. CONTRACTOR shall not employ same entity engaged by OWNER, unless agreed to in writing by OWNER.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 3. Where quality-control services are indicated as CONTRACTOR's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspecting requested by CONTRACTOR and not required by the Contract Documents are CONTRACTOR's responsibility.
 - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."
- D. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

- E. Testing Agency Responsibilities: Cooperate with ENGINEER and CONTRACTOR in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify ENGINEER and CONTRACTOR promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through CONTRACTOR.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of CONTRACTOR.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are CONTRACTOR's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

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**SECTION 01630
SUBSTITUTION PROCEDURES**

1.1 PROCEDURE FOR REQUESTING SUBSTITUTION:

- A. In order that the Owner may determine if a proposed, unnamed substitute item shall be allowed for the specified and named equipment/supplier, the information below shall be SUBMITTED A MINIMUM 10 DAYS PRIOR TO PROPOSAL BID DATE.
- B. Written requests must be submitted to the Engineer.
- C. Transmittal Contents:
 - 1. Product identification:
 - a. Manufacturer's name.
 - b. Telephone number and representative contact name.
 - c. Specification section or drawing reference of originally specified product, including discrete name or tag number assigned to original product in the Contract Documents.
 - 2. Manufacturer's literature clearly marked to show compliance of proposed product with Contract Documents.
 - 3. Itemized comparison of original and proposed product addressing product characteristics including but not necessarily limited to:
 - a. Size.
 - b. Composition or materials of construction.
 - c. Weight.
 - d. Electrical or mechanical requirements.
 - 4. Product experience:
 - a. Location of past projects utilizing product including three of the most recent installations where similar equipment by the manufacturer or manufacturer's representative is currently in service; include contact name, telephone number, mailing address, and the names of the Engineer, Owner, and installation contractor; if three installations do not exist, the list shall include all that do exist, if any.
 - b. Available field data and reports associated with proposed product.
 - 5. Data relating to changes in construction schedule.
 - 6. Data relating to changes in cost.
 - 7. Samples:
 - a. As requested by the Engineer/ Owner.

**SECTION 01630
SUBSTITUTION PROCEDURES**

1.2 APPROVAL OR REJECTION:

- A. Written approval or rejection of substitution given by the Engineer.
- B. Engineer reserves the right to require proposed product to comply with color and pattern of specified product if necessary to secure design intent.
- C. In event substitution results in a change in design or time, provisions in General Conditions will be applied for adjustment.
- D. Substitutions will be rejected if:
 - 1. Submittal is not through the Supplier with their written approval product is of equal quality and service.
 - 2. Requests are not made in accordance with this Section.
 - 3. In the Engineer's opinion, acceptance will require substantial revision of the original design.
 - 4. In the Engineer's opinion, substitution will not perform adequately the function consistent with the design intent, including operational and maintenance impacts.

END OF SECTION

**SECTION 01630
SUBSTITUTION PROCEDURES**

SECTION 01640

MANUFACTURER'S SERVICES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Reference Section 01650, FACILITY STARTUP
- B. Person-Day: One person for 8 hours within regular CONTRACTOR working hours.

1.2 SCOPE

- A. Work under this section defines the minimum scope of services to be provided using factory representatives of the manufacturers of the equipment to be installed during installation, start-up, and operator training.
- B. Equipment manufacturers assigned unit responsibility for systems comprised of several components shall provide the service of factory representative from each component manufacturer to perform the duties required under these Specifications. The equipment manufacturer assigned unit responsibility shall be responsible for coordinating the activities of the system component manufacturers.

1.3 SUBMITTALS

- A. Training Schedule: Submit not less than 15 days prior to equipment installation and revise as necessary for acceptance.
- B. Training Materials:
 - 1. Final training materials must be approved by ENGINEER prior to equipment startup and training.
 - 2. Furnish complete outlines of proposed training session, operation and maintenance data for each trainee in attendance.
- C. Quality Control Submittals: As required in the individual Specification, submit:
 - 1. Qualifications of Manufacturer's Representative performing specified services.
 - 2. Manufacturer's Certificate of Proper Installation using form provided by Manufacturer.

1.4 QUALIFICATION

- A. Qualification of the representatives for installation, startup, and operator training purposes shall be an authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation and maintenance of the equipment being installed and shall be subject to the approval of the ENGINEER. No substitutions of approved representatives will be allowed without the prior written approval of the ENGINEER.
- B. References in various equipment sections of the terms “factory representative” or “field representative” shall mean an employee or contractor of the equipment manufacturer who is trained, articulate, capable of coordinating and expediting training, and familiar with operation and maintenance manual information specified in Section 01782, OPERATION AND MAINTENANCE DATA.

1.5 COORDINATION

- A. Contractor shall notify ENGINEER 72 hours prior to any impending visit by factory representatives so that the ENGINEER may be present.
- B. ENGINEER may approve the services of a manufacturer’s representative for more than one system during the same site visit.
- C. Installation Contractor shall perform the necessary inspections to ensure that all conditions necessary for successful training and/or startup services have been met prior to scheduling manufacturer’s onsite services.

1.6 MINIMUM MANUFACTURER’S SERVICES REQUIREMENTS

- A. Qualified factory representatives shall furnish manufacturer’s services as specified in the Contract Documents.
- B. Where time is specified in the Contract Documents for manufacturer’s services, the specified time shall be considered a minimum time and any time in excess of the specified time stated in the specifications to perform the required manufacturer’s services shall be considered incidental work. ENGINEER approved days of service will be credited to fulfill the specified minimum manufacturer’s services.
- C. Installation Contractor’s training and startup schedule shall coordinate manufacturer’s services to avoid conflicting with other onsite testing or other manufacturer’s services.
- D. Manufacturer’s services will include the following, as applicable to the specific system or equipment items:
 - 1. Installation assistance including observation, guidance, instruction of Installation Contractor’s assembly, erection, installation or applications.

MANUFACTURER'S SERVICES

2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish written approval of installation.
3. Additional site visits as necessary to address problems and until installation and operation are acceptable to ENGINEER.
4. Perform, coordinate, and assist during functional and performance testing and startup demonstration, and until product acceptance by the ENGINEER.
5. Training of OWNER'S personnel in the operation and maintenance of respective product as required.
6. Completion of Manufacturer's Certificate of Proper Installation with applicable certificates for proper installation and initial, interim, and final test or service.

1.7 SCHEDULE

- A. Coordinate with Installation Contractor the following.
- B. List specified equipment and systems with respective manufacturers that require training services of manufacturers' representatives and show:
 1. Estimated dates for installation completion.
 2. Estimated training dates to allow for multiple sessions when several shifts are involved.
- C. Adjust training schedule to ensure training of appropriate personnel as deemed necessary by OWNER, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.

1.8 TRAINING PLAN

- A. Training Plan: Submit for each proposed course:
 1. Title and objectives.
 2. Schedule of training courses including dates, durations, and locations of each class.
 3. Recommended types of attendees (e.g., managers, engineers, operators, maintenance).
 4. Course description and outline of course content.
 5. Duration.
 6. Instruction materials and equipment requirements.
 7. Detailed course schedule for each day showing time allocated to each topic.
 8. Resumes of instructors providing the training.

1.9 TRAINING OWNER'S PERSONNEL

- A. Manufacturer shall furnish the services of a factory representative to train the operations staff in the operation and maintenance of each item installed under these

Specifications. The time required to perform these services shall be shown in the equipment section, but shall be no less than one (1), eight (8) hour day.

- B. Prestartup Training:
 - 1. Coordinate training sessions with operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01782, OPERATION AND MAINTENANCE DATA.
 - 2. Complete at least 14 days prior to actual startup.

- C. Post-Startup Training: If required in Specifications, furnish and coordinate training of OWNER'S operating personnel by respective manufacturer's representatives.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01650 FACILITY STARTUP

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Reference Section 01640, MANUFACTURER'S SERVICES
- B. Functional Test: A test or tests in the presence of the ENGINEER and OWNER to demonstrate that the installed equipment or system meets manufacturer's installation and adjustment requirements and other requirements specified including, but not limited to, noise, vibration, alignment, speed, proper electrical and mechanical connections, thrust restraint, proper rotation, and initial servicing.
- C. Performance Test: A test performed in the presence of the ENGINEER and OWNER and after any required functional test specified, to demonstrate and confirm that the equipment and/or system meet the specified performance requirements.
- D. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment. Examples of systems on this Project are as follows:
 - 1. FRP wetwell, discharge piping.
 - 2. Pumps, motors, equipment appurtenances, transducers.
 - 3. Instrumentation and control system(s).

1.2 SCOPE

- A. Work under this Section includes, but is not necessarily limited to, the provision of all labor and material required to perform startup of all equipment and mechanical systems installed under this Contract.
- B. Work defined under this Section includes providing the services of a factory representative in accordance with the requirements of Section 01640 MANUFACTURER'S SERVICES.

1.3 SUBMITTALS

A. Administrative Submittals:

1. Functional and performance test schedules and plan for equipment, units, and systems at least 15 days prior to start of related testing. Include test plan, procedures, and log format.
2. Schedule and plan of facility startup activities at least 15 days prior to commencement.

B. Quality Control Submittals:

1. Manufacturer's Certificate of Proper Installation as required.
2. Test Reports: Functional and performance testing, in format acceptable to ENGINEER and certification of functional and performance test for each piece of equipment or system specified.
3. Certifications of Calibration: Testing equipment.

1.4 MANUFACTURER AND INSTALLATION CONTRACTOR FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Perform all Work necessary for functional and performance tests specified in the Contract Documents.
2. Demonstrate proper installation, adjustment, function, performance, and operation of equipment, systems, control devices, and required interfaces individually and in conjunction with process instrumentation and control system.
3. Complete Work associated with the unit and related processes before testing, including related manufacturer's representative services.
4. Installation Contractor shall have, at the plant site, Operation and Maintenance Manuals for equipment to be started.
5. Furnish qualified manufacturer's representatives when required to assist in testing.
6. Utilize the Manufacturer's Certificate of Proper Installation Form from Section 01640, MANUFACTURERS' SERVICES, supplemented as necessary, to document functional and performance procedures, results, problems, and conclusions.
7. Schedule and attend pretest (functional and performance) meetings related to test schedule, plan of test, materials, chemicals, and liquids required, facilities' operations interface, ENGINEER and OWNER involvement.
8. Designate and furnish one or more persons to be responsible for coordinating and expediting Installation Contractor's facility startup duties. The person or persons shall be present during facility startup meetings and shall be available at all times during the facility startup period.

9. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing.

1.5 OWNER/ENGINEER FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Review CONTRACTOR'S test plan and schedule.
2. Witness each functional or performance test.
3. Coordinate other plant operations, if necessary, to facilitate testing.
4. Provide water, power, chemicals, and other items as required for testing, unless otherwise indicated.

B. Startup Test Period:

1. Operate process units and devices, with support of Installation Contractor.
2. Provide sampling, labor, and materials as required and provide laboratory analyses.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Cleaning and Checking: Prior to starting functional testing:

1. Calibrate testing equipment for accurate results.
2. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.
3. Lubricate equipment in accordance with manufacturer's instructions.
4. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
5. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
6. Check power supply to electric-powered equipment for correct voltage.
7. Adjust clearances and torques.
8. Test piping for leaks.
9. Balance HVAC systems, measuring airflow (cfm) static pressure, and component pressure losses. Furnish typed report documenting results of balancing.
10. Obtain completion of applicable portions of Manufacturer's Certificate of Proper Installation in accordance with Section 01640, MANUFACTURERS' SERVICES.

B. Startup Test Period:

1. As applicable to the equipment furnished, state in writing that all necessary hydraulic structures, piping systems, and valves have been successfully tested; that all necessary equipment systems and subsystems have been checked for

proper installation, started, and successfully tested to indicate that they are all operational; that the systems and subsystems are capable of performing their intended functions; and that the facilities are ready for startup and intended operation.

2. Attend prestartup planning meetings and arrange for attendants by key major equipment manufacturer representatives as required by the Contract Documents.
 3. Designate and provide one or more persons to be responsible for coordinating and expediting Installation Contractor's startup duties.
 4. When plant startup has commenced, schedule remaining Work so as not to interfere with or delay the completion of plant startup. Support the startup activities with adequate staff to prevent delays, process upsets. This staff shall include, but not be limited to, major equipment and system manufacturers' representatives, subcontractors, electricians, instrumentation personnel, millwrights, pipefitters, plumbers.
 5. Supply and coordinate specified manufacturer's plant startup services.
 6. Make adjustments, repairs, and corrections necessary to complete plant startup.
 7. After the plant is operating, complete the testing of those items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to plant startup.
- C. Ready-to-test determination will be by ENGINEER based at least on the following:
1. Notification by CONTRACTOR of equipment and system readiness for testing.
 2. Acceptable testing plan.
 3. Acceptable Operation and Maintenance Manuals.
 4. Receipt of Manufacturer's Certificate of Proper Installation, if specified.
 5. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.
 6. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment, and satisfactory fulfillment of other specified manufacturers' responsibilities.
 7. Equipment and electrical tagging complete.
 8. All spare parts and special tools delivered to OWNER.

3.2 FUNCTIONAL TESTING—GENERAL

- A. Begin testing at a time mutually agreed upon by the OWNER, ENGINEER, and Installation Contractor.
- B. ENGINEER will be present during test. Notify in writing OWNER, ENGINEER, and manufacturer's representative(s) at least 10 days prior to scheduled date of functional tests.
- C. Separate items of equipment demonstrated to function properly during subsystem testing may require no further functional test if documentation of subsystem testing is acceptable to ENGINEER.

- D. Conduct functional tests as specified for each equipment item or system.
- E. Demonstrate all operational features and instrumentation and control functions while in automatic mode.
- F. If, in ENGINEER'S opinion, functional test results do not meet requirements specified, the systems will be considered as nonconforming.
- G. Performance testing shall not commence until the equipment or system meets the specified functional tests.

3.3 PERFORMANCE TEST –GENERAL

- A. Begin testing at a time mutually agreed upon by the OWNER, ENGINEER, and Installation Contractor.
- B. ENGINEER will be present during test. Notify in writing OWNER, ENGINEER, and manufacturer's representative(s) at least 15 days prior to scheduled date of functional tests.
- C. Conduct performance tests as specified for each equipment item or system.
- D. Unless otherwise indicated, Installation Contractor shall furnish all labor, materials, and supplies for conducting the test and taking all samples and performance measurements.
- E. Prepare performance test report summarizing test method. Include test logs, pertinent calculations, and Manufacturer's written certification that the equipment or system performs as specified.

3.4 STARTUP TEST PERIOD

- A. A. General:
 - 1. Attend planning meetings and arrange for attendance by key major equipment manufacturer representatives as required by the Contract Documents.
 - 2. When facility startup has commenced, schedule remaining Work so as not to interfere with or delay the completion of facility startup.
 - 3. Support facility startup activities with adequate staff to prevent delays. Such staff shall include, but not be limited to, major equipment and system manufacturer's representatives, electricians, instrumentation and control personnel, millwrights, pipefitters, and plumbers.
 - 4. Furnish and coordinate specified manufacturer's facility startup services.
 - 5. After the facility is operating, complete the testing of those items of equipment, systems, and subsystems which could not or were not successfully tested prior to the startup test period.

- B. Startup Testing:
1. Startup of the entire facility or any portion thereof requires the coordinated operation of the facilities by the CONTRACTOR, subcontractors, OWNER'S operating personnel, and manufacturer's representatives.
 2. Startup test period shall occur after all required functional tests have been completed and those performance tests deemed necessary for the safe operation of the entire facility have been completed.
 3. Startup of the entire facility or any portion thereof shall be considered complete when, in the opinion of the ENGINEER, the facility or designated portion has operated in the manner intended for 20 continuous days without significant interruption. This period is in addition to any training, functional, or performance test periods specified elsewhere.
 4. Signification interruption may include any of the following events:
 - a. Failure of CONTRACTOR to maintain qualified onsite startup personnel as schedule.
 - b. Failure to meet specified performance for more than 2 consecutive hours.
 - c. Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within 5 hours after failure.
 - d. Failure of any non-critical unit, system, or subsystem that is not satisfactorily corrected within 8 hours after failure.
 - e. As may be determined by ENGINEER.
 5. A significant interruption will require the startup then in progress to be stopped and restarted after corrections are made.
- C. Startup Test Reports: As applicable to the equipment furnished, certify in writing that:
1. Hydraulic structures, piping systems, and valves have been successfully tested.
 2. Equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are operational.
 3. Systems and subsystems are capable of performing their intended functions, including fully-automatic.
 4. Facilities are ready for intended operation.

END OF SECTION

**SECTION 01782
OPERATION AND MAINTENANCE DATA**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Emergency manuals.
 - 2. Operation manuals for systems, subsystems, and equipment.
 - 3. Maintenance manuals for the care and maintenance of products, materials, finishes, systems, and equipment.
- B. See Divisions 16 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 SUBMITTALS

- A. Manual: Submit 3 copies of each manual in final form at least 15 days before final inspection. ENGINEER will return copy with comments within 15 days after final inspection.
 - 1. Correct or modify each manual to comply with ENGINEER's comments. Submit 3 copies of each corrected manual within 20 days of receipt of ENGINEER's comments.

PART 2 - PRODUCTS

2.1 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project and Project Number.
 - 3. Name and address of OWNER.

4. Date of submittal.
 5. Name, address, and telephone number of CONTRACTOR.
 6. Name and address of ENGINEER.
 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project name and number, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for type of emergency, emergency instructions, and emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment,

and component for fire, flood, gas leak, water leak, power failure, water outage, equipment failure, and chemical release or spill.

- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of OWNER's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include instructions on stopping, shutdown instructions for each type of emergency, operating instructions for conditions outside normal operating limits, and required sequences for electric or electronic systems.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
- B. Descriptions: Include the following:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

- B. Source Information: List each product included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- D. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions, and demonstration and training videotape if available, that detail essential maintenance procedures:

- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by OWNER's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.

END OF SECTION

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SECTION 11145
SUBMERSIBLE PUMPS & FRP LIFT STATION & MANHOLE SPECIFICATIONS PART

1 - GENERAL

1.1 DESCRIPTION

A. General Requirements:

1. As-Built Records:

a. A complete set of As-Built records shall be kept by the Site Contractor. These records shall show all items of construction and equipment which differ in size, shape or location from those shown on the contract drawings, also any additional work, existing features or utilities revealed by construction work which are not shown on the contract drawings. These reports shall be kept up-to-date daily. They may be kept on a marked set of contract drawings to be furnished by the contractor for this purpose, or in any other form, which is approved prior to the beginning of the work. They shall be available at all times during construction for reference by the Engineer and Owner, and shall be delivered to the OCWS Engineering Department upon completion of the work.

2. Nameplate:

a. Each piece of mechanical equipment and motors shall be provided with a substantial nameplate of non-corrodible metal securely fastened in place, and clearly and permanently inscribed with the manufacturer's name, model, or type designation, serial number, rated capacity, electrical or other power characteristics, and other appropriate nameplate data. Spare nameplates shall be provided for each lift station and placed inside each control panel (one nameplate for each model pump).

3. Lubricants:

a. All the equipment shall be delivered fully lubricated with oil and/or grease insofar as possible. If any point cannot be so serviced, it shall be clearly marked to the effect that it is not lubricated and requires servicing prior to operation. An adequate supply of the proper lubricant, with the instructions for its application shall be supplied with the equipment for each point not lubricated prior to shipment. The Contractor shall also provide the Owner with a sufficient amount of proper lubricants for one complete change of lubricant for all equipment furnished.

4. Operating Manuals and Parts Listed:

a. The Contractor shall furnish three (3) complete, bound sets and one electronic pdf version of literature giving the following information to the Okaloosa County Water and Sewer Engineering Department.

b. Clear and Concise instruction for operations, adjustment and lubrication and other of the equipment. These instructions shall include a complete lubrication chart.

c. A list of all parts of the equipment, with catalog number and other data necessary for ordering replacement parts.

d. Such instructions and parts listed shall have been prepared specifically for the model and type of equipment furnished and shall not refer to other models and types of similar equipment.

e. Complete sets of electrical schematic(s), (as built) one of which shall be

encapsulated in plastic and permanently mounted to the inside of panel door.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Flow Isolation and Monitor Equipment:
1. There shall be a minimum of 18" clearance on all sides of valves and fittings.
 2. The check valves shall be a Series 9001 Swing Check (Spring Loaded Type) manufactured by Henry Pratt Company, or approved equal. Valve shall be in accordance with ANSI/AWWA C508. Ductile Iron Body & Cover with internal & epoxy coating in accordance with AWWA C550, ANSI B16.1, Class 125 Flanged connection. Disc shall be BUNA-N with 316 stainless steel hinge pin. Disc seats shall be 316 stainless steel, standard manufactured, and field replaceable.
 3. All exposed hardware shall be of corrosion resistant, 316 stainless steel.
 4. Flow Isolation valves shall be AWWA C504 Ballcentric Plug Valves or Knife Valves, Flanged Cast Iron Body, epoxy coated and manual handwheel actuator.
 5. Pressure gauges shall be equipped with sealing diaphragm and shall be located on each pump discharge line. Gauge and diaphragm shall be manufacture by Ashcroft or approved equal. Gauge shall be Type 45- 1279-R-04B -0/200 psi with Type 20-102SS-04T diaphragm seal. Pressure gauges shall be rated for 1-1/2 times specified pumping pressures with 3/4" SST ball valves must be provided for each discharge. Gauges must be located between check and plug valve so that static head can be observed when pump is off, TDH can be observed while pumps are running, and valves can be shut to observe "dead head" pressure.
 6. Air Release Valves (ARV) shall be designed for wastewater application and provided on the discharge piping as shown on the drawings. ARV shall be Model# M986 as manufactured by H-Tec, Inc. Combination Air/Vacuum valves shall be Model# VM 302A Air/Vacuum Valve as manufactured by Val-Matic Valve and Manufacturing Corp. or approved equal. Valve shall be mounted in vertical position on host pipe, with equivalent size opening brass saddle tap and brass isolation valve. Provide 1" diameter flexible tubing or sch 40 pvc drain pipe to contain discharged air or liquids and drain back into wetwell.

SUBMERSIBLE PUMPS & FRP LIFT STATION & MANHOLE SPECIFICATIONS

B. Wet Well: (By Supplier)

1. Access frames and covers shall be rated at 300 lb/sq. ft. complete with hinged and flush mounted automatic 316 S.S. locking mechanism; hinged fall protection grating (safety orange) opposite opening of main hatch; two 316 S.S. upper guide cable holders (8 hook Min); odor tight gasketed; removable cross bracing; independent opening access lids for triplex and quadplex application with minimum 34" x 48" clear opening per pump or as specified on drawings. Frame shall be securely placed, with center of access opening mounted directly above the pumps. Frame shall be provided with sliding nut rails to attach the accessories required. Lower guide bar holders shall be integral with the discharge connection. Guide bars shall be of at least 316 stainless steel pipes. Doors shall be of skid proof design.
2. The discharge piping shall be intermediately supported inside the wet well by the use of a stainless steel uni-strut bolted to the well wall, and stainless steel u-bolts and clamps secured to the discharge pipe and strut.
3. All fasteners inside wet well shall be 316 stainless steel.
4. A guide rail system for pump removal shall be installed inside the wet well for each pump. The guide rails shall be of at least 316 stainless steel pipe of the size indicated on the drawing, but a minimum of two (2") inches in diameter. The guide bars shall not support any portion of the weight of the pump. The lower guide bracket shall be incorporated and tightly secured to the discharge connection elbow with 316 stainless steel fasteners. The base elbow and sealing flange shall be constructed of Cast Iron and hard mounted to the base of wet well.
5. The guardrail system shall be manufactured for use in NEC Class I, Division I, Group D environments.
6. WET WELL shall be stand alone Fiberglass Reinforced Polyester (FRP) structure, with minimum dynamic load rating of 16,000 ft-lbs. The sides, top and bottom shall be type Grade "E" glass, with smooth interior and exterior surfaces. Exterior resin shall include a minimum 1/8" layer of UV inhibitor. The top and bottom shall be reinforced with layup in accordance with ASTM D3299. The FRP structures must meet and or exceed ASTM-D3753 standards. The structures must be Third Party Tested and Certified to meet the ASTM-D3753 standards. The structures must have labels that have serial numbers visible and states the manufacturer, date of manufacture, depth, diameter, and that structure meets ASTM-D3753 standards. Bottom shall be truncated as shown on drawings.
7. The fiberglass structures must have a standard 10 Year structural warranty. The fiberglass structures must have a printed 10 Year warranty label gel coated next to ASTM and serial number label. Copy of this warranty must be included with the submittal data. Approved Manufacturer is L.F. Manufacturing, EFI and Xerxes. OCWS approved equal may be substituted.
8. All access opening shall have 12" risers with "Drop In" Aluminum Hatch Cover or OCWS approved equal. Upon completion the wet well and valve pit will have a 6" minimum concrete slab poured over top. On wet wells 8' in diameter or larger an additional hatch cover shall be supplied on opposite side of wet well over invert piping to allow for installation of future equipment and maintenance.
9. Where piping passes through a wall sleeves shall be used with rubber link seals to make a watertight penetration. The sleeves must be large enough for flange of pipe being used to pass freely through (Example: 4" pipe would require a 10"

SUBMERSIBLE PUMPS & FRP LIFT STATION & MANHOLE SPECIFICATIONS

sleeve to allow 9-1/2" O.D. diameter of 4" flange). The link seals are used so that the rubber acts as vibration isolator while pump is running.

10. All piping in wet well, including 24" exterior extensions sections shall be welded Flange X Flange Sch 40 316 SS-L piping (Class 250 Ductile Iron approved equal may be substituted as an Alternate if identified in proposal section). All wetwell ductile iron piping shall be interior coated with Protecto 401 and all exterior surfaces shall be coated with two (2) layers of epoxy at 5 mils per coat.
11. Hardware used for connections must be 316 SST bolts and nuts with anti- seize.

C. Valve Vault (By Supplier)

1. Clearance must be provided in the valve pit to allow for maintenance of the valves. Th exact dimensions will be determined by the discharge pipe size and specific valve assembly and disassembly clearances. The pit shall contain all check valves, plug valves, and associated fittings for station operation. At least 24-inch of spacing should be provided between the pipe and the valve pit bottom. Pipe supports should be located as needed to fully support the equipment in the valve pit, without hindering their operation or maintenance.
2. Concrete Valve Vault
 - a. The manufacturer shall waterproof the exterior of the valve vault with two coats of Kopper's Bitumastic 300-M or approved equal type sealant to prevent groundwater infiltration.
 - b. The interior of the valve vault shall have a smooth plastered finish, bottom section to be sloped to one corner or center with a drain seal inserted to prevent gases from entering the vault.
3. FRP Valve Vault
 - a. Fiber Reinforced Polyester (FRP) Vault shall be suitable for wastewater applications.
 - b. Manufacture shall be regularly engaged in the production of the specified vault and shall meet UL-1316 - Standard for Safety Glass Fiber Reinforced Plastic Underground Storage for Petroleum Products.
 - c. Buoyancy and Structural Design Calculations signed and sealed by a professional engineers registered in state of the project site location will be provided and shall include:
 - d. Empty tank buoyancy with fully flooded condition (water table at grade elevation).
 - e. Structural calculations shall address configuration, thickness and the calculations (moment of inertia), hydrostatic pressure, deflection due to soil and traffic load, buckling when Vault is above water level, and local buckling of the shell between ribs.
 - 1) Fiberglass composites shall be a minimum of:
 - 2) Tensile Modules 900,000 psi
 - 3) Flexural Modulus 900,000 psi
 - 4) Tensile Strength 10,000 psi
 - 5) Compressive Strength 20,000 psi
 - f. Vaults shall be capable handling domestic wastewater, petroleum, petroleum condensates aromatic hydrocarbons and gasoline additives at temperatures as low as -5° C (23°F) and high as 40° C (104°F).
 - g. The primary and secondary walls shall be manufactured with 100% premium

SUBMERSIBLE PUMPS & FRP LIFT STATION & MANHOLE SPECIFICATIONS

isophthalic polyester resin and glass-fiber reinforcement. No sand or silica fillers shall be added to the resin. The interstitial space between the primary and secondary walls shall be constructed with a glass reinforcement material such as Parabeam®, which provides a structural bond between the two walls, while creating a defined interstice that allows for free flow of liquid.

- h. All fiberglass nozzles shall be gusseted to handle the backfill and external loads. Gussets shall not interfere with anchor strap locations or flange bolt holes.
 - i. Vault access shall be sized with a 12" raised collar to accept a drop in aluminum access hatch cover.
 - j. The Vault shall be equipped with a minimum of (2) lifting lugs evenly spaced to ensure a balanced lift and designed to carry (4) times the empty weight of the Vault.
4. There shall be a minimum of 12" clearance on all sides of valves and fittings.
 5. All exposed hardware shall be of corrosion resistant, stainless steel.
 6. The Access Hatches shall be aluminum double-door type, rated at 300 lb/sq. ft. A minimum of 5' x 2' overall, mounted and centered on the box as shown in the drawings. Doors shall be of skid-proof design.
 7. All valve vault shall be a solid cast in place or precast concrete box with the bottom.
 8. The plug valves shall be shall be manufactured by DeZurik or approved equal, manufactured in accordance with ANSI/ AWWA C606, resilient-faced, non-lubricating variety and shall be of an eccentric design, bubble-tight at the rated pressure (175 PSI 4" through 12", 150 PSI 14" and above) the , flanged cast iron body with epoxy coated interior and manual handwheel actuator.
 9. Pressure gauges shall be equipped with sealing diaphragm and shall be located on each pump discharge line. Gauge and diaphragm shall be manufactured by Ashcroft or approved equal. Gauge shall be Type 45-1279-R-04B -0/200 psi with Type 20-102SS-04T diaphragm seal. Pressure gauges shall be rated for 1-1/2 times specified pumping pressures with 3/4" SST ball valves must be provided for each discharge. Gauges must be located between the check and plug valve so that static head can be observed when the pump is off, TDH can be observed while pumps are running, and plug valves can be shut to observe "dead head" pressure.

D. Fiberglass Manhole: (By Supplier)

1. Fiber Reinforced Polyester (FRP) Manholes shall be suitable for wastewater applications.
2. Manufacture shall be regularly engaged in the production of the specified manhole and shall meet UL-1316 - Standard for Safety Glass Fiber Reinforced Plastic
3. Underground Storage Manholes for Petroleum Products.
4. Acceptable Manufacturer: Fiberglass Tank Solutions and Xerxes Corporation
5. Buoyancy and Structural Design Calculations signed and sealed by a professional engineers registered in state of the project site location will be provided and shall include:
6. Empty tank buoyancy with fully flooded condition (water table at grade elevation).
7. Uplift with soil shear planes considered vertical with no angle.
8. Structural calculations shall address Manhole configuration, thickness and the calculations (moment of inertia), hydrostatic pressure, deflection due to soil and traffic load, buckling when Manhole is above water level, and local buckling of the shell between ribs.
9. Fiberglass composites shall be a minimum of:
10. Tensile Modules 900,000 psi
11. Flexural Modulus 900,000 psi

SUBMERSIBLE PUMPS & FRP LIFT STATION & MANHOLE SPECIFICATIONS

12. Tensile Strength 10,000 psi
13. Compressive Strength 20,000 psi
14. Loading Conditions - Manhole shall withstand a minimum 20-psig internal pressure test; withstand external surface H-20 and HS-20 axle loads; 7' of overburden external hydrostatic loads over the top of the Manhole with a safety factor of 5:1 against general buckling when properly installed
15. Manholes shall be capable handling domestic wastewater, petroleum, petroleum condensates aromatic hydrocarbons and gasoline additives at temperatures as low as -5° C (23°F) and high as 40° C (104°F).
16. The primary and secondary walls of the Manhole shall be manufactured with 100% premium isophthalic polyester resin and glass-fiber reinforcement. No sand or silica fillers shall be added to the resin. The interstitial space between the primary and secondary walls shall be constructed with a glass reinforcement material such as Parabeam®, which provides a structural bond between the two Manhole walls, while creating a defined interstice that allows for free flow of liquid.
17. All fiberglass nozzles shall be gusseted to handle the backfill and external loads. Gussets shall not interfere with anchor strap locations or flange bolt holes.
18. Manholes will be designed with external reinforcement ribs and structural domed ends.
19. Manhole access manways shall be sized with a 12" raised collar to accept a drop in aluminum access hatch cover. Collar internal dimensions shall be 30"x30".
20. Each Manhole shall be equipped with a minimum of (2) lifting lugs evenly spaced to ensure a balanced lift and designed to carry (4) times the empty weight of the Manhole.
21. Bottom stingers shall be constructed of FRP pipe matching the diameter of the flange nozzle and cut at 45° angle 12 inches off Manhole bottom.
22. All manhole surfaces shall be provided with a white gel coat for exposed fiberglass. Gel coat shall be a min of 10 mm thickness
23. Manufactures nameplate shall be laminated as close as possible to the top of the sump pump manway and include the Manhole manufactured, year of manufacture, burial depth, Customer Name and Order #:
24. h) Customer Purchase Order Number:
25. Prior to shipment the unit shall be thoroughly cleaned internally; all flanges or openings covered with wood or wood fiber.
26. Packaged components susceptible to shipping damage shall be braced for shipment to prevent damage from vibration, fatigue, or shock.

E. Plates, Sheets, and Shapes:

1. Aluminum Plates, Sheets and Shapes:
 - a. All aluminum plates and shapes shall be of type AA 5052 alloy conforming to applicable requirements of ASTM Designation B 209- 67, (latest revision).
 - b. Aluminum extended shapes shall be 6061 or 6062 alloy conforming to ASTM B 221-67, (latest revision).
 - c. All surfaces in contact with concrete shall be coated with Bitumastic (Kopper's 50 or equal).
2. Stainless Steel Plates, Sheets, and Shapes:
 - a. All stainless steel plates and sheets shall be type 316 alloy conforming to the applicable requirements of ASTM Designation A-182, (latest revision).
 - b. Stainless steel pipe shall be schedule 40, Type 316 alloy conforming to applicable requirements of ASTM – 312, (latest revision).

SUBMERSIBLE PUMPS & FRP LIFT STATION & MANHOLE SPECIFICATIONS

3. Fastenings:
 - a. Fasteners insofar as practical shall be concealed. Where exposed, fastening shall be of 316 stainless steel, where not indicated otherwise and countersunk wherever possible.
 - b. All fastenings coming into contact with aluminum and /or submerged shall be of stainless steel.
 - c. All hardware used to assemble ductile iron fittings shall be stainless steel. Threads shall be coated with anti-seize compound.
 - d. All threaded fasteners to include threaded rods shall be coated with anti-seize compound.

F. Submersible Pumping Equipment:

1. Pumps:

- a. Pumps shall be submersible, heavy duty, recessed or non-clog impeller type or an approved equal by the Okaloosa County Water & Sewer Engineering Department.
- b. The pumps shall be capable of handling raw, unscreened sewage. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. The pumps shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service. There shall be no need for personnel to enter pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by the simple linear downward force of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pump unit shall be guided by no less than two guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact by gravity only. Sealing of the discharge interface by means of a diaphragm, O-ring, or other devices will not be acceptable. No portion of the pump shall bear directly on the floor of the wet well. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater, without loss of water-tight integrity to a depth of 65 ft. Totally submersible design, with all electrical parts housed in cast-iron, water tight enclosure. Motor cooling system shall be "closed-loop" system without induction of pumping liquid as cooling source. Cooling fluid shall be propylene glycol with water mix. Pump must be able to operate continuously in dry or fully submerged conditions. Thrust and radial bearings shall be of the ball type. The motor shafting shall be stainless steel and designed for extremely difficult sewage pumping service.
- c. The motor shall be designed to operate on 3-phase, 60-cycle, and 480 volt current and shall be non-overloading at all points on the pump curve.
- d. All submersible pump motors shall be manufactured for use in NEC Class I, Division I, Group D environments.
- e. The pump shall be fitted with a rigid explosion proof lifting bail of suitable strength to lift up to two times the weight of the pump. The

lifting bail shall provide a large open loop so that the bail can be hooked from the surface, precluding the need for personnel to enter the dry well. The bail shall be designed so that standard, commercially available shackles and fittings can be used to attach lifting chains or wire rope lifting assemblies. All materials and fasteners of the lifting bail device shall be 316 stainless steel.

SUBMERSIBLE PUMPS & FRP LIFT STATION & MANHOLE SPECIFICATIONS

2. Manufacturing:
 - a. The duplex submersible pumps shall be as manufactured by WEMCO, WILO, Flygt, or an approved equal by the Okaloosa County Water & Sewer Engineering Department. Submittal data required before approval if equal is requested.
3. Submittal Data:
 - a. The contractor shall provide three (3) hard copies and one (1) electronic pdf of the following submittal data for each item of pumping equipment:
 - 1) Certified Dimensional Print
 - 2) Typical Performance Curve
 - 3) Pictorial and Schematic Wiring Prints
 - 4) Parts Listed and Instructional Prints
 - 5) Pump Components and Warranty.
4. Pump Characteristics:
 - a. Pumps shall furnish the following:
 - 1) Pump to handle passing sphere of 4" diameter.
 - 2) Maximum motor size shall be specifically noted on contract drawings, "Pump Characteristics", unless otherwise approved by OCWS Engineering.
 - 3) Impeller unless otherwise approved by the OCWS Engineering Department or Contract Drawings.
 - 4) Pump shall be equipped with self aligning, oil float balanced double mechanical seals. Seal shall be housed in oil filled reservoir. Both mating surfaces shall be **silicon carbide** faced.
 - 5) Impellers shall be cast iron or hardened steel as alternate, if identified in proposal section, with replaceable wear rings. Both impeller and volute shall receive two coats of ceramic coating of equivalent to the Belzona 1321 product. Coating shall be installed in accordance with manufactures requirements for high corrosive and abrasive wastewater application. Metal shall be sandblasted to near white finish prior to application to remove production coating surface. Impeller shall be fully balance in two planes after coating application.
 - 6) The maximum allowed pump motor shaft speed shall be identified on the contract drawings. In no case shall a motor be supplied to operate under normal condition in excess of 1800 RPM, unless specifically noted on the contract drawings, "Pump Characteristics".
 - 7) Upper and lower bearings shall be sealed permanently lubricated, B10 life (100,000 hours at design hydraulic conditions). Provide sealed/shielded bearings.
5. Controls:
 - a. Controls/Monitoring Sensors
 - 1) A motor over-temp circuitry shall be installed, so that if the motor reaches an over-temp condition, the control voltage to that motor is interrupted. A seal fail circuitry shall be installed to detect potential failure or seepage of liquid into motor seal housing through shaft seal.
 - 2) All monitoring equipment, starters and drives shall be completely assembled, tested and ready for operation prior to delivery to the site. Local representatives for supplied pump and controls shall be onsite to perform field start-up and final acceptance inspection by OWNER.

SUBMERSIBLE PUMPS & FRP LIFT STATION & MANHOLE SPECIFICATIONS

6. Electrical:
 - a. General:
 - b. All electrical equipment shall be installed in accordance with the N.E.C. Code, as last revised. All materials used shall be new and unused, of the highest quality, and of proper type for the use intended. Where applicable, all material shall carry the approval of the Underwriters' Laboratory. Substitutes, which tend to lower the quality of the work, will not be permitted. The project is to result in a complete and operable Lift Station. Any items not specified, but normally included in such installations shall be finished and installed regardless of omissions from specifications. However, specified omissions are not affected by this requirement.
7. Materials:
 - a. Conduit and conduit fittings shall be P.V.C. Electrical connectors and couplings shall be of the approved plastic water-tight type.
 - b. Wire and cable shall be properly sized to carry the anticipated loading. Insulation, unless otherwise noted, shall be typed RHW neoprene jacket for all sizes.
 - c. Conduit into wet well shall be large enough for easy removal of pump leads and/or float leads but as a minimum 1½" diameter. There shall be one conduit for each pump, plus one for float switch cables, plus two (2) additional sleeves with cups.
8. Installations: (By Owner)
 - a. All conduit runs, whether or not terminated in boxes, shall be capped or plugged to prevent the entrance of foreign objects before wires are pulled. Conduit projecting into the wet well shall be plugged to a depth no more than 2"
 - b. Outlets, switches, boxes, etc., shall be rigidly secured and located properly with respect to easy accessibility.
 - c. No electrical splices allowed except in control panel.
 - d. All work shall be tested and subject to final approval of the engineer.
9. Lightning Arrestor: (By Owner)
 - a. The lightning arrestor for the main service entrance shall be Joshlin or approved equal.
10. Main Disconnect: (By Owner)
 - a. Unless noted otherwise A main disconnect safety switch shall be provided in an enclosed service entrance, panel shall be NEMA rated to meet Environmental Exposure condition stated. Switch shall be 3 pst, 4 wire S/N, 277/480 Volt AC of sufficient size to carry two pumps operating simultaneously.
11. Wetwell Level Monitoring:
 - a. Level/Pressure Transducer: Transducer shall be non-fouling type designed to continuously operate and monitor liquid level in a highly corrosive wastewater application (confined wetwell). Transducer exterior housing shall be 316 SS L with Kynar diaphragm. Signal cable shall be Hytrel jacketed, shielded with vent and drain tube. Cable length shall be 100 feet in length. The unit shall be with standard 2- wire 4-20 mA output, 24 VDC supply with minimum operating range of 0-100 feet, WC level, +/-1% accuracy, & -10C to 70C temperature range. Acceptable manufacture shall be Endress+Hausser "Waterpilot" or approved equal. Unit shall be supplied with all necessary 316 SS hardware to stationary mount
 - b. Free-Hanging Float Switches: Free-hanging float switches shall be

SUBMERSIBLE PUMPS & FRP LIFT STATION & MANHOLE SPECIFICATIONS

constructed of molded polyethylene with internal and redundant polyurethane foam. All cable and switch connections shall be potted and cable shall be rubber jacketed with fine stranded #18 conductors. The float switch shall be equipped with a suspended weight kit. Hanging float switches shall be manufactured ROTO-FLOAT or approved equal.

G. Alternates:

1. Harden Steel Pump Impeller (Section D.4.a.5)
 - a. Supplier to provide additional price to provide harden steel impeller in place of coated system.
 - b. Material shall be ASTM A532IIC with 15% CrMo-HC. Hardness shall be minimum 690 Bn.
2. Harden Steel Pump Volute (Section D.4.a.5)
 - a. Supplier to provide additional price to provide harden steel volute and water plate in place of coated system.
 - b. Material shall be ASTM A532IIC with 15% CrMo-HC. Hardness shall be minimum 690 Bn.

END OF SECTION

SECTION 16060 GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
 - 1. Underground distribution grounding.
 - 2. Common ground bonding with lightning protection system.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Ground rings.
 - 3. Grounding arrangements and connections for separately derived systems.
 - 4. Grounding for sensitive electronic equipment.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at ground rings grounding connections for separately derived systems based on NFPA 70.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type, 1 inch in diameter (length as required to achieve resistance to ground as specified in 3.5, B).

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: All conductors shall be stranded.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.

ELECTRICAL SUPPORTS

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 1. Feeders and branch circuits.
 2. Lighting circuits.

ELECTRICAL SUPPORTS

3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

ELECTRICAL SUPPORTS

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a

ELECTRICAL SUPPORTS

lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building area or item indicated.
1. Install copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches from building foundation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

ELECTRICAL SUPPORTS

- b. Perform tests by fall-of-potential method according to IEEE 81.
3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 5 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm.
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 16072 ELECTRICAL SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IBC: International Building Code.
- C. IMC: Intermediate metal conduit.
- D. NBC: National Building Code.
- E. OSHPD: Office of Statewide Health Planning and Development.
- F. RMC: Rigid metal conduit.
- G. SBC: Standard Building Code.
- H. UBC: Uniform Building Code.

1.4 SUBMITTALS

- A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support component used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.
- B. Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.
 - 1. Available Manufacturers:
 - a. Cooper B-Line; a division of Cooper Industries.
 - b. Allied Support Systems; Power-Strut Unit.
 - c. Unistrut; Tyco International, Ltd.
 - 2. Finishes:
 - a. Interior Locations: Metallic Coatings - Hot-dip galvanized after fabrication and applied according to MFMA-3.
 - b. Exterior Locations: SS4-AISI Type 304 Stainless Steel or 6063-T6 Aluminum
 - 3. Channel Dimensions: Selected for structural loading.
- C. Raceway and Cable Supports: As described in NECA 1.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/ A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

ELECTRICAL SUPPORTS

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers:
 - 1) Hilti, Inc.
 - 2) MKT Fastening, LLC.
 - 3) Simpson Strong-Tie Co. Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers:
 - 1) Cooper B-Line; a division of Cooper Industries.
 - 2) Hilti, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Powers Fasteners.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 for installation requirements, except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.3 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions at Project.
- B. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.

ELECTRICAL SUPPORTS

1. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
2. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
3. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3.

END OF SECTION

SECTION 16075 ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1, ANSI C2, and ANSI Z635.4.
- B. Comply with NFPA 70.

ELECTRICAL IDENTIFICATION

- C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.
- E. Install all signs and labels horizontal (level) and consistent for similar equipment and panels.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

ELECTRICAL IDENTIFICATION

- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength: 50 lb, minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with snap-around label.
 1. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, snap-around, color-coding bands:

ELECTRICAL IDENTIFICATION

1. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
 2. Fire Alarm System: Red.
 3. Fire-Suppression Supervisory and Control System: Red and yellow.
 4. Combined Fire Alarm and Security System: Red and blue.
 5. Security System: Blue and yellow.
 6. Mechanical and Electrical Supervisory System: Green and blue.
 7. Telecommunication System: Green and yellow.
 8. Control Wiring: Green and red.
- C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use metal tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
1. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.
- D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
1. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
1. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
 2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

ELECTRICAL IDENTIFICATION

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
 4. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway. During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches above duct. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
1. Description:
 - a. Permanent, bright-colored, continuous-printed, polyethylene tape.
 - b. Not less than 6 inches wide by 4 mils thick.
 - c. Compounded for permanent direct-burial service.
 - d. Embedded continuous metallic strip or core.
 - e. Printed legend shall indicate type of underground line.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
 2. Comply with NFPA 70 and 29 CFR 1910.145.
 3. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

ELECTRICAL IDENTIFICATION

4. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
5. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
6. Warning label and sign shall include, but are not limited to, the following legends:
 - a. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWERSOURCES."
 - b. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

I. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with ENGINEER/OWNER APPROVED instructions where needed for system or equipment operation. Instructions are needed for all equipment unless otherwise noted.
 - a. Signs shall be engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - b. The engraved legend shall be 1/2 " White letters on Brown face, and punched or drilled for mechanical fasteners.
 - c. The signs shall be installed with stainless hardware.
2. Emergency Operating Instructions: Install emergency operating instruction signs at equipment used for power transfer, safety shutdown, or any other locations requiring operation in an emergency.
 - a. Signs shall be engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - b. The engraved legend shall be 1/2 " White letters on Red face, and punched or drilled for mechanical fasteners.
 - c. The signs shall be installed with stainless hardware.

- J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets,

ELECTRICAL IDENTIFICATION

and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
 - a. Indoor and Outdoor Equipment: Use engraved, laminated acrylic or melamine labels, punched or drilled for screw mounting. Identification labels shall have white letters on a dark-gray background. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where 2 lines of text are required, use labels 2 inches high. Mount labels with stainless hardware.
 - b. Elevated Components: Increase the size of the labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:
 - a. Identification labeling of some items listed below may be required by individual Sections or by NFPA 70.
 - b. Panelboards, electrical cabinets, and enclosures.
 - c. Access doors and panels for concealed electrical items.
 - d. Electrical switchgear and switchboards.
 - e. Transformers.
 - f. Electrical substations.
 - g. Emergency system boxes and enclosures.
 - h. Motor-control centers.
 - i. Disconnect switches.
 - j. Enclosed circuit breakers.
 - k. Motor starters.
 - l. Push-button stations.
 - m. Power transfer equipment.
 - n. Contactors.
 - o. Battery inverter units.
 - p. Battery racks.
 - q. Power-generating units.
 - r. Voice and data cable terminal equipment.
 - s. Television/audio components, racks, and controls.

- t. Fire-alarm control panel and annunciators.
- u. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- v. Monitoring and control equipment.
- w. Uninterruptible power supply equipment.
- x. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- y. Control systems
- z. Field mounted control devices
- aa. Field mounted instruments

3.2 INSTALLATION PRACTICES

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- D. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes LARGER than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or

ELECTRICAL IDENTIFICATION

taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

- E. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- F. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

END OF SECTION 16075

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SECTION 16120 CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Wires and cables rated 600 V and less.
- 2. Connectors and terminations rated 600 V and less.
- 3. Sleeves and sleeve seals for cables.

- B. Restrictions

- 1. All wire/cable runs of any type must be continuous. Splices are expressly prohibited.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. Beldon CDT Inc.
 - 4. General Cable Corporation.
 - 5. Senator Wire & Cable Company.
 - 6. Southwire Company.
- C. Copper Conductors: Comply with NEMA WC 70.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types XHHW and SO.
- E. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC and Type SO with ground wire.
- F. VFD Rated Cable: Shall be 2000V UL Flexible Motor Supply cable with 3 stranded tinned copper circuit conductors plus (3) symmetrical bare copper ground wires,

XLPW insulation, two spiral copper tape shields with a sun and oil resistant PVC jacket. The cable shall be a Belden 29546 or engineer approved equal.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.

4. Pipeline Seal and Insulator, Inc.
 - B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper, stranded.
- B. Branch Circuits: Copper, stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type XHHW-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type XHHW-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type XHHW-2, single conductors in raceway.
- F. Feeders in Cable Tray: Type XHHW-2, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspace: Type XHHW-2, single conductors in raceway.

- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type XHHW-2, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Metal-clad cable, Type MC.
- K. Branch Circuits in Cable Tray: Type TC.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- M. All control cables between the PLCs / MMCs and field instruments: 2 # 18 AWG, twisted shielded pair, UL Instrument Cable, XLPE conductor insulation, PVC outer jacket.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to local codes and the manufacturer's written instructions.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to local codes and the manufacturer's written instructions.
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to local codes and the manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
 - a. All Process Equipment.
 - b. Panels/Switchboards/Transformers/Transfer Switches
 - c. Pumps
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. All megger readings using a 1000 V dc megger shall be greater than 50 mega ohms.
 - 4. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and

conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

- a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 16140 WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Receptacles with integral surge suppression units.
 - 4. Isolated-ground receptacles.
 - 5. Snap switches and wall-box dimmers.
 - 6. Wall-switch and exterior occupancy sensors.
 - 7. Communications outlets.
 - 8. Pendant cord-connector devices.
 - 9. Cord and plug sets.

1.3 DEFINITIONS

- A. Retain term and abbreviations that remain after this Section has been edited.
- B. EMI: Electromagnetic interference.
- C. GFCI: Ground-fault circuit interrupter.
- D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- E. RFI: Radio-frequency interference.

- F. TVSS: Transient voltage surge suppressor.
- G. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Retain first paragraph below if products have critical features needing hands-on appraisal.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain all wiring devices and associated wall plates from a single manufacturer and one source. (No deviation without written permission from the owner and engineer.)
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Retain subparagraph below if cord and plug sets are specified in Part 2.
 - 2. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 3. Leviton Mfg. Company Inc. (Leviton).
 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).
- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; CR 5253IG.
 - b. Leviton; 5362-IG.
 - c. Pass & Seymour; IG6300.
 2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TR8300.
 - b. Hubbell; HBL8300SG.
 - c. Leviton; 8300-SGG.
 - d. Pass & Seymour; 63H.
 - e. <Insert manufacturer's name; catalog number.>
3. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Products: Subject to compliance with requirements, provide one of the following:
 1. Cooper; GF20.
 2. Pass & Seymour; 2084.

2.4 TVSS RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.
 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
 2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
- B. Duplex TVSS Convenience Receptacles:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5362BLS.
 - b. Hubbell; HBL5362SA.
 - c. Leviton; 5380.

2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

C. Isolated-Ground, Duplex Convenience Receptacles:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; IG5362BLS.
 - b. Hubbell; IG5362SA.
 - c. Leviton; 5380-IG.
2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Crouse-Hinds.
 - b. EGS/Appleton Electric.
 - c. Killark; a division of Hubbell Inc.

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
2. Hubbell; IG2310.
 - a. Leviton; 2310-IG.
3. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.7 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.8 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
- b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
- c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
- d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.

- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.10 OCCUPANCY SENSORS

- A. Each manufacturer's switch rating is different, but rated design values are generally not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- B. Retain one of two paragraphs and associated subparagraphs below. Adaptive technology includes the ability to sense and memorize usage patterns in the space and help eliminate false offs.
- C. Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..
- D. Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.

2. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..
- E. Retain one of first two paragraphs and associated subparagraphs below for square and near-square rectangular rooms.
- F. Long-Range Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Pass & Seymour; WA1001.
 - d. Watt Stopper (The); CX-100.
 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft..
- G. Long-Range Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
 2. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft..
- H. Wide-Range Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBWP.
 - b. Leviton; ODWHB-IRW.
 - c. Pass & Seymour; HS1001.
 - d. Watt Stopper (The); CX-100-3.
 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft..

I. Exterior Occupancy Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Leviton; PS200-10.
 - b. Watt Stopper (The); EW-100-120.
2. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.11 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3560-6.
 - b. Leviton; 40649.
2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3562.
 - b. Leviton; 40595.
2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.12 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.05-inch- thick anodized aluminum.
3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum with lockable cover.

2.13 MULTIOUTLET ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold Company (The).
- B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: PVC.
- D. Wire: No. 12 AWG.

2.14 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Engineer, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. TVSS Devices: Blue.
 - 4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
- F. Recommendation in subparagraph below is made in IEEE 602.
- G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- H. Coordinate two paragraphs below with Drawings.
- I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- J. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 16 Section "Electrical Identification."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with [black] [white] [red]-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

SECTION 16410
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. First two paragraphs below are defined in Division 1 Section "Submittal Procedures" as "Action Submittals."
 - B. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

2. Current and voltage ratings.
 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 4. Retain first subparagraph below if using series rating of overcurrent protective devices.
 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 6. Retain subparagraph below if final system short-circuit and coordination studies will be performed by the designer or will be assigned to an independent consultant. These curves are also beneficial to Owner for future additions or reevaluations of settings of overcurrent protective devices. Although some manufacturers no longer offer curves on translucent graph paper, curves can normally be downloaded from manufacturers' Web sites or be obtained, in electronic form, from various coordination software vendors as part of a subscription service. Retain option in subparagraph below only if manufacturers selected offer curves on graph paper.
 7. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- C. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: For power, signal, and control wiring.
- D. Remaining paragraphs are defined in Division 1 Section "Submittal Procedures" as "Informational Submittals."
- E. Coordinate first paragraph below with qualification requirements in Division 1 Section "Quality Requirements" and as supplemented in "Quality Assurance" Article.
- F. Retain first paragraph below if retaining "Manufacturer's Field Service" Paragraph in "Field Quality Control" Article. Consider manufacturer's field services especially when retaining zone-selective interlocking because setting it to operate properly requires factory-trained expertise.
- G. Manufacturer's field service report.
- H. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
- 1.5 Retain option in subparagraph below only if manufacturers selected offer curves on graph paper.
- 1.6 QUALITY ASSURANCE
- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
 - B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
 - C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - D. Comply with NFPA 70.
- 1.7 PROJECT CONDITIONS
- A. Specify unusual environmental or service conditions in first paragraph below. For equipment installed outdoors, indicate maximum and minimum ambient temperature and expected humidity range. For additional ambient compensation requirements for fuses, see Editing Instruction No. 5 in the Evaluations.
 - B. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 2. Altitude: Not exceeding 6600 feet (2010 m).
 - C. Retain paragraph below if interruption of existing electric service is required.
 - D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Engineer no fewer than seven days in advance of proposed interruption

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

of electric service.

2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Engineer's written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Siemens
 2. Square D
 3. Allen-Bradley
 4. Cutler-Hammer
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: Two (2) NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Siemens
 - 2. Square D
 - 3. Allen-Bradley
 - 4. Cutler-Hammer
- B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Auxiliary Contact Kit: Two (2) NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 Retain subparagraph below if retaining "Auxiliary Contact Kit" Subparagraph above and if remote-control power for remote indication is not specified in other Sections. See "Control Power Options" Article in the Evaluations for various sources available for control power. Although other voltages are available, the Section Text includes only those that are most frequently encountered and listed in manufacturers' literature. Integrally mounted control power is not available in safety switches.

2.4 RECEPTACLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Hubble
- B. Type 4, IP66 Rated, Twist lock, amp rated, combination safety switch and receptacle

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- C. Receptacle: Twist lock, three-phase, four-wire or five-wire receptacle (one wire connected to enclosure ground lug).
- 2.5 If more than one type or rating of receptacle-switch combination is required, consider showing location of each on Drawings and deleting subparagraph below; otherwise, insert required information.
- 2.6 MOLDED-CASE CIRCUIT BREAKERS.
- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following (all switches to be manufactured by the same manufacturer as the motor control centers used on the project):
 - 1. Cutler-Hammer
 - 2. Allen Bradley
 - 3. Square D
 - B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
 - C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
 - F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
 - G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor. (Provide only when shown on the single line, or required by code)
 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact. (Provide when indicated on drawing)
 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay. (Provide when indicated on drawings)
 7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts. (Provide when indicated on drawing)
 8. Alarm Switch: One NO contact that operates only when circuit breaker has tripped. (Provide when indicated on drawing)
 9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position. (Provide when indicated on drawing)
- 2.7 Retain first option in first subparagraph below for solid-state trip units; retain second option for thermal-magnetic trip units.
- 2.8 Retain subparagraph below if retaining options requiring integral or remote-control power in subparagraphs above and if control power for remote indication or operation is not specified in other Sections. See "Control Power Options" Article in the Evaluations for various sources available for control power. Although other voltages are available, the Section Text includes only those that are most frequently encountered and listed in manufacturers' literature. First option below may not be available in all voltages;

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

coordinate with manufacturers' literature.

2.9 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 4X stainless steel.
 - 3. Corrosion Areas: NEMA 250, Type 4X fiberglass.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X stainless steel.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 4X stainless steel

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 16 Section "Electrical Identification."
 - 1. Identify field-installed conductors, interconnecting wiring, and components;

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
 - D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections..
 - E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 3.5 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
 - B. Set field-adjustable circuit-breaker trip ranges as specified in Division 16 Section "Overcurrent Protective Device Coordination".

END OF SECTION

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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SECTION 16443 MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes motor-control centers for use on ac circuits rated 600 V and less.
- B. Related Sections include the following:
 - 1. Division 16 Section

1.3 SUBMITTALS

- A. Product Data: For each type of controller and each type of motor-control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each motor-control center.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current ratings of buses and installed units.
 - d. Vertical and horizontal bus capacities.
 - e. Retain first subparagraph below if series rating of overcurrent protective devices is used or if combination controllers are used.
 - f. Features, characteristics, ratings, and factory settings of each motor-control center unit.
 - g. Harmonic correction calculations.
 - h. Cable Terminations
 - i. Busway connections

- j. Listing of overcurrent device coordination
- 2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor-control center. Provide schematic wiring diagram for each type of controller.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around motor-control centers where pipe and ducts are prohibited. Show motor-control center layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Qualification Data: For manufacturer.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For motor-control centers, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1.
 - 1. Routine maintenance requirements for motor-control centers and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain motor-control centers and controllers of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. Motor control centers are to be built to the latest NEMA standards.

- F. The motor control center shall be designed, manufactured and tested in facilities registered to the ISO 9001 standard.
- G. Product Selection for Restricted Space: Drawings indicate maximum dimensions for motor-control centers, including clearances between motor-control centers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver motor-control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- B. Handle motor-control centers according to the following:
 - 1. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
 - 2. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."

1.6 COORDINATION

- A. Coordinate layout and installation of motor-control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place" Concrete."
- C. Coordinate features of motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- D. Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.
- E. Provide selective coordination of all overcurrent devices including: circuit breakers, fuses, overload relays, and motor circuit protectors. The selective coordination shall be from the generator circuit breaker, through the low voltage transfer switch, through the MCC, to the motors/low voltage panelboard breakers.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Furnish one spare for every five installed, but no less than one set of three of each type and rating.
 - 2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allen Bradley
 - 2. Eaton (Cutler-Hammer)

2.2 MOTOR-CONTROL CENTERS

- A. Wiring: NEMA ICS 3, Class I, Type B.
- B. Enclosures: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 4X Stainless Steel.
 - 2. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.
 - 3. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor-control center; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
 - 4. Wiring Spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place.

5. Provide a barrier between the wiring spaces and the MCC buckets to prevent inadvertent contact with energized parts.
- C. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-control center location.
- D. Each MCC bucket shall have the ground connection made before the power connections are made.

2.3 BUSES

- A. Material: Plated hard-drawn copper, 98 percent conductivity.
- B. Ampacity Ratings: As indicated for horizontal and vertical main buses.
- C. Neutral Buses: Full size.
- D. Equipment Ground Bus: Non-insulated, horizontal configuration; adequate for equipment ground conductors; bonded to enclosure.
- E. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent.
- F. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.

2.4 FUNCTIONAL FEATURES

- A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center.
- B. Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated.
 1. Install units up to and including Size 3 on draw-out mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
 2. Provide units with short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center section.
 3. Equip units in Type B and Type C motor-control centers with pull-apart terminal strips or draw-out terminal boards for external control connections.
 4. Controller Disconnecting Means: Factory-assembled combination disconnect and controller (see single line for type).

- a. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
 - b. Non-fusible Disconnecting Means: NEMA KS 1, heavy-duty, non-fusible switch.
 - c. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- C. Overcurrent Protective Devices: Individual feeder-tap units through 225-A rating shall have draw-out mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
 - D. Retain paragraph below if suppressors are required. Suppressors are specified in Division 16 Section "Transient Voltage Suppression."
 - E. Transient Voltage Surge Suppressors (TVSS): Connect to motor-control center bus. Provide TVSS protection for all MCC equipment, VFDs, and Soft Starts.
 - F. Coordinate two paragraphs below with Drawings. Indicate, in schedule, sizes of future controllers to be accommodated.
 - G. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of draw-out units.
 - H. Spare Units: Type, sizes, and ratings indicated; installed in compartments indicated "spare."
 - I. Conductor Entry/Exit: Entry and exit for conductors shall be through the bottom of the MCC for all power distribution and motor load cubicles including the incoming power.
 - J. The pump motor thermal, seal failure and disconnect position signals for each pump shall terminate in each pump cubicle. Terminals, relays and circuitry shall be provided to accept these signals, incorporate them into the control circuits in the MCC and reproduce them for use by the local site control system.

2.5 ACROSS-THE-LINE CONTROLLERS

- A. Manual Controller: NEMA ICS 2, general purpose, Class A, with toggle action and overload element.
- B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
 2. Overload Relay: See Section 2.9 for overload relay requirements.
- C. See plans for necessary schematic to allow for proper system integration with the control panel.
- D. All starters and variable frequency drives shall be provided with Ethernet communication modules.

2.6 REDUCED-VOLTAGE CONTROLLERS

- A. Solid-State, Reduced-Voltage Controller (see drawing for requirements): NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, induction motors.
1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.
 2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 3. Motor running contactor operating automatically when full voltage is applied to motor.
- B. See plans for necessary schematics to allow for proper system integration with the control panel.
- C. The reduced voltage starter shall be provided with an Ethernet communication module.

2.7 VARIABLE FREQUENCY DRIVES (VFD)

- A. Description: NEMA ICS 2, pulse-width-modulated, variable frequency controller; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency. The VFDs shall be the Allen Bradley Power Flex 753 series or Danfoss VLT series. The supplied VFDs shall be provided with extended warranties equivalent to the Danfoss DrivePro-tection warranty.
1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.

- B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- D. Unit Operating Requirements:
 - 1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
 - 2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
 - 3. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - 4. Minimum Displacement Primary-Side Power Factor: 96 percent.
 - 5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
 - 6. Starting Torque: 100 percent of rated torque or as indicated.
 - 7. Speed Regulation: Plus or minus 1 percent.
 - 8. Ambient Temperature: 0 to 40 deg C.
- E. Isolated control interface allows controller to follow control signal over an 11:1 speed range.
 - 1. Electrical Signal: 4 to 20 mA at 24 V.
- F. Internal Adjustability Capabilities:
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3. Acceleration: 2 to a minimum of 22 seconds.
 - 4. Deceleration: 2 to minimum of 22 seconds.
 - 5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
- G. Self-Protection and Reliability Features:
 - 1. Input transient protection by means of surge suppressors.
 - 2. Under- and overvoltage trips; inverter over-temperature, overload, and overcurrent trips.

3. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 10, 20, or 30 performance.
 4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 5. Instantaneous line-to-line and line-to-ground overcurrent trips.
 6. Loss-of-phase protection.
 7. Reverse-phase protection.
 8. Short-circuit protection.
 9. Motor over-temperature fault.
- H. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Restarting during deceleration shall not damage controller, motor, or load.
- I. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.
- J. Bypass Controller (provide bypass controller when shown on single line diagram): NEMA ICS 2, full-voltage, non-reversing enclosed controller with across-the-line starting capability in manual-bypass mode or soft starts based on what is shown. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
- K. Integral Disconnecting Means: NEMA AB 1, molded-case switch with lockable handle.
- L. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
- M. Provide 5% input line reactors and output reactors for each VFD supplied.
- N. See plans for necessary schematics to allow for proper system integration with the control panel.
- O. The VFD shall be provided with an Ethernet communication module.

2.8 FEEDER OVERCURRENT PROTECTION

- A. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 2. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 5. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 6. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 7. Ground-Fault Protection (provide when shown on single line diagram): Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 8. Communication Capability (provide when required by control system): Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system.
 9. Shunt Trip (provide when required by control system): 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 10. Auxiliary Switch (provide when required by control system): One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts; "b" contacts operate in reverse of circuit-breaker contacts.
- B. Fusible Switch: NEMA KS 1, Type HD, clips to accommodate specified fuses with lockable handle.

2.9 ACCESSORIES

- A. The Motor Control Center shall be provided with automatic vertical bus shutters.

- B. Control power shall be provided by individual unit control power transformers located in each individual MCC cubicle, as required for control circuit power. The control power transformer shall be de-energized upon power being disengaged from the associated cubicle.

2.10 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and factory-tested, motor-control centers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive motor-control centers for compliance with requirements, installation tolerances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Install motor-control centers on concrete bases.
- B. Comply with mounting and anchoring requirements specified in Division 16 Section "Electrical Supports and Seismic Restraints."

3.4 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

3.5 IDENTIFICATION

- A. Identify motor-control center, motor-control center components, and control wiring according to Division 16 Section "Electrical Identification."
- B. Operating Instructions: Frame printed operating instructions for motor-control centers, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of motor-control centers.

3.6 CONTROL WIRING INSTALLATION

- A. Install wiring between motor-control devices according to Division 16 Section "Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 16 Section "Grounding and Bonding."

3.8 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each motor-control center element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
1. Perform each electrical test and visual and mechanical inspection, except for optional tests, stated in NETA ATS "Motor Control Centers." Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges based on overcurrent device coordination study.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain components of motor-control centers including solid-state controllers. Refer to Division 1.

END OF SECTION

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SECTION 16900 INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes all elements required to furnish and install a complete electrical system to control, operate, and display information as indicated in the plans and specifications. The instrumentation and control system shall include all equipment, devices, wiring, and incidental materials desired to operate the system and display information in accordance with these specifications. The intention of this section is to detail a complete control system that will operate equipment in accordance with narratives and requirements indicated in the plans, specifications, and manufacturer's literature for the equipment installed. All circuits and protection devices for the installed equipment shall be included in the price bid.

1.2 SCOPE

- A. The control panel manufacturer shall work directly for the client. The panel provider will be responsible for providing the following equipment and services:
 - 1. Control panel
 - 2. Programming of the control panel, if necessary
 - 3. Configuration of the variable speed drives, if necessary
 - 4. Factory testing of the pump control panel. The testing shall be performed in the control panel manufacturer's facility and be witnessed by the Owner and/or Owner's representative.
 - 5. On-Site installation assistance as required by the electrical contractor
 - 6. Field verification of the variable frequency drive parameters
 - 7. Field Start-Up services
 - 8. O&M Manuals
 - 9. As-Built drawings in AutoCAD 2012 format.
 - 10. Coordination with the Owner regarding integration of the pump control panel signals into the Owner's SCADA system. Actual integration into the SCADA system will be performed by the Owner.

1.3 SYSTEM DESCRIPTION - WASTEWATER PUMPING STATION CONTROL SYSTEM

- A. Pump Station Control Panel. The pump station control panel shall contain all components necessary to power and control the pumps and interface with the SCADA panel. The control panel shall be provided with the following features/attributes:

1. The pumps shall have three modes of operation: manual, automatic and backup. Selection of the mode of operation for each pump shall be achieved through the use of a 30mm 3 position selector switch (Hand-Off-Auto). When placed in the manual (hand) mode of operation the pump shall be commanded to run. When placed in the automatic (auto) mode of operation the pump shall be commanded to start/stop via the SCADA panel or from the float backup circuitry.
2. All manufacturer required warranty signals (motor thermal, seal failure, etc) shall be incorporated into the automatic and manual modes of operation. Pilot lights for each fault condition shall be provide on the panel exterior to alert site personnel. Additionally, a dry set of form C contacts shall be provided for all fault signals to allow the SCADA system to monitor the status of the station.
3. 30MM push buttons/pilot lights shall be mounted on the panel exterior. The push buttons shall provide the following functions/indications:
 - a. 3 Position selector switch (Hand-Off-Auto) for each pump to select the mode of operation
 - b. Green pilot light to indicate the running status for each pump
 - c. Red pilot lights for any permissive (shutdown) signals for each pump
 - d. Amber pilot lights for any warning (non-shutdown related) signals for each pump
4. Dry contacts shall be provided for all of the following signals so that the local SCADA panel can monitor the status of the well:
 - a. Running status for each pump
 - b. HOA in Auto for each pump
 - c. Motor Overload for each pump
 - d. Motor Thermal Failure for each pump
 - e. Seal Failure for each pump
 - f. High level float
 - g. Low level float
 - h. Station running in float backup mode
 - i. Panel power failure
5. The controls shall be housed in a stainless steel NEMA type 4X assembly with 3 point latch manufactured by Pentair (Hoffman) or engineer approved equal. It shall be constructed to UL508A and UL698A standards.
6. Float backup circuitry. All the components necessary for a float backup circuit shall be supplied to act as a backup mode of operation in the event of a transducer/PLC failure. The float backup circuitry shall consist of the following components at a minimum:
 - a. Intrinsically safe barrier relays. Intrinsically safe barrier relays shall be used for interconnection with the float switches.
 - b. Time delay relay. Time delay relay should be supplied to prevent the simultaneous operation of multiple pumps in the backup mode. The time

delay relays shall be Schneider Electric Zelio RE48A series or engineer approved equal.

7. Pump Monitoring System. In the event that a pump is selected for the project that requires a specific/proprietary pump monitoring system/relay to maintain the manufacturer's warranty the monitoring system or relay shall be provided by the pump supplier to the control panel manufacturer. The monitoring system/relay shall be incorporated into the control panel and all of the manufacturers required interlocks to maintain the pump warranty shall be wired into both the automatic and hand modes of operation.
- B. Pump Station SCADA Panel. The pump station SCADA panel shall be provided by the owner. The control assembly shall be constructed to the Owner's current standard and housed in a NEMA 4X stainless steel enclosure. All configuration, programming and integration into the Owner's SCADA system shall be performed by the Owner.

1.4 INSTRUMENTS

- A. The following instruments shall be supplied for the project:
 1. Float switches. The total number of floats supplied shall be as dictated by the project plans. The floats shall match the Owner's standard throughout the wastewater collection system.
 2. Submersible pressure transducer (level). The submersible pressure transducer shall match the Owner's standard throughout the wastewater collection system. The transducer shall be provided with cable clamp installation/mounting hardware.
 3. Pressure transducer (water system pressure): The pressure transducer shall match the Owner's standard throughout the water distribution system. The pressure transducer shall be provided by the Owner.

1.5 INTEGRATION

- A. Integration of the lift station into the Owner's SCADA system shall be performed by the Owner. However, the pump control panel manufacture shall provide drawings and information as necessary to incorporate the pump control panel signals into the SCADA system.

1.6 SUBMITTALS

- A. Product Data: Manufacturing data sheets for all components indicating pertinent data and identifying each component by item number and nomenclature as indicated on the drawings and in the specifications. Designation as listed in the bill of material shall be clearly indicated on the data sheet. If multiple products or options are shown on the same sheet, Contractor shall clearly indicate which products and options are intended for the item being provided.
- B. Shop Drawings: Submit shop drawings in accordance with the submittals specification section. Include the following:
1. Bill of Material listing all components provided in the control panel.
 2. Complete control schematic in ladder diagram format. Diagram shall include all terminal and wire numbering. Designations for components shall match that used in the bill of material.
 3. Physical layout drawing of switches, meters, pilot lights, and other devices on the control panel door or motor control center cover. If there is a dead front panel behind the door on which components are mounted, then a physical layout drawing of the dead front panel is also required. Component designations shall match the bill of material. Also indicate location and designation of each nameplate.
 4. Physical layout drawing of all devices on the back planes. This shall include but not be limited to relays, starters, contactors, terminal blocks, and wiring troughs. Component designations shall match the bill of material.
 5. A detailed system of identification for control conductors using both color coding and a coded numbering system. Identification system shall be in accordance with industrial standards and practices.
 6. A set of physical wiring diagram drawings. Diagrams shall be point-to-point, and shall include all terminal and wire numbering. The physical layout drawings shall be used as base sheets for the wiring diagrams. The number of wiring diagram sheets shall be kept to a minimum, but still allow the accurate tracing of circuits during troubleshooting. There shall be no overlapping of wires shown in the diagrams.
 7. A set of physical wiring diagram drawings detailing interconnection between the control panel and each Motor Control Center (MCC) cubicle.
 8. Nameplate legend, showing the designation for each, and a scaled or full-size detail of the nameplate. Contractor shall also include a description of the material used for the plate, and the size and typeface of the lettering.
 9. Range of and differential control setting for each variable control device.

- C. Closeout Documentation: Prior to Contract Closeout, Contractor shall turn over to the Engineer one set of reproducible "as built" drawings as described below, and one set of all equipment catalog and maintenance data. Explain and demonstrate the electrical control systems to Owner and/or Owner's representative. As-built drawings shall consist of one complete set of drawings as described in the paragraph on Submittals, with modifications made to reflect any changes made in the field during construction. Contractor shall submit four (4) sets of complete drawings, one (1) electronic version in PDF format and one (1) in CAD drawings on a CD-ROM. It is permissible to use any part of the Contract Documents as a starting point in the development of As-Built drawings; however, the Contract Documents have no terminal and wire numbers, and will require substantial modification before submission.
- D. All above submittals shall be completed and approved prior to construction of systems. Submittal shall be bound with pages continuously numbered. Any oversize documents shall be folded so as to be 8.5"x11" or smaller. Submittals shall include a cover sheet and table of contents listing all items being submitted, and the starting page number of each submittal item. Partial submittals will not be acceptable.
- E. Qualification Data: For testing personnel, as described in "Startup and Testing" article of this section.

1.7 QUALITY ASSURANCE

- A. All control equipment shall conform to UL 508.
- B. Freestanding control panels shall be constructed in accordance with UL 508A.
- C. Controls which are installed in Motor Control Centers shall comply with the requirements of UL 845.
- D. Control panels containing circuitry for hazardous areas shall be constructed in accordance with UL 698A.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All materials relating to this section individually and as completed panels shall be handled as fragile equipment and stored only inside closed buildings and protected from moisture entry. All openings shall be continuously plugged until the moment that connections thereto are actually made.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All power and control sections shall be constructed in accordance with the following standards: National Electrical Manufacturers Association (NEMA), Institute of Electrical and Electronics Engineers (IEEE), Underwriter Laboratories (UL), Nation Fire Protection Association (NFPA), and Instrumentation Systems and Automation Society (ISA)
- B. The control panel shall be constructed in a UL approved production facility and bear all applicable UL labels for panel construction (i.e. UL508A, UL 698A etc.).
- C. The completed panel assembly shall be factory tested prior to shipment. Field installation by the Contractor shall consist only of setting the panel in place and making necessary pneumatic and/or electrical connections.
- D. All power and control sections shall be designed to operate at the service voltage as indicated in the project plans.
- E. Control Panel manufacturing shall be provided by EMC, Automation Control Service, Inc., or engineer approved equal.

2.2 ENCLOSURES

- A. Exterior enclosures shall stainless steel NEMA 4X unless otherwise noted. Interior enclosures shall be NEMA 12 unless otherwise noted.
- B. All interior components shall be mounted with stainless steel hardware and shall be clearly identified with plastic identification nametags. The tags shall be white with black lettering.
- C. All enclosure doors shall be constructed with a 3-point steel latching mechanism in lieu of individual clamps.
- D. All doors shall be provided with heavy gauge stainless steel hinges.
- E. All enclosures shall be constructed of 14 gauge mild steel. The enclosure shall also include a 10 gauge mild steel sub-panel mounted on collar studs for equipment mounting.
- F. All enclosure seams shall be continuously welded and ground smooth.
- G. Data pockets shall be provide on all interior panel doors. The equipment supplier shall provide laminated schematics in each pocket for the associated control panel.

- H. All cabinets shall be sized to accommodate the equipment required plus 25% spare space.
- I. All enclosures shall be provided with hardware to hold the enclosure door(s) open while they are being serviced.

2.3 CONTROL WIRING

- A. Wiring, where required, shall be general-purpose open type, neatly bundled and laced or installed in plastic wiring troughs. Wire shall be stranded No. 16 AWG minimum, with thermoplastic insulation rated for 600V and 90 degrees C.
- B. All equipment mounting backboards shall be provided with nonmetallic slotted ducts. All nonmetallic slotted ducts shall have spare space equal to 40% of the depth of the duct.
- C. Wiring colors shall be as follows:
 1. All ungrounded AC conductors operating at the supply voltage shall be "Black"
 2. All ungrounded AC control conductors operating at a voltage less than or equal to the supply shall be "Red"
 3. All grounded AC current carrying conductors shall be "White"
 4. All ground conductors shall be "Green"
 5. All ungrounded DC control conductors shall be "Orange"
 6. All grounded DC current carrying conductors shall be "Brown"
 7. All intrinsically safe circuits shall be "Blue"
 8. A wiring color code legend shall be mounted inside the control panel door.
- D. All wires entering and leaving all panels shall be terminated at barrier type terminal strips with integral surge protection. All terminals shall be identified and labeled per the Owner's standard naming conventions. It shall be the Supplier's responsibility to coordinate with the Owner for the accepted naming conventions. (All terminal strips shall be designed for #12 AWG, XHHW-2, 90 degree C field wiring for terminations.)
- E. No terminal strip may be located closer than 8" from any side or bottom of the control panel. This is designed to allow for adequate wire bending radius for field terminations.
- F. All wiring shall be clearly marked with an identification number consistent with the wiring schematic.

- G. Devices mounted on the enclosure door or interior dead front panel shall be run in spiral wrap to avoid pinch points when opening and closing the enclosure door(s) or interior panels

2.4 SURGE PROTECTION

- A. All power and digital I/O signals shall be protected from surges at the control panel with suitable surge suppression devices. Panel mounted surge protection shall be Plug in Style & DIN rail mounted to allow for easy replacement. The power and digital I/O signals shall be protected with solid state surge suppression devices manufactured by Phoenix Contact or Engineer approved equal. MOV only type surge suppression is not acceptable.
- B. All analog I/O signals shall be protected by loop powered isolators manufactured by Phoenix Contact or Engineer approved equal.
- C. All incoming power to the control panel shall be protected by Phoenix Contacts "Trabtech" surge protectors or Engineered approved equal rated for the voltage being supplied. Protection shall be provided for all phase and neutral conductors.

2.5 PANEL MOUNTED DEVICES

- A. Indicating lights to be heavy duty, push-to-test type, oil tight, industrial type with integral transformer for 120 VAC applications. Lenses shall be colored as noted on drawings or as required by the equipment manufacturers if not specified on the drawings. Legend plates shall be factory engraved as required. Shall be Allen- Bradley Bulletin 800T 30.5mm, Square D 9001 or approved equal.
- B. Momentary pushbuttons to be heavy duty, oil tight, industrial type with full guard and momentary contact rated at 10 Amps continuous at 120 VAC. Legend plates shall be factory engraved as required. Shall be Allen-Bradley Bulletin 800T 30.5mm, Square D 9001 or approved equal.
- C. Selector switches, on/off and H.O.A. to be heavy duty, oil tight, industrial type with contact rated at 120 VAC, 10 amps continuous service. Legend plates shall be factory engraved as required. Shall be Allen-Bradley Bulletin 800T 30.5mm, Square D 9001 or approved equal.
- D. Current to voltage converters, 4-20mA_{dc} to 1-5V_{dc} shall be as manufactured by Phoenix Contact or Engineer approved equal.
- E. D.C. power supplies shall be as manufactured by PLC Manufacturer, PULS, or approved equal and shall be sized for 1.5 times the application requirements. (No open power supplies will be allowed.)

- F. All relays shall be Potter Brumfield, Omron series MY or G2R series based on the application requirements for switching and ampacity. Units shall incorporate a lamp in parallel with relay coil.
- G. Time delay relays shall be solid state relays with a minimum adjustable range of 0 to 60 minutes unless other ranges are indicated or required. Relays will have a round 8-pin or 11-pin base with an indicator light to show when the relay is energized and/or timing. Time delay relays shall be Schneider Electric or equal.
- H. All circuit breakers shall be of the same AIC rating as the panel to which they are connected and shall be required to selectively coordinate above 0.1 seconds.
- I. H-O-A selector switches are required for each motor starter contained within a control panel. All adjustable speed controllers shall be provided with manual speed adjustment devices (separate from any HMI or Operator Interface Panel), which may be located on the face of the enclosure. H-O-A selector switches and manual speed switches shall allow the operator to control all motors and valves manually in the event of a PLC failure.
- J. Runtimes for each motor starter located in the control panel shall be tracked in the PLC and displayed on the HMI.
- K. Power distribution blocks shall be block style distribution blocks manufactured by Bussmann, Mersen or Engineer approved equal. All distribution blocks shall be provided with polycarbonate safety covers to provide dead front protection if they aren't inherently finger safe. The safety cover shall have a test prod hole for testing purposes
- L. Fuse blocks/holders shall be UL style fuse blocks manufactured by Bussmann, Mersen or Engineer approved equal.
- M. General purpose fuses shall be by Bussmann, Ferrez Shawmut or Engineer approved equal. Unless otherwise noted the fuse rating and type shall be determined based on the equipment (which the fuse is protecting) manufacturer's recommendations for overcurrent protection.
- N. Semiconductor fuses shall be Mersen Amp Trap series fuses or Engineer approved equal. Unless otherwise noted the fuse rating and type shall be determined based on the equipment (which the fuse is protecting) manufacturer's recommendations for overcurrent protection.
- O. All control transformers shall be sized to provide 25% spare capacity. The transformer connections shall be provided with protective covers to guard against accidental contact, and the transformer shall be provided with primary and secondary fusing per the manufacturer's recommendations.

INSTRUMENTATION AND CONTROLS

- P. Each control panel shall be provided with a ground fault duplex service receptacle that is accessible from the interior dead-front panel. The service receptacle shall be capable of providing 15A at 125VAC
- Q. All intrinsically safe barrier relays shall be UL listed and shall be manufactured by Phoenix Contact or Engineer approved equal.
- R. All circuit breakers shall be manufactured by Square D or Engineer approved equal. A main circuit breaker shall be provided for each control panel.
- S. Pilot lights shall be provided for each starter located inside the control panel. The lights shall be as follows: Green (Run), Amber (Fault).
- T. Control power transformers shall be provided in each control panel with a supply voltage other than 120V or 120/208V. Control power transformers shall be manufactured by Square D, Allen Bradley or engineer approved equal and provided with both primary and secondary fuses per the NEC.
- U. Terminal strips shall be solderless box lug compression type of adequate capacity for the size and number of conductors to be terminated. The area around each lug and set screw shall have insulation barriers to prevent accidental shorting during assembly or use. Ratings: 300V and 20A minimum. Shall be by Allen Bradley, Phoenix Contact or engineer approved equal.
- V. Panel mounted lighting. Luminaries shall be 15 to 30 watt, rapid start fluorescent strip type, with warm white lamps. A lens or guard shall be provided over each lamp. Luminaire ballasts shall be rated for reliable operation in an ambient temperature of 30 degrees Fahrenheit. Door switches should be provided to energize the lights once the doors are opened.

2.6 MISCELLANEOUS

- A. Engraved laminated plastic nameplates shall be furnished for each front panel mounted instrument. The Contractor shall coordinate with the Owner for nameplate color and naming conventions. All instruments and components shall be tagged on rear with embossed plastic tape labels.
- B. No pneumatic tubing shall be installed inside the control panels.

PART 3 - EXECUTION

3.1 GENERAL

- A. All Work shall be done in accordance with appropriate Division 16 Sections and shall be performed in a workmanlike manner.

3.2 FABRICATION

- A. All control panels shall be shop assembled and factory tested prior to delivery to the site. Final as-built drawings shall be made to reflect all adjustments and modifications made to the systems after start-up has been completed satisfactorily. All equipment and devices shall be mounted, adjusted, calibrated and operated exactly as recommended by the manufacturer of each component.
- B. Control switches, pilot lights, and other devices shall be grouped in a logical arrangement for ease of operation.
- C. Control equipment shall be mounted to panel back plates with screws or bolts fastened into drilled and tapped holes. Nuts shall not be used. Panel face mountings shall be made by cutting holes exactly to manufacturer's instructions including keyways, etc. Engraved legend plates indicating function and operational instructions as applicable shall be mounted on all devices. All equipment shall be labeled and identified with designations which match the control wiring diagrams.

3.3 EQUIPMENT INSTALLATION

- A. All equipment shall be installed in accordance with approved shop drawings and manufacturer's written instructions.

3.4 WIRING AND TERMINATIONS

- A. All wires shall be run parallel to side walls of panels and/or in covered wiring troughs. Wiring passing across hinged areas shall be protected by abrasion resistant cabling material.
- B. All connections shall be made on mechanical compression or screw type terminals whenever possible. All connections for incoming and outgoing electrical wires in all panels and junction boxes shall be made on fully labeled terminal boards mounted inside the panel.

3.5 IDENTIFICATION

- A. All conductors shall be labeled at each end with numbers matching shop drawings and all wire terminations shall be identified by the component terminal numbers and shown on shop drawings. Each conductor shall be identified at each terminal end and each accessible manhole or junction box.
- B. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."
- C. Identify all major components as shown on plans, according to Division 16 Section "Electrical Identification".

3.6 FIELD CALIBRATION

- A. All instrumentation shall be calibrated in the presence of the Engineer, Owners Rep or Owner in accordance with the range and accuracy specified herein.
- B. All equipment shall be calibrated using a standard calibration sheet which has been approved by the Engineer. This calibration sheet shall be filled out identifying the instrument or item to be calibrated and signed with date and initials of the person calibrating the device.

3.7 START-UP AND TESTING

- A. Start-up and testing services shall be performed by ISA certified technicians experienced in these type systems. Certifications shall be attached with the bid documents.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control devices.
- B. Train Owner's maintenance personnel on procedures and schedules for maintaining control devices.
- C. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
- D. Schedule training with Owner with at least ten (10) business days advance notice

END OF SECTION

**SECTION 01010
SUMMARY OF WORK**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General Description of Project
- B. CONTRACTOR - Responsibility
- C. OWNER - Responsibility
- D. Contractor's Use of Site and Equipment Offload

1.2 GENERAL DESCRIPTION OF PROJECT

- A. Supply a new complete sanitary sewer pumping station. Bid shall include 2-15 HP recessed impeller submersible sewer pumps, 8' diameter FRP wetwell, stainless steel discharge piping, 5' diameter FRP manhole; and all other appurtenances and related work required to complete the Work.
- B. Contracting Method: Direct Bid (MATERIAL ONLY).

1.3 MATERIAL CONTRACTOR RESPONSIBILITY

- A. The following items are intended to identify the general materials and deliverables to be included in the Material Contractor's bid proposal.
 - 1. Furnish the following pumps and pump components and appurtenances.
 - a. A 8' diameter single molded FRP wetwell in accordance with the Contract Drawings and Specification. Wetwell shall be delivered to the site fully assembled and ready for operation. The wetwell shall include hatch covers, pumps, guiderails systems, piping supports, fasteners, influent drop structure, floats and level transducer, discharge piping, wall penetration sleeves and seals as noted on drawings.
 - b. Note: Wetwell discharge piping shall be extended to 24" from outer wall of wetwell and shall include 125 lb flange fitting for future connection of Owner supplied piping.
 - c. Cut openings and field fabricate sleeves for large diameter pipe penetration and electrical pump leads. Coordinate with OWNER on final location and elevation. Provide mechanical seal between carrier pipe and sleeve after installation and testing.
 - d. Provide minimum 60 ft pump electrical leads for each pump and floats. Leads shall be capable of being extended for termination by Owner into Disconnect Switch and Junction Box. The Level Transducer shall be supplied with a minimum 100 ft lead, to provide uninterrupted connectivity to the control system.

- e. Deliver and offload at project site location in accordance with Section 13125, and shall include all necessary material and labor to secure structure as a permanent fixture. Coordinate with the OWNER a minimum 3 weeks in advance of delivery.

1.4 OWNER RESPONSIBILITY

- A. OWNER will perform certain activities in connection with the Work as follows:
 - 1. Furnish and Install the following components and appurtenances.
 - a. All below ground discharge piping, valves and fittings outside the wetwell (See Contract Drawings for Owner Responsibility)
 - b. AR valves, taps and pressure gauges.
 - c. 10" influent piping (Material Contractor to field fabricated sleeves after installation of wetwell)
 - d. Below ground electrical and control wiring and conduits
 - e. Control Panel mounting material and foundation, including electrical stub-ups
 - f. Wetwell installation, including annual space fill and concrete pads.
 - g. 4 - NEMA 4x Disconnect Switches, conduit and supporting structures.

1.5 MATERIAL CONTRACTOR'S USE OF SITE

- A. CONTRACTOR'S use of the Site shall be confined to the areas shown.
- B. CONTRACTOR shall:
 - 1. Contractor shall coordinate with the OWNER and assume full responsibility for delivery of equipment to the project site and the associated labor, material and equipment required to fully offload the specified equipment at the OWNERS specified location.
 - 2. Obtain and pay for all additional storage or work areas required for its operations and testing, prior to schedule delivery.

END OF SECTION

**SECTION 01330
SUBMITTALS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Submittals are required prior to, during, and at the end of the installation period. The submittals shall conform to the requirements described in this Section and all referenced Sections or Articles.

1.2 PROCEDURE

- A. Submit the following items within five days after the Contract is executed.
 - 1. Shop Drawings, Product Data and Samples: Submit Shop Drawings, product data and samples in accordance with Section 01332, Shop Drawing Procedures, and as required in applicable Sections of the Contract Documents.
 - 2. Request for Information: Submit a Request for Information (RFI), when any of the following are required: an interpretation of the Specifications; additional details; information not shown on the Drawings or in the Specifications; or clarification of discrepancies is required. Manufacturer shall retain one copy and submit one copy to the ENGINEER for response.
 - 3. Operation and Maintenance Manuals and Lesson Plans: Submit Equipment Operation and Maintenance Manuals for approval, by the ENGINEER, within 30 days after approval of Equipment Shop Drawing. Submit Equipment Training Lesson Plans for approval, by the ENGINEER, 60 days prior to commencement of training. Submit Operation and Maintenance Data and Lesson Plans in accordance with Section 01782, Operation and Maintenance Data.
- B. Submittal At Final Completion: Submit the following items in the proper form as a condition of Final Acceptance of the Work:
 - 1. Guarantees, Warranties, and Bonds: Submit as listed in various Sections of the Specifications.
 - 2. Operations and Maintenance Data: Submit all remaining product data and manuals as specified in various Sections of the Specifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SHOP DRAWING PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The submittal of Shop Drawings shall conform to requirements in this Section. A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required.
- B. The term "Shop Drawings" as used herein shall be understood to include detailed design calculations, fabrication and installation drawings, lists, graphs, test data, operating instructions, and other items which shall include, but are not necessarily limited to:
 - 1. Drawings and catalog information and cuts.
 - 2. Specifications, parts list, suggested spare parts lists, and equipment drawings.
 - 3. Wiring diagrams of systems and equipment.
 - 4. Complete lubrication, maintenance and operation instructions, including initial startup instructions.
 - 5. Applicable certifications.
 - 6. Anchor bolt templates, mounting instructions, and mounting design calculations as required.
 - 7. Required maintenance operations to allow all installed equipment to remain idle for a period of time not to exceed 24 months.
 - 8. Other technical, installation, and maintenance data as applicable.
 - 9. Unloading and handling methods and storage requirements.
 - 10. Note, highlight, and explain proposed changes to the Contract Documents.
 - 11. Paint submittal showing type of paint and the mils thickness of coating system used.
 - 12. Drawings showing Installation Contractor field verifications illustrating all field dimensions. Installation Contractor shall field verify all dimensions and existing materials shown on the Drawings. Any modifications required shall be at Installation Contractor's expense.

1.2 PROCEDURE

- A. Submit Shop Drawings to ENGINEER.
- B. A letter of transmittal shall accompany each submittal. If data for more than one Section of the Specifications is submitted, a separate transmittal letter shall accompany the data submitted for each Section.
- C. All letters of transmittal shall be submitted in duplicate.

SHOP DRAWING PROCEDURES

- D. At the beginning of each letter of transmittal, provide a reference heading indicating the following:
 - 1. OWNER'S Name: _____
 - 2. Project Name: _____
 - 3. Contract No.: _____
 - 4. Transmittal No.: _____
 - 5. Section No.: _____

- E. If a Shop Drawing deviates from the requirements of the Contract Documents, Manufacturer shall specifically note each variation in his letter of transmittal.

- F. All Shop Drawings submitted for approval shall have a title block with complete identifying information satisfactory to ENGINEER.

- G. All Shop Drawings submitted shall bear the stamp of approval and signature of Manufacturer as evidence that they have been reviewed and verified to the completeness of the submittal by Manufacturer. Submittal without this stamp of approval will not be reviewed by ENGINEER and will be returned to Manufacturer. Manufacturer's stamp shall contain the following minimum information:

Project Name: _____

Manufacturer's Name: _____

Date: _____

-----Reference-----

Item: _____

Specifications:

Section: _____

Page No.: _____

Page No.: _____

Drawing No.: _____ of _____

Location: _____

Submittal No.: _____

Approved By: _____

- H. Manufacturer shall utilize the submittal identification numbering system as follows:
 - 1. The Submittal Number shall be a separate and unique number correlating to each individual submittal that is required to be tracked as a separate and unique item. The Submittal Number shall be a two part, eight character, alpha/numeric number assigned by Manufacturer in the following manner:

SHOP DRAWING PROCEDURES

- a. The first part of the Submittal Number shall consist of five characters that pertain to the applicable Specification Section number.
 - b. The second part of the Submittal Number shall consist of three digits (numbers 001 to 999) to number each separate and unique submittal submitted under each Specification Section.
 - c. A dash shall separate the two parts of the Submittal Number.
 - d. A typical Submittal Number for the third Working Drawing submitted under Section 15101, Ductile Iron Pipe, would be 15101-003.
2. The Review Cycle shall be a three-digit number indicating the initial submission or resubmission of the same submittal. For example:

001 = First (initial) submission.
002 = Second submission (first resubmission).
003 = Third submission (second resubmission).

3. An example of the typical submittal identification numbers for the first submission of the third submittal submitted under Section 15051, Buried Piping Installation is:

<u>Submittal Number</u>	<u>Review Cycle</u>
15051-003	001

An example of the typical submittal identification numbers for the second submission of the third submittal submitted under Section 15051, Buried Piping Installation is:

<u>Submittal Number</u>	<u>Review Cycle</u>
15051-003	002

- I. Manufacturer shall initially submit to ENGINEER a minimum of five copies of all submittals that are on 11-inch by 17-inch or smaller sheets, and one unfolded reproducible and three prints made from that reproducible for all submittal on sheets larger than 11-inch by 17-inch.
- J. After ENGINEER completes his review, Shop Drawings will be affixed with a stamp and marked with one of the following notations:
 1. Approved.
 2. Approved as Corrected.
 3. Approved as Corrected, Resubmit.
 4. Revise and Resubmit.
 5. Not Approved.
 6. Not Reviewed.
 7. For Information Only.

SHOP DRAWING PROCEDURES

- K. If a submittal is acceptable, it will be marked "Approved" or "Approved as Corrected." Three prints or copies of the submittal will be returned to Manufacturer.
- L. Upon return of a submittal marked "Approved" or "Approved as Corrected," Manufacturer may order, ship or fabricate the materials included on the submittal, provided it is in accordance with the corrections indicated.
- M. If a Shop Drawing marked "Approved as Corrected" has extensive corrections or corrections affecting other Shop Drawings or Work, ENGINEER may require that Manufacturer make the corrections indicated thereon and resubmit the Shop Drawings for record purposes. Such Shop Drawings will have the notation, "Approved as Corrected - Resubmit." The corrected Shop Drawing shall be a pre-condition for payment for the work item of the Shop Drawing.
- N. If a submittal is unacceptable, two copies will be returned to Manufacturer with one of the following notations:
 - 1. "Revise and Resubmit."
 - 2. "Not Approved."
- O. Upon return of a submittal marked "Revise and Resubmit", Manufacturer shall make the corrections indicated and repeat the initial approval procedure. The "Not Approved" notation is used to indicate material or equipment that is not acceptable. Upon return of a submittal so marked, Manufacturer shall repeat the initial approval procedure utilizing acceptable material or equipment.
- P. Shop Drawings shall be submitted well in advance of the need for the material or equipment for construction and with ample allowance for the time required to make delivery of material or equipment after data covering such is approved. Manufacturer and Installation Contractor shall assume the risk for all Work, materials or equipment that are fabricated, delivered or installed prior to the approval of Shop Drawings. Materials or equipment will not be included in periodic progress payments until approval thereof has been obtained in the specified manner.
- Q. ENGINEER will review and process all submittals promptly; a reasonable time shall be allowed for this, for the Shop Drawings being revised and resubmitted, and for time required to return the approved Shop Drawings to Manufacturer.
- R. Manufacturer shall furnish required submittals with complete information and accuracy in order to achieve required approval of an item within two submittals.
- S. Mark each page of a submittal and each individual component submitted with the specification number, paragraph, and subparagraph. Arrange submittal information presentation to appear in the sequence in the Specification Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01400
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve CONTRACTOR of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit CONTRACTOR's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for CONTRACTOR to provide quality-assurance and -control services required by ENGINEER, OWNER, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See Divisions 2 through 16 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by ENGINEER.
- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. Installer/Applicator/Erector: CONTRACTOR or another entity engaged by CONTRACTOR as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to ENGINEER for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to ENGINEER for a decision before proceeding.

1.4 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Reports: Prepare and submit certified written reports that include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- C. Permits, Licenses, and Certificates: For OWNER's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by ENGINEER.
 2. Notify ENGINEER seven days in advance of dates and times when mockups will be constructed.
 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 4. Obtain ENGINEER's approval of mockups before starting work, fabrication, or construction.
 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 6. Demolish and remove mockups when directed, unless otherwise indicated.

- J. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 2 through 16.

1.6 QUALITY CONTROL

- A. OWNER Responsibilities: Where quality-control services are indicated as OWNER's responsibility, OWNER will engage a qualified testing agency to perform these services.
 - 1. OWNER will furnish CONTRACTOR with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to CONTRACTOR, and the Contract Sum will be adjusted by Change Order.
- B. Tests and inspections not explicitly assigned to OWNER are CONTRACTOR's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of CONTRACTOR by authorities having jurisdiction, whether specified or not.
 - 1. Where services are indicated as CONTRACTOR's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. CONTRACTOR shall not employ same entity engaged by OWNER, unless agreed to in writing by OWNER.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 3. Where quality-control services are indicated as CONTRACTOR's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspecting requested by CONTRACTOR and not required by the Contract Documents are CONTRACTOR's responsibility.
 - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."
- D. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

- E. Testing Agency Responsibilities: Cooperate with ENGINEER and CONTRACTOR in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify ENGINEER and CONTRACTOR promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through CONTRACTOR.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of CONTRACTOR.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are CONTRACTOR's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

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**SECTION 01630
SUBSTITUTION PROCEDURES**

1.1 PROCEDURE FOR REQUESTING SUBSTITUTION:

- A. In order that the Owner may determine if a proposed, unnamed substitute item shall be allowed for the specified and named equipment/supplier, the information below shall be SUBMITTED A MINIMUM 10 DAYS PRIOR TO PROPOSAL BID DATE.
- B. Written requests must be submitted to the Engineer.
- C. Transmittal Contents:
 - 1. Product identification:
 - a. Manufacturer's name.
 - b. Telephone number and representative contact name.
 - c. Specification section or drawing reference of originally specified product, including discrete name or tag number assigned to original product in the Contract Documents.
 - 2. Manufacturer's literature clearly marked to show compliance of proposed product with Contract Documents.
 - 3. Itemized comparison of original and proposed product addressing product characteristics including but not necessarily limited to:
 - a. Size.
 - b. Composition or materials of construction.
 - c. Weight.
 - d. Electrical or mechanical requirements.
 - 4. Product experience:
 - a. Location of past projects utilizing product including three of the most recent installations where similar equipment by the manufacturer or manufacturer's representative is currently in service; include contact name, telephone number, mailing address, and the names of the Engineer, Owner, and installation contractor; if three installations do not exist, the list shall include all that do exist, if any.
 - b. Available field data and reports associated with proposed product.
 - 5. Data relating to changes in construction schedule.
 - 6. Data relating to changes in cost.
 - 7. Samples:
 - a. As requested by the Engineer/ Owner.

1.2 APPROVAL OR REJECTION:

- A. Written approval or rejection of substitution given by the Engineer.
- B. Engineer reserves the right to require proposed product to comply with color and pattern of specified product if necessary to secure design intent.
- C. In event substitution results in a change in design or time, provisions in General Conditions will be applied for adjustment.
- D. Substitutions will be rejected if:
 - 1. Submittal is not through the Supplier with their written approval product is of equal quality and service.
 - 2. Requests are not made in accordance with this Section.
 - 3. In the Engineer's opinion, acceptance will require substantial revision of the original design.
 - 4. In the Engineer's opinion, substitution will not perform adequately the function consistent with the design intent, including operational and maintenance impacts.

END OF SECTION

**SECTION 01640
MANUFACTURER'S SERVICES**

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Reference Section 01650, FACILITY STARTUP
- B. Person-Day: One person for 8 hours within regular CONTRACTOR working hours.

1.2 SCOPE

- A. Work under this section defines the minimum scope of services to be provided using factory representatives of the manufacturers of the equipment to be installed during installation, start-up, and operator training.
- B. Equipment manufacturers assigned unit responsibility for systems comprised of several components shall provide the service of factory representative from each component manufacturer to perform the duties required under these Specifications. The equipment manufacturer assigned unit responsibility shall be responsible for coordinating the activities of the system component manufacturers.

1.3 SUBMITTALS

- A. Training Schedule: Submit not less than 15 days prior to equipment installation and revise as necessary for acceptance.
- B. Training Materials:
 - 1. Final training materials must be approved by ENGINEER prior to equipment startup and training.
 - 2. Furnish complete outlines of proposed training session, operation and maintenance data for each trainee in attendance.
- C. Quality Control Submittals: As required in the individual Specification, submit:
 - 1. Qualifications of Manufacturer's Representative performing specified services.
 - 2. Manufacturer's Certificate of Proper Installation using form provided by Manufacturer.

1.4 QUALIFICATION

- A. Qualification of the representatives for installation, startup, and operator training purposes shall be an authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation and maintenance of the equipment being installed and shall be subject to the approval of the ENGINEER. No substitutions of approved representatives will be allowed without the prior written approval of the ENGINEER.
- B. References in various equipment sections of the terms "factory representative" or "field representative" shall mean an employee or contractor of the equipment manufacturer who is trained, articulate, capable of coordinating and expediting training, and familiar with operation and maintenance manual information specified in Section 01782, OPERATION AND MAINTENANCE DATA.

1.5 COORDINATION

- A. Contractor shall notify ENGINEER 72 hours prior to any impending visit by factory representatives so that the ENGINEER may be present.
- B. ENGINEER may approve the services of a manufacturer's representative for more than one system during the same site visit.
- C. Installation Contractor shall perform the necessary inspections to ensure that all conditions necessary for successful training and/or startup services have been met prior to scheduling manufacturer's onsite services.

1.6 MINIMUM MANUFACTURER'S SERVICES REQUIREMENTS

- A. Qualified factory representatives shall furnish manufacturer's services as specified in the Contract Documents.
- B. Where time is specified in the Contract Documents for manufacturer's services, the specified time shall be considered a minimum time and any time in excess of the specified time stated in the specifications to perform the required manufacturer's services shall be considered incidental work. ENGINEER approved days of service will be credited to fulfill the specified minimum manufacturer's services.
- C. Installation Contractor's training and startup schedule shall coordinate manufacturer's services to avoid conflicting with other onsite testing or other manufacturer's services.
- D. Manufacturer's services will include the following, as applicable to the specific system or equipment items:
 - 1. Installation assistance including observation, guidance, instruction of Installation Contractor's assembly, erection, installation or applications.

2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish written approval of installation.
3. Additional site visits as necessary to address problems and until installation and operation are acceptable to ENGINEER.
4. Perform, coordinate, and assist during functional and performance testing and startup demonstration, and until product acceptance by the ENGINEER.
5. Training of OWNER'S personnel in the operation and maintenance of respective product as required.
6. Completion of Manufacturer's Certificate of Proper Installation with applicable certificates for proper installation and initial, interim, and final test or service.

1.7 SCHEDULE

- A. Coordinate with Installation Contractor the following.
- B. List specified equipment and systems with respective manufacturers that require training services of manufacturers' representatives and show:
 1. Estimated dates for installation completion.
 2. Estimated training dates to allow for multiple sessions when several shifts are involved.
- C. Adjust training schedule to ensure training of appropriate personnel as deemed necessary by OWNER, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.

1.8 TRAINING PLAN

- A. Training Plan: Submit for each proposed course:
 1. Title and objectives.
 2. Schedule of training courses including dates, durations, and locations of each class.
 3. Recommended types of attendees (e.g., managers, engineers, operators, maintenance).
 4. Course description and outline of course content.
 5. Duration.
 6. Instruction materials and equipment requirements.
 7. Detailed course schedule for each day showing time allocated to each topic.
 8. Resumes of instructors providing the training.

1.9 TRAINING OWNER'S PERSONNEL

- A. Manufacturer shall furnish the services of a factory representative to train the operations staff in the operation and maintenance of each item installed under these

MANUFACTURER'S SERVICES

Specifications. The time required to perform these services shall be shown in the equipment section, but shall be no less than one (1), eight (8) hour day.

- B. Prestartup Training:
 - 1. Coordinate training sessions with operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01782, OPERATION AND MAINTENANCE DATA.
 - 2. Complete at least 14 days prior to actual startup.

- C. Post-Startup Training: If required in Specifications, furnish and coordinate training of OWNER'S operating personnel by respective manufacturer's representatives.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01650
FACILITY STARTUP**

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Reference Section 01640, MANUFACTURER'S SERVICES
- B. Functional Test: A test or tests in the presence of the ENGINEER and OWNER to demonstrate that the installed equipment or system meets manufacturer's installation and adjustment requirements and other requirements specified including, but not limited to, noise, vibration, alignment, speed, proper electrical and mechanical connections, thrust restraint, proper rotation, and initial servicing.
- C. Performance Test: A test performed in the presence of the ENGINEER and OWNER and after any required functional test specified, to demonstrate and confirm that the equipment and/or system meet the specified performance requirements.
- D. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment. Examples of systems on this Project are as follows:
 - 1. FRP wetwell, discharge piping.
 - 2. Pumps, motors, equipment appurtenances, transducers.
 - 3. Instrumentation and control system(s).

1.2 SCOPE

- A. Work under this Section includes, but is not necessarily limited to, the provision of all labor and material required to perform startup of all equipment and mechanical systems installed under this Contract.
- B. Work defined under this Section includes providing the services of a factory representative in accordance with the requirements of Section 01640 MANUFACTURER'S SERVICES.

1.3 SUBMITTALS

A. Administrative Submittals:

1. Functional and performance test schedules and plan for equipment, units, and systems at least 15 days prior to start of related testing. Include test plan, procedures, and log format.
2. Schedule and plan of facility startup activities at least 15 days prior to commencement.

B. Quality Control Submittals:

1. Manufacturer's Certificate of Proper Installation as required.
2. Test Reports: Functional and performance testing, in format acceptable to ENGINEER and certification of functional and performance test for each piece of equipment or system specified.
3. Certifications of Calibration: Testing equipment.

1.4 MANUFACTURER AND INSTALLATION CONTRACTOR FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Perform all Work necessary for functional and performance tests specified in the Contract Documents.
2. Demonstrate proper installation, adjustment, function, performance, and operation of equipment, systems, control devices, and required interfaces individually and in conjunction with process instrumentation and control system.
3. Complete Work associated with the unit and related processes before testing, including related manufacturer's representative services.
4. Installation Contractor shall have, at the plant site, Operation and Maintenance Manuals for equipment to be started.
5. Furnish qualified manufacturer's representatives when required to assist in testing.
6. Utilize the Manufacturer's Certificate of Proper Installation Form from Section 01640, MANUFACTURERS' SERVICES, supplemented as necessary, to document functional and performance procedures, results, problems, and conclusions.
7. Schedule and attend pretest (functional and performance) meetings related to test schedule, plan of test, materials, chemicals, and liquids required, facilities' operations interface, ENGINEER and OWNER involvement.
8. Designate and furnish one or more persons to be responsible for coordinating and expediting Installation Contractor's facility startup duties. The person or persons shall be present during facility startup meetings and shall be available at all times during the facility startup period.

9. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing.

1.5 OWNER/ENGINEER FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Review CONTRACTOR'S test plan and schedule.
2. Witness each functional or performance test.
3. Coordinate other plant operations, if necessary, to facilitate testing.
4. Provide water, power, chemicals, and other items as required for testing, unless otherwise indicated.

B. Startup Test Period:

1. Operate process units and devices, with support of Installation Contractor.
2. Provide sampling, labor, and materials as required and provide laboratory analyses.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Cleaning and Checking: Prior to starting functional testing:

1. Calibrate testing equipment for accurate results.
2. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.
3. Lubricate equipment in accordance with manufacturer's instructions.
4. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
5. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
6. Check power supply to electric-powered equipment for correct voltage.
7. Adjust clearances and torques.
8. Test piping for leaks.
9. Balance HVAC systems, measuring airflow (cfm) static pressure, and component pressure losses. Furnish typed report documenting results of balancing.
10. Obtain completion of applicable portions of Manufacturer's Certificate of Proper Installation in accordance with Section 01640, MANUFACTURERS' SERVICES.

B. Startup Test Period:

1. As applicable to the equipment furnished, state in writing that all necessary hydraulic structures, piping systems, and valves have been successfully tested; that all necessary equipment systems and subsystems have been checked for

proper installation, started, and successfully tested to indicate that they are all operational; that the systems and subsystems are capable of performing their intended functions; and that the facilities are ready for startup and intended operation.

2. Attend prestartup planning meetings and arrange for attendants by key major equipment manufacturer representatives as required by the Contract Documents.
 3. Designate and provide one or more persons to be responsible for coordinating and expediting Installation Contractor's startup duties.
 4. When plant startup has commenced, schedule remaining Work so as not to interfere with or delay the completion of plant startup. Support the startup activities with adequate staff to prevent delays, process upsets. This staff shall include, but not be limited to, major equipment and system manufacturers' representatives, subcontractors, electricians, instrumentation personnel, millwrights, pipefitters, plumbers.
 5. Supply and coordinate specified manufacturer's plant startup services.
 6. Make adjustments, repairs, and corrections necessary to complete plant startup.
 7. After the plant is operating, complete the testing of those items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to plant startup.
- C. Ready-to-test determination will be by ENGINEER based at least on the following:
1. Notification by CONTRACTOR of equipment and system readiness for testing.
 2. Acceptable testing plan.
 3. Acceptable Operation and Maintenance Manuals.
 4. Receipt of Manufacturer's Certificate of Proper Installation, if specified.
 5. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.
 6. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment, and satisfactory fulfillment of other specified manufacturers' responsibilities.
 7. Equipment and electrical tagging complete.
 8. All spare parts and special tools delivered to OWNER.

3.2 FUNCTIONAL TESTING—GENERAL

- A. Begin testing at a time mutually agreed upon by the OWNER, ENGINEER, and Installation Contractor.
- B. ENGINEER will be present during test. Notify in writing OWNER, ENGINEER, and manufacturer's representative(s) at least 10 days prior to scheduled date of functional tests.
- C. Separate items of equipment demonstrated to function properly during subsystem testing may require no further functional test if documentation of subsystem testing is acceptable to ENGINEER.

- D. Conduct functional tests as specified for each equipment item or system.
- E. Demonstrate all operational features and instrumentation and control functions while in automatic mode.
- F. If, in ENGINEER'S opinion, functional test results do not meet requirements specified, the systems will be considered as nonconforming.
- G. Performance testing shall not commence until the equipment or system meets the specified functional tests.

3.3 PERFORMANCE TEST –GENERAL

- A. Begin testing at a time mutually agreed upon by the OWNER, ENGINEER, and Installation Contractor.
- B. ENGINEER will be present during test. Notify in writing OWNER, ENGINEER, and manufacturer's representative(s) at least 15 days prior to scheduled date of functional tests.
- C. Conduct performance tests as specified for each equipment item or system.
- D. Unless otherwise indicated, Installation Contractor shall furnish all labor, materials, and supplies for conducting the test and taking all samples and performance measurements.
- E. Prepare performance test report summarizing test method. Include test logs, pertinent calculations, and Manufacturer's written certification that the equipment or system performs as specified.

3.4 STARTUP TEST PERIOD

- A. A. General:
 - 1. Attend planning meetings and arrange for attendance by key major equipment manufacturer representatives as required by the Contract Documents.
 - 2. When facility startup has commenced, schedule remaining Work so as not to interfere with or delay the completion of facility startup.
 - 3. Support facility startup activities with adequate staff to prevent delays. Such staff shall include, but not be limited to, major equipment and system manufacturer's representatives, electricians, instrumentation and control personnel, millwrights, pipefitters, and plumbers.
 - 4. Furnish and coordinate specified manufacturer's facility startup services.
 - 5. After the facility is operating, complete the testing of those items of equipment, systems, and subsystems which could not or were not successfully tested prior to the startup test period.

- B. Startup Testing:
1. Startup of the entire facility or any portion thereof requires the coordinated operation of the facilities by the CONTRACTOR, subcontractors, OWNER'S operating personnel, and manufacturer's representatives.
 2. Startup test period shall occur after all required functional tests have been completed and those performance tests deemed necessary for the safe operation of the entire facility have been completed.
 3. Startup of the entire facility or any portion thereof shall be considered complete when, in the opinion of the ENGINEER, the facility or designated portion has operated in the manner intended for 20 continuous days without significant interruption. This period is in addition to any training, functional, or performance test periods specified elsewhere.
 4. Signification interruption may include any of the following events:
 - a. Failure of CONTRACTOR to maintain qualified onsite startup personnel as schedule.
 - b. Failure to meet specified performance for more than 2 consecutive hours.
 - c. Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within 5 hours after failure.
 - d. Failure of any non-critical unit, system, or subsystem that is not satisfactorily corrected within 8 hours after failure.
 - e. As may be determined by ENGINEER.
 5. A significant interruption will require the startup then in progress to be stopped and restarted after corrections are made.
- C. Startup Test Reports: As applicable to the equipment furnished, certify in writing that:
1. Hydraulic structures, piping systems, and valves have been successfully tested.
 2. Equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are operational.
 3. Systems and subsystems are capable of performing their intended functions, including fully-automatic.
 4. Facilities are ready for intended operation.

END OF SECTION

**SECTION 01782
OPERATION AND MAINTENANCE DATA**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Emergency manuals.
 - 2. Operation manuals for systems, subsystems, and equipment.
 - 3. Maintenance manuals for the care and maintenance of products, materials, finishes, systems, and equipment.
- B. See Divisions 16 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 SUBMITTALS

- A. Manual: Submit 3 copies of each manual in final form at least 15 days before final inspection. ENGINEER will return copy with comments within 15 days after final inspection.
 - 1. Correct or modify each manual to comply with ENGINEER's comments. Submit 3 copies of each corrected manual within 20 days of receipt of ENGINEER's comments.

PART 2 - PRODUCTS

2.1 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project and Project Number.
 - 3. Name and address of OWNER.

4. Date of submittal.
 5. Name, address, and telephone number of CONTRACTOR.
 6. Name and address of ENGINEER.
 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project name and number, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for type of emergency, emergency instructions, and emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment,

and component for fire, flood, gas leak, water leak, power failure, water outage, equipment failure, and chemical release or spill.

- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of OWNER's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include instructions on stopping, shutdown instructions for each type of emergency, operating instructions for conditions outside normal operating limits, and required sequences for electric or electronic systems.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
- B. Descriptions: Include the following:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

- B. Source Information: List each product included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- D. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions, and demonstration and training videotape if available, that detail essential maintenance procedures:

- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by OWNER's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.

END OF SECTION

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SECTION 11145
SUBMERSIBLE PUMPS & FRP LIFT STATION & MANHOLE SPECIFICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. General Requirements:

1. As-Built Records:

a. A complete set of As-Built records shall be kept by the Site Contractor. These records shall show all items of construction and equipment which differ in size, shape or location from those shown on the contract drawings, also any additional work, existing features or utilities revealed by construction work which are not shown on the contract drawings. These reports shall be kept up-to-date daily. They may be kept on a marked set of contract drawings to be furnished by the contractor for this purpose, or in any other form, which is approved prior to the beginning of the work. They shall be available at all times during construction for reference by the Engineer and Owner, and shall be delivered to the OCWS Engineering Department upon completion of the work.

2. Nameplate:

a. Each piece of mechanical equipment and motors shall be provided with a substantial nameplate of non-corrodible metal securely fastened in place, and clearly and permanently inscribed with the manufacturer's name, model, or type designation, serial number, rated capacity, electrical or other power characteristics, and other appropriate nameplate data. Spare nameplates shall be provided for each lift station and placed inside each control panel (one nameplate for each model pump).

3. Lubricants:

a. All the equipment shall be delivered fully lubricated with oil and/or grease insofar as possible. If any point cannot be so serviced, it shall be clearly marked to the effect that it is not lubricated and requires servicing prior to operation. An adequate supply of the proper lubricant, with the instructions for its application shall be supplied with the equipment for each point not lubricated prior to shipment. The Contractor shall also provide the Owner with a sufficient amount of proper lubricants for one complete change of lubricant for all equipment furnished.

4. Operating Manuals and Parts Listed:

a. The Contractor shall furnish three (3) complete, bound sets and one (1) electronic pdf version of literature giving the following information to the Okaloosa County Water and Sewer Engineering Department.

1) Clear and Concise instruction for operations, adjustment and lubrication and other of the equipment. These instructions shall

- include a complete lubrication chart.
- 2) A list of all parts of the equipment, with catalog number and other data necessary for ordering replacement parts.
 - 3) Such instructions and parts listed shall have been prepared specifically for the model and type of equipment furnished and shall not refer to other models and types of similar equipment.
 - 4) Complete sets of electrical schematic(s), (as built) one of which shall be encapsulated in plastic and permanently mounted to the inside of lift station door. (by panel supplier)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Flow Isolation and Monitor Equipment: (By Owner)
 1. There shall be a minimum of 18" clearance on all sides of valves and fittings.
 2. The check valves shall be a Series 9001 Swing Check (Spring Loaded Type) manufactured by Henry Pratt Company, or approved equal. Valve shall be in accordance with ANSI/AWWA C508. Ductile Iron Body & Cover with internal & epoxy coating in accordance with AWWA C550, ANSI B16.1, Class 125 Flanged connection. Disc shall be BUNA-N with 316 stainless steel hinge pin. Disc seats shall be 316 stainless steel, standard manufactured, and field replaceable.
 3. All exposed hardware shall be of corrosion resistant, 316 stainless steel.
 4. Flow Isolation valves shall be AWWA C509 Compression Resilient Seated Gate Valves or Knife Valves, Flanged Cast Iron Body, epoxy coated and manual handwheel actuator.
 5. Pressure gauges shall be equipped with sealing diaphragm and shall be located on each pump discharge line. Gauge and diaphragm shall be manufacture by Ashcroft or approved equal. Gauge shall be Type 45-1279-R-04B -0/200 psi with Type 20-102SS-04T diaphragm seal. Pressure gauges shall be rated for 1-1/2 times specified pumping pressures with 3/4" SST ball valves must be provided for each discharge. Gauges must be located between check and plug valve so that static head can be observed when pump is off, TDH can be observed while pumps are running, and valves can be shut to observe "dead head" pressure.
 6. Air Release Valves (ARV) shall be designed for wastewater application and provided on the discharge piping as shown on the drawings. ARV shall be Model# M986 as manufactured by H-Tec, Inc. Combination Air/Vacuum valves shall be Model# VM 302A Air/Vacuum Valve as manufactured by Val-Matic Valve and Manufacturing Corp. or approved equal. Valve shall be mounted in vertical position on host pipe, with equivalent size opening brass saddle tap and brass isolation valve. Provide 1" diameter flexible tubing or sch 40 pvc drain pipe to contain discharged air or liquids and drain back into wetwell.

- B. Wet Well: (By Supplier)
1. Access frames and covers shall be rated at 300 lb/sq. ft. complete with hinged and flush mounted automatic 316 S.S. locking mechanism; hinged fall protection grating (safety orange) opposite opening of main hatch; two 316 S.S. upper guide cable holders (8 hook Min); odor tight gasketed; removable cross bracing; independent opening access lids for triplex and quadplex application with minimum 34" x 48" clear opening per pump or as specified on drawings. Frame shall be securely placed, with center of access opening mounted directly above the pumps. Frame shall be provided with sliding nut rails to attach the accessories required. Lower guide bar holders shall be integral with the discharge connection. Guide bars shall be of at least 316 stainless steel pipes. Doors shall be of skid proof design.
 2. The discharge piping shall be intermediately supported inside the wet well by the use of a stainless steel uni-strut bolted to the well wall, and stainless steel u-bolts and clamps secured to the discharge pipe and strut.
 3. All fasteners inside wet well shall be 316 stainless steel.
 4. A guide rail system for pump removal shall be installed inside the wet well for each pump. The guide rails shall be of at least 316 stainless steel pipe of the size indicated on the drawing, but a minimum of two (2") inches in diameter. The guide bars shall not support any portion of the weight of the pump. The lower guide bracket shall be incorporated and tightly secured to the discharge connection elbow with 316 stainless steel fasteners. The base elbow and sealing flange shall be constructed of Cast Iron and hard mounted to the base of wet well.
 5. The guardrail system shall be manufactured for use in NEC Class I, Division I, Group D environments.
 6. WET WELL shall be stand alone Fiberglass Reinforced Polyester (FRP) structure, with minimum dynamic load rating of 16,000 ft-lbs. The sides, top and bottom shall be type Grade "E" glass, with smooth interior and exterior surfaces. Exterior resin shall include a minimum 1/8" layer of UV inhibitor. The top and bottom shall be reinforced with layup in accordance with ASTM D3299. The FRP structures must meet and or exceed ASTM-D3753 standards. The structures must be Third Party Tested and Certified to meet the ASTM-D3753 standards. The structures must have labels that have serial numbers visible and states the manufacturer, date of manufacture, depth, diameter, and that structure meets ASTM-D3753 standards. Bottom shall be truncated as shown on drawings.
 7. The fiberglass structures must have a standard 10 Year structural warranty. The fiberglass structures must have a printed 10 Year warranty label gel coated next to ASTM and serial number label. Copy of this warranty must be included with the submittal data. Approved Manufacturer is L.F. Manufacturing, EFI and Xerxes. OCWS approved equal may be substituted.
 8. All access opening shall have 12" risers with "Drop In" Aluminum Hatch Cover (Item 2), or OCWS approved equal. Upon completion the wet well

and valve pit will have a 6" minimum concrete slab poured over top. On wet wells 8' in diameter or larger an additional hatch cover shall be supplied on opposite side of wet well over invert piping to allow for installation of future equipment and maintenance.

9. Where piping passes through a wall sleeves shall be used with rubber link seals to make a watertight penetration. The sleeves must be large enough for flange of pipe being used to pass freely through (Example: 4" pipe would require a 10" sleeve to allow 9-1/2" O.D. diameter of 4" flange). The link seals are used so that the rubber acts as vibration isolator while pump is running.
 10. All piping in wet well, including 24" exterior extensions sections shall be welded Flange X Flange Sch 40 316 SS-L piping (Class 250 Ductile Iron approved equal may be substituted as an Alternate if identified in proposal section). All wetwell ductile iron piping shall be interior coated with Protecto 401 and all exterior surfaces shall be coated with two (2) layers of epoxy at 5 mils per coat.
 11. Hardware used for connections must be 316 SST bolts and nuts with anti-seize.
- C. Fiberglass Manhole: (By Supplier)
1. Fiber Reinforced Polyester (FRP) Manholes shall be suitable for wastewater applications.
 2. Manufacture shall be regularly engaged in the production of the specified manhole and shall meet UL-1316 - Standard for Safety Glass Fiber Reinforced Plastic Underground Storage Manholes for Petroleum Products.
 3. Acceptable Manufacturer: Fiberglass Tank Solutions and Xerxes Corporation
 4. Buoyancy and Structural Design Calculations signed and sealed by a professional engineers registered in state of the project site location will be provided and shall include:
 - a. Empty tank buoyancy with fully flooded condition (water table at grade elevation).
 - b. Uplift with soil shear planes considered vertical with no angle.
 - c. Structural calculations shall address Manhole configuration, thickness and the calculations (moment of inertia), hydrostatic pressure, deflection due to soil and traffic load, buckling when Manhole is above water level, and local buckling of the shell between ribs.
 5. Fiberglass composites shall be a minimum of:

a. Tensile Modules	900,000 psi
b. Flexural Modulus	900,000 psi
c. Tensile Strength	10,000 psi
d. Compressive Strength	20,000 psi
 6. Loading Conditions - Manhole shall withstand a minimum 20-psig internal pressure test; withstand external surface H-20 and HS-20 axle loads; 7' of overburden external hydrostatic loads over the top of the Manhole with a safety factor of 5:1 against general buckling when properly installed.

7. Manholes shall be capable handling domestic wastewater, petroleum, petroleum condensates aromatic hydrocarbons and gasoline additives at temperatures as low as -5° C (23°F) and high as 40° C (104°F).
 8. The primary and secondary walls of the Manhole shall be manufactured with 100% premium isophthalic polyester resin and glass-fiber reinforcement. No sand or silica fillers shall be added to the resin. The interstitial space between the primary and secondary walls shall be constructed with a glass reinforcement material such as Parabeam®, which provides a structural bond between the two Manhole walls, while creating a defined interstice that allows for free flow of liquid.
 9. All fiberglass nozzles shall be gusseted to handle the backfill and external loads. Gussets shall not interfere with anchor strap locations or flange bolt holes.
 10. Manholes will be designed with external reinforcement ribs and structural domed ends.
 11. Manhole access manways shall be sized with a 12" raised collar to accept a drop in aluminum access hatch cover. Collar internal dimensions shall be 30"x30".
 12. Each Manhole shall be equipped with a minimum of (2) lifting lugs evenly spaced to ensure a balanced lift and designed to carry (4) times the empty weight of the Manhole.
 13. Bottom stingers shall be constructed of FRP pipe matching the diameter of the flange nozzle and cut at 45° angle 12 inches off Manhole bottom.
 14. All manhole surfaces shall be provided with a white gel coat for exposed fiberglass. Gel coat shall be a min of 10 mm thickness
 15. Manufactures nameplate shall be laminated as close as possible to the top of the sump pump manway and include the Manhole manufactured, year of manufacture, burial depth, Customer Name and Order #:
 16. h) Customer Purchase Order Number:
 17. Prior to shipment the unit shall be thoroughly cleaned internally; all flanges or openings covered with wood or wood fiber.
 18. Packaged components susceptible to shipping damage shall be braced for shipment to prevent damage from vibration, fatigue, or shock.
- D. Plates, Sheets, and Shapes:
1. Aluminum Plates, Sheets and Shapes:
 - a. All aluminum plates and shapes shall be of type AA 5052 alloy conforming to applicable requirements of ASTM Designation B 209-67, (latest revision).
 - b. Aluminum extended shapes shall be 6061 or 6062 alloy conforming to ASTM B 221-67, (latest revision).
 - c. All surfaces in contact with concrete shall be coated with Bitumastic (Kopper's 50 or equal).
 2. Stainless Steel Plates, Sheets, and Shapes:
 - a. All stainless steel plates and sheets shall be type 316 alloy conforming to the applicable requirements of ASTM Designation A-182, (latest revision).
 - b. Stainless steel pipe shall be schedule 40, Type 316 alloy conforming to

- applicable requirements of ASTM - 312, (latest revision).
3. Fastenings:
 - a. Fasteners insofar as practical shall be concealed. Where exposed, fastening shall be of 316 stainless steel, where not indicated otherwise and countersunk wherever possible.
 - b. All fastenings coming into contact with aluminum and /or submerged shall be of stainless steel.
 - c. All hardware used to assemble ductile iron fittings shall be stainless steel. Threads shall be coated with anti-seize compound.
 - d. All threaded fasteners to include threaded rods shall be coated with anti- seize compound.
- E. Submersible Pumping Equipment:
1. Pumps:
 - a. Pumps shall be submersible, heavy duty, recessed or non-clog impeller type or an approved equal by the Okaloosa County Water & Sewer Engineering Department.
 - b. The pumps shall be capable of handling raw, unscreened sewage. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. The pumps shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service. There shall be no need for personnel to enter pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by the simple linear downward force of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pump unit shall be guided by no less than two guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact by gravity only. Sealing of the discharge interface by means of a diaphragm, O-ring, or other devices will not be acceptable. No portion of the pump shall bear directly on the floor of the wet well. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater, without loss of water-tight integrity to a depth of 65 ft. Totally submersible design, with all electrical parts housed in cast-iron, water tight enclosure. Motor cooling system shall be "closed-loop" system without induction of pumping liquid as cooling source. Cooling fluid shall be propylene glycol with water mix. Pump must be able to operate continuously in dry or fully submerged conditions. Thrust and radial bearings shall be of the ball type. The motor shafting shall be stainless steel and designed for extremely difficult sewage pumping service. The motor shall be designed to operate on 3-phase, 60-cycle, and 480 volt current and shall be non-overloading at all points on the pump curve.
 - c. All submersible pump motors shall be manufactured for use in NEC Class I, Division I, Group D environments.
 - d. The pump shall be fitted with a rigid explosion proof lifting bail of suitable strength to lift up to two times the weight of the pump. The

lifting bail shall provide a large open loop so that the bail can be hooked from the surface, precluding the need for personnel to enter the dry well. The bail shall be designed so that standard, commercially available shackles and fittings can be used to attach lifting chains or wire rope lifting assemblies. All materials and fasteners of the lifting bail device shall be 316 stainless steel.

2. Manufacturing:
 - a. The duplex submersible pumps shall be as manufactured by WEMCO, WILO, Flygt, KSB, or an approved equal by the Okaloosa County Water & Sewer Engineering Department. Submittal data required before approval if equal is requested.
3. Submittal Data:
 - a. The contractor shall provide three (3) hard copies and one (1) electronic pdf of the following submittal data for each item of pumping equipment:
 - 1) Certified Dimensional Print
 - 2) Typical Performance Curve
 - 3) Pictorial and Schematic Wiring Prints
 - 4) Parts Listed and Instructional Prints
 - 5) Pump Components and Warranty.
4. Pump Characteristics:
 - a. Pumps shall furnish the following:
 - 1) Pump to handle passing sphere of 4" diameter.
 - 2) Maximum motor size shall be specifically noted on contract drawings, "Pump Characteristics", unless otherwise approved by OCWS Engineering.
 - 3) Impeller unless otherwise approved by the OCWS Engineering Department or Contract Drawings.
 - 4) Pump shall be equipped with self aligning, oil float balanced double mechanical seals. Seal shall be housed in oil filled reservoir. Both mating surfaces shall be **silicon carbide** faced.
 - 5) Impellers shall be cast iron or hardened steel as alternate, if identified in proposal section, with replaceable wear rings. Both impeller and volute shall receive two coats of ceramic coating of equivalent to the Belzona 1321 product. Coating shall be installed in accordance with manufactures requirements for high corrosive and abrasive wastewater application. Metal shall be sandblasted to near white finish prior to application to remove production coating surface. Impeller shall be fully balance in two planes after coating application.
 - 6) The maximum allowed pump motor shaft speed shall be identified on the contract drawings. In no case shall a motor be supplied to operate under normal condition in excess of 1800 RPM, unless specifically noted on the contract drawings, "Pump Characteristics".
 - 7) Upper and lower bearings shall be sealed permanently lubricated, B10 life (100,000 hours at design hydraulic conditions). Provide

- sealed/shielded bearings.
5. Controls:
 - a. Controls/Monitoring Sensors
 - 1) A motor over-temp circuitry shall be installed, so that if the motor reaches an over-temp condition, the control voltage to that motor is interrupted. A seal fail circuitry shall be installed to detect potential failure or seepage of liquid into motor seal housing through shaft seal.
 - 2) All monitoring equipment, starters and drives shall be completely assembled, tested and ready for operation prior to delivery to the site. Local representatives for supplied pump and controls shall be onsite to perform field start-up and final acceptance inspection by OWNER.
 6. Electrical:
 - a. General:
 - 1) All electrical equipment shall be installed in accordance with the N.E.C. Code, as last revised. All materials used shall be new and unused, of the highest quality, and of proper type for the use intended. Where applicable, all material shall carry the approval of the Underwriters' Laboratory. Substitutes, which tend to lower the quality of the work, will not be permitted. The project is to result in a complete and operable Lift Station. Any items not specified, but normally included in such installations shall be finished and installed regardless of omissions from specifications. However, specified omissions are not affected by this requirement.
 7. Materials:
 - a. Conduit and conduit fittings shall be P.V.C. Electrical connectors and couplings shall be of the approved plastic water-tight type.
 - b. Wire and cable shall be properly sized to carry the anticipated loading. Insulation, unless otherwise noted, shall be typed RHW neoprene jacket for all sizes.
 - c. Conduit into wet well shall be large enough for easy removal of pump leads and/or float leads but as a minimum 1½" diameter. There shall be one conduit for each pump, plus one for float switch cables, plus two (2) additional sleeves with cups.
 8. Installations:
 - a. All conduit runs, whether or not terminated in boxes, shall be capped or plugged to prevent the entrance of foreign objects before wires are pulled. Conduit projecting into the wet well shall be plugged to a depth no more than 2"
 - b. Outlets, switches, boxes, etc., shall be rigidly secured and located properly with respect to easy accessibility.
 - c. No electrical splices allowed except in control panel.
 - d. All work shall be tested and subject to final approval of the engineer.
 9. Lightning Arrestor: (By Owner)
 - a. The lightning arrestor for the main service entrance shall be Joshlin or

- approved equal.
10. Main Disconnect: (By Owner)
 - a. Unless noted otherwise A main disconnect safety switch shall be provided in an enclosed service entrance, panel shall be NEMA rated to meet Environmental Exposure condition stated. Switch shall be 3 pst, 4 wire S/N, 277/480 Volt AC of sufficient size to carry three pumps operating simultaneously.
 11. Wetwell Level Monitoring:
 - a. Level/Pressure Transducer: Transducer shall be non-fouling type designed to continuously operate and monitor liquid level in a highly corrosive wastewater application (confined wetwell). Transducer exterior housing shall be 316 SS L with Kynar diaphragm. Signal cable shall be Hytrel jacketed, shielded with vent and drain tube. Cable length shall be 100 feet in length. The unit shall be with standard 2-wire 4-20 mA output, 24 VDC supply with minimum operating range of 0-100 feet, WC level, +/-1% accuracy, & -10C to 70C temperature range. Acceptable manufacture shall be Endress+Hausser "Waterpilot" or approved equal. Unit shall be supplied with all necessary 316 SS hardware to stationary mount
 - b. Free-Hanging Float Switches: Free-hanging float switches shall be constructed of molded polyethylene with internal and redundant polyurethane foam. All cable and switch connections shall be potted and cable shall be rubber jacketed with fine stranded #18 conductors. The float switch shall be equipped with a suspended weight kit. Hanging float switches shall be manufactured ROTO-FLOAT or approved equal.
- F. Alternates:
1. Harden Steel Pump Impeller (Section D.4.a.5)
 - a. Supplier to provide additional price to provide harden steel impeller in place of coated system.
 - b. Material shall be ASTM A532Ic with 15% CrMo-HC. Hardness shall be minimum 690 Bn.
 2. Harden Steel Pump Volute (Section D.4.a.5)
 - a. Supplier to provide additional price to provide harden steel volute and water plate in place of coated system.
 - b. Material shall be ASTM A532Ic with 15% CrMo-HC. Hardness shall be minimum 690 Bn.

END OF SECTION

SECTION 16060
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
 - 1. Underground distribution grounding.
 - 2. Common ground bonding with lightning protection system.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Ground rings.
 - 3. Grounding arrangements and connections for separately derived systems.
 - 4. Grounding for sensitive electronic equipment.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at ground rings grounding connections for separately derived systems based on NFPA 70.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type, 1 inch in diameter (length as required to achieve resistance to ground as specified in 3.5, B).

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: All conductors shall be stranded.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 1. Feeders and branch circuits.
 2. Lighting circuits.

3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a

lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building area or item indicated.
1. Install copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches from building foundation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

- b. Perform tests by fall-of-potential method according to IEEE 81.
3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 5 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm.
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

**SECTION 16072
ELECTRICAL SUPPORTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IBC: International Building Code.
- C. IMC: Intermediate metal conduit.
- D. NBC: National Building Code.
- E. OSHPD: Office of Statewide Health Planning and Development.
- F. RMC: Rigid metal conduit.
- G. SBC: Standard Building Code.
- H. UBC: Uniform Building Code.

1.4 SUBMITTALS

- A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support component used.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.
- B. Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.
 - 1. Available Manufacturers:
 - a. Cooper B-Line; a division of Cooper Industries.
 - b. Allied Support Systems; Power-Strut Unit.
 - c. Unistrut; Tyco International, Ltd.
 - 2. Finishes:
 - a. Interior Locations: Metallic Coatings - Hot-dip galvanized after fabrication and applied according to MFMA-3.
 - b. Exterior Locations: SS4-AISI Type 304 Stainless Steel or 6063-T6 Aluminum
 - 3. Channel Dimensions: Selected for structural loading.
- C. Raceway and Cable Supports: As described in NECA 1.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers:
 - 1) Hilti, Inc.
 - 2) MKT Fastening, LLC.
 - 3) Simpson Strong-Tie Co. Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers:
 - 1) Cooper B-Line; a division of Cooper Industries.
 - 2) Hilti, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Powers Fasteners.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 for installation requirements, except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.3 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions at Project.

- B. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.
1. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 2. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 3. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3.

END OF SECTION

**SECTION 16075
ELECTRICAL IDENTIFICATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1, ANSI C2, and ANSI Z635.4.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.
- E. Install all signs and labels horizontal (level) and consistent for similar equipment and panels.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb, minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with snap-around label.
 - 1. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, snap-around, color-coding bands:

1. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
 2. Fire Alarm System: Red.
 3. Fire-Suppression Supervisory and Control System: Red and yellow.
 4. Combined Fire Alarm and Security System: Red and blue.
 5. Security System: Blue and yellow.
 6. Mechanical and Electrical Supervisory System: Green and blue.
 7. Telecommunication System: Green and yellow.
 8. Control Wiring: Green and red.
- C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use metal tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
1. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.
- D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
1. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
1. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
 2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
 4. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway. During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches above duct. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
1. Description:
 - a. Permanent, bright-colored, continuous-printed, polyethylene tape.
 - b. Not less than 6 inches wide by 4 mils thick.
 - c. Compounded for permanent direct-burial service.
 - d. Embedded continuous metallic strip or core.
 - e. Printed legend shall indicate type of underground line.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
 2. Comply with NFPA 70 and 29 CFR 1910.145.
 3. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

4. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
5. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
6. Warning label and sign shall include, but are not limited to, the following legends:
 - a. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWERSOURCES."
 - b. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

I. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with ENGINEER/OWNER APPROVED instructions where needed for system or equipment operation. Instructions are needed for all equipment unless otherwise noted.
 - a. Signs shall be engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - b. The engraved legend shall be 1/2 " White letters on Brown face, and punched or drilled for mechanical fasteners.
 - c. The signs shall be installed with stainless hardware.
2. Emergency Operating Instructions: Install emergency operating instruction signs at equipment used for power transfer, safety shutdown, or any other locations requiring operation in an emergency.
 - a. Signs shall be engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - b. The engraved legend shall be 1/2 " White letters on Red face, and punched or drilled for mechanical fasteners.
 - c. The signs shall be installed with stainless hardware.

- J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets,

and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
 - a. Indoor and Outdoor Equipment: Use engraved, laminated acrylic or melamine labels, punched or drilled for screw mounting. Identification labels shall have white letters on a dark-gray background. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high. Mount labels with stainless hardware.
 - b. Elevated Components: Increase the size of the labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:
 - a. Identification labeling of some items listed below may be required by individual Sections or by NFPA 70.
 - b. Panelboards, electrical cabinets, and enclosures.
 - c. Access doors and panels for concealed electrical items.
 - d. Electrical switchgear and switchboards.
 - e. Transformers.
 - f. Electrical substations.
 - g. Emergency system boxes and enclosures.
 - h. Motor-control centers.
 - i. Disconnect switches.
 - j. Enclosed circuit breakers.
 - k. Motor starters.
 - l. Push-button stations.
 - m. Power transfer equipment.
 - n. Contactors.
 - o. Battery inverter units.
 - p. Battery racks.
 - q. Power-generating units.
 - r. Voice and data cable terminal equipment.
 - s. Television/audio components, racks, and controls.

- t. Fire-alarm control panel and annunciators.
- u. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- v. Monitoring and control equipment.
- w. Uninterruptible power supply equipment.
- x. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- y. Control systems
- z. Field mounted control devices
- aa. Field mounted instruments

3.2 INSTALLATION PRACTICES

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- D. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes LARGER than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or

ELECTRICAL IDENTIFICATION

taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

- E. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- F. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

END OF SECTION 16075

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**SECTION 16120
CONDUCTORS AND CABLES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Wires and cables rated 600 V and less.
 - 2. Connectors and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
- B. Restrictions
 - 1. All wire/cable runs of any type must be continuous. Splices are expressly prohibited.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. Beldon CDT Inc.
 - 4. General Cable Corporation.
 - 5. Senator Wire & Cable Company.
 - 6. Southwire Company.
- C. Copper Conductors: Comply with NEMA WC 70.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types XHHW and SO.
- E. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC and Type SO with ground wire.
- F. VFD Rated Cable: Shall be 2000V UL Flexible Motor Supply cable with 3 stranded tinned copper circuit conductors plus (3) symmetrical bare copper ground wires,

XLPW insulation, two spiral copper tape shields with a sun and oil resistant PVC jacket. The cable shall be a Belden 29546 or engineer approved equal.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.

4. Pipeline Seal and Insulator, Inc.
 - B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper, stranded.
- B. Branch Circuits: Copper, stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type XHHW-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type XHHW-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type XHHW-2, single conductors in raceway.
- F. Feeders in Cable Tray: Type XHHW-2, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspace: Type XHHW-2, single conductors in raceway.

- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type XHHW-2, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Metal-clad cable, Type MC.
- K. Branch Circuits in Cable Tray: Type TC.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- M. All control cables between the PLCs / MMCs and field instruments: 2 # 18 AWG, twisted shielded pair, UL Instrument Cable, XLPE conductor insulation, PVC outer jacket.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to local codes and the manufacturer's written instructions.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to local codes and the manufacturer's written instructions.
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to local codes and the manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
 - a. All Process Equipment.
 - b. Panels/Switchboards/Transformers/Transfer Switches
 - c. Pumps
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. All megger readings using a 1000 V dc megger shall be greater than 50 mega ohms.
 - 4. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and

conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

- a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

**SECTION 16140
WIRING DEVICES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Receptacles with integral surge suppression units.
 - 4. Isolated-ground receptacles.
 - 5. Snap switches and wall-box dimmers.
 - 6. Wall-switch and exterior occupancy sensors.
 - 7. Communications outlets.
 - 8. Pendant cord-connector devices.
 - 9. Cord and plug sets.

1.3 DEFINITIONS

- A. Retain term and abbreviations that remain after this Section has been edited.
- B. EMI: Electromagnetic interference.
- C. GFCI: Ground-fault circuit interrupter.
- D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- E. RFI: Radio-frequency interference.

- F. TVSS: Transient voltage surge suppressor.
- G. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Retain first paragraph below if products have critical features needing hands-on appraisal.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain all wiring devices and associated wall plates from a single manufacturer and one source. (No deviation without written permission from the owner and engineer.)
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Retain subparagraph below if cord and plug sets are specified in Part 2.
 - 2. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 3. Leviton Mfg. Company Inc. (Leviton).
 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).
- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; CR 5253IG.
 - b. Leviton; 5362-IG.
 - c. Pass & Seymour; IG6300.
 2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TR8300.
 - b. Hubbell; HBL8300SG.
 - c. Leviton; 8300-SGG.
 - d. Pass & Seymour; 63H.
 - e. <Insert manufacturer's name; catalog number.>
3. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Products: Subject to compliance with requirements, provide one of the following:
 1. Cooper; GF20.
 2. Pass & Seymour; 2084.

2.4 TVSS RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.
 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
 2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
- B. Duplex TVSS Convenience Receptacles:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5362BLS.
 - b. Hubbell; HBL5362SA.
 - c. Leviton; 5380.

2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.
- C. Isolated-Ground, Duplex Convenience Receptacles:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; IG5362BLS.
 - b. Hubbell; IG5362SA.
 - c. Leviton; 5380-IG.
 2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Crouse-Hinds.
 - b. EGS/Appleton Electric.
 - c. Killark; a division of Hubbell Inc.

2.6 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
2. Hubbell; IG2310.
 - a. Leviton; 2310-IG.
3. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.7 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.8 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
- b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
- c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
- d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.

- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.10 OCCUPANCY SENSORS

- A. Each manufacturer's switch rating is different, but rated design values are generally not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- B. Retain one of two paragraphs and associated subparagraphs below. Adaptive technology includes the ability to sense and memorize usage patterns in the space and help eliminate false offs.
- C. Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..
- D. Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.

2. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..
- E. Retain one of first two paragraphs and associated subparagraphs below for square and near-square rectangular rooms.
- F. Long-Range Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Pass & Seymour; WA1001.
 - d. Watt Stopper (The); CX-100.
 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft..
- G. Long-Range Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
 2. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft..
- H. Wide-Range Wall-Switch Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBRP.
 - b. Leviton; ODWHB-IRW.
 - c. Pass & Seymour; HS1001.
 - d. Watt Stopper (The); CX-100-3.
 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft..

I. Exterior Occupancy Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Leviton; PS200-10.
 - b. Watt Stopper (The); EW-100-120.
2. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.11 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3560-6.
 - b. Leviton; 40649.
2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3562.
 - b. Leviton; 40595.
2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.12 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.05-inch- thick anodized aluminum.
3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum with lockable cover.

2.13 MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: PVC.

D. Wire: No. 12 AWG.

2.14 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Engineer, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.

- b. Straighten conductors that remain and remove corrosion and foreign matter.
- c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Recommendation in subparagraph below is made in IEEE 602.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. Coordinate two paragraphs below with Drawings.

- I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- J. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 16 Section "Electrical Identification."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with [black] [white] [red]-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

SECTION 16410
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. First two paragraphs below are defined in Division 1 Section "Submittal Procedures" as "Action Submittals."
 - B. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

2. Current and voltage ratings.
 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 4. Retain first subparagraph below if using series rating of overcurrent protective devices.
 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 6. Retain subparagraph below if final system short-circuit and coordination studies will be performed by the designer or will be assigned to an independent consultant. These curves are also beneficial to Owner for future additions or reevaluations of settings of overcurrent protective devices. Although some manufacturers no longer offer curves on translucent graph paper, curves can normally be downloaded from manufacturers' Web sites or be obtained, in electronic form, from various coordination software vendors as part of a subscription service. Retain option in subparagraph below only if manufacturers selected offer curves on graph paper.
 7. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- C. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: For power, signal, and control wiring.
- D. Remaining paragraphs are defined in Division 1 Section "Submittal Procedures" as "Informational Submittals."
- E. Coordinate first paragraph below with qualification requirements in Division 1 Section "Quality Requirements" and as supplemented in "Quality Assurance" Article.
- F. Retain first paragraph below if retaining "Manufacturer's Field Service" Paragraph in "Field Quality Control" Article. Consider manufacturer's field services especially when retaining zone-selective interlocking because setting it to operate properly requires factory-trained expertise.
- G. Manufacturer's field service report.
- H. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
- 1.5 Retain option in subparagraph below only if manufacturers selected offer curves on graph paper.
- 1.6 QUALITY ASSURANCE
- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
 - B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
 - C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - D. Comply with NFPA 70.
- 1.7 PROJECT CONDITIONS
- A. Specify unusual environmental or service conditions in first paragraph below. For equipment installed outdoors, indicate maximum and minimum ambient temperature and expected humidity range. For additional ambient compensation requirements for fuses, see Editing Instruction No. 5 in the Evaluations.
 - B. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 2. Altitude: Not exceeding 6600 feet (2010 m).
 - C. Retain paragraph below if interruption of existing electric service is required.
 - D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Engineer no fewer than seven days in advance of proposed interruption of electric service.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Engineer's written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Siemens
 2. Square D
 3. Allen-Bradley
 4. Cutler-Hammer
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: Two (2) NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Siemens
 - 2. Square D
 - 3. Allen-Bradley
 - 4. Cutler-Hammer
- B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 4. Auxiliary Contact Kit: Two (2) NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 Retain subparagraph below if retaining "Auxiliary Contact Kit" Subparagraph above and if remote-control power for remote indication is not specified in other Sections. See "Control Power Options" Article in the Evaluations for various sources available for control power. Although other voltages are available, the Section Text includes only those that are most frequently encountered and listed in manufacturers' literature. Integrally mounted control power is not available in safety switches.

2.4 RECEPTACLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Hubble
- B. Type 4, IP66 Rated, Twist lock, amp rated, combination safety switch and receptacle

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- C. Receptacle: Twist lock, three-phase, four-wire or five-wire receptacle (one wire connected to enclosure ground lug).
- 2.5 If more than one type or rating of receptacle-switch combination is required, consider showing location of each on Drawings and deleting subparagraph below; otherwise, insert required information.
- 2.6 MOLDED-CASE CIRCUIT BREAKERS.
- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following (all switches to be manufactured by the same manufacturer as the motor control centers used on the project):
 - 1. Cutler-Hammer
 - 2. Allen Bradley
 - 3. Square D
 - B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
 - C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
 - F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
 - G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- I. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor. (Provide only when shown on the single line, or required by code)
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact. (Provide when indicated on drawing)
 - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay. (Provide when indicated on drawings)
 - 7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts. (Provide when indicated on drawing)
 - 8. Alarm Switch: One NO contact that operates only when circuit breaker has tripped. (Provide when indicated on drawing)
 - 9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position. (Provide when indicated on drawing)

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- 2.7 Retain first option in first subparagraph below for solid-state trip units; retain second option for thermal-magnetic trip units.
- 2.8 Retain subparagraph below if retaining options requiring integral or remote-control power in subparagraphs above and if control power for remote indication or operation is not specified in other Sections. See "Control Power Options" Article in the Evaluations for various sources available for control power. Although other voltages are available, the Section Text includes only those that are most frequently encountered and listed in manufacturers' literature. First option below may not be available in all voltages; coordinate with manufacturers' literature.
- 2.9 ENCLOSURES
- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 4X stainless steel.
 3. Corrosion Areas: NEMA 250, Type 4X fiberglass.
 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X stainless steel.
 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 4X stainless steel

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 16 Section "Electrical Identification."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections..
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 16 Section "Overcurrent Protective Device Coordination".

END OF SECTION

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SECTION 16443
MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes motor-control centers for use on ac circuits rated 600 V and less.
- B. Related Sections include the following:
 - 1. Division 16 Section

1.3 SUBMITTALS

- A. Product Data: For each type of controller and each type of motor-control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each motor-control center.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current ratings of buses and installed units.
 - d. Vertical and horizontal bus capacities.
 - e. Retain first subparagraph below if series rating of overcurrent protective devices is used or if combination controllers are used.
 - f. Features, characteristics, ratings, and factory settings of each motor-control center unit.
 - g. Harmonic correction calculations.
 - h. Cable Terminations
 - i. Busway connections

- j. Listing of overcurrent device coordination
- 2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor-control center. Provide schematic wiring diagram for each type of controller.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around motor-control centers where pipe and ducts are prohibited. Show motor-control center layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Qualification Data: For manufacturer.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For motor-control centers, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1.
 - 1. Routine maintenance requirements for motor-control centers and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain motor-control centers and controllers of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. Motor control centers are to be built to the latest NEMA standards.

- F. The motor control center shall be designed, manufactured and tested in facilities registered to the ISO 9001 standard.
- G. Product Selection for Restricted Space: Drawings indicate maximum dimensions for motor-control centers, including clearances between motor-control centers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver motor-control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- B. Handle motor-control centers according to the following:
 - 1. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
 - 2. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."

1.6 COORDINATION

- A. Coordinate layout and installation of motor-control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place" Concrete."
- C. Coordinate features of motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- D. Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.
- E. Provide selective coordination of all overcurrent devices including: circuit breakers, fuses, overload relays, and motor circuit protectors. The selective coordination shall be from the generator circuit breaker, through the low voltage transfer switch, through the MCC, to the motors/low voltage panelboard breakers.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spare Fuses: Furnish one spare for every five installed, but no less than one set of three of each type and rating.
 - 2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allen Bradley
 - 2. Eaton (Cutler-Hammer)

2.2 MOTOR-CONTROL CENTERS

- A. Wiring: NEMA ICS 3, Class I, Type B.
- B. Enclosures: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 4X Stainless Steel.
 - 2. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.
 - 3. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor-control center; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
 - 4. Wiring Spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place.

5. Provide a barrier between the wiring spaces and the MCC buckets to prevent inadvertent contact with energized parts.
- C. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-control center location.
- D. Each MCC bucket shall have the ground connection made before the power connections are made.

2.3 BUSES

- A. Material: Plated hard-drawn copper, 98 percent conductivity.
- B. Ampacity Ratings: As indicated for horizontal and vertical main buses.
- C. Neutral Buses: Full size.
- D. Equipment Ground Bus: Non-insulated, horizontal configuration; adequate for equipment ground conductors; bonded to enclosure.
- E. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent.
- F. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.

2.4 FUNCTIONAL FEATURES

- A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center.
- B. Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated.
 1. Install units up to and including Size 3 on draw-out mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
 2. Provide units with short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center section.
 3. Equip units in Type B and Type C motor-control centers with pull-apart terminal strips or draw-out terminal boards for external control connections.
 4. Controller Disconnecting Means: Factory-assembled combination disconnect and controller (see single line for type).

- a. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
 - b. Non-fusible Disconnecting Means: NEMA KS 1, heavy-duty, non-fusible switch.
 - c. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- C. Overcurrent Protective Devices: Individual feeder-tap units through 225-A rating shall have draw-out mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
- D. Retain paragraph below if suppressors are required. Suppressors are specified in Division 16 Section "Transient Voltage Suppression."
- E. Transient Voltage Surge Suppressors (TVSS): Connect to motor-control center bus. Provide TVSS protection for all MCC equipment, VFDs, and Soft Starts.
- F. Coordinate two paragraphs below with Drawings. Indicate, in schedule, sizes of future controllers to be accommodated.
- G. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of draw-out units.
- H. Spare Units: Type, sizes, and ratings indicated; installed in compartments indicated "spare."
- I. Conductor Entry/Exit: Entry and exit for conductors shall be through the bottom of the MCC for all power distribution and motor load cubicles including the incoming power.
- J. The pump motor thermal, seal failure and disconnect position signals for each pump shall terminate in each pump cubicle. Terminals, relays and circuitry shall be provided to accept these signals, incorporate them into the control circuits in the MCC and reproduce them for use by the local site control system.

2.5 ACROSS-THE-LINE CONTROLLERS

- A. Manual Controller: NEMA ICS 2, general purpose, Class A, with toggle action and overload element.
- B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
 2. Overload Relay: See Section 2.9 for overload relay requirements.
- C. See plans for necessary schematic to allow for proper system integration with the control panel.
- D. All starters and variable frequency drives shall be provided with Ethernet communication modules.

2.6 REDUCED-VOLTAGE CONTROLLERS

- A. Solid-State, Reduced-Voltage Controller (see drawing for requirements): NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, induction motors.
1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.
 2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 3. Motor running contactor operating automatically when full voltage is applied to motor.
- B. See plans for necessary schematics to allow for proper system integration with the control panel.
- C. The reduced voltage starter shall be provided with an Ethernet communication module.

2.7 VARIABLE FREQUENCY DRIVES (VFD)

- A. Description: NEMA ICS 2, pulse-width-modulated, variable frequency controller; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency. The VFDs shall be the Allen Bradley Power Flex 753 series or Danfoss VLT series. The supplied VFDs shall be provided with extended warranties equivalent to the Danfoss DrivePro-tection warranty.
1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.

- B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- D. Unit Operating Requirements:
 - 1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
 - 2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
 - 3. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - 4. Minimum Displacement Primary-Side Power Factor: 96 percent.
 - 5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
 - 6. Starting Torque: 100 percent of rated torque or as indicated.
 - 7. Speed Regulation: Plus or minus 1 percent.
 - 8. Ambient Temperature: 0 to 40 deg C.
- E. Isolated control interface allows controller to follow control signal over an 11:1 speed range.
 - 1. Electrical Signal: 4 to 20 mA at 24 V.
- F. Internal Adjustability Capabilities:
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3. Acceleration: 2 to a minimum of 22 seconds.
 - 4. Deceleration: 2 to minimum of 22 seconds.
 - 5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
- G. Self-Protection and Reliability Features:
 - 1. Input transient protection by means of surge suppressors.
 - 2. Under- and overvoltage trips; inverter over-temperature, overload, and overcurrent trips.

3. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 10, 20, or 30 performance.
 4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 5. Instantaneous line-to-line and line-to-ground overcurrent trips.
 6. Loss-of-phase protection.
 7. Reverse-phase protection.
 8. Short-circuit protection.
 9. Motor over-temperature fault.
- H. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Restarting during deceleration shall not damage controller, motor, or load.
- I. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.
- J. Bypass Controller (provide bypass controller when shown on single line diagram): NEMA ICS 2, full-voltage, non-reversing enclosed controller with across-the-line starting capability in manual-bypass mode or soft starts based on what is shown. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
- K. Integral Disconnecting Means: NEMA AB 1, molded-case switch with lockable handle.
- L. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
- M. Provide 5% input line reactors and output reactors for each VFD supplied.
- N. See plans for necessary schematics to allow for proper system integration with the control panel.
- O. The VFD shall be provided with an Ethernet communication module.

2.8 FEEDER OVERCURRENT PROTECTION

- A. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 2. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 5. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 6. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 7. Ground-Fault Protection (provide when shown on single line diagram): Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 8. Communication Capability (provide when required by control system): Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system.
 9. Shunt Trip (provide when required by control system): 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 10. Auxiliary Switch (provide when required by control system): One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts; "b" contacts operate in reverse of circuit-breaker contacts.
- B. Fusible Switch: NEMA KS 1, Type HD, clips to accommodate specified fuses with lockable handle.

2.9 ACCESSORIES

- A. The Motor Control Center shall be provided with automatic vertical bus shutters.

- B. Control power shall be provided by individual unit control power transformers located in each individual MCC cubicle, as required for control circuit power. The control power transformer shall be de-energized upon power being disengaged from the associated cubicle.

2.10 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and factory-tested, motor-control centers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive motor-control centers for compliance with requirements, installation tolerances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Install motor-control centers on concrete bases.
- B. Comply with mounting and anchoring requirements specified in Division 16 Section "Electrical Supports and Seismic Restraints."

3.4 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

3.5 IDENTIFICATION

- A. Identify motor-control center, motor-control center components, and control wiring according to Division 16 Section "Electrical Identification."
- B. Operating Instructions: Frame printed operating instructions for motor-control centers, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of motor-control centers.

3.6 CONTROL WIRING INSTALLATION

- A. Install wiring between motor-control devices according to Division 16 Section "Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 16 Section "Grounding and Bonding."

3.8 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each motor-control center element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

MOTOR CONTROL CENTERS

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
1. Perform each electrical test and visual and mechanical inspection, except for optional tests, stated in NETA ATS "Motor Control Centers." Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges based on overcurrent device coordination study.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain components of motor-control centers including solid-state controllers. Refer to Division 1.

END OF SECTION

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**SECTION 16900
INSTRUMENTATION AND CONTROLS**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes all elements required to furnish and install a complete electrical system to control, operate, and display information as indicated in the plans and specifications. The instrumentation and control system shall include all equipment, devices, wiring, and incidental materials desired to operate the system and display information in accordance with these specifications. The intention of this section is to detail a complete control system that will operate equipment in accordance with narratives and requirements indicated in the plans, specifications, and manufacturer's literature for the equipment installed. All circuits and protection devices for the installed equipment shall be included in the price bid.

1.2 SCOPE

- A. The control panel manufacturer shall work directly for the client. The panel provider will be responsible for providing the following equipment and services:
1. Control panel
 2. Programming of the control panel, if necessary
 3. Configuration of the variable speed drives, if necessary
 4. Factory testing of the pump control panel. The testing shall be performed in the control panel manufacturer's facility and be witnessed by the Owner and/or Owner's representative.
 5. On-Site installation assistance as required by the electrical contractor
 6. Field verification of the variable frequency drive parameters
 7. Field Start-Up services
 8. O&M Manuals
 9. As-Built drawings in AutoCAD 2012 format.
 10. Coordination with the Owner regarding integration of the pump control panel signals into the Owner's SCADA system. Actual integration into the SCADA system will be performed by the Owner.

1.3 SYSTEM DESCRIPTION - WASTEWATER PUMPING STATION CONTROL SYSTEM

- A. Pump Station Control Panel. The pump station control panel shall contain all components necessary to power and control the pumps and interface with the SCADA panel. The control panel shall be provided with the following features/attributes:

1. The pumps shall have three modes of operation: manual, automatic and backup. Selection of the mode of operation for each pump shall be achieved through the use of a 30mm 3 position selector switch (Hand-Off-Auto). When placed in the manual (hand) mode of operation the pump shall be commanded to run. When placed in the automatic (auto) mode of operation the pump shall be commanded to start/stop via the SCADA panel or from the float backup circuitry.
2. All manufacturer required warranty signals (motor thermal, seal failure, etc) shall be incorporated into the automatic and manual modes of operation. Pilot lights for each fault condition shall be provide on the panel exterior to alert site personnel. Additionally, a dry set of form C contacts shall be provided for all fault signals to allow the SCADA system to monitor the status of the station.
3. 30MM push buttons/pilot lights shall be mounted on the panel exterior. The push buttons shall provide the following functions/indications:
 - a. 3 Position selector switch (Hand-Off-Auto) for each pump to select the mode of operation
 - b. Green pilot light to indicate the running status for each pump
 - c. Red pilot lights for any permissive (shutdown) signals for each pump
 - d. Amber pilot lights for any warning (non-shutdown related) signals for each pump
4. Dry contacts shall be provided for all of the following signals so that the local SCADA panel can monitor the status of the well:
 - a. Running status for each pump
 - b. HOA in Auto for each pump
 - c. Motor Overload for each pump
 - d. Motor Thermal Failure for each pump
 - e. Seal Failure for each pump
 - f. High level float
 - g. Low level float
 - h. Station running in float backup mode
 - i. Panel power failure
5. The controls shall be housed in a stainless steel NEMA type 4X assembly with 3 point latch manufactured by Pentair (Hoffman) or engineer approved equal. It shall be constructed to UL508A and UL698A standards.
6. Float backup circuitry. All the components necessary for a float backup circuit shall be supplied to act as a backup mode of operation in the event of a transducer/PLC failure. The float backup circuitry shall consist of the following components at a minimum:
 - a. Intrinsically safe barrier relays. Intrinsically safe barrier relays shall be used for interconnection with the float switches.
 - b. Time delay relay. Time delay relay should be supplied to prevent the simultaneous operation of multiple pumps in the backup mode. The time

delay relays shall be Schneider Electric Zelio RE48A series or engineer approved equal.

7. Pump Monitoring System. In the event that a pump is selected for the project that requires a specific/proprietary pump monitoring system/relay to maintain the manufacturer's warranty the monitoring system or relay shall be provided by the pump supplier to the control panel manufacturer. The monitoring system/relay shall be incorporated into the control panel and all of the manufacturers required interlocks to maintain the pump warranty shall be wired into both the automatic and hand modes of operation.
- B. Pump Station SCADA Panel. The pump station SCADA panel shall be provided by the owner. The control assembly shall be constructed to the Owner's current standard and housed in a NEMA 4X stainless steel enclosure. All configuration, programming and integration into the Owner's SCADA system shall be performed by the Owner.

1.4 INSTRUMENTS

- A. The following instruments shall be supplied for the project:
 1. Float switches. The total number of floats supplied shall be as dictated by the project plans. The floats shall match the Owner's standard throughout the wastewater collection system.
 2. Submersible pressure transducer (level). The submersible pressure transducer shall match the Owner's standard throughout the wastewater collection system. The transducer shall be provided with cable clamp installation/mounting hardware.
 3. Pressure transducer (water system pressure): The pressure transducer shall match the Owner's standard throughout the water distribution system. The pressure transducer shall be provided by the Owner.

1.5 INTEGRATION

- A. Integration of the lift station into the Owner's SCADA system shall be performed by the Owner. However, the pump control panel manufacture shall provide drawings and information as necessary to incorporate the pump control panel signals into the SCADA system.

1.6 SUBMITTALS

- A. Product Data: Manufacturing data sheets for all components indicating pertinent data and identifying each component by item number and nomenclature as indicated on the drawings and in the specifications. Designation as listed in the bill of material shall be clearly indicated on the data sheet. If multiple products or options are shown on the same sheet, Contractor shall clearly indicate which products and options are intended for the item being provided.
- B. Shop Drawings: Submit shop drawings in accordance with the submittals specification section. Include the following:
1. Bill of Material listing all components provided in the control panel.
 2. Complete control schematic in ladder diagram format. Diagram shall include all terminal and wire numbering. Designations for components shall match that used in the bill of material.
 3. Physical layout drawing of switches, meters, pilot lights, and other devices on the control panel door or motor control center cover. If there is a dead front panel behind the door on which components are mounted, then a physical layout drawing of the dead front panel is also required. Component designations shall match the bill of material. Also indicate location and designation of each nameplate.
 4. Physical layout drawing of all devices on the back planes. This shall include but not be limited to relays, starters, contactors, terminal blocks, and wiring troughs. Component designations shall match the bill of material.
 5. A detailed system of identification for control conductors using both color coding and a coded numbering system. Identification system shall be in accordance with industrial standards and practices.
 6. A set of physical wiring diagram drawings. Diagrams shall be point-to-point, and shall include all terminal and wire numbering. The physical layout drawings shall be used as base sheets for the wiring diagrams. The number of wiring diagram sheets shall be kept to a minimum, but still allow the accurate tracing of circuits during troubleshooting. There shall be no overlapping of wires shown in the diagrams.
 7. A set of physical wiring diagram drawings detailing interconnection between the control panel and each Motor Control Center (MCC) cubicle.
 8. Nameplate legend, showing the designation for each, and a scaled or full-size detail of the nameplate. Contractor shall also include a description of the material used for the plate, and the size and typeface of the lettering.
 9. Range of and differential control setting for each variable control device.

- C. Closeout Documentation: Prior to Contract Closeout, Contractor shall turn over to the Engineer one set of reproducible "as built" drawings as described below, and one set of all equipment catalog and maintenance data. Explain and demonstrate the electrical control systems to Owner and/or Owner's representative. As-built drawings shall consist of one complete set of drawings as described in the paragraph on Submittals, with modifications made to reflect any changes made in the field during construction. Contractor shall submit four (4) sets of complete drawings, one (1) electronic version in PDF format and one (1) in CAD drawings on a CD-ROM. It is permissible to use any part of the Contract Documents as a starting point in the development of As-Built drawings; however, the Contract Documents have no terminal and wire numbers, and will require substantial modification before submission.
- D. All above submittals shall be completed and approved prior to construction of systems. Submittal shall be bound with pages continuously numbered. Any oversize documents shall be folded so as to be 8.5"x11" or smaller. Submittals shall include a cover sheet and table of contents listing all items being submitted, and the starting page number of each submittal item. Partial submittals will not be acceptable.
- E. Qualification Data: For testing personnel, as described in "Startup and Testing" article of this section.

1.7 QUALITY ASSURANCE

- A. All control equipment shall conform to UL 508.
- B. Freestanding control panels shall be constructed in accordance with UL 508A.
- C. Controls which are installed in Motor Control Centers shall comply with the requirements of UL 845.
- D. Control panels containing circuitry for hazardous areas shall be constructed in accordance with UL 698A.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All materials relating to this section individually and as completed panels shall be handled as fragile equipment and stored only inside closed buildings and protected from moisture entry. All openings shall be continuously plugged until the moment that connections thereto are actually made.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All power and control sections shall be constructed in accordance with the following standards: National Electrical Manufacturers Association (NEMA), Institute of Electrical and Electronics Engineers (IEEE), Underwriter Laboratories (UL), Nation Fire Protection Association (NFPA), and Instrumentation Systems and Automation Society (ISA)
- B. The control panel shall be constructed in a UL approved production facility and bear all applicable UL labels for panel construction (i.e. UL508A, UL 698A etc.).
- C. The completed panel assembly shall be factory tested prior to shipment. Field installation by the Contractor shall consist only of setting the panel in place and making necessary pneumatic and/or electrical connections.
- D. All power and control sections shall be designed to operate at the service voltage as indicated in the project plans.
- E. Control Panel manufacturing shall be provided by EMC, Automation Control Service, Inc., or engineer approved equal.

2.2 ENCLOSURES

- A. Exterior enclosures shall stainless steel NEMA 4X unless otherwise noted. Interior enclosures shall be NEMA 12 unless otherwise noted.
- B. All interior components shall be mounted with stainless steel hardware and shall be clearly identified with plastic identification nametags. The tags shall be white with black lettering.
- C. All enclosure doors shall be constructed with a 3-point steel latching mechanism in lieu of individual clamps.
- D. All doors shall be provided with heavy gauge stainless steel hinges.
- E. All enclosures shall be constructed of 14 gauge mild steel. The enclosure shall also include a 10 gauge mild steel sub-panel mounted on collar studs for equipment mounting.
- F. All enclosure seams shall be continuously welded and ground smooth.
- G. Data pockets shall be provide on all interior panel doors. The equipment supplier shall provide laminated schematics in each pocket for the associated control panel.

- H. All cabinets shall be sized to accommodate the equipment required plus 25% spare space.
- I. All enclosures shall be provided with hardware to hold the enclosure door(s) open while they are being serviced.

2.3 CONTROL WIRING

- A. Wiring, where required, shall be general-purpose open type, neatly bundled and laced or installed in plastic wiring troughs. Wire shall be stranded No. 16 AWG minimum, with thermoplastic insulation rated for 600V and 90 degrees C.
- B. All equipment mounting backboards shall be provided with nonmetallic slotted ducts. All nonmetallic slotted ducts shall have spare space equal to 40% of the depth of the duct.
- C. Wiring colors shall be as follows:
 - 1. All ungrounded AC conductors operating at the supply voltage shall be "Black"
 - 2. All ungrounded AC control conductors operating at a voltage less than or equal to the supply shall be "Red"
 - 3. All grounded AC current carrying conductors shall be "White"
 - 4. All ground conductors shall be "Green"
 - 5. All ungrounded DC control conductors shall be "Orange"
 - 6. All grounded DC current carrying conductors shall be "Brown"
 - 7. All intrinsically safe circuits shall be "Blue"
 - 8. A wiring color code legend shall be mounted inside the control panel door.
- D. All wires entering and leaving all panels shall be terminated at barrier type terminal strips with integral surge protection. All terminals shall be identified and labeled per the Owner's standard naming conventions. It shall be the Supplier's responsibility to coordinate with the Owner for the accepted naming conventions. (All terminal strips shall be designed for #12 AWG, XHHW-2, 90 degree C field wiring for terminations.)
- E. No terminal strip may be located closer than 8" from any side or bottom of the control panel. This is designed to allow for adequate wire bending radius for field terminations.
- F. All wiring shall be clearly marked with an identification number consistent with the wiring schematic.

- G. Devices mounted on the enclosure door or interior dead front panel shall be run in spiral wrap to avoid pinch points when opening and closing the enclosure door(s) or interior panels

2.4 SURGE PROTECTION

- A. All power and digital I/O signals shall be protected from surges at the control panel with suitable surge suppression devices. Panel mounted surge protection shall be Plug in Style & DIN rail mounted to allow for easy replacement. The power and digital I/O signals shall be protected with solid state surge suppression devices manufactured by Phoenix Contact or Engineer approved equal. MOV only type surge suppression is not acceptable.
- B. All analog I/O signals shall be protected by loop powered isolators manufactured by Phoenix Contact or Engineer approved equal.
- C. All incoming power to the control panel shall be protected by Phoenix Contacts "Trabtech" surge protectors or Engineered approved equal rated for the voltage being supplied. Protection shall be provided for all phase and neutral conductors.

2.5 PANEL MOUNTED DEVICES

- A. Indicating lights to be heavy duty, push-to-test type, oil tight, industrial type with integral transformer for 120 VAC applications. Lenses shall be colored as noted on drawings or as required by the equipment manufacturers if not specified on the drawings. Legend plates shall be factory engraved as required. Shall be Allen-Bradley Bulletin 800T 30.5mm, Square D 9001 or approved equal.
- B. Momentary pushbuttons to be heavy duty, oil tight, industrial type with full guard and momentary contact rated at 10 Amps continuous at 120 VAC. Legend plates shall be factory engraved as required. Shall be Allen-Bradley Bulletin 800T 30.5mm, Square D 9001 or approved equal.
- C. Selector switches, on/off and H.O.A. to be heavy duty, oil tight, industrial type with contact rated at 120 VAC, 10 amps continuous service. Legend plates shall be factory engraved as required. Shall be Allen-Bradley Bulletin 800T 30.5mm, Square D 9001 or approved equal.
- D. Current to voltage converters, 4-20mA_{dc} to 1-5V_{dc} shall be as manufactured by Phoenix Contact or Engineer approved equal.
- E. D.C. power supplies shall be as manufactured by PLC Manufacturer, PULS, or approved equal and shall be sized for 1.5 times the application requirements. (No open power supplies will be allowed.)

INSTRUMENTATION AND CONTROLS

- F. All relays shall be Potter Brumfield, Omron series MY or G2R series based on the application requirements for switching and ampacity. Units shall incorporate a lamp in parallel with relay coil.
- G. Time delay relays shall be solid state relays with a minimum adjustable range of 0 to 60 minutes unless other ranges are indicated or required. Relays will have a round 8-pin or 11-pin base with an indicator light to show when the relay is energized and/or timing. Time delay relays shall be Schneider Electric or equal.
- H. All circuit breakers shall be of the same AIC rating as the panel to which they are connected and shall be required to selectively coordinate above 0.1 seconds.
- I. H-O-A selector switches are required for each motor starter contained within a control panel. All adjustable speed controllers shall be provided with manual speed adjustment devices (separate from any HMI or Operator Interface Panel), which may be located on the face of the enclosure. H-O-A selector switches and manual speed switches shall allow the operator to control all motors and valves manually in the event of a PLC failure.
- J. Runtimes for each motor starter located in the control panel shall be tracked in the PLC and displayed on the HMI.
- K. Power distribution blocks shall be block style distribution blocks manufactured by Bussmann, Mersen or Engineer approved equal. All distribution blocks shall be provided with polycarbonate safety covers to provide dead front protection if they aren't inherently finger safe. The safety cover shall have a test prod hole for testing purposes
- L. Fuse blocks/holders shall be UL style fuse blocks manufactured by Bussmann, Mersen or Engineer approved equal.
- M. General purpose fuses shall be by Bussmann, Ferrez Shawmut or Engineer approved equal. Unless otherwise noted the fuse rating and type shall be determined based on the equipment (which the fuse is protecting) manufacturer's recommendations for overcurrent protection.
- N. Semiconductor fuses shall be Mersen Amp Trap series fuses or Engineer approved equal. Unless otherwise noted the fuse rating and type shall be determined based on the equipment (which the fuse is protecting) manufacturer's recommendations for overcurrent protection.
- O. All control transformers shall be sized to provide 25% spare capacity. The transformer connections shall be provided with protective covers to guard against accidental contact, and the transformer shall be provided with primary and secondary fusing per the manufacturer's recommendations.

- P. Each control panel shall be provided with a ground fault duplex service receptacle that is accessible from the interior dead-front panel. The service receptacle shall be capable of providing 15A at 125VAC
- Q. All intrinsically safe barrier relays shall be UL listed and shall be manufactured by Phoenix Contact or Engineer approved equal.
- R. All circuit breakers shall be manufactured by Square D or Engineer approved equal. A main circuit breaker shall be provided for each control panel.
- S. Pilot lights shall be provided for each starter located inside the control panel. The lights shall be as follows: Green (Run), Amber (Fault).
- T. Control power transformers shall be provided in each control panel with a supply voltage other than 120V or 120/208V. Control power transformers shall be manufactured by Square D, Allen Bradley or engineer approved equal and provided with both primary and secondary fuses per the NEC.
- U. Terminal strips shall be solderless box lug compression type of adequate capacity for the size and number of conductors to be terminated. The area around each lug and set screw shall have insulation barriers to prevent accidental shorting during assembly or use. Ratings: 300V and 20A minimum. Shall be by Allen Bradley, Phoenix Contact or engineer approved equal.
- V. Panel mounted lighting. Luminaries shall be 15 to 30 watt, rapid start fluorescent strip type, with warm white lamps. A lens or guard shall be provided over each lamp. Luminaire ballasts shall be rated for reliable operation in an ambient temperature of 30 degrees Fahrenheit. Door switches should be provided to energize the lights once the doors are opened.

2.6 MISCELLANEOUS

- A. Engraved laminated plastic nameplates shall be furnished for each front panel mounted instrument. The Contractor shall coordinate with the Owner for nameplate color and naming conventions. All instruments and components shall be tagged on rear with embossed plastic tape labels.
- B. No pneumatic tubing shall be installed inside the control panels.

PART 3 - EXECUTION

3.1 GENERAL

- A. All Work shall be done in accordance with appropriate Division 16 Sections and shall be performed in a workmanlike manner.

3.2 FABRICATION

- A. All control panels shall be shop assembled and factory tested prior to delivery to the site. Final as-built drawings shall be made to reflect all adjustments and modifications made to the systems after start-up has been completed satisfactorily. All equipment and devices shall be mounted, adjusted, calibrated and operated exactly as recommended by the manufacturer of each component.
- B. Control switches, pilot lights, and other devices shall be grouped in a logical arrangement for ease of operation.
- C. Control equipment shall be mounted to panel back plates with screws or bolts fastened into drilled and tapped holes. Nuts shall not be used. Panel face mountings shall be made by cutting holes exactly to manufacturer's instructions including keyways, etc. Engraved legend plates indicating function and operational instructions as applicable shall be mounted on all devices. All equipment shall be labeled and identified with designations which match the control wiring diagrams.

3.3 EQUIPMENT INSTALLATION

- A. All equipment shall be installed in accordance with approved shop drawings and manufacturer's written instructions.

3.4 WIRING AND TERMINATIONS

- A. All wires shall be run parallel to side walls of panels and/or in covered wiring troughs. Wiring passing across hinged areas shall be protected by abrasion resistant cabling material.
- B. All connections shall be made on mechanical compression or screw type terminals whenever possible. All connections for incoming and outgoing electrical wires in all panels and junction boxes shall be made on fully labeled terminal boards mounted inside the panel.

3.5 IDENTIFICATION

- A. All conductors shall be labeled at each end with numbers matching shop drawings and all wire terminations shall be identified by the component terminal numbers and shown on shop drawings. Each conductor shall be identified at each terminal end and each accessible manhole or junction box.
- B. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."
- C. Identify all major components as shown on plans, according to Division 16 Section "Electrical Identification".

3.6 FIELD CALIBRATION

- A. All instrumentation shall be calibrated in the presence of the Engineer, Owners Rep or Owner in accordance with the range and accuracy specified herein.
- B. All equipment shall be calibrated using a standard calibration sheet which has been approved by the Engineer. This calibration sheet shall be filled out identifying the instrument or item to be calibrated and signed with date and initials of the person calibrating the device.

3.7 START-UP AND TESTING

- A. Start-up and testing services shall be performed by ISA certified technicians experienced in these type systems. Certifications shall be attached with the bid documents.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control devices.
- B. Train Owner's maintenance personnel on procedures and schedules for maintaining control devices.
- C. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
- D. Schedule training with Owner with at least ten (10) business days advance notice

END OF SECTION