

INVITATION TO BID
ITB # 4351

WWTP Secondary Effluent Pump Replacement Project



Proposal Due Date: Tuesday, January 13, 2015
On or Before 2:00 P.M. (Local Time)

Public Services Area/Project Management Services Unit

Issued By:

City of Ann Arbor
Procurement Unit
301 E. Huron Street
Ann Arbor, MI 48104

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ADVERTISEMENT FOR THE
WWTP SECONDARY EFFLUENT PUMP REPLACEMENT PROJECT
CITY OF ANN ARBOR

ITB # 4351

Sealed Bids will be received by the City of Ann Arbor Customer Service Desk, First (1st) Floor, Guy Larcom City Hall, on or before **Tuesday, January 13, 2014** by **2:00 PM** for construction of the **WWTP Secondary Effluent Pump Replacement Project**. Bids will be publicly opened and read aloud at this time.

The Tertiary Filter Building at the City of Ann Arbor WWTP houses six secondary effluent pumps and four variable frequency drives (VFD's) that pump secondary effluent to the tertiary filters and/or the WWTP outfall. The Work includes the provision of all necessary permitting, construction, labor and materials to demolish five (5) existing vertical turbine wastewater pumps and related appurtenances; install, start-up, test six (6) new vertical turbine wastewater pumps that will be purchased and furnished by the City; furnishing and installation of two (2) new variable speed drives (VFDs) and the associated wiring and conduit, and setting up and starting the new VFDs; installation of a new PLC I/O module that will be provided by the City into the existing rack in CP-70, and the associated wiring and conduit; providing, installing and starting/debugging changes to the existing PLC Programming to the PLC in CP-70 as described in the Specifications; and providing, installing and starting/debugging Plant SCADA System application Programming changes as described in the Specifications to the existing Plant SCADA System. Services include WWTP staff training.

The Contractor shall coordinate delivery, unloading, storage and installation of the new pumps in a sequential manner that keeps four pumps operational at all times.

A pre-bid conference will be held on Friday, December 19, 2014 at 10:30 a.m. in the WWTP Storage Trailer located at 49 Old Dixboro Rd., Ann Arbor, Michigan 48105. Attendance is required. Hard hats, safety vests and safety glasses are required to enter the WWTP.

Bid documents, specifications, plans and addendum shall be downloaded by vendors at either of the following websites, Michigan Inter-governmental Trade Network (MITN) www.mitn.info or City of Ann Arbor web site www.A2gov.org. It is the bidder's responsibility to verify they have obtained all information before submitting a bid, including addenda.

Each Bid shall be accompanied by a certified check, or Bid Bond by a recognized surety, in the amount of 5% of the total of the bid price. A Bid, once submitted, becomes the property of the City. In the sole discretion of the City, the City reserves the right to allow a bidder to reclaim submitted documents provided the documents are requested and retrieved no later than 48 hours prior to the scheduled bid opening.

The successful Bidder will be required to furnish satisfactory performance, labor and material and maintenance and guarantee bonds in the amount of 100% of the bid price and satisfactory insurance coverage.

Preconditions for entering into a contract with the City of Ann Arbor include: (i) compliance with Chapter 112 of Title IX of the Code of the City of Ann Arbor, and (ii) compliance with applicable prevailing wage and living wage requirements of Chapter 23 of Title I of the Code of the City of Ann Arbor. Further information is outlined in the contract documents.

After the time of Bid opening, no Bid may be withdrawn for a period of 90 days. The City reserves the right to accept any Bid, to reject any or all Bids, to waive irregularities and/or informalities in any Bid, and to make the award in any manner the City believes to be in its best interest.

Any further information may be obtained from the Ann Arbor Procurement Office,
(734) 794- 6000 Ext. 45206, CITY OF ANN ARBOR, MICHIGAN

NOTICE OF PRE-BID CONFERENCE

A pre-bid conference for this project will be held on Friday, December 19, 2014 at 10:30 AM local time in the WWTP Storage Trailer located at 49 Old Dixboro Rd., Ann Arbor, Michigan 48105.

Attendance at this conference is required. Administrative and technical questions regarding this project will be answered at this time. The pre-bid meeting is for information only. Any answers furnished will not be official until verified in writing by the Financial Service Area, Procurement Unit. Answers that change or substantially clarify the bid will be affirmed in an addendum.

A site walkthrough will be conducted immediately after the pre-bid meeting. Hard hats, safety vests and safety glasses are required to enter the WWTP.

INSTRUCTIONS TO BIDDERS

General

Work to be done under this Contract is generally described through the detailed specifications and must be completed fully in accordance with the contract documents. All work to be done under this Contract is located in or near the City of Ann Arbor.

The City shall make available to all prospective Bidders, prior to receipt of the Bids, access to the area in which the work is to be performed. Advance notice should be given to the Administering Service Area/Unit in cases where access to the site must be arranged by the City.

Any Bid which does not conform fully to these instructions may be rejected.

Preparation of Bids

Bids should be prepared providing a straight-forward, concise description of the Bidder's ability to meet the requirements of the Invitation to Bid (ITB). Bids shall be written in ink or typewritten. No erasures are permitted. Mistakes may be crossed out and corrected and must be initialed and dated in ink by the person signing the Bid.

Bids must be submitted on the "Bid Forms" provided with each blank properly filled in. If forms are not fully completed it may disqualify the bid.

Each person signing the Bid certifies that he/she is the person in the Bidder's firm/organization responsible for the decision as to the fees being offered in the Bid and has not and will not participated in any action contrary to the terms of this provision.

Questions or Clarification on ITB Specifications

All questions regarding this ITB shall be submitted via email. Emailed questions and inquires will be accepted from any and all prospective Bidders in accordance with the terms and conditions of the ITB.

All questions shall be due on or before January 7, 2015 by 4:30 p.m. and should be addressed as follows:

Specification/Scope of Work questions emailed to mamicangelo@a2gov.org

Bid Process and HR Compliance questions emailed to mberryman@a2gov.org

Addenda

If it becomes necessary to revise any part of the ITB, notice of the Addendum will be posted to Michigan Inter-governmental Trade Network (MITN) www.mitn.info and/or City of Ann Arbor web site www.A2gov.org for all parties to download.

Each Bidder must in its Bid, to avoid any miscommunications, acknowledge all addenda which it has received, but the failure of a Bidder to receive, or acknowledge receipt of any addenda shall not relieve the Bidder of the responsibility for complying with the terms thereof.

The City will not be bound by oral responses to inquiries or written responses other than written addenda.

Bid Submission

All Bids are due and must be delivered to the Customer Service Department on or before **Tuesday, January 13, 2015 by 2:00 p.m.** Bids submitted late or via oral, telephonic, telegraphic, electronic mail or facsimile **will not** be considered or accepted.

Each Bidder must submit one (1) original Bid and one (1) Bid copy in a sealed envelope clearly marked: **ITB No. 4351 WWTP Secondary Effluent Pump Replacement Project.**

Bids must be addressed and delivered to:

City of Ann Arbor
1st Floor Customer Service Department,
301 East Huron Street
P.O. Box 8647
Ann Arbor, MI 48107

All Bids received on or before the Due Date will be publicly opened and recorded immediately. No immediate decisions are rendered.

Hand delivered bids will be date/time stamped/signed at the address above in order to be considered. Normal business hours are 8:00 a.m. to 4:00 p.m. Monday through Friday. The City will not be liable to any Bidder for any unforeseen circumstances, delivery or postal delays. Postmarking to the Due Date will not substitute for receipt of the Bid. Each Bidder is responsible for submission of their Bid.

Additional time will not be granted to a single Bidder; however, additional time may be granted to all Bidders when the City determines that circumstances warrant it.

Award

The City intends to award a Contract(s) to the lowest responsible Bidder(s). On multi-divisional contracts, separate divisions may be awarded to separate Bidders. The City may also utilize alternatives offered in the Bid Forms, if any, to determine the lowest responsible Bidder on each division, and award multiple divisions to a single Bidder, so that the lowest total cost is achieved for the City. For unit price bids, the contract will be awarded based upon the unit prices and the lump sum prices stated by the bidder for the work items specified in the bid documents, with consideration given to any alternates selected by the City. If the City determines that the unit price for any item is materially different for the work item bid than either other bidders or the general market, the City, in its sole discretion, in addition to any other right it may have, may reject the bid as not responsible or non-conforming.

The acceptability of major subcontractors will be considered in determining if a Bidder is responsible. In comparing Bids, the City will give consideration to alternate Bids for items listed in the bid forms.

Official Documents

The City of Ann Arbor shall accept no alternates to the bid documents made by the Bidder unless those alternatives are set forth in the "Alternate" section of the Bid Form.

The City of Ann Arbor officially distributes bid documents from the Procurement Unit or through the Michigan Intergovernmental Trade Network (MITN). Copies of the bid documents obtained from any other source are not Official copies. Addenda and other bid information will only be posted to these official distribution sites. If you obtained City of Ann Arbor Bid documents from other sources, it is recommended that you register on www.MITN.info and obtain an official Bid.

Bid Security

Each bid must be accompanied by a certified check, or Bid Bond by a surety licensed and authorized to do business within the State of Michigan, in the amount of 5% of the total of the bid price.

Withdrawal of Bids

After the time of opening, no Bid may be withdrawn for the period of 90 days, as specified in the Advertisement.

Contract Time

Time is of the essence in the performance of the work under this Contract. The available time for work under this Contract is indicated on page C-1, Article III of the Contract. If these time requirements cannot be met, the Bidder must stipulate on Bid Form Section 3 - Time Alternate its schedule for performance of the work. Consideration will be given to time in evaluating bids.

Liquidated Damages

A liquidated damages clause, as given on page C-1, Article III of the Contract, provides that the Contractor shall pay the City as liquidated damages, and not as a penalty, a sum certain per day for each and every day that the Contractor may be in default of completion of the specified work, within the time(s) stated in the Contract, or written extensions.

Liquidated damages clauses, as given in the General Conditions, provide further that the City shall be entitled to impose and recover liquidated damages for breach of the obligations under Chapter 112 of the City Code.

The liquidated damages are for the non-quantifiable aspects of any of the previously identified events and do not cover actual damages that can be shown or quantified nor are they intended to preclude recovery of actual damages in addition to the recovery of liquidated damages.

Human Rights Information

Section 5, beginning at page GC-3, outlines the requirements for fair employment practices under City of Ann Arbor Contracts. To establish compliance with this Ordinance, the Bidder must complete and return with its bid completed copies of the Human Rights Division Contract Compliance Forms (Attachment A) or an acceptable equivalent.

In the event the Human Rights forms are not submitted with the bid, the bidder will have 24 hours to submit upon notice from the City.

Wage Requirements

Section 4, beginning at page GC-1, outlines the requirements for payment of prevailing wages or of a “living wage” to employees providing service to the City under this contract. The successful bidder must comply with all applicable requirements and provide documentary proof of compliance when requested.

Major Subcontractors

The Bidder shall identify each major subcontractor it expects to engage for this Contract if the work to be subcontracted is 15% or more of the bid sum or over \$50,000, whichever is less. The Bidder also shall identify the work to be subcontracted to each major subcontractor and the approximate dollar value of each subcontract.

Debarment

Submission of a Bid in response to this ITB is certification that the Bidder is not currently debarred, suspended, proposed for debarment, and declared ineligible or voluntarily excluded from participation in this transaction by any State or Federal departments or agency. Submission is also agreement that the City will be notified of any changes in this status.

Disclosures

After bids are opened, all information in a bidder’s bid is subjected to disclosure under the provisions of Michigan Public Act No. 442 of 1976, as amended (MCL 15.231 et seq.), known as the “Freedom of Information Act.” The Freedom of Information Act also provides for the complete disclosure of contracts and attachments thereto except where specifically exempted.

Bid Protest

All Bid protests must be in writing and filed with the Purchasing Agent within five (5) business days of the award action. The bidder must clearly state the reasons for the protest. If a bidder contacts a City Service Area/Unit and indicates a desire to protest an award, the Service Area/Unit shall refer the bidder to the Purchasing Agent. The Purchasing Agent will provide the bidder with the appropriate instructions for filing the protest. The protest shall be reviewed by the City Administrator or designee whose decision shall be final.

Reservation of Rights

The City of Ann Arbor reserves the right to accept any bid or alternative bid proposed in whole or in part, to reject any or all bids or alternatives bids in whole or in part and to waive irregularity and/or informalities in any bid and to make the award in any manner deemed in the best interest of the City.

INVITATION TO BID

City of Ann Arbor
Guy C. Larcom Municipal Building
Ann Arbor, Michigan 48107

Ladies and Gentlemen:

The undersigned, as Bidder, declares that this Bid is made in good faith, without fraud or collusion with any person or persons bidding on the same Contract; that this Bidder has carefully read and examined the bid documents, including Advertisement, Human Rights Division Contract Compliance Forms, Notice of Pre-Bid Conference, Instructions to Bidders, Bid, Bid Forms, Contract, Bond Forms, General Conditions, Standard Specifications, Detailed Specifications, all Addenda, and the Plans and understands them. The Bidder declares that it conducted a full investigation at the site and of the work proposed and is fully informed as to the nature of the work and the conditions relating to the work's performance. The Bidder also declares that it has extensive experience in successfully completing projects similar to this one.

The Bidder acknowledges that it has not received or relied upon any representations or warrants of any nature whatsoever from the City of Ann Arbor, its agents or employees, and that this Bid is based solely upon the Bidder's own independent business judgment.

The undersigned proposes to perform all work shown on the plans or described in the bid documents, including any addenda issued, and to furnish all necessary machinery, tools, apparatus, and other means of construction to do all the work, furnish all the materials, and complete the work in strict accordance with all terms of the Contract of which this Bid is one part.

In accordance with these bid documents, and Addenda numbered _____, the undersigned, as Bidder, proposes to perform at the sites in and/or around Ann Arbor, Michigan, all the work included herein for the amounts set forth in the Bid Forms.

The Bidder declares that it has become fully familiar with the liquidated damage clauses for completion times and for compliance with City Code Chapter 112, understands and agrees that the liquidated damages are for the non-quantifiable aspects of non-compliance and do not cover actual damages that may be shown and agrees that if awarded the Contract, all liquidated damage clauses form part of the Contract.

The Bidder declares that it has become fully familiar with the provisions of Chapter 14, Section 1:319 (Prevailing wages) and Chapter 23 (Living Wage) of the Code of the City of Ann Arbor and that it understands and agrees to comply, to the extent applicable to employees providing services to the City under this Contract, with the wage and reporting requirements stated in the City Code provisions cited. Bidder further agrees that the cited provisions of Chapter 14 and Chapter 23 form a part of this Contract.

The Bidder encloses a certified check or Bid Bond in the amount of 5% of the total of the Bid Price. The Bidder agrees both to contract for the work and to furnish the necessary Bonds and insurance documentation within 10 days after being notified of the

acceptance of the Bid.

If this Bid is accepted by the City and the Bidder fails to contract and furnish the required Bonds and insurance documentation within 10 days after being notified of the acceptance of this Bid, then the Bidder shall be considered to have abandoned the Contract and the certified check or Bid Bond accompanying this Bid shall become due and payable to the City.

If the Bidder enters into the Contract in accordance with this Bid, or if this Bid is rejected, then the accompanying check or Bid Bond shall be returned to the Bidder.

In submitting this Bid, it is understood that the right is reserved by the City to accept any Bid, to reject any or all Bids, to waive irregularities and/or informalities in any Bid, and to make the award in any manner the City believes to be in its best interest.

SIGNED THIS _____ DAY OF _____, 2015.

Bidders Name

Authorized Signature of Bidder

Official Address

Telephone Number

(Print Name of Signer Above)

LEGAL STATUS OF BIDDER

(The Bidder shall fill out the appropriate form and strike out the other two.)

Bidder declares that it is:

*A corporation organized and doing business under the laws of the state of _____, for whom _____, bearing the office title of _____, whose signature is affixed to this Bid, is authorized to execute contracts.

*A partnership, list all members and the street and mailing address of each:

Also identify the County and State where partnership papers are filed:

County of _____, State of _____

*An individual, whose signature with address, is affixed to this Bid: _____
(initial here)

BID FORM

Section 1 - Schedule of Prices

Base Bid

For the entire work outlined in these documents, complete as specified, using equipment and materials only of the type and manufacturers where specifically named.

TOTAL BASE BID:

_____ Dollars (\$ _____)

BID FORM

Section 2 - Material and Equipment Alternates

The Base Bid price shall include materials and equipment selected from the designated items and manufacturers listed in the bidding documents. This is done to establish uniformity in bidding and to establish standards of quality for the items named.

If the Contractor wishes to quote alternate items for consideration by the City, it may do so under this Section. A complete description of the item and the proposed price differential must be provided. Unless approved at the time of award, substitutions where items are specifically named will be considered only as a negotiated change in Contract Sum.

<u>Item Number</u> <u>Amount</u>	<u>Description</u>	<u>Add/Deduct</u>
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If the Bidder does not suggest any material or equipment alternate, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT propose any material or equipment alternate under the contract.

Signature of Authorized Representative of Bidder

BID FORM

Section 3 - Time Alternate

If the Bidder takes exception to the time stipulated in Article III of the Contract, Time of Completion, page C-1, it is requested to stipulate below its proposed time for performance of the work. Consideration will be given to time in evaluating bids.

If the Bidder does not suggest any time alternate, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT propose any time alternate under the contract.

Signature of Authorized Representative of Bidder

BID FORM

Section 4 - Subcontractors

For purposes of this contract, a Subcontractor is anyone (other than the Contractor) who performs work (other than or in addition to the furnishing of materials, plans or equipment) at or about the construction site, directly or indirectly for or on behalf of the Contractor (and whether or not in privity of contract with the Contractor), but shall not include any individual who furnishes merely the individual's own personal labor or services.

For the work outlined in these documents the Bidder expects to engage the following major subcontractors to perform the work identified.

<u>Subcontractor (Name and Address)</u>	<u>Work</u>	<u>Amount</u>
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If the Bidder does not expect to engage any major subcontractor, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT expect to engage any major subcontractor to perform work under the contract.

Signature of Authorized Representative of Bidder

CONTRACT

THIS AGREEMENT is made on the _____ day of _____, 200_, between the CITY OF ANN ARBOR, a Michigan Municipal Corporation, 301 E. Huron Street, Ann Arbor, Michigan 48104 (“City”) and _____ (“Contractor”)

(An individual/partnership/corporation, include state of incorporation)

(Address)

Based upon the mutual promises below, the Contractor and the City agree as follows:

ARTICLE I - Scope of Work

The Contractor agrees to furnish all of the materials, equipment and labor necessary; and to abide by all the duties and responsibilities applicable to it for the project titled “WWTP Secondary Effluent Pump Replacement Project” in accordance with the requirements and provisions of the following documents, including all written modifications incorporated into any of the documents, which are incorporated as part of this Contract:

Human Rights Division Contract

Compliance Forms

Living Wage Declaration of
Compliance Forms (if applicable)

Bid Forms

Contract and Exhibits

Bonds

General Conditions

Standard Specifications

Detailed Specifications

Plans

Addenda

ARTICLE II - Definitions

Administering Service Area/Unit means Public Services Area, WWTP Unit

Supervising Professional means Public Services Unit Manager acting personally or through any assistants authorized by the Administrator/Manager of the Administering Service Area/Unit.

Project means WWTP Secondary Effluent Pump Replacement Project, ITB - 4351

ARTICLE III - Time of Completion

- (A) The work to be completed under this Contract shall begin immediately on the date specified in the Notice to Proceed issued by the City.
- (B) The entire work for this Contract shall be completed within **190 consecutive calendar days**. Shorter completion times for certain portions of the work may be specified in the Detailed Specifications.
- (C) Failure to complete all the work within the time specified above, including any extension granted in writing by the Supervising Professional, shall obligate the Contractor to pay the City, as liquidated damages and not as a penalty, an amount equal to **\$1000.00** for each calendar day of delay in the completion of all the work. If any liquidated damages are unpaid by the Contractor, the City shall be entitled to deduct these unpaid liquidated damages from the monies due the Contractor.

As an independent requirement, where the Detailed Specifications identify

certain portions of the work to be completed within a shorter period of time and the Contractor fails to complete each portion within the shorter period specified for each portion, including any extension granted in writing by the Project Supervisor, the City is entitled to deduct from the monies due the Contractor, as liquidated damages and not as a penalty, the amount identified in the Detailed Specifications for each portion of the work not timely completed for each calendar day of delay in completion of each portion of the work.

The liquidated damages are for the non-quantifiable aspects of any of the previously identified events and do not cover actual damages that can be shown or quantified nor are they intended to preclude recovery of actual damages in addition to the recovery of liquidated damages.

Liquidated damages under this section are in addition to any liquidated damages due under Section 5 of the General Conditions.

ARTICLE IV - The Contract Sum

- (A) The City shall pay to the Contractor for the performance of the Contract, the unit prices as given in the Bid Forms for the estimated total of:
- _____ Dollars (\$ _____)
- (B) The amount paid shall be equitably adjusted to cover changes in the work ordered by the Supervising Professional but not required by the contract documents.

ARTICLE V - Assignment

This Contract may not be assigned or subcontracted without the written consent of the City.

ARTICLE VI - Choice of Law

This Contract shall be construed, governed, and enforced in accordance with the laws of the State of Michigan. By executing this agreement, the Contractor and the City agree to venue in a court of appropriate jurisdiction sitting within Washtenaw County for purposes of any action arising under this Contract. The parties stipulate that the venue referenced in this Contract is for convenience and waive any claim of non-convenience.

Whenever possible, each provision of the contract will be interpreted in a manner as to be effective and valid under applicable law. The prohibition or invalidity, under applicable law, of any provision will not invalidate the remainder of the contract.

ARTICLE VII - Relationship of the Parties

The parties of the Contract agree that it is not a contract of employment but is a contract to accomplish a specific result. Contractor is an independent contractor performing services for the City. Nothing contained in this Contract shall be deemed to constitute any other relationship between the City and the Contractor.

Contractor certifies that it has no personal or financial interest in the project other than the compensation it is to receive under the Contract. Contractor certifies that it is not, and shall not

become, overdue or in default to the City for any contract, debt, or any other obligation to the City including real or personal property taxes. City shall have the right to set off any such debt against compensation awarded for services under this agreement.

ARTICLE VIII - Notice

All notices given under this contract shall be in writing, and shall be by personal delivery or by certified mail with return receipt requested to the parties at their respective addresses as specified in the contract documents or other address the Contractor may specify in writing.

ARTICLE IX - Indemnification

To the fullest extent permitted by law, Contractor shall indemnify, defend and hold harmless the City, its officers, employees and agents harmless from all suits, claims, judgments and expenses including attorney's fees resulting or alleged to result, in whole or in part, from any act or omission, which is in any way connected or associated with this contract, by the Contractor or anyone acting on the Contractor's behalf under this contract. Contractor shall not be responsible to indemnify the City for losses or damages caused by or resulting from the City's sole negligence.

ARTICLE X - Entire Agreement

This Contract represents the entire understanding between the City and the Contractor and it supersedes all prior representations or agreements whether written or oral. Neither party has relied on any prior representations in entering into this Contract. This Contract may be altered, amended or modified only by written amendment signed by the City and the Contractor.

FOR CONTRACTOR

By _____

Its: _____

FOR THE CITY OF ANN ARBOR

By _____

Christopher Taylor, Mayor

By _____

Jacqueline Beaudry, City Clerk

Approved as to substance

By _____

Steve Powers, City Administrator

By _____

Craig Hupy, Public Services Area Administrator

Approved as to form and content

Stephen K. Postema, City Attorney

PERFORMANCE BOND

- (1) _____ of
(referred to as "Principal"), and _____, a
corporation duly authorized to do business in the State of Michigan (referred to as "Surety"), are
bound to the City of Ann Arbor, Michigan (referred to as "City"), for
\$ _____, the payment of which Principal and Surety bind
themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by
this bond.
- (2) The Principal has entered a written contract with the City dated _____,
2015, for: WWTP Secondary Effluent Pump Replacement Project and this bond is given
for that contract in compliance with Act No. 213 of the Michigan Public Acts of 1963, as
amended, being MCL 129.201 et seq.
- (3) Whenever the Principal is declared by the City to be in default under the contract, the Surety may
promptly remedy the default or shall promptly:
- (a) complete the contract in accordance with its terms and conditions; or
 - (b) obtain a bid or bids for submission to the City for completing the contract in accordance with
its terms and conditions, and upon determination by Surety of the lowest responsible bidder,
arrange for a contract between such bidder and the City, and make available, as work progresses,
sufficient funds to pay the cost of completion less the balance of the contract price; but not
exceeding, including other costs and damages for which Surety may be liable hereunder, the
amount set forth in paragraph 1.
- (4) Surety shall have no obligation to the City if the Principal fully and promptly performs under the
contract.
- (5) Surety agrees that no change, extension of time, alteration or addition to the terms of the contract
or to the work to be performed thereunder, or the specifications accompanying it shall in any way
affect its obligations on this bond, and waives notice of any such change, extension of time,
alteration or addition to the terms of the contract or to the work, or to the specifications.

SIGNED AND SEALED this _____ day of _____, 2015.

_____ (Name of Surety Company)	_____ (Name of Principal)
By _____ (Signature)	By _____ (Signature)
Its _____ (Title of Office)	Its _____ (Title of Office)

Approved as to form:

Name and address of agent:

Stephen K. Postema, City Attorney

LABOR AND MATERIAL BOND

- (1) _____ of __ (referred to as "Principal"), and _____, a corporation duly authorized to do business in the State of Michigan, (referred to as "Surety"), are bound to the City of Ann Arbor, Michigan (referred to as "City"), for the use and benefit of claimants as defined in Act 213 of Michigan Public Acts of 1963, as amended, being MCL 129.201 et seq., in the amount of \$ _____, for the payment of which Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by this bond.
- (2) The Principal has entered a written contract with the City, dated _____, 2015, for the WWTP Secondary Effluent Pump Replacement Project; and this bond is given for that contract in compliance with Act No. 213 of the Michigan Public Acts of 1963 as amended;
- (3) If the Principal fails to promptly and fully repay claimants for labor and material reasonably required under the contract, the Surety shall pay those claimants.
- (4) Surety's obligations shall not exceed the amount stated in paragraph 1, and Surety shall have no obligation if the Principal promptly and fully pays the claimants.

SIGNED AND SEALED this _____ day of _____, 2015.

_____ (Name of Surety Company)	_____ (Name of Principal)
By _____ (Signature)	By _____ (Signature)
Its _____ (Title of Office)	Its _____ (Title of Office)
Approved as to form:	Name and address of agent:
_____ Stephen K. Postema, City Attorney	_____ _____

MAINTENANCE AND GUARANTEE BOND

(1) _____ of (referred to as "Principal"), and _____, a corporation duly authorized to do business in the State of Michigan, (referred to as "Surety"), are bound to the City of Ann Arbor, Michigan (referred to as "City"), for the use and benefit of claimants as defined in Act 213 of Michigan Public Acts of 1963, as amended, being MCL 129.201 et seq., in the amount of

\$ _____, for the payment of which Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by this bond.

(2) NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that by and under such contract, the above named principal has agreed with the City that for a period of one (1) year(s) from the date of approval of the Final Estimate, to keep in good order and repair any defect in all the work done under said contract, either by the principal, his subcontractors, or his material suppliers, that may develop during said period due to improper materials, defective equipment, workmanship or arrangements, and any other work affected in making good such imperfections, all to be made good without expense to the City, (excepting only such part or parts of said work as may have been disturbed without the consent or approval of the principal after the final acceptance of the work), and whenever directed so to do by the Owner, by notice served in writing, either personally or by mail, on the principal at _____ or _____, its legal representatives, or successors, or on the surety at _____ to proceed at once to make such repairs as directed by the City and in case of failure to do so within one (1) week from the date of service of such notice, or within reasonable time not less than one (1) week, as shall be fixed in said notice, then the City_ shall have the right to purchase such materials and employ such labor and equipment as may be necessary for the purpose, and to undertake, do and make such repairs, and charge the expense thereof to, and be fully reimbursed for same from said principal or surety. If any repair is necessary to be made at once to protect life and property, the _City may take immediate steps to repair or barricade such defects without notice to the contractor. In such case the City shall not be held to obtain the lowest figures for the doing of the work, or any part thereof, but all sums actually paid therefor shall be charged to the principal or surety. In this connection the judgment of the City is final and conclusive.

(3) If the principal for a period of one (1) year from the date of approval of a Final Estimate, shall keep the work so constructed under the contract in good order and repair, excepting only such parts of said work which have been disturbed without the consent or approval of the principal after the final acceptance of same, and whenever notice is given as hereinbefore specified, at once proceed to make the repair as the notice directs, or reimburse the for any expenses incurred by it in making such repairs should the principal or surety fail to do so, then the above obligation shall be void; otherwise, it will remain in full force and effect.

SIGNED AND SEALED this _____ day of _____, 2015.

_____ (Name of Surety Company)	_____ (Name of Principal)
By _____ (Signature)	By _____ (Signature)
Its _____ (Title of Office)	Its _____ (Title of Office)

Approved as to form:

Name and address of agent:

 Stephen K. Postema, City Attorney

GENERAL CONDITIONS

Section 1 - Execution, Correlation and Intent of Documents

The contract documents shall be signed in 2 copies by the City and the Contractor.

The contract documents are complementary and what is called for by any one shall be binding. The intention of the documents is to include all labor and materials, equipment and transportation necessary for the proper execution of the work. Materials or work described in words which so applied have a well-known technical or trade meaning have the meaning of those recognized standards.

In case of a conflict among the contract documents listed below in any requirement(s), the requirement(s) of the document listed first shall prevail over any conflicting requirement(s) of a document listed later.

(1) Addenda in reverse chronological order; (2) Detailed Specifications; (3) Standard Specifications; (4) Plans; (5) General Conditions; (6) Contract; (7) Bid Forms; (8) Bond Forms; (9) Bid.

Section 2 - Order of Completion

The Contractor shall submit with each invoice, and at other times reasonably requested by the Supervising Professional, schedules showing the order in which the Contractor proposes to carry on the work. They shall include the dates at which the Contractor will start the several parts of the work, the estimated dates of completion of the several parts, and important milestones within the several parts.

Section 3 - Familiarity with Work

The Bidder or its representative shall make personal investigations of the site of the work and of existing structures and shall determine to its own satisfaction the conditions to be encountered, the nature of the ground, the difficulties involved, and all other factors affecting the work proposed under this Contract. The Bidder to whom this Contract is awarded will not be entitled to any additional compensation unless conditions are clearly different from those which could reasonably have been anticipated by a person making diligent and thorough investigation of the site.

The Bidder shall immediately notify the City upon discovery, and in every case prior to submitting its Bid, of every error or omission in the bidding documents that would be identified by a reasonably competent, diligent Bidder. In no case will a Bidder be allowed the benefit of extra compensation or time to complete the work under this Contract for extra expenses or time spent as a result of the error or omission.

Section 4 - Wage Requirements

Under this Contract, the Contractor shall conform to Chapter 14 of Title I of the Code of the City of Ann Arbor as amended; which in part states "...that all craftsmen, mechanics and laborers employed directly on the site in connection with said improvements, including said employees of subcontractors, shall receive the prevailing wage for the corresponding classes of craftsmen, mechanics and laborers, as determined by statistics for the Ann Arbor area compiled by the United States Department of Labor. At the request of the City, any contractor or subcontractor shall provide satisfactory proof of compliance with the contract provisions required by the Section."

Where the Contract and the Ann Arbor City Ordinance are silent as to definitions of terms

required in determining contract compliance with regard to prevailing wages, the definitions provided in the Davis-Bacon Act as amended (40 U.S.C. 278-a to 276-a-7) for the terms shall be used.

Further, to the extent that any employees of the Contractor providing services under this contract are not part of the class of craftsmen, mechanics and laborers who receive a prevailing wage in conformance with Section 1:319 of Chapter 14 of Title I of the Code of the City of Ann Arbor, the Contractor agrees to conform to Chapter 23 of Title I of the Code of the City of Ann Arbor, as amended, which in part states:

1:814. Applicability.

- (1) This Chapter shall apply to any person that is a contractor/vendor or grantee as defined in Section 1:813 that employs or contracts with five (5) or more individuals; provided, however, that this Chapter shall not apply to a non-profit contractor/vendor or non-profit grantee unless it employs or contracts with ten (10) or more individuals.
- (2) This Chapter shall apply to any grant, contract, or subcontract or other form of financial assistance awarded to or entered into with a contractor/vendor or grantee after the effective date of this Chapter and to the extension or renewal after the effective date of this Chapter of any grant, contract, or subcontract or other form of financial assistance with a contractor/vendor or grantee.

1:815. Living Wages Required.

- (1) Every contractor/vendor or grantee, as defined in Section 1:813, shall pay its covered employees a living wage as established in this Section.
 - (a) For a covered employer that provides employee health care to its employees, the living wage shall be \$9.42 an hour, or the adjusted amount hereafter established under Section 1:815(3).
 - (b) For a covered employer that does not provide health care to its employees, the living wage shall be \$10.91 a hour, or the adjusted amount hereafter established under Section 1:815(3).
- (2) In order to qualify to pay the living wage rate for covered employers providing employee health care under subsection 1:815(1)(a), a covered employer shall furnish proof of said health care coverage and payment therefor to the City Administrator or his/her designee.
- (3) The amount of the living wage established in this Section shall be adjusted upward no later than April 30, 2002, and every year thereafter by a percentage equal to the percentage increase, if any, in the federal poverty guidelines as published by the United States Department of Health and Human Services for the years 2001 and 2002. Subsequent annual adjustments shall be based upon the percentage increase, if any, in the United States Department of Health and Human Services poverty guidelines when comparing the prior calendar year's poverty guidelines to the present calendar year's guidelines. The applicable percentage amount will be converted to an amount in cents by multiplying the existing wage under Section 1.815(1)(b) by said percentage, rounding upward to the next cent, and adding this amount of cents to the existing living wage levels established under Sections 1:815(1)(a) and 1:815(1)(b). Prior to April 1 of each calendar year, the City will notify any covered employer of this adjustment by posting a written notice in a prominent place in City Hall, and, in the case of a covered employer that has provided an address of record to the City, by a written letter to each such covered

employer.

Contractor agrees that all subcontracts entered into by the Contractor shall contain similar wage provision covering subcontractor's employees who perform work on this contract.

Section 5 - Non-Discrimination

The Contractor agrees to comply, and to require its subcontractor(s) to comply, with the nondiscrimination provisions of Section 209 of the Elliot-Larsen Civil Rights Act (MCL 37.2209). The Contractor further agrees to the nondiscrimination provisions of Chapter 112 of the Ann Arbor City Code and to take affirmative action to assure that applicants are employed and that employees are treated during employment in a manner which provides equal employment. The Contractor agrees to comply with the provisions of Section 9:161 of Chapter 112 of the Ann Arbor City Code and in particular the following excerpts:

9:161 NONDISCRIMINATION BY CITY CONTRACTORS

- (1) All contractors proposing to do business with the City of Ann Arbor shall satisfy the nondiscrimination administrative policy adopted by the City Administrator in accordance with the guidelines of this section. All contractors shall receive approval from the Director prior to entering into a contract with the City, unless specifically exempted by administrative policy. All City contractors shall take affirmative action to insure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity and tends to eliminate inequality based upon race, national origin or sex.
- (2) Each prospective contractor shall submit to the City data showing current total employment by occupational category, sex and minority group. If, after verifying this data, the Director concludes that it indicates total minority and female employment commensurate with their availability within the contractor's labor recruitment area, i.e., the area from which the contractor can reasonably be expected to recruit, said contractor shall be accepted by the Director as having fulfilled affirmative action requirements for a period of one year at which time the Director shall conduct another review. Other contractors shall develop an affirmative action program in conjunction with the Director. Said program shall include specific goals and timetables for the hiring and promotion of minorities and females. Said goals shall reflect the availability of minorities and females within the contractor's labor recruitment area. In the case of construction contractors, the Director shall use for employment verification the labor recruitment area of the Ann Arbor-Ypsilanti standard metropolitan statistical area. Construction contractors determined to be in compliance shall be accepted by the Director as having fulfilled affirmative action requirements for a period of six (6) months at which time the Director shall conduct another review.
- (3) In hiring for construction projects, contractors shall make good faith efforts to employ local persons, so as to enhance the local economy.
- (4) All contracts shall include provisions through which the contractor agrees, in addition to any other applicable Federal or State labor laws:
 - (a) To set goals, in conference with the Human Resources Director, for each job category or division of the work force used in the completion of the City work;
 - (b) To provide periodic reports concerning the progress the contractor has made in meeting the affirmative action goals it has agreed to;

- (c) To permit the Director access to all books, records and accounts pertaining to its employment practices for the purpose of determining compliance with the affirmative action requirements.
- (5) The Director shall monitor the compliance of each contractor with the nondiscrimination provisions of each contract. The Director shall develop procedures and regulations consistent with the administrative policy adopted by the City Administrator for notice and enforcement of non-compliance. Such procedures and regulations shall include a provision for the posting of contractors not in compliance.
- (6) All City contracts shall provide further that breach of the obligation not to discriminate shall be a material breach of the contract for which the City shall be entitled, at its option, to do any or all of the following:
 - (a) To cancel, terminate, or suspend the contract in whole or part and/or refuse to make any required periodic payments under the contract;
 - (b) Declare the contractor ineligible for the award of any future contracts with the City for a specified length of time;
 - (c) To recover liquidated damages of a specified sum, said sum to be that percentage of the labor expenditure for the time period involved which would have accrued to minority group members had the affirmative action not been breached;
 - (d) Impose for each day of non-compliance, liquidated damages of a specified sum, based upon the following schedule:

<u>Contract Amount</u>	Assessed Damages Per Day of <u>Non-Compliance</u>
\$ 10,000 - 24,999	\$ 25.00
25,000 - 99,999	50.00
100,000 - 199,999	100.00
200,000 - 499,999	150.00
500,000 - 1,499,999	200.00
1,500,000 - 2,999,999	250.00
3,000,000 - 4,999,999	300.00
5,000,000 - and above	500.00

- (e) In addition the contractor shall be liable for any costs or expenses incurred by the City of Ann Arbor in obtaining from other sources the work and services to be rendered or performed or the goods or properties to be furnished or delivered to the City under this contract.

Section 6 - Materials, Appliances, Employees

Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, light, power, transportation, and other facilities necessary or used for the execution and completion of the work. Unless otherwise specified, all materials incorporated in the permanent work shall be new, and both workmanship and materials shall be of the highest quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

The Contractor shall at all times enforce strict discipline and good order among its employees, and shall seek to avoid employing on the work any unfit person or anyone not skilled in the work assigned.

Adequate sanitary facilities shall be provided by the Contractor.

Section 7 - Qualifications for Employment

The Contractor shall employ competent laborers and mechanics for the work under this Contract. For work performed under this Contract, employment preference shall be given to qualified local residents.

Section 8 - Royalties and Patents

The Contractor shall pay all royalties and license fees. It shall defend all suits or claims for infringements of any patent rights and shall hold the City harmless from loss on account of infringement except that the City shall be responsible for all infringement loss when a particular process or the product of a particular manufacturer or manufacturers is specified, unless the City has notified the Contractor prior to the signing of the Contract that the particular process or product is patented or is believed to be patented.

Section 9 - Permits and Regulations

The Contractor must secure and pay for all permits, permit or plan review fees and licenses necessary for the prosecution of the work. These include but are not limited to local Township permits, City building permits, right-of-way permits, lane closure permits, right-of-way occupancy permits, and the like. The City shall secure and pay for easements shown on the plans unless otherwise specified.

The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the contract documents are at variance with those requirements, it shall promptly notify the Supervising Professional in writing, and any necessary changes shall be adjusted as provided in the Contract for changes in the work.

Section 10 - Protection of the Public and of Work and Property

The Contractor is responsible for the means, methods, sequences, techniques and procedures of construction and safety programs associated with the work contemplated by this contract. The Contractor, its agents or sub-contractors, shall comply with the "General Rules and Regulations for the Construction Industry" as published by the Construction Safety Commission of the State of Michigan and to all other local, State and National laws, ordinances, rules and regulations pertaining to safety of persons and property.

The Contractor shall take all necessary and reasonable precautions to protect the safety of the public. It shall continuously maintain adequate protection of all work from damage, and shall take all necessary and reasonable precautions to adequately protect all public and private

property from injury or loss arising in connection with this Contract. It shall make good any damage, injury or loss to its work and to public and private property resulting from lack of reasonable protective precautions, except as may be due to errors in the contract documents, or caused by agents or employees of the City. The Contractor shall obtain and maintain sufficient insurance to cover damage to any City property at the site by any cause.

In an emergency affecting the safety of life, or the work, or of adjoining property, the Contractor is, without special instructions or authorization from the Supervising Professional, permitted to act at its discretion to prevent the threatened loss or injury. It shall also so act, without appeal, if authorized or instructed by the Supervising Professional.

Any compensation claimed by the Contractor for emergency work shall be determined by agreement or in accordance with the terms of Claims for Extra Cost - Section 15.

Section 11 - Inspection of Work

The City shall provide sufficient competent personnel for the inspection of the work.

The Supervising Professional shall at all times have access to the work whenever it is in preparation or progress, and the Contractor shall provide proper facilities for access and for inspection.

If the specifications, the Supervising Professional's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Supervising Professional timely notice of its readiness for inspection, and if the inspection is by an authority other than the Supervising Professional, of the date fixed for the inspection. Inspections by the Supervising Professional shall be made promptly, and where practicable at the source of supply. If any work should be covered up without approval or consent of the Supervising Professional, it must, if required by the Supervising Professional, be uncovered for examination and properly restored at the Contractor's expense.

Re-examination of any work may be ordered by the Supervising Professional, and, if so ordered, the work must be uncovered by the Contractor. If the work is found to be in accordance with the contract documents, the City shall pay the cost of re-examination and replacement. If the work is not in accordance with the contract documents, the Contractor shall pay the cost.

Section 12 - Superintendence

The Contractor shall keep on the work site, during its progress, a competent superintendent and any necessary assistants, all satisfactory to the Supervising Professional. The superintendent will be responsible to perform all on-site project management for the Contractor. The superintendent shall be experienced in the work required for this Contract. The superintendent shall represent the Contractor and all direction given to the superintendent shall be binding as if given to the Contractor. Important directions shall immediately be confirmed in writing to the Contractor. Other directions will be confirmed on written request. The Contractor shall give efficient superintendence to the work, using its best skill and attention.

Section 13 - Changes in the Work

The City may make changes to the quantities of work within the general scope of the Contract at any time by a written order and without notice to the sureties. If the changes add to or deduct from the extent of the work, the Contract Sum shall be adjusted accordingly. All the changes shall be executed under the conditions of the original Contract except that any claim for extension of time caused by the change shall be adjusted at the time of ordering the change.

In giving instructions, the Supervising Professional shall have authority to make minor changes

in the work not involving extra cost and not inconsistent with the purposes of the work, but otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless in pursuance of a written order by the Supervising Professional, and no claim for an addition to the Contract Sum shall be valid unless the additional work was ordered in writing.

The Contractor shall proceed with the work as changed and the value of the work shall be determined as provided in Claims for Extra Cost - Section 15.

Section 14 - Extension of Time

Extension of time stipulated in the Contract for completion of the work will be made if and as the Supervising Professional may deem proper under any of the following circumstances:

- (1) When work under an extra work order is added to the work under this Contract;
- (2) When the work is suspended as provided in Section 20;
- (3) When the work of the Contractor is delayed on account of conditions which could not have been foreseen, or which were beyond the control of the Contractor, and which were not the result of its fault or negligence;
- (4) Delays in the progress of the work caused by any act or neglect of the City or of its employees or by other Contractors employed by the City;
- (5) Delay due to an act of Government;
- (6) Delay by the Supervising Professional in the furnishing of plans and necessary information;
- (7) Other cause which in the opinion of the Supervising Professional entitles the Contractor to an extension of time.

The Contractor shall notify the Supervising Professional within 7 days of an occurrence or conditions which, in the Contractor's opinion, entitle it to an extension of time. The notice shall be in writing and submitted in ample time to permit full investigation and evaluation of the Contractor's claim. The Supervising Professional shall acknowledge receipt of the Contractor's notice within 7 days of its receipt. Failure to timely provide the written notice shall constitute a waiver by the Contractor of any claim.

In situations where an extension of time in contract completion is appropriate under this or any other section of the contract, the Contractor understands and agrees that the only available adjustment for events that cause any delays in contract completion shall be extension of the required time for contract completion and that there shall be no adjustments in the money due the Contractor on account of the delay.

Section 15 - Claims for Extra Cost

If the Contractor claims that any instructions by drawings or other media issued after the date of the Contract involved extra cost under this Contract, it shall give the Supervising Professional written notice within 7 days after the receipt of the instructions, and in any event before proceeding to execute the work, except in emergency endangering life or property. The procedure shall then be as provided for Changes in the Work-Section 13. No claim shall be valid unless so made.

If the Supervising Professional orders, in writing, the performance of any work not covered by the contract documents, and for which no item of work is provided in the Contract, and for which

no unit price or lump sum basis can be agreed upon, then the extra work shall be done on a Cost-Plus-Percentage basis of payment as follows:

- (1) The Contractor shall be reimbursed for all reasonable costs incurred in doing the work, and shall receive an additional payment of 15% of all the reasonable costs to cover both its indirect overhead costs and profit;
- (2) The term "Cost" shall cover all payroll charges for employees and supervision required under the specific order, together with all worker's compensation, Social Security, pension and retirement allowances and social insurance, or other regular payroll charges on same; the cost of all material and supplies required of either temporary or permanent character; rental of all power-driven equipment at agreed upon rates, together with cost of fuel and supply charges for the equipment; and any costs incurred by the Contractor as a direct result of executing the order, if approved by the Supervising Professional;
- (3) If the extra is performed under subcontract, the subcontractor shall be allowed to compute its charges as described above. The Contractor shall be permitted to add an additional charge of 5% percent to that of the subcontractor for the Contractor's supervision and contractual responsibility;
- (4) The quantities and items of work done each day shall be submitted to the Supervising Professional in a satisfactory form on the succeeding day, and shall be approved by the Supervising Professional and the Contractor or adjusted at once;
- (5) Payments of all charges for work under this Section in any one month shall be made along with normal progress payments. Retainage shall be in accordance with Progress Payments-Section 16.

No additional compensation will be provided for additional equipment, materials, personnel, overtime or special charges required to perform the work within the time requirements of the Contract.

When extra work is required and no suitable price for machinery and equipment can be determined in accordance with this Section, the hourly rate paid shall be 1/40 of the basic weekly rate listed in the Rental Rate Blue Book published by Dataquest Incorporated and applicable to the time period the equipment was first used for the extra work. The hourly rate will be deemed to include all costs of operation such as bucket or blade, fuel, maintenance, "regional factors", insurance, taxes, and the like, but not the costs of the operator.

Section 16 - Progress Payments

The Contractor shall submit each month, or at longer intervals, if it so desires, an invoice covering work performed for which it believes payment, under the Contract terms, is due. The submission shall be to the City's Finance Department - Accounting Division. The Supervising Professional will, within 10 days following submission of the invoice, prepare a certificate for payment for the work in an amount to be determined by the Supervising Professional as fairly representing the acceptable work performed during the period covered by the Contractor's invoice. To insure the proper performance of this Contract, the City will retain a percentage of the estimate in accordance with Act 524, Public Acts of 1980. The City will then, following the receipt of the Supervising Professional's Certificate, make payment to the Contractor as soon as feasible, which is anticipated will be within 15 days.

An allowance may be made in progress payments if substantial quantities of permanent material have been delivered to the site but not incorporated in the completed work if the Contractor, in

the opinion of the Supervising Professional, is diligently pursuing the work under this Contract. Such materials shall be properly stored and adequately protected. Allowance in the estimate shall be at the invoice price value of the items. Notwithstanding any payment of any allowance, all risk of loss due to vandalism or any damages to the stored materials remains with the Contractor.

In the case of Contracts which include only the Furnishing and Delivering of Equipment, the payments shall be; 60% of the Contract Sum upon the delivery of all equipment to be furnished, or in the case of delivery of a usable portion of the equipment in advance of the total equipment delivery, 60% of the estimated value of the portion of the equipment may be paid upon its delivery in advance of the time of the remainder of the equipment to be furnished; 30% of the Contract Sum upon completion of erection of all equipment furnished, but not later than 60 days after the date of delivery of all of the equipment to be furnished; and payment of the final 10% on final completion of erection, testing and acceptance of all the equipment to be furnished; but not later than 180 days after the date of delivery of all of the equipment to be furnished, unless testing has been completed and shows the equipment to be unacceptable.

With each invoice for periodic payment, the Contractor shall enclose a Contractor's Declaration - Section 43, and an updated project schedule per Order of Completion - Section 2.

Section 17 - Deductions for Uncorrected Work

If the Supervising Professional decides it is inexpedient to correct work that has been damaged or that was not done in accordance with the Contract, an equitable deduction from the Contract price shall be made.

Section 18 - Correction of Work Before Final Payment

The Contractor shall promptly remove from the premises all materials condemned by the Supervising Professional as failing to meet Contract requirements, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute the work in accordance with the Contract and without expense to the City and shall bear the expense of making good all work of other contractors destroyed or damaged by the removal or replacement.

If the Contractor does not remove the condemned work and materials within 10 days after written notice, the City may remove them and, if the removed material has value, may store the material at the expense of the Contractor. If the Contractor does not pay the expense of the removal within 10 days thereafter, the City may, upon 10 days written notice, sell the removed materials at auction or private sale and shall pay to the Contractor the net proceeds, after deducting all costs and expenses that should have been borne by the Contractor. If the removed material has no value, the Contractor must pay the City the expenses for disposal within 10 days of invoice for the disposal costs.

The inspection or lack of inspection of any material or work pertaining to this Contract shall not relieve the Contractor of its obligation to fulfill this Contract and defective work shall be made good. Unsuitable materials may be rejected by the Supervising Professional notwithstanding that the work and materials have been previously overlooked by the Supervising Professional and accepted or estimated for payment or paid for. If the work or any part shall be found defective at any time before the final acceptance of the whole work, the Contractor shall forthwith make good the defect in a manner satisfactory to the Supervising Professional. The judgment and the decision of the Supervising Professional as to whether the materials supplied and the work done under this Contract comply with the requirements of the Contract shall be conclusive and final.

Section 19 - Acceptance and Final Payment

Upon receipt of written notice that the work is ready for final inspection and acceptance, the Supervising Professional will promptly make the inspection. When the Supervising Professional finds the work acceptable under the Contract and the Contract fully performed, the Supervising Professional will promptly sign and issue a final certificate stating that the work required by this Contract has been completed and is accepted by the City under the terms and conditions of the Contract. The entire balance found to be due the Contractor, including the retained percentage, shall be paid to the Contractor by the City within 30 days after the date of the final certificate.

Before issuance of final certificates, the Contractor shall file with the City:

- (1) The consent of the surety to payment of the final estimate;
- (2) The Contractor's Affidavit in the form required by Section 44.

In case the Affidavit or consent is not furnished, the City may retain out of any amount due the Contractor, sums sufficient to cover all lienable claims.

The making and acceptance of the final payment shall constitute a waiver of all claims by the City except those arising from:

- (1) unsettled liens;
- (2) faulty work appearing within 12 months after final payment;
- (3) hidden defects in meeting the requirements of the plans and specifications;
- (4) manufacturer's guarantees.

It shall also constitute a waiver of all claims by the Contractor, except those previously made and still unsettled.

Section 20 - Suspension of Work

The City may at any time suspend the work, or any part by giving 5 days notice to the Contractor in writing. The work shall be resumed by the Contractor within 10 days after the date fixed in the written notice from the City to the Contractor to do so. The City shall reimburse the Contractor for expense incurred by the Contractor in connection with the work under this Contract as a result of the suspension.

If the work, or any part, shall be stopped by the notice in writing, and if the City does not give notice in writing to the Contractor to resume work at a date within 90 days of the date fixed in the written notice to suspend, then the Contractor may abandon that portion of the work suspended and will be entitled to the estimates and payments for all work done on the portions abandoned, if any, plus 10% of the value of the work abandoned, to compensate for loss of overhead, plant expense, and anticipated profit.

Section 21 - Delays and The City's Right to Terminate Contract

If the Contractor refuses or fails to prosecute the work, or any separate part of it, with the diligence required to insure completion, ready for operation, within the allowable number of consecutive calendar days specified plus extensions, or fails to complete the work within the required time, the City may, by written notice to the Contractor, terminate its right to proceed with the work or any part of the work as to which there has been delay. After providing the notice the City may take over the work and prosecute it to completion, by contract or otherwise, and the Contractor and its sureties shall be liable to the City for any excess cost to the City. If the Contractor's right to proceed is terminated, the City may take possession of and utilize in completing the work, any materials, appliances and plant as may be on the site of the work and useful for completing the work. The right of the Contractor to proceed shall not be terminated or the Contractor charged with liquidated damages where an extension of time is granted under Extension of Time - Section 14.

If the Contractor is adjudged a bankrupt, or if it makes a general assignment for the benefit of creditors, or if a receiver is appointed on account of its insolvency, or if it persistently or repeatedly refuses or fails except in cases for which extension of time is provided, to supply enough properly skilled workers or proper materials, or if it fails to make prompt payments to subcontractors or for material or labor, or persistently disregards laws, ordinances or the instructions of the Supervising Professional, or otherwise is guilty of a substantial violation of any provision of the Contract, then the City, upon the certificate of the Supervising Professional that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the Contractor 3 days written notice, terminate this Contract. The City may then take possession of the premises and of all materials, tools and appliances thereon and without prejudice to any other remedy it may have, make good the deficiencies or finish the work by whatever method it may deem expedient, and deduct the cost from the payment due the Contractor. The Contractor shall not be entitled to receive any further payment until the work is finished. If the expense of finishing the work, including compensation for additional managerial and administrative services exceeds the unpaid balance of the Contract Sum, the Contractor and its surety are liable to the City for any excess cost incurred. The expense incurred by the City, and the damage incurred through the Contractor's default, shall be certified by the Supervising Professional.

Section 22 - Contractor's Right to Terminate Contract

If the work should be stopped under an order of any court, or other public authority, for a period of 3 months, through no act or fault of the Contractor or of anyone employed by it, then the Contractor may, upon 7 days written notice to the City, terminate this Contract and recover from the City payment for all acceptable work executed plus reasonable profit.

Section 23 - City's Right To Do Work

If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this Contract, the City, 3 days after giving written notice to the Contractor and its surety may, without prejudice to any other remedy the City may have, make good the deficiencies and may deduct the cost from the payment due to the Contractor.

Section 24 - Removal of Equipment and Supplies

In case of termination of this Contract before completion, from any or no cause, the Contractor, if notified to do so by the City, shall promptly remove any part or all of its equipment and supplies from the property of the City, failing which the City shall have the right to remove the equipment and supplies at the expense of the Contractor.

The removed equipment and supplies may be stored by the City and, if all costs of removal and storage are not paid by the Contractor within 10 days of invoicing, the City upon 10 days written notice may sell the equipment and supplies at auction or private sale, and shall pay the Contractor the net proceeds after deducting all costs and expenses that should have been borne by the Contractor and after deducting all amounts claimed due by any lien holder of the equipment or supplies.

Section 25 - Responsibility for Work and Warranties

The Contractor assumes full responsibility for any and all materials and equipment used in the construction of the work and may not make claims against the City for damages to materials and equipment from any cause except negligence or willful act of the City. Until its final acceptance, the Contractor shall be responsible for damage to or destruction of the project. The Contractor shall make good all work damaged or destroyed before acceptance. All risk of loss remains with the Contractor until final acceptance of the work (Section 19) or partial acceptance (Section 26). The Contractor is advised to investigate obtaining its own builders risk insurance.

The Contractor shall guarantee the quality of the work for a period of one year. The Contractor shall also unconditionally guarantee the quality of all equipment and materials that are furnished and installed under the contract for a period of one year. At the end of one year after the Contractor's receipt of final payment, the complete work, including equipment and materials furnished and installed under the contract, shall be inspected by the Contractor and the Supervising Professional. Any defects shall be corrected by the Contractor at its expense as soon as practicable but in all cases within 60 days. Any defects that are identified prior to the end of one year shall also be inspected by the Contractor and the Supervising Professional and shall be corrected by the Contractor at its expense as soon as practicable but in all cases within 60 days.

The Contractor shall assign all manufacturer or material supplier warranties to the City prior to final payment. The assignment shall not relieve the Contractor of its obligations under this paragraph to correct defects.

Section 26 - Partial Completion and Acceptance

If at any time prior to the issuance of the final certificate referred to in Acceptance and Final Payment - Section 19, any portion of the permanent construction has been satisfactorily completed, and if the Supervising Professional determines that portion of the permanent construction is not required for the operations of the Contractor but is needed by the City, the Supervising Professional shall issue to the Contractor a certificate of partial completion, and immediately the City may take over and use the portion of the permanent construction described in the certificate.

The issuance of a certificate of partial completion shall not constitute an extension of the Contractor's time to complete the portion of the permanent construction to which it relates if the Contractor has failed to complete it in accordance with the terms of this Contract. The issuance of the certificate shall not release the Contractor or its sureties from any obligations under this Contract including bonds.

If prior use increases the cost of, or delays the work, the Contractor shall be entitled to extra compensation, or extension of time, or both, as the Supervising Professional may determine.

Section 27 - Payments Withheld Prior to Final Acceptance of Work

The City may withhold or, on account of subsequently discovered evidence, nullify the whole or part of any certificate to the extent reasonably appropriate to protect the City from loss on account of:

- (1) Defective work not remedied;
- (2) Claims filed or reasonable evidence indicating probable filing of claims by other parties against the Contractor;
- (3) Failure of the Contractor to make payments properly to subcontractors or for material or labor;
- (4) Damage to another Contractor.

When the above grounds are removed or the Contractor provides a Surety Bond satisfactory to the City which will protect the City in the amount withheld, payment shall be made for amounts withheld under this section.

Section 28 - Contractor's Insurance

A. The Contractor shall procure and maintain during the life of this Contract, including the guarantee period and during any warranty work, such insurance policies, including those set forth below, as will protect itself from all claims for bodily injuries, death or property damage which may arise under this Contract; whether the acts were made by the Contractor or by any subcontractor or anyone employed by them directly or indirectly. The following insurance policies are required:

1. Worker's Compensation Insurance in accordance with all applicable state and federal statutes. Further, Employers Liability Coverage shall be obtained in the following minimum amounts:

Bodily Injury by Accident - \$500,000 each accident

Bodily Injury by Disease - \$500,000 each employee

Bodily Injury by Disease - \$500,000 each policy limit

2. Commercial General Liability Insurance equivalent to, as a minimum, Insurance Services Office form CG 00 01 07 98. The City of Ann Arbor shall be named as an additional insured. There shall be no added exclusions or limiting endorsements including, but not limited to: Products and Completed Operations, Explosion, Collapse and Underground coverage or Pollution. Further, the following minimum limits of liability are required:

\$1,000,000 Each occurrence as respect Bodily Injury Liability or Property Damage Liability, or both combined.

\$2,000,000 Per Job General Aggregate

\$1,000,000 Personal and Advertising Injury

\$2,000,000 Products and Completed Operations Aggregate

3. Motor Vehicle Liability Insurance, including Michigan No-Fault Coverages, equivalent to, as a minimum, Insurance Services Office form CA 00 01 07 97. The

City of Ann Arbor shall be named as an additional insured. There shall be no added exclusions or limiting endorsements. Coverage shall include all owned vehicles, all non-owned vehicles and all hired vehicles. Further, the limits of liability shall be \$1,000,000 for each occurrence as respects Bodily Injury Liability or Property Damage Liability, or both combined.

4. Umbrella/Excess Liability Insurance shall be provided to apply excess of the Commercial General Liability, Employers Liability and the Motor Vehicle coverage enumerated above, for each occurrence and for aggregate in the amount of \$1,000,000.
- B. Insurance required under Section A.2 and A.3 of this Contract shall be considered primary as respects any other valid or collectible insurance that the City may possess, including any self-insured retentions the City may have; and any other insurance the City does possess shall be considered excess insurance only and shall not be required to contribute with this insurance. Further, the Contractor agrees to waive any right of recovery by its insurer against the City.
- C. In the case of all Contracts involving on-site work, the Contractor shall provide to the City before the commencement of any work under this Contract documentation demonstrating it has obtained the above mentioned policies. Documentation must provide and demonstrate an unconditional 30 day written notice of cancellation in favor of the City of Ann Arbor. Further, the documentation must explicitly state the following: (a) the policy number; name of insurance company; name and address of the agent or authorized representative; name and address of insured; project name; policy expiration date; and specific coverage amounts; (b) any deductibles or self-insured retentions which shall be approved by the City, in its sole discretion; (c) that the policy conforms to the requirements specified. An original certificate of insurance may be provided as an initial indication of the required insurance, provided that no later than 21 calendar days after commencement of any work the Contractor supplies a copy of the endorsements required on the policies. Upon request, the Contractor shall provide within 30 days a copy of the policy(ies) to the City. If any of the above coverages expire by their terms during the term of this Contract, the Contractor shall deliver proof of renewal and/or new policies to the Administering Service Area/Unit at least ten days prior to the expiration date.
- D. Any Insurance provider of Contractor shall be admitted and authorized to do business in the State of Michigan and shall carry and maintain a minimum rating assigned by A.M. Best & Company's Key Rating Guide of "A-" Overall and a minimum Financial Size Category of "V". Insurance policies and certificates issued by non-admitted insurance companies are not acceptable unless approved in writing by the City.

Section 29 - Surety Bonds

Bonds will be required from the successful bidder as follows:

- (1) A Performance Bond to the City of Ann Arbor for the amount of the bid(s) accepted;
- (2) A Labor and Material Bond to the City of Ann Arbor for the amount of the bid(s) accepted; and
- (3) A Maintenance and Guarantee Bond to the City of Ann Arbor for the amount of the bid(s) accepted.

Bonds shall be executed on forms supplied by the City in a manner and by a Surety Company

satisfactory to the City Attorney.

Section 30 - Damage Claims

The Contractor shall be held responsible for all damages to property of the City or others, caused by or resulting from the negligence of the Contractor, its employees, or agents during the progress of or connected with the prosecution of the work, whether within the limits of the work or elsewhere. The Contractor must restore all property injured including sidewalks, curbing, sodding, pipes, conduit, sewers or other public or private property to not less than its original condition with new work.

Section 31 - Refusal to Obey Instructions

If the Contractor refuses to obey the instructions of the Supervising Professional, the Supervising Professional shall withdraw inspection from the work, and no payments will be made for work performed thereafter nor may work be performed thereafter until the Supervising Professional shall have again authorized the work to proceed.

Section 32 - Assignment

Neither party to the Contract shall assign the Contract without the written consent of the other. The Contractor may assign any monies due to it to a third party acceptable to the City.

Section 33 - Rights of Various Interests

Whenever work being done by the City's forces or by other contractors is contiguous to work covered by this Contract, the respective rights of the various interests involved shall be established by the Supervising Professional, to secure the completion of the various portions of the work in general harmony.

The Contractor is responsible to coordinate all aspects of the work, including coordination of, and with, utility companies and other contractors whose work impacts this project.

Section 34 - Subcontracts

The Contractor shall not award any work to any subcontractor without prior written approval of the City. The approval will not be given until the Contractor submits to the City a written statement concerning the proposed award to the subcontractor. The statement shall contain all information the City may require.

The Contractor shall be as fully responsible to the City for the acts and omissions of its subcontractors, and of persons either directly or indirectly employed by them, as it is for the acts and omissions of persons directly employed by it.

The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the Contractor by the terms of the General Conditions and all other contract documents applicable to the work of the subcontractors and to give the Contractor the same power to terminate any subcontract that the City may exercise over the Contractor under any provision of the contract documents.

Nothing contained in the contract documents shall create any contractual relation between any subcontractor and the City.

Section 35 - Supervising Professional's Status

The Supervising Professional has the right to inspect any or all work. The Supervising Professional has authority to stop the work whenever stoppage may be appropriate to insure the proper execution of the Contract. The Supervising Professional has the authority to reject all work and materials which do not conform to the Contract and to decide questions which arise in the execution of the work.

The Supervising Professional shall make all measurements and determinations of quantities. Those measurements and determinations are final and conclusive between the parties.

Section 36 - Supervising Professional's Decisions

The Supervising Professional shall, within a reasonable time after their presentation to the Supervising Professional, make decisions in writing on all claims of the City or the Contractor and on all other matters relating to the execution and progress of the work or the interpretation of the contract documents.

Section 37 - Storing Materials and Supplies

Materials and supplies may be stored at the site of the work at locations agreeable to the City unless specific exception is listed elsewhere in these documents. Ample way for foot traffic and drainage must be provided, and gutters must, at all times, be kept free from obstruction. Traffic on streets shall be interfered with as little as possible. The Contractor may not enter or occupy with agents, employees, tools, or material any private property without first obtaining written permission from its owner. A copy of the permission shall be furnished to the Supervising Professional.

Section 38 - Lands for Work

The Contractor shall provide, at its own expense and without liability to the City, any additional land and access that may be required for temporary construction facilities or for storage of materials.

Section 39 - Cleaning Up

The Contractor shall, as directed by the Supervising Professional, remove at its own expense from the City's property and from all public and private property all temporary structures, rubbish and waste materials resulting from its operations unless otherwise specifically approved, in writing, by the Supervising Professional.

Section 40 - Salvage

The Supervising Professional may designate for salvage any materials from existing structures or underground services. Materials so designated remain City property and shall be transported or stored at a location as the Supervising Professional may direct.

Section 41 - Night, Saturday or Sunday Work

No night or Sunday work (without prior written City approval) will be permitted except in the case of an emergency and then only to the extent absolutely necessary. The City may allow night work which, in the opinion of the Supervising Professional, can be satisfactorily performed at night. Night work is any work between 8:00 p.m. and 7:00 a.m. No Saturday work will be permitted unless the Contractor gives the Supervising Professional at least 48 hours but not more than 5 days notice of the Contractor's intention to work the upcoming Saturday.

Section 42 - Sales Taxes

Under State law the City is exempt from the assessment of State Sales Tax on its direct purchases. Contractors who acquire materials, equipment, supplies, etc. for incorporation in City projects are not likewise exempt. State Law shall prevail. The Bidder shall familiarize itself with the State Law and prepare its Bid accordingly. No extra payment will be allowed under this Contract for failure of the Contractor to make proper allowance in this bid for taxes it must pay.

Section 43

CONTRACTOR'S DECLARATION

I hereby declare that I have not, during the period _____, 20___, to _____, 20___, performed any work, furnished any materials, sustained any loss, damage or delay, or otherwise done anything in addition to the regular items (or executed change orders) set forth in the Contract titled WWTP Secondary Effluent Pump Replacement Project, for which I shall ask, demand, sue for, or claim compensation or extension of time from the City, except as I hereby make claim for additional compensation or extension of time as set forth on the attached itemized statement. I further declare that I have paid all payroll obligations related to this Contract that have become due during the above period and that all invoices related to this Contract received more than 30 days prior to this declaration have been paid in full except as listed below.

There is/is not (Contractor please circle one and strike one as appropriate) an itemized statement attached regarding a request for additional compensation or extension of time.

Contractor _____ Date _____

By _____
(Signature)

Its _____
(Title of Office)

Past due invoices, if any, are listed below.

Section 44

CONTRACTOR'S AFFIDAVIT

The undersigned Contractor, _____, represents that on _____, 2015, it was awarded a contract by the City of Ann Arbor, Michigan to _____ under the terms and conditions of a Contract titled WWTP Secondary Effluent Pump Replacement Project.

The Contractor represents that all work has now been accomplished and the Contract is complete.

The Contractor warrants and certifies that all of its indebtedness arising by reason of the Contract has been fully paid or satisfactorily secured; and that all claims from subcontractors and others for labor and material used in accomplishing the project, as well as all other claims arising from the performance of the Contract, have been fully paid or satisfactorily settled. The Contractor agrees that, if any claim should hereafter arise, it shall assume responsibility for it immediately upon request to do so by the City of Ann Arbor.

The Contractor, for valuable consideration received, does further waive, release and relinquish any and all claims or right of lien which the Contractor now has or may acquire upon the subject premises for labor and material used in the project owned by the City of Ann Arbor.

This affidavit is freely and voluntarily given with full knowledge of the facts.

Contractor

By

(Signature)

Its

(Title of Office)

Subscribed and sworn to before me, on this ____ day of _____, 2015

_____, _____ County, Michigan

Notary Public

My commission expires on:

STANDARD SPECIFICATIONS

All work under this contract shall be performed in accordance with the Public Services Department Standard Specifications in effect at the date of availability of the contract documents stipulated in the Advertisement. All work under this Contract which is not included in these Standard Specifications, or which is performed using modifications to these Standard Specifications, shall be performed in accordance with the Detailed Specifications included in these contract documents.

A copy of the Public Services Department Standard Specifications may be purchased from the Engineering Division, (Fourth Floor, City Hall, Ann Arbor, Michigan), for \$35.00 per copy. In addition, a copy of these Standard Specifications is available for public viewing at the Engineering Division office, for review Monday through Friday between the hours of 8:30 a.m. and 4:00 p.m.

Copies of the Standard Specifications can also be downloaded from the web link:

http://www.a2gov.org/government/publicservices/project_management/privatedev/pages/standardspecificationsbook.aspx.

ATTACHMENT A

Contract Compliance Forms

City of Ann Arbor Procurement Office

INSTRUCTIONS FOR CONTRACTORS

For Completing CONTRACT COMPLIANCE FORM

City Policy

The “non discrimination in contracts” provision of the City Code, (Chapter 112, Section 9:161) requires contractors/vendors/grantees doing business with the City not to discriminate on the basis of actual or perceived race, color, religion, national origin, sex, age, condition of pregnancy, marital status, physical or mental limitations, source of income, family responsibilities, educational association, sexual orientation, gender identity or HIV status against any of their employees, any City employee working with them, or any applicant for employment. It also requires that the contractors/vendors/grantees include a similar provision in all subcontracts that they execute for City work or programs.

This Ordinance further requires that each prospective contractor/vendor submit employment data to the City showing current total employee breakdown by occupation, race and gender. This allows the Procurement Office to determine whether or not the contractor/vendor has a workforce that is reflective of the availability of women and under-represented minorities within the contractor’s labor recruitment area (the area where they can reasonably be expected to recruit employees). ***This data is provided to the City on the Human Rights Contract Compliance Forms (attached).***

To complete the form:

1) If a company has more than one location, then that company must complete 2 versions of the form.

- **Form #1** should contain the employment data for the **entire corporation.**
- **Form #2** should contain the employment data for those employees:
 - who will be working on-site;
 - in the office responsible for completing the contract; or,
 - in the case of non-profit grantees, those employees working on the project funded by the City grant(s).

2) If the company has only one location, fill out Form #1 only.

3) Complete all data in the upper section of the form including the name of the person who completes the form and the name of the company/organization’s president.

4) Complete the Employment Data in the remainder of the form. Please be sure to complete all columns including the Total Columns on the far right side of the form, and the Total row and Previous Year Total row at the bottom of the form.

5) Return the completed form(s) to your contact in the City Department for whom you will be conducting the work.

For assistance in completing the form, contact:

Procurement Office of the City of Ann Arbor
734/794-6576

If a contractor is determined to be out of compliance, the Procurement Office will work with them to assist them in coming into compliance.



**CITY OF ANN ARBOR PROCUREMENT OFFICE
HUMAN RIGHTS CONTRACT COMPLIANCE FORM**
Entire Organization (Totals for All Locations where applicable)

Form #1

Name of Company/Organization _____ Date Form Completed _____

Name and Title of Person Completing this Form _____ Name of President _____

Address _____ County _____ Phone # _____
(Street address) (City) (State) (Zip) (Area Code)

Fax# _____ Email Address _____
(Area Code)

EMPLOYMENT DATA

Job Categories	Number of Employees (Report employees in only one category)												
	Male						Female						TOTAL COLUMNS A-L
	White	Black or African American	Asian	Hispanic or Latino	Native Hawaiian or Other Pacific Islander	American Indian or Alaska Native	White	Black or African American	Asian	Hispanic or Latino	Native Hawaiian or Other Pacific Islander	American Indian or Alaskan Native	
	A	B	C	D	E	F	G	H	I	J	K	L	
Exec/Sr. Level Officials													
Supervisors													
Professionals													
Technicians													
Sales													
Admin. Support													
Craftspeople													
Operatives													
Service Workers													
Laborers/Helper													
Apprentices													
Other													
TOTAL													
PREVIOUS YEAR TOTAL													



**CITY OF ANN ARBOR PROCUREMENT OFFICE
HUMAN RIGHTS CONTRACT COMPLIANCE FORM**
Local Office (Only those employees that will do local or on-site work, if applicable)

Form #2

Name of Company/Organization _____ Date Form Completed _____

Name and Title of Person Completing this Form _____ Name of President _____

Address _____ County _____ Phone # _____
(Street address) (City) (State) (Zip) (Area Code)

Fax# _____ Email Address _____
(Area Code)

EMPLOYMENT DATA

Job Categories	Number of Employees (Report employees in only one category)												TOTAL COLUMNS A-L
	Male						Female						
	White	Black or African American	Asian	Hispanic or Latino	Native Hawaiian or Other Pacific Islander	American Indian or Alaska Native	White	Black or African American	Asian	Hispanic or Latino	Native Hawaiian or Other Pacific Islander	American Indian or Alaska Native	
A	B	C	D	E	F	G	H	I	J	K	L		
Exec/Sr. Level Officials													
Supervisors													
Professionals													
Technicians													
Sales													
Admin. Support													
Craftspeople													
Operatives													
Service Workers													
Laborers/Helper													
Apprentices													
Other													
TOTAL													
PREVIOUS YEAR TOTAL													





Vendor Conflict of Interest Disclosure Form

All vendors interested in conducting business with the City of Ann Arbor must complete and return the Vendor Conflict of Interest Disclosure Form in order to be eligible to be awarded a contract. Please note that all vendors are subject to comply with the City of Ann Arbor's conflict interest policies as stated within the certification section below.

If a vendor has a relationship with a City of Ann Arbor official or employee, an immediate family member of a City of Ann Arbor official or employee, the vendor shall disclose the information required below.

Certification: I hereby certify that to my knowledge, there is no conflict of interest involving the vendor named below:

1. No City official or employee or City employee's immediate family member has an ownership interest in vendor's company or is deriving personal financial gain from this contract.
2. No retired or separated City official or employee who has been retired or separated from the City for less than one (1) year has an ownership interest in vendor's Company.
3. No City employee is contemporaneously employed or prospectively to be employed with the vendor.
4. Vendor hereby declares it has not and will not provide gifts or hospitality of any dollar value or any other gratuities to any City employee or elected official to obtain or maintain a contract.
5. Please note any exceptions below:

Vendor Name	Vendor Phone Number
Conflict of Interest Disclosure *	
Name of City of Ann Arbor employees, elected officials, or immediate family members with whom there maybe a potential conflict of interest.	<input type="checkbox"/> Relationship to employee _____ <input type="checkbox"/> Interest in vendor's company _____ <input type="checkbox"/> Other _____

*Disclosing a potential conflict of interest does not disqualify vendors. In the event vendors do not disclose potential conflicts of interest and they are detected by the City, vendor will be exempt from doing business with the City.

I certify that the information provided is true and correct by my signature below:

 Signature of Vendor Authorized Representative Date Printed Name of Vendor Authorized Representative

PROCUREMENT USE ONLY

- Yes, named employee was involved in Bid / Proposal process.
 No, named employee was not involved in procurement process or decision.

ATTACHMENT B

Living Wage Forms

**CITY OF ANN ARBOR
LIVING WAGE ORDINANCE**

RATE EFFECTIVE APRIL 30, 2014 - ENDING APRIL 29, 2015

\$12.70 per hour

If the employer provides health
care benefits*

\$14.18 per hour

If the employer does **NOT**
provide health care benefits*

Employers providing services to or for the City of Ann Arbor or recipients of grants or financial assistance from the City of Ann Arbor for a value of more than \$10,000 in a twelve-month period of time must pay those employees performing work on a City of Ann Arbor contract or grant, the above living wage.

ENFORCEMENT

The City of Ann Arbor may recover back wages either administratively or through court action for the employees that have been underpaid in violation of the law. Persons denied payment of the living wage have the right to bring a civil action for damages in addition to any action taken by the City.

Violation of this Ordinance is punishable by fines of not more than \$500/violation plus costs, with each day being considered a separate violation. Additionally, the City of Ann Arbor has the right to modify, terminate, cancel or suspend a contract in the event of a violation of the Ordinance.

* Health Care benefits include those paid for by the employer or making an employer contribution toward the purchase of health care. The employee contribution must not exceed \$.50 an hour for an average work week; and the employer cost or contribution must equal no less than \$1/hr for the average work week.

The Law Requires Employers to Display This Poster Where Employees Can Readily See It.

**For Additional Information or to File a Complaint Contact
Mark Berryman at 734/794-6500 or mberryman@a2gov.org**

████████████████████
**CITY OF ANN ARBOR
LIVING WAGE ORDINANCE
DECLARATION OF COMPLIANCE**

The Ann Arbor Living Wage Ordinance (Section 1:811-1:821 of Chapter 23 of Title I of the Code) requires that employers providing services to the City or recipients of grants for financial assistance (in amounts greater than \$10,000 in a twelve-month period of time) pay their employees who are working on the City project or grant, a minimum level of compensation known as the **Living Wage**. This wage must be paid to the employees for the length of the contract/project.

Companies employing fewer than 5 persons and non-profits employing fewer than 10 persons are exempt from the Ordinance. If this exemption applies to your firm, please check below:

- _____ This **company** is exempt due to the fact that we employ or contract with fewer than 5 individuals.
_____ This **non-profit agency** is exempt due to the fact that we employ or contract with fewer than 10 employees.

The Ordinance requires that all contractors/vendors and/or grantees agree to the following terms:

- a) To pay each of its employees performing work on any covered contract or grant with the City, no less than the living wage, which is defined as \$12.70/hour when health care is provided, or no less than \$14.18/hour for those employers that do *not* provide health care. It is understood that the Living Wage will be adjusted each year on April 30, and covered employers will be required to pay the adjusted amount thereafter. The rates stated above include any adjustment for 2014.
- b) Please check the boxes below which apply to your workforce:
- Employees who are assigned to *any covered* City project or grant will be paid at or above the applicable living wage without health benefits Yes _____ No _____
- OR**
- Employees who are assigned to *any covered* City project or grant will be paid at or above the applicable living wage with health benefits Yes _____ No _____
- c) To post a notice approved by the City regarding the Living Wage Ordinance in every work place or other location in which employees or other persons contracting for employment are working.
- d) To provide the City payroll records or other documentation as requested; and,
- e) To permit access to work sites to City representatives for the purposes of monitoring compliance, investigating complaints or non-compliance.

The undersigned authorized representative hereby obligates the contractor/vendor or grantee to the above stated conditions under penalty of perjury and violation of the Ordinance.

Company Name

Address, City, State, Zip

Signature of Authorized Representative

Phone (area code)

Type or Print Name and Title

Email address

Date signed

Questions about this form? Please contact:
Procurement Office City of Ann Arbor
Phone: 734/794-6500

ATTACHMENT C

WWTP Secondary Effluent Pumps Replacement
Vertical Wastewater Pumps Purchase
ITB No. 4328

CITY OF ANN ARBOR

INVITATION TO BID



**WASTEWATER TREATMENT PLANT
SECONDARY EFFLUENT PUMPS REPLACEMENT
VERTICAL WASTEWATER PUMPS PURCHASE
ITB No. 4328**

Due Date: April 10, 2014, by 2:00 p.m. (Local Time)

Wastewater Treatment Plan/ Public Services Area
Administering Service Unit

Issued By:
City of Ann Arbor
Procurement Unit
301 E. Huron Street
Ann Arbor, MI 48107

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ADVERTISEMENT TO BID
CITY OF ANN ARBOR, MICHIGAN

ITB No. 4328

Sealed Bids will be received by the Procurement Unit, c/o Customer Service, 1st Floor, Guy Larcom City Hall, on or before **April 10, 2014 by 2:00 p.m.** (Local Time) for the Wastewater Treatment Plant Secondary Effluent Pumps Replacement Vertical Wastewater Pumps Purchase. Bids will be publicly opened and read aloud at this time.

Work includes supplying Secondary Effluent Pumps Replacement Vertical Wastewater Pumps including shipping and delivery to be used at the Ann Arbor Wastewater Treatment Plant. No pre-bid conference will be held in connection with this purchase.

Bid documents, specifications, plans and addendum shall be downloaded by vendors at either of the following web sites, Michigan Inter-governmental Trade Network (MITN) www.mitn.info or City of Ann Arbor web site www.A2gov.org.

Each bid shall be accompanied by a certified check, or Bid Bond by a recognized surety, in the amount of 5% of the total of the bid price. A proposal, once submitted, becomes the property of the City. In the sole discretion of the City, the City reserves the right to allow a bidder to reclaim submitted documents provided the documents are requested and retrieved no later than 48 hours prior to the scheduled bid opening.

Precondition for entering into a contract with the City of Ann Arbor is compliance with Chapter 112 of Title IX of the Code of the City of Ann Arbor.. All bidders are required to complete and submit the City of Ann Arbor Conflict of Interest Disclosure Form with the bid. Further information is outlined in the contract documents.

After the time of opening, no Bid may be withdrawn for a period of ninety (90) days.

The City reserves the right to accept any Bid, to reject any or all Bids, to waive irregularities and/or informalities in any Bid, and to make the award in any manner the City believes to be in its best interest.

Any further information may be obtained from the Procurement Unit, (734) 794-6576.

CITY OF ANN ARBOR, MICHIGAN

INSTRUCTIONS TO BIDDERS

General

The City of Ann Arbor's Procurement Office is soliciting bids for the purchase of Secondary Effluent Pumps Replacement Vertical Wastewater Pumps, including shipping and delivery, to be used at the Ann Arbor Wastewater Treatment Plant Pumps bid must meet detailed specification included in the document. No substitutions or equivalents will be accepted.

Any Bid which does not conform fully with these instructions may be rejected.

Preparation of Bids

Bids should be prepared providing a straight-forward, concise description of the Bidder's ability to meet the requirements of the ITB. Bids shall be written in ink or typewritten. No erasures are permitted. Mistakes may be crossed out and corrected and must be initialed in ink by the person signing the Bid.

Bids must be submitted on the "Bid Forms" provided, with each blank properly filled in. If forms are not fully completed it may disqualify the bid.

Each person signing the Bid certifies that he/she is the person in the Bidder's firm/organization responsible for the decision as to the fees being offered in the Bid and has not and will not participated in any action contrary to the terms of this provision.

Questions or Clarification on ITB Specifications

All questions regarding this ITB shall be submitted via email. Emailed questions and inquires will be accepted from any and all prospective Bidders in accordance with the terms and conditions of the ITB.

All questions shall be due on or before March 31, 2014 by 2:00 p.m. and should be addressed as follows:

Specification/Scope of Work questions emailed to Esajewski@a2gov.org

Bid Process and HR Compliance questions emailed to Mberryman@a2gov.org.

Addenda

If it becomes necessary to revise any part of the ITB, notice of the Addendum will be posted to Michigan Inter-governmental Trade Network (MITN) www.mitn.info or City of Ann Arbor web site www.A2gov.org for all parties to download.

Each Bidder must in its Bid, to avoid any miscommunications, acknowledge all addenda which it has received, but the failure of a Bidder to receive, or acknowledge receipt of; any addenda shall not relieve the Bidder of the responsibility for complying with the terms thereof.

The City will not be bound by oral responses to inquiries or written responses other than written addenda.

Bid Submission

All Bids are due and must be delivered to the City of Ann Arbor Procurement Unit on or before April 10, 2014 by 2:00 p.m. (Local Time) Bids submitted late or via oral, telephonic, telegraphic, electronic mail or facsimile **will not** be considered or accepted.

Each Bidder must submit one (1) original Bid and two (2) Bid copies in a sealed envelope clearly marked: **ITB No. 4328 WWTP Secondary Effluent Pumps Purchase.**

Bids must be addressed and delivered to:

City of Ann Arbor
Procurement Unit
c/o Customer Service Desk,
First Floor, Guy C. Larcom Building
301 East Huron Street
P.O. Box 8647
Ann Arbor, MI 48107

All Bids received on or before the Due Date will be publicly opened and recorded immediately. No immediate decisions are rendered.

Bids should be date/time stamped/signed at the address above in order to be considered. Normal business hours are 9:00 a.m. to 3:00 p.m. Monday through Friday, excluding Holidays. The City will not be liable to any Bidder for any unforeseen circumstances, delivery or postal delays. Postmarking to the Due Date will not substitute for receipt of the Bid. Each Bidder is responsible for submission of their Bid.

Additional time will not be granted to a single Bidder; however, additional time may be granted to all Bidders when the City determines that circumstances warrant it.

Award

The City intends to award a Contract(s) to the lowest responsible Bidder(s). The City may also utilize discounts offered in the Bid Forms, if any, to determine the lowest responsible Bidder, so that the lowest total cost is achieved for the City. For unit price bids, the contract will be awarded based upon the lump sum and unit prices stated by the bidder for the work items specified in the bid documents. If the City determines that the unit price for any item is materially different for the work item bid than either other bidders or the general market, the City, in its sole discretion, in addition to any other right it may have, may reject the bid as not responsible or non-conforming.

The City reserves the right to accept any Bid, to reject any or all Bids, to waive irregularities and/or informalities in any Bid, and to make the award in any manner the City believes to be in its best interest.

Official Documents

The City of Ann Arbor shall accept no changes to the bid documents made by the Bidder unless those changes are set forth in the "Alternate" section of Bid form.

The City of Ann Arbor officially distributes bid documents from the Purchasing Unit or through the Michigan Intergovernmental Trade Network (MITN). Copies of the bid documents obtained from any other source are not considered Official copies. Only those Bidders who obtain bid documents from MITN system are guaranteed access to receive addendum information if issued. If you obtained City of Ann Arbor Bid documents from other sources, it is recommended that you register on www.MITN.info and obtain an official Bid.

Bid Security

Each bid must be accompanied by a certified check, or Bid Bond by a surety licensed and authorized to do business within the State of Michigan, in the amount of 5% of the total of the bid price.

Withdrawal of Bids

After the time of opening, no Bid may be withdrawn for the period of days specified in the Advertisement.

Contract Time

Time is of the essence in the performance of the work under this Contract. The available time for work under this Contract is indicated on page C-1, Article III of the Contract. If these time requirements cannot be met, the Bidder must stipulate on Bid Form Section 3 – Time Alternate its schedule for performance of the work. Consideration will be given to time in evaluating bids.

Liquidated Damages

A liquidated damages clause, as given on page C-2, Article III of the Contract, provides that the Contractor shall pay the City as liquidated damages, and not as a penalty, a sum certain per day for each and every day that the Contractor may be in default of completion of the specified work, within the time(s) stated in the Contract, or written extensions.

In addition, the City shall be entitled to impose and recover liquidated damages for breach of the obligations under Chapter 112 of the City Code.

The liquidated damages are for the non-quantifiable aspects of any of the previously identified events and do not cover actual damages that can be shown or quantified nor are they intended to preclude recovery of actual damages in addition to the recovery of liquidated damages.

Human Rights Compliance Requirement

Ann Arbor City Ordinance requires the selected Bidder take affirmative action to insure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity and tends to eliminate inequality based upon race, national origin or sex

To establish compliance with the City ordinance, the Bidder should complete and return with its bid completed copies of the Human Rights Division Contract Compliance forms or an acceptable equivalent. (See Attachment A) In the event Human Rights forms are not submitted with the bid, the bidder will have twenty-four (24) hours to provide once requested by the City.

Conflict Of Interest Disclosure

The City of Ann Arbor Purchasing Policy requires that prospective Vendors complete a Conflict of Interest Disclosure form. A contract may not be awarded to the selected Vendor unless and until the Procurement Unit and the City Administrator have reviewed the Disclosure form and determined that no conflict exists under applicable federal, state, or local law or administrative regulation. Not every relationship or situation disclosed on the Disclosure Form may be a disqualifying conflict. Depending on applicable law and regulations, some contracts may awarded on the recommendation of the City Administrator after full disclosure, where such action is allowed by law, if demonstrated competitive pricing exists and/or it is determined the award is in the best interest of the City. A copy of the Vendor Conflict of Interest Disclosure Form is attached as Attachment B.

Vendor's Responsibility

The basic unit and all required components shall be compatible and are recommended for use in combination by the manufacturer. It shall be the vendor's responsibility to insure that all components operate according to manufacturer's recommendations in regard to operation speed, imposed load, etc., and to deliver a functionally complete unit, complying with good engineering and accepted commercial practice and in accordance with the intent and details of the specifications.

Failure To Fulfill Guarantee:

In the event of the failure of any equipment within the guarantee period to meet the requirements of the detailed specifications, or failure to perform satisfactorily in service, such failure shall be adequate cause and justification for rejection of any or all equipment furnished under these "detailed specifications."

Inspection:

Any materials, workmanship, or equipment, which may be discovered to be defective within the guarantee period, shall be removed and made good by the contractor at their expense regardless of any previous inspection or final acceptance.

If any campaign change made necessary by improper material, improper installation or material or faulty designs, the campaign change shall be made and the cost shall be borne by the manufacturer of the truck chassis and/or the equipment manufacturer.

Debarment

Submission of a Bid in response to this ITB is certification that the Bidder is not currently debarred, suspended, proposed for debarment, and declared ineligible or voluntarily excluded from participation in this transaction by any State or Federal departments or agency. Submission is also agreement that the City will be notified of any changes in this status.

Cost Liability

The City of Ann Arbor assumes no responsibility or liability for costs incurred by the Bidder prior to the execution of a contract with the City. By submitting a bid, a bidder agrees to bear all costs incurred or related to the preparation, submission and selection process for the bid.

Disclosures

All information in a submitter's bid is subjected to disclosure under the provisions of Public Act No. 442 of 1976 know as the "Freedom of Information Act". This act also provides for the complete disclosure of contracts and attachments thereto except where specifically exempted under the Freedom of Information Act.

Bid Protest

All Bid protests must be in writing and filed with the Purchasing Agent within five (5) business days of the award action. The vendor must clearly state the reasons for the protest. If a vendor contacts a City Service Area/Unit and indicates a desire to protest an award, the Service Area/Unit shall refer the vendor to the Purchasing Agent. The Purchasing Agent will provide the vendor with the appropriate instructions for filing the protest. The protest shall be reviewed by the City Administrator or designee whose decision shall be final.

Reservation of Rights

The City of Ann Arbor reserves the right to accept any bid or alternative bid proposed in whole or in part, to reject any or all bids or alternatives bids in whole or in part and to waive irregularity and/or informalities in any bid and to make the award in any manner deemed in the best interest of the City.

INVITATION TO BID

City of Ann Arbor
Guy C. Larcom Municipal Building
Ann Arbor, Michigan 48107

Ladies and Gentlemen:

The undersigned, as Bidder, declares that this Bid is made in good faith, without fraud or collusion with any person or persons bidding on the same Contract; that this Bidder has carefully read and examined the bid documents, including Advertisement, Human Rights Division Contract Compliance Forms, Vendor Conflict of Interest Disclosure Form, Instructions to Bidders, Bid, Bid Forms, Contract, Detailed Specifications, and all Addenda. The Bidder declares that it is fully informed as to the nature of the work and the conditions relating to the work's performance. The Bidder also declares that it has extensive experience in successfully completing projects similar to this one.

The Bidder acknowledges that it has not received or relied upon any representations or warrants of any nature whatsoever from the City of Ann Arbor, its agents or employees, and that this Bid is based solely upon the Bidder's own independent business judgment.

The undersigned proposes to perform all work shown on the plans or described in the bid documents, including any addenda issued, and to furnish all necessary machinery, tools, apparatus, and other means of construction to do all the work, furnish all the materials, and complete the work in strict accordance with all terms of the Contract of which this Bid is one part.

In accordance with these bid documents, and Addenda numbered 1 , the undersigned, as Bidder, proposes to perform at the sites in and/or around Ann Arbor, Michigan, all the work included herein for the amounts set forth in the Bid Forms.

The Bidder declares that it has become fully familiar with the liquidated damage clauses for completion times and for compliance with City Code Chapter 112, understands and agrees that the liquidated damages are for the non-quantifiable aspects of non-compliance and do not cover actual damages that may be shown and agrees that if awarded the Contract, all liquidated damage clauses form part of the Contract.

The Bidder declares that it has become familiar with the City Vendor Conflict of Interest Disclosure Form and certifies that the statement contained therein is true and correct.

The Bidder encloses a certified check or Bid Bond in the amount of 5% of the total of the Bid Price. The Bidder agrees both to contract for the work and to furnish the necessary Bonds and insurance documentation within 10 days after being notified of the acceptance of the Bid.

If this Bid is accepted by the City and the Bidder fails to contract and furnish the required Bond and insurance documentation within 10 days after being notified of the acceptance of this Bid, then the Bidder shall be considered to have abandoned the Contract and the certified check or

Bid Bond accompanying this Bid shall become due and payable to the City.

If the Bidder enters into the Contract in accordance with this Bid, or if this Bid is rejected, then the accompanying check or Bid Bond shall be returned to the Bidder.

In submitting this Bid, it is understood that the right is reserved by the City to accept any Bid, to reject any or all Bids, to waive irregularities and/or informalities in any Bid, and to make the award in any manner the City believes to be in its best interest.

SIGNED THIS 10TH DAY OF APRIL, 2014.

PREMIER PUMP INC.

Bidder's Name

4891 VAN EPPS RD

CLEVELAND, OH 44131

Official Address

216-739-1600

Telephone Number

Brian K. Sublett

Authorized Signature of Bidder

BRIAN K. SUBLETT

(Print Name of Signer Above)

bsublett@premierpump.com

Email Address for Award Notice

LEGAL STATUS OF BIDDER

(The Bidder shall fill out the appropriate form and strike out the others)

* A corporation organized and doing business under the laws of the State of OHIO, for whom BRIAN K. SUBLETT, bearing the office title of SALES MGR., whose signature is affixed to this Bid, is authorized to execute contracts.

*If not incorporated in Michigan, please attach the corporation's Certificate of Authority.

~~* A limited liability company doing business under the laws of the State of _____, whom _____ bearing the title of _____ whose signature is affixed to this proposal, is authorized to execute contract on behalf of the LLC.~~

~~* A partnership organized under the laws of the State of _____ and filed with the county of _____, whose members are (list names and the street and mailing address of each):~~

An individual, whose signature with address, is affixed to this Bid.

Brian K. Sublett Date: 4-10-14
Signature (

(Print) Name BRIAN K. SUBLETT Title SALES MANAGER

Company: PREMIER PUMP INC.

Address: 4891 VAN EPPS RD CLEVELAND, OH 44131

Contact Phone 216 739-1600 Fax 216 739-3195

Email bsublett@premierpump.com

BID FORM

Section I - Equipment Data Sheet

SECONDARY EFFLUENT PUMPS
EQUIPMENT DATA SHEET

Manufacturer: AMERICAN MARSH

Model No.: 20 MEP-1

Motor Manufacturer: US/NIDEC

Pump Data:

(flow) 13,890 gpm and (efficiency-bowl) 80.06 % at 31-feet TDH (bowl)

(flow) 12,454 gpm and (efficiency-bowl) 83.6 % at 37.5-feet TDH (bowl)

(NPSH_{REQUIRED}) 32.07 feet at 37.5-feet TDH (bowl)

(low flow) 8,000 gpm at (TDH) 48 feet at (speed) 880 rpm

BID FORM

Section 2 - Schedule of Prices

<u>Item from Section 1</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total Cost</u>
1. AMERICAN MARSH 20 MFP-1	6 ea @	\$ 70,947	= \$ 425,682.00
Total Amount of Bid			\$ 425,682.00

Optional Adder - Extended Warranty

Provide extended warranty on all materials and equipment provided for two years beyond the warranty included in the Base Bid.

Total _____ (\$ _____)

CERTIFICATION:

Bidder certifies that all applicable Federal, State and Local taxes of whatever character and description are included in all prices stated above. (Note: Michigan law exempts the City from assessment of State Sales Tax on direct purchases. Contractors who acquire materials, equipment, supplies, etc. for incorporation in City projects are not likewise exempt. State law shall prevail. The Bidder is making this certification acknowledges it is familiar with the State law and has prepared its Bid accordingly) /all materials in the bid are new, in unused condition and will meet or exceed your specifications in every respect.

Premier Pump Inc.
Company

Brian K. Suber
Authorized Representative's Signature

Brian K. Suber
Printed Name

BID FORM

Section 3 -- Delivery

DELIVERY: Delivery of the pumps is desired as soon as possible. At a minimum, the pumps must be delivered within two hundred twenty four (224) calendar days after receipt of written Notice to Proceed.

We can meet delivery schedule.

We cannot meet the above delivery schedule, but we offer the Time Alternate as described in Section 4 of the Bid Form.

We can improve the above delivery schedule, and we offer the Time Alternate as described in Section 4 of the Bid Form.

NOTE: The City of Ann Arbor reserves the right to reject bids which offer an unsatisfactory delivery schedule.

BID FORM

Section 4 -- Time Alternate

If the Bidder takes exception to the time stipulated in Article III of the Contract, Time of Completion, page C-1, it is requested to stipulate below its proposed time for performance of the work. Consideration will be given to time in evaluating bids.

If the Bidder does not suggest any time alternate, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT propose any time alternate under the contract.

Brian K. Sublett
Signature of Authorized Representative of Bidder

CONTRACT

THIS AGREEMENT is made on the 1ST day of OCTOBER, 2014, between the CITY OF ANN ARBOR, a Michigan Municipal Corporation, 301 E. Huron Street, Ann Arbor, Michigan 48104 ("City") and Premier Pump, Inc. ("Contractor") an Ohio Corporation with its address 4891 Van Epps Road, Cleveland, Ohio 44131.

Based upon the mutual promises below, the Contractor and the City agree as follows:

ARTICLE I – Scope of Work

The Contractor agrees to furnish all of the materials, equipment and labor necessary; and to abide by all the duties and responsibilities applicable to it for the project titled "**ITB No. 4328 Wastewater Treatment Plant Secondary Effluent Pumps Replacement Vertical Wastewater Pumps**" in accordance with the requirements and provisions of the following documents, including all written modifications incorporated into any of the documents, which are incorporated as part of this Contract:

Human Rights Division Contract Compliance Forms	Letter from Hubbell, Roth & Clark, Inc. (HRC) dated June 2, 2014
Bid Forms	E-mail from American-Marsh Pumps to HRC dated June 6, 2014
Bid	E-mail from Premier Pump, Inc. to HRC dated June 6, 2014
Contract and Exhibits (if any)	Pump dimensions detail drawing from American-Marsh Pumps
Bonds	Pump performance curves (2) from American-Marsh Pumps
General Conditions	
Detailed Specifications	
Plans	
Addenda	

ARTICLE II – Definitions

Administering Service Area/Unit means Wastewater Treatment Services Unit (WWTSU).

Contract Administrator means the WWTSU Manager, acting personally or through any assistants authorized by the Administrator/Manager of the Administering Service Area/Unit.

Project means Wastewater Treatment Plant Secondary Effluent Pumps Replacement Vertical Wastewater Pumps Purchase, Bid No. 4328.

ARTICLE III – Time of Completion

- (A) The work to be completed under this Contract shall begin only after the Contractor's receipt of a fully executed Contract.
- (B) The entire work for this Contract shall be completed within 224 consecutive calendar days.
- (C) Failure to complete all the work within the time specified above, including any extension granted in writing by the Supervising Professional, shall obligate the Contractor to pay the City, as liquidated damages and not as a penalty one thousand and no/100 dollars (\$1,000.00) for each calendar day of delay in the completion of all the work. If any liquidated damages are unpaid by the Contractor, the City shall be entitled to deduct these unpaid liquidated damages from the monies due the Contractor.

As an independent requirement, where the Detailed Specifications identify certain portions of the work to be completed within a shorter period of time and the Contractor fails to complete each portion within the shorter period specified for each portion, including any extension granted in writing by the Project Supervisor, the City is entitled to deduct from the monies due the Contractor, as liquidated damages and not as a penalty, the amount identified in the Detailed Specifications for each portion of the work not timely completed for each calendar day of delay in completion of each portion of the work.

The liquidated damages are for the non-quantifiable aspects of any of the previously identified events and do not cover actual damages that can be shown or quantified nor are they intended to preclude recovery of actual damages in addition to the recovery of liquidated damages.

Liquidated damages under this section are in addition to any liquidated damages due under Section 5 of the General Conditions.

ARTICLE IV – The Contract Sum

- (A) The City shall pay to the Contractor for the performance of the Contract, the unit prices as given in the Bid Forms for the estimated total of: four hundred twenty five thousand six hundred eighty two and no/100 dollars (\$425,682.00).
- (B) The amount paid shall be equitably adjusted to cover changes in the work ordered by the Supervising Professional but not required by the contract documents.

ARTICLE V – Assignment

This Contract may not be assigned or subcontracted without the written consent of the City.

ARTICLE VI – Choice of Law

This Contract shall be construed, governed, and enforced in accordance with the laws of the State of Michigan. By executing this agreement, the Contractor and the City agree to venue in a court of appropriate jurisdiction sitting within Washtenaw County for purposes of any action arising under this Contract.

Whenever possible, each provision of the contract will be interpreted in a manner as to be effective and valid under applicable law. The prohibition or invalidity, under applicable law, of any provision will not invalidate the remainder of the contract.

ARTICLE VII – Relationship of the Parties

The parties of the Contract agree that it is not a contract of employment but is a contract to accomplish a specific result. Contractor is an independent contractor performing services for the City. Nothing contained in this Contract shall be deemed to constitute any other relationship between the City and the Contractor.

Contractor certifies that it has no personal or financial interest in the project other than the compensation it is to receive under the Contract. Contractor certifies that it is not, and shall not become, overdue or in default to the City for any contract, debt, or any other obligation to the City including real or personal property taxes. City shall have the right to set off any such debt against compensation awarded for services under this agreement.

ARTICLE VIII – Notice

All notices given under this contract shall be in writing, and shall be by personal delivery or by certified mail with return receipt requested to the parties at their respective addresses as specified in the contract documents or other address the Contractor may specify in writing.


ARTICLE IX – Indemnification

To the fullest extent permitted by law, for any loss not covered by insurance under this contract, Contractor shall indemnify, defend and hold harmless the City, its officers, employees and agents harmless from all suits, claims, judgments and expenses including attorney's fees resulting or alleged to result, in whole or in part, from any act or omission, which is in any way connected or associated with this contract, by the Contractor or anyone acting on the Contractor's behalf under this contract. Contractor shall not be responsible to indemnify the City for losses or damages caused by or resulting from the City's sole negligence.

ARTICLE X – Entire Agreement

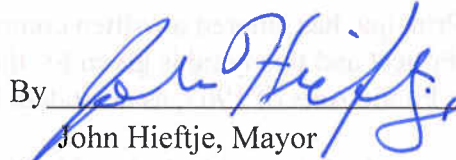
This Contract represents the entire understanding between the City and the Contractor and it supersedes all prior representations or agreements whether written or oral. Neither party has relied on any prior representations in entering into this Contract. This Contract may be altered, amended or modified only by written amendment signed by the City and the Contractor.

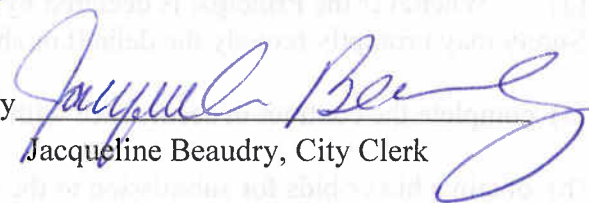
FOR CONTRACTOR

By 
BRIAN K. SUBLETT
Its: ENGINEERING SERVICES MGR.

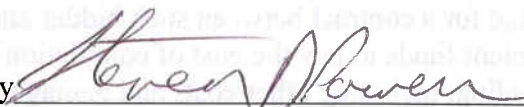
By _____
Its: _____

FOR THE CITY OF ANN ARBOR

By 
John Hieftje, Mayor


By 
Jacqueline Beaudry, City Clerk

Approved as to substance

By 
Steven D. Powers, City Administrator

By 
Craig Hupy
Public Services Area Administrator

Approved as to form and content

AE By 
Stephen K. Postema, City Attorney

PERFORMANCE BOND

(1) _____ of _____ (referred to as "Principal"), and _____, a corporation duly authorized to do business in the State of Michigan (referred to as "Surety"), are bound to the City of Ann Arbor, Michigan (referred to as "City"), for \$ _____, the payment of which Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by this bond.

(2) The Principal has entered a written contract with the City dated _____, 2014, for: Project and this bond is given for that contract in compliance with Act No. 213 of the Michigan Public Acts of 1963, as amended, being MCL 129.201 et seq.

(3) Whenever the Principal is declared by the City to be in default under the contract, the Surety may promptly remedy the default or shall promptly:

(a) complete the contract in accordance with its terms and conditions; or

(b) obtain a bid or bids for submission to the City for completing the contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, arrange for a contract between such bidder and the City, and make available, as work progresses, sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which Surety may be liable hereunder, the amount set forth in paragraph 1.

(4) Surety shall have no obligation to the City if the Principal fully and promptly performs under the contract.

(5) Surety agrees that no change, extension of time, alteration or addition to the terms of the contract or to the work to be performed thereunder, or the specifications accompanying it shall in any way affect its obligations on this bond, and waives notice of any such change, extension of time, alteration or addition to the terms of the contract or to the work, or to the specifications.

SIGNED AND SEALED this _____ day of _____, 2014.

(Name of Surety Company)

(Name of Principal)

By _____
(Signature)

By _____
(Signature)

Its _____
(Title of Office)

Its _____
(Title of Office)

Approved as to form:

Name and address of agent:

Stephen K. Postema, City Attorney

ADDENDUM No. 1

WASTEWATER TREATMENT PLANT SECONDARY EFFLUENT PUMPS REPLACEMENT VERTICAL WASTEWATER PUMPS PURCHASE ITB No. 4328

The following changes, additions, and/or deletions shall be made to the Invitation to Bid (ITB) for WASTEWATER TREATMENT PLANT SECONDARY EFFLUENT PUMPS REPLACEMENT VERTICAL WASTEWATER PUMPS PURCHASE, ITB No. 4328.

The information contained herein shall take precedence over the original documents and all previous addenda, and is appended thereto.

The Contractor is to acknowledge receipt of this Addendum No. 1 on page P-1 of the Bid Documents prior to submitting its Bid. This Addendum includes 2 page.

Questions and Answers

Q: "Is this a furnish and install project or a furnish only project?"

A: ITB 4328 is furnish. There will be a subsequent ITB to install.

Q: "Do you have an estimated value from the above project (4328)?"

A: We have not determined value with any precision. A suggested range would be from \$300,000 to \$550,000 depending on the competitiveness of respondents.

Q: "Is copper rotor bar required in the motors?"

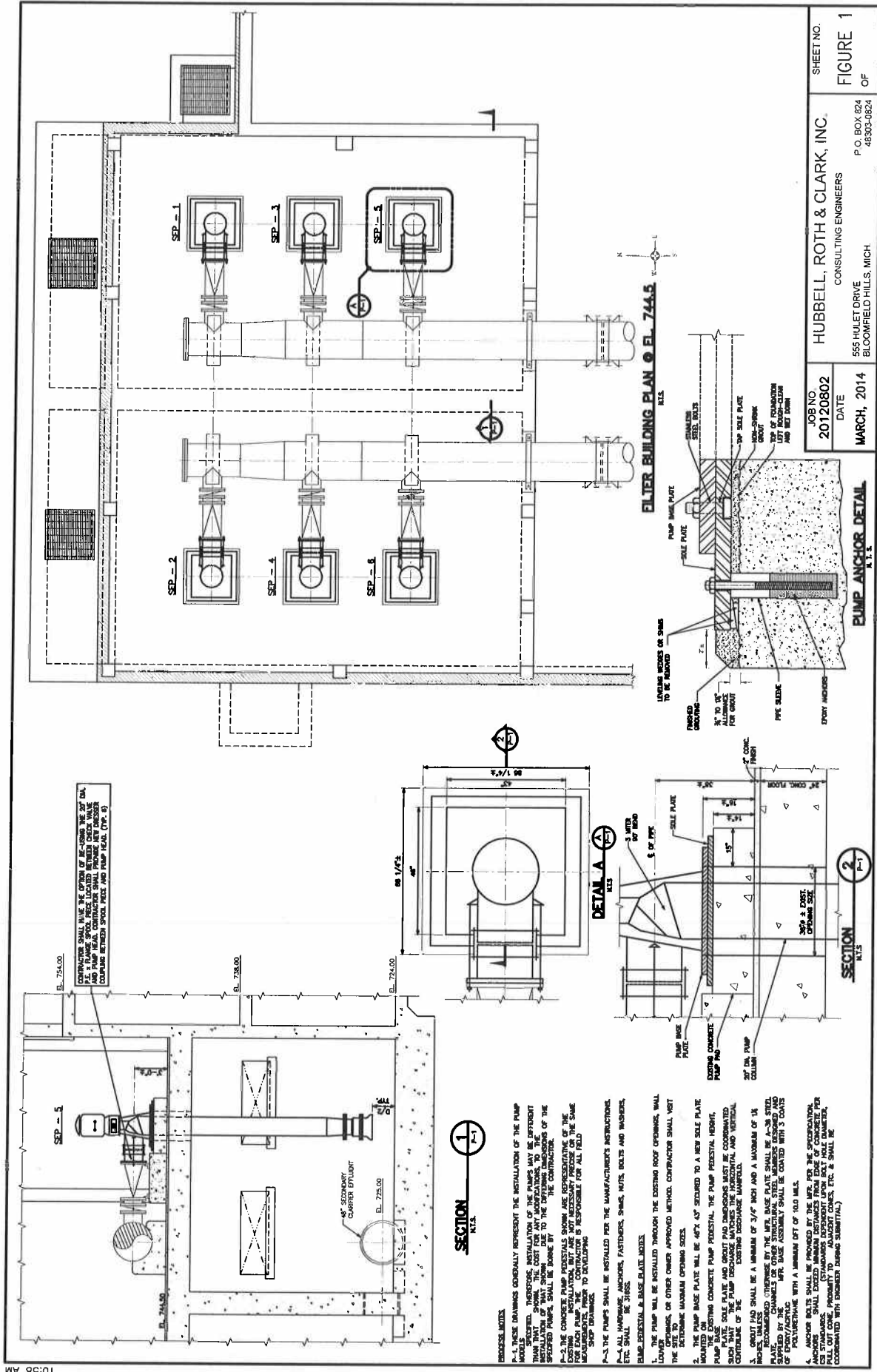
A: No, cast aluminum rotor bar is acceptable.

Modifications to the Specifications

Section 11321 Vertical Wastewater Pumps

- Paragraph 2.1, C, 1, a and b: Revise the minimum bowl efficiencies to 80%.
- Paragraph 2.1, C, 1, c: Revise this item to read – "The minimum NPSH_{available} at the site is 34.9'."
- Paragraph 2.1, E, 11, c: Delete items 1) through 4) and replace with the following:
 - 1) Sole plate

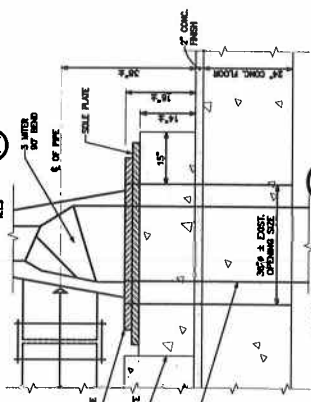
- 2) Bottom of base plate
 - 3) Inside of discharge column and elbow
 - 4) Outside of discharge column
 - 5) Bowl assembly (inside and outside)
 - 6) Intake vane assembly
- Paragraph 2.1, E, 15, d: Add the following sentence after the fourth sentence of this item – “The pumps shall be tested and shall pass the requirements of Table 14.6.3.4, Grade 1U using the Efficiency tolerance of -0%.”



CONTRACTOR SHALL TAKE THE CARE OF REPAIRING OF DIAL P.L. & FLANGE SPILL. PIPES LOCATED BETWEEN CHECK VALVE AND PUMP HEAD. CONTRACTOR SHALL PROVIDE NEW PRESSURE GAUGES BETWEEN STOP VALVE AND PUMP HEAD. (P.P. 9)

GENERAL NOTES
 P-1 THESE DRAWINGS GENERALLY REPRESENT THE INSTALLATION OF THE PUMP MODELS INDICATED. THEREFORE, INSTALLATION OF THE PUMPS MAY BE DIFFERENT THAN THAT SHOWN. THE COST FOR ANY MODIFICATIONS TO THE SPECIFICATIONS AND THE COST FOR ANY MODIFICATIONS TO THE CONTRACTOR'S SPECIFIED PUMPS, SHALL BE BORNE BY THE CONTRACTOR.
 P-2 THE CONCRETE PUMP PEDISTALS SHOWN ARE REPRESENTATIVE OF THE EXISTING PUMP INSTALLATION, BUT ARE NOT NECESSARILY PRECISE OR THE SAME MEASUREMENTS. OWNER IS RESPONSIBLE FOR ALL FIELD MEASUREMENTS.
 P-3 THE PUMPS SHALL BE INSTALLED PER THE MANUFACTURER'S INSTRUCTIONS. ALL HARDWARE, ANCHORS, FASTENERS, SHIMS, NUTS, BOLTS AND WASHERS, ETC. SHALL BE 308SS.
 P-4 THE PUMP SHALL BE INSTALLED THROUGH THE EXISTING ROOF OPENINGS, WALL OPENINGS, OR OTHER OWNER APPROVED METHOD. CONTRACTOR SHALL VERIFY THE EXISTING MAXIMUM OPENING SIZES.
 P-5 THE PUMP BASE PLATE SHALL BE 48" x 48" SECURED TO A NEW SILE PLATE MOUNTED ON EXISTING CONCRETE PUMP PEDISTAL, THE PUMP PEDISTAL, PUMP BASE PLATE AND ORBIT FAN DIMENSIONS MUST BE COORDINATED WITH THE PUMP MANUFACTURER'S DIMENSIONS AND VERTICAL CLEARANCE.
 P-6 ORBIT FAN SHALL BE A MINIMUM OF 3/4" INCH AND A MAXIMUM OF 18 INCHES, UNLESS OTHERWISE BY THE MFR. BASE PLATE SHALL BE 3/4" THICK PLATE WITH CHANNELS OR OTHER STRUCTURAL STEEL MEMBERS EXPOSED AND POLYURETHANE WITH A MINIMUM OF 1.0 DFT OF 10.0 MBS.
 P-7 ANCHOR BOLTS SHALL BE PROVIDED BY THE MFR. PER THE SPECIFICATION. CONTRACTOR SHALL ESTABLISH DOCUMENTATION FROM MFR FOR ALL CONCRETE PER ALL OFF CONE. PROBABLY TO ALUMINUM CORNERS, ETC. & SHALL BE COORDINATED WITH DOMESTIC (AS SUBMITTED).

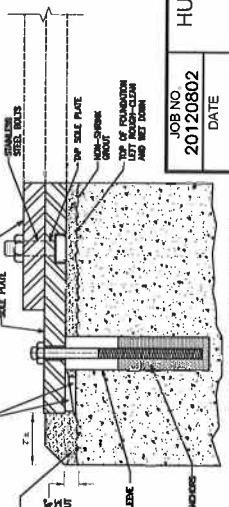
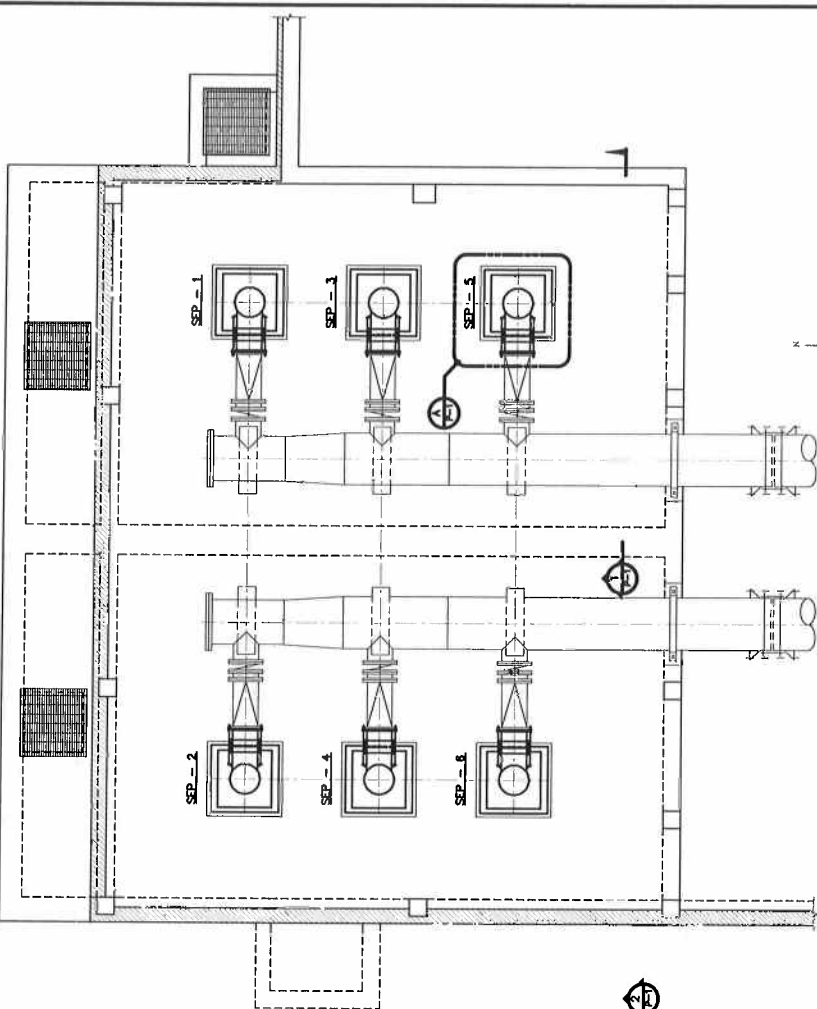
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SECTION
N.T.S.

2
P-1

FILTER BUILDING PLAN @ EL. 744.5
N.T.S.



PUMP ANCHOR DETAIL
N.T.S.

JOB NO. 20120802
 DATE MARCH, 2014
 HUBBELL, ROTH & CLARK, INC.
 CONSULTING ENGINEERS
 555 HULET DRIVE
 BLOOMFIELD HILLS, MICH.
 SHEET NO. FIGURE 1
 OF

SECTION 01015
SPECIAL CONDITIONS

PART 1 GENERAL

The General Conditions are a part of this section. In case of conflict between this section and the General Conditions, this section shall govern.

Wherever the General Conditions are referred to in the specifications, such reference shall be understood to include these Special Conditions.

1.1 WORK INCLUDED

- A. The work included under these specifications consists of, but is not limited to, the supply of the Secondary Effluent Pumps to the Owner. Unless otherwise specified, the specifications are intended to include everything requisite and necessary for the proper and complete furnishing, testing, start-up, commissioning and training of the specified equipment and facility components. Accordingly, all work is to be done under all headings, as required to carry out the full intent of the Contract Documents whether or not each individual item is specifically mentioned or not.

1.2 STANDARD SPECIFICATIONS

- A. The chemical and physical properties of all materials, and the design, performance characteristics and methods of construction of all items of equipment shall be in accordance with the requirements of the latest issue of the various applicable standard specifications.
- B. These Standard Specifications have been prepared by authorities, which are recognized by the various trades. The names of these authorities are listed below together with the well known abbreviations of their names.

American Institute of Elec. Engineers	A.I.E.E.
American National Standards Institute	A.N.S.I.
American Society for Testing Materials	A.S.T.M.
American Welding Association	A.W.A.
National Electrical Code	N.E.C.
Antifriction Bearing Manufacturers Association	A.F.B.M.A.
American Society of Mechanical Engineers	A.S.M.E.
American Water Works Association	A.W.W.A.
National Electrical Manufacturers Assoc.	N.E.M.A.
American Institute of Steel Construction	A.I.S.C.
National Sanitation Foundation	N.S.F.
Hydraulic Institute	H.I.

1.3 ALTERATIONS AND ADDITIONS

- A. The Engineer and Owner shall each have the right, and the Contractor acknowledges such right, to require, by written order, changes in, additions to and deductions from the work required under the Contract without notice to sureties or in any way rendering void the Contract.

- B. Under no circumstances are verbal commitments to be accepted by this Contractor that will in any way:
 - 1. Increase or decrease the quantities or amounts specified in the Bid Form.
 - 2. Alter, revise, add or deduct any information, or change the scope of work, which is detailed in the drawings or specifications that are considered a part of the bid Form.
- C. All extra work quotes shall be based on Actual Cost plus Fee based on the percentages agreed to in the Bid Form. All quotes shall be detailed to show material units, labor hours, overhead, burden, profit, etc., for each item.

1.4 DELIVERY SCHEDULE

- A. The Contractor is bound to the Bid Package and Delivery schedule identified in the Proposal and Contract. In meeting the date, the Contractor shall assume the following:
 - 1. The Engineer requires 2 weeks to review the first shop drawing submittal, and 1 week for each subsequent shop drawing submittal.

1.5 PAYMENT SCHEDULE

- A. The payment schedule for the Work will be as follows:
 - 1. 5% for approved shop drawings
 - 2. 10% for approved O&M manuals
 - 3. 80% for fabrication and approved factory pump testing
 - 4. 90% for acceptable delivery to temporary storage
 - 5. 94% for successful inspection, start-up, training and testing of first set of two pumps installed
 - 6. 96% for successful inspection, start-up, training and testing of second set of two pumps installed
 - 7. 100% for successful inspection, start-up, training and testing of third set of two pumps installed
- B. Retainage will be deducted from payments.

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1.6 COORDINATION AND WORK BY OTHERS

- A. The equipment provided herein will be installed by the successful bidder to the City of Ann Arbor Wastewater Treatment Plant Secondary Effluent Pumps Replacement construction contract. Coordination between parties is a requirement to both contracts. These requirements are as follows:

Description	General Contractor (GC) (1)	P2 Contractor (2)
Submittals	Review as necessary for bid, installation, start-up, and commissioning.	Prepare, submit, re-submit until approved. Provide installation instructions, including entire pump assembly from the motor to the suction bell for the GC to properly Bid, plan and install.
Shop Testing	N/A	Provide documentation of proper factory pump test procedures, data, results, submittals and certification where required.
Shipping	Coordinate delivery schedule with Contractor prior to bid. Offload pumps and ancillary items at temporary storage facility. Inspect with Contractor to confirm satisfactory shipping condition.	Ship to the site, inspect with GC to confirm proper shipment, and that there are no visible defects.
Temporary Storage	Provide temporary covered, temperature controlled storage of pumps and ancillary equipment, off-site (not at WWTP) prior to actual installation. Perform periodic pre-installation lubrication, rotation, etc. of pumps and ancillary items per manufacturer instructions.	N/A
Installation	Install equipment, coordinate all trades	Provide installation instructions, including entire pump assembly from the motor to the suction bell and provide any other assistance necessary.
Start-up	Coordinate time/place. Provide Start-up Work plan. Lead coordination of start-up.	Perform pre-start requirements, provide start-up of pumps, provide acceptance tests, assist with SCADA / I&C start-up, provide training materials, train staff, etc.
As-Builts	Provide	Provide

Notes:

1. General Contractor – GC is the successful bidder for the City of Ann Arbor Wastewater Treatment Plant Secondary Effluent Pumps Replacement.
2. P2 Contractor is the successful Purchase Bid Package vertical pump manufacturer for the City of Ann Arbor Wastewater Treatment Plant Secondary Effluent Pumps Replacement Vertical Wastewater Pumps Purchase, ITB No. 4328.
3. The responsibility for proper care and maintenance shall transition from the pump manufacturer to the Contractor upon proper unloading, checking and temporary storage of the six pumps and ancillary items.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Format and content of manuals.
- B. Instruction of Owner's personnel.
- C. Submittals.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Individual Specifications Sections: Specific requirements for operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.4 FORMAT

- A. Prepare data in the form of an instructional manual.
- B. Electronic: Provide two (2) CDs or DVDs of the O&M manuals in PDF format for with indexing activated for review. Submit one (1) final approved O&M manual.
- C. Binders: Commercial quality, 8-1/2 x 11 inch three D side ring binders with durable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings. Fill binders to no more than 75% capacity. Provide six (6) bound copies of the final, approved O&M manual.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; Volume number, General Contractor name and address and Engineer name and address.
- E. Provide tabbed indexes for each separate product and system, with typed description of product and system.
- F. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

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- H. Arrange content by process flow under section numbers and sequence of Table of Contents of this Project Manual.

1.5 CONTENTS, GENERAL FOR EACH VOLUME

- A. Table of Contents: Provide title of Projects and the names, addresses, and telephone numbers of Engineer, Subconsultants, and Contractor in the heading. Next, provide a schedule of products and systems, indexed to content of the volume.
- B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information. Identify specific model numbers, size, etc.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- F. Warranties and Bonds: Bind in copy of each.
- G. Start-up documentation. Provide a binder tab for inclusion following start-up.

1.6 MANUFACTURERS MANUALS FOR EQUIPMENT AND SYSTEMS

- A. Each Item of Equipment and Each System: Include description of unit or system, and component parts with diagrams, charts, capabilities, etc. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, complete nomenclature and model number of replaceable parts, and catalog data or literature with correct model number of equipment noted where literature covers more than one model.
- B. Shipping, storage and handling: Include all necessary requirements.
- C. Storage maintenance: Include all necessary rotation, lubrication, heating or other provisions required during storage.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions and drawings; and alignment, adjusting, balancing, calibration and checking instructions.

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- F. Provide preventive maintenance recommendations servicing and lubrication schedule, and list of lubricants required. Include manufacturer's printed storage and installation instructions with alignment instructions and tolerances.
- G. Include manufacturer's printed operation and maintenance instructions. Provide trouble shooting guide for equipment and system components.
- H. Provide original manufacturer's detailed parts list and parts drawing, illustrations, assembly/disassembly drawings and instructions, and diagrams required for maintenance. Provide a cross reference to all individual component manuals for all parts lists and illustrations provide correct parts numbers. All bearing numbers shall be listed.
- I. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage and how to obtain them.
- J. Include test and balancing reports.
- K. Include start-up documentation.
- L. Additional Requirements: As specified in individual Product specification sections.
- M. Provide a listing in Table of Contents for design data, with tabbed indexed and space for insertion of data.

1.7 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.
- B. For equipment requiring seasonal operation, perform instructions for other seasons.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.
- E. Refer to individual equipment specification section for instruction and training requirements.

1.8 SUBMITTALS

- A. Submittals for review and approval must be submitted 6 weeks prior to shipment.
- B. Submit revised volumes prior to equipment start-up. These copies will be used during training. Revise content of all document sets where required following training within 60 days.
- C. Submit revisions of final documents following training where required.

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PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF TEXT SECTION 01730

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O&M MANUAL CHECKLIST

Note to Contractor: This form must be submitted with all O&M manuals.

Equipment Name _____ Specification Number _____

I, _____ do hereby certify that the O&M Manual for the referenced equipment:
 (Print / Type Name) _____
 meets requirements and specification for 01730 as noted below:

	<u>yes</u>	<u>no</u>		<u>yes</u>	<u>no</u>
Format					
Table of Contents:	<input type="checkbox"/>	<input type="checkbox"/>	Annotated Format:	<input type="checkbox"/>	<input type="checkbox"/>
Provide 3-Ring Binder:	<input type="checkbox"/>	<input type="checkbox"/>	Tabs:	<input type="checkbox"/>	<input type="checkbox"/>
Cover/Spine					
Equip. Title:	<input type="checkbox"/>	<input type="checkbox"/>	Owner:	<input type="checkbox"/>	<input type="checkbox"/>
Project Title:	<input type="checkbox"/>	<input type="checkbox"/>	Contractor:	<input type="checkbox"/>	<input type="checkbox"/>
Date:	<input type="checkbox"/>	<input type="checkbox"/>	Engineer:	<input type="checkbox"/>	<input type="checkbox"/>
			Representative:	<input type="checkbox"/>	<input type="checkbox"/>
			Manufacturer:	<input type="checkbox"/>	<input type="checkbox"/>
General					
Design Data:	<input type="checkbox"/>	<input type="checkbox"/>	Expanded Views:	<input type="checkbox"/>	<input type="checkbox"/>
Spare Parts List:	<input type="checkbox"/>	<input type="checkbox"/>	Complete Parts List:	<input type="checkbox"/>	<input type="checkbox"/>
Equip. Drawings:	<input type="checkbox"/>	<input type="checkbox"/>			
Operations:					
Handling & Storage:	<input type="checkbox"/>	<input type="checkbox"/>	Start-Up:	<input type="checkbox"/>	<input type="checkbox"/>
Installation Procedures:	<input type="checkbox"/>	<input type="checkbox"/>	Trouble Shooting:	<input type="checkbox"/>	<input type="checkbox"/>
Maintenance					
Maintenance Procedures:	<input type="checkbox"/>	<input type="checkbox"/>	Preventive Maint. Req.:	<input type="checkbox"/>	<input type="checkbox"/>
Lubrication Specs.:	<input type="checkbox"/>	<input type="checkbox"/>	Preventive Maint. Sched.:	<input type="checkbox"/>	<input type="checkbox"/>
Electrical					
Motor Data:	<input type="checkbox"/>	<input type="checkbox"/>	Control Wiring Diagram:	<input type="checkbox"/>	<input type="checkbox"/>
Wiring Diagrams:	<input type="checkbox"/>	<input type="checkbox"/>			
Test / Field Reports					
Balance Report:	<input type="checkbox"/>	<input type="checkbox"/>	Noise (dB) Readings:	<input type="checkbox"/>	<input type="checkbox"/>
Certif. of Installation:	<input type="checkbox"/>	<input type="checkbox"/>	Pressure Tests:	<input type="checkbox"/>	<input type="checkbox"/>
Miscellaneous					
Extended Warranty:	<input type="checkbox"/>	<input type="checkbox"/>	MSDS Sheets:	<input type="checkbox"/>	<input type="checkbox"/>

Comments: _____

Signature _____

Date _____

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SECTION 01850

TRAINING

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Instruct and train Owner's personnel in maintenance and operation of equipment for systems supplied under this Contract, including the following items:
 - 1. All process, mechanical, service and other equipment as noted in the detailed specifications.
- B. Incorporate the following maintenance and operation data and training services into the training program:
 - 1. Shop Drawings.
 - 2. Equipment Operation and Maintenance Manuals.
- C. Prepare instruction training materials, and student notes/guides for complete classroom and hands-on training of all individuals requiring training.

1.2 RELATED REQUIREMENTS

- A. General Requirements including:
 - 1. Section 01300 – Submittals.
 - 2. Section 01730 – Operation and Maintenance Data.
 - 3. Section 11321 – Vertical Wastewater Pumps

1.3 QUALITY ASSURANCE

- A. Preparations of training materials and instruction to be provided shall be performed by personnel trained and experienced in maintenance and operation of equipment and systems to be installed under this Contract.

1.4 SCHEDULE OF CONDUCTING TRAINING

- A. Field training programs shall be conducted after performance testing begins but prior to substantial completion.
- B. Training programs shall be planned and conducted for:
 - 1. Operations Personnel.
 - 2. Maintenance Personnel.
- C. Provide training of operations and maintenance staff as indicated in Specification Section 11321 – Vertical Wastewater Pumps.
- D. All scheduling shall be coordinated through the Engineer.

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1.5 TRAINING FOR OPERATION AND MAINTENANCE OF PUMPS

- A. Train the Owner's maintenance personnel as follows:
 - 1. Describe and provide field instruction for all preventive maintenance required on entire pump and motor assembly.
 - 2. Locating the probable source of pumps malfunction, determining the symptoms of the trouble, establishing the probable cause and effecting a solution.
- B. Course materials to be used for training Owner's maintenance personnel shall include pertinent portions of the submittals specified in the Specifications including calibration data, trouble-shooting guides and maintenance instructions.
- C. The training program shall not include the time required for system start-up instructions or the field acceptance tests.
- D. Train the Owner's operations personnel as follows:
 - 1. Implement start-up and shutdown procedures for each piece of equipment individually. This instruction shall include normal operation, alternative operations, and emergency operations.
 - 2. Discuss the operating modes possible as a result of the modifications and installations made under this Contract.
 - 3. Locating the probable source of pumps trouble, determining the symptoms, establishing the probable cause, and re-stabilizing system efficiency or systems installed under this contract.
 - 4. Demonstrate necessary precautions for safe operation of the pumps.
 - 5. Demonstrate emergency procedures for pumps.
- E. Course materials to be used for training Owner's operation personnel include pertinent portions of the Operations and Maintenance Manuals, including start-up and shutdown procedures; descriptions of equipment and instrumentation functions and modes of operations, control and monitoring; trouble-shooting instructions and process control instructions.
- F. Methods of training Owner's operations personnel shall include a field training program at the Owner's site consisting of classrooms and hands-on training using the Owner's equipment and systems.
- G. The field training program shall not include the time required for system start-up instructions or the field acceptance test.

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CITY OF ANN ARBOR
WASTEWATER TREATMENT PLANT
SECONDARY EFFLUENT PUMPS PURCHASE

TRAINING
01850 / 3

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 11321

VERTICAL WASTEWATER PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Work herein specified and/or shown on the Plans consists of furnishing all labor, material, equipment, etc., for the fabrication, supply and delivery of six (6) vertical wastewater pumps, complete in all details, as shown on the Plans and/or specified herein.
- B. This Section makes reference to other supportive Sections which shall form a part of this Section and shall govern the work described herein.

1.2 RELATED WORK

- A. Section 01015 – Special Conditions
- B. Section 01300 – Shop Drawings
- C. Section 01730 – Operation and Maintenance Data
- D. Section 01850 – Training

1.3 REFERENCES

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
- D. ANSI/NEMA MG1 - Motors and Generators.
- E. ANSI/NFPA 70 - National Electrical Code.

1.4 INSPECTION AND TRAINING REQUIREMENTS

- A. A factory representative employed by the manufacturer shall visit the site prior to equipment start-up to verify the proper installation of the equipment and to instruct the Owner's operating personnel in the maintenance and operation of these units.
- B. Three (3) separate inspection and start-up visits shall be provided, one for each pair of pumps that becomes installed. A minimum of two (2), eight (8) hour days for each visit shall be included in the lump sum bid.
- C. The scheduling of this service shall be coordinated with the Owner and the cost of this service shall be included in the Contractor's bid price.

- D. Training requirements shall be a minimum 16 hours at the site, unless otherwise specified. The wastewater treatment plant is staffed with two shifts during (day and night). Training shall be provided during both of the shifts. Training shall occur during the first inspection and start-up visit.

1.5 WARRANTY

- A. The pumping units and accessories shall be guaranteed in writing to be free of defects in workmanship and material for a period of (one) 1 year from the date of acceptance.
- B. The pump warranty period shall not commence until such time as acceptable testing is performed on each pump and each pump is accepted by Owner.

1.6 REGULATORY REQUIREMENTS

- A. Furnish Products listed and classified by Underwriters' Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, and as acceptable to authority having jurisdiction, as suitable for purpose specified and indicated.
- B. All equipment and workmanship shall be in conformance with all applicable standards and requirements of the following documents:
 - 1. Any and all Federal, State, and/or local codes, ordinances, or regulations, including OSHA/MIOSHA.
 - 2. Latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories.

1.7 QUALITY ASSURANCE

- A. Monitor quality control over suppliers, manufacturers, products, services, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.8 SHOP DRAWINGS AND O&M MANUALS

- A. Shop drawings are required for the items specified in this Section of the Specifications. Each shop drawing submittal shall include as a minimum the following information:
 - 1. Identification of the item, i.e., written description, reference to equipment schedule.

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2. Assembly drawings that identify each part of the item specified. These should include dimensions and a materials of construction list.
 3. Information which verifies that the item meets process specifications, i.e., corrosion resistance, temperature rating, pressure rating, strength, performance curve.
 4. Electrical and control information for the appropriate equipment, including motor nameplate data, wiring diagrams, and control panel layouts, where applicable.
 5. Electrical characteristics and connection requirements including layout of completed assemblies, interconnecting cabling, tubing, dimensions, weights, and external air and power requirements.
 6. Manufacturer's installation instructions including application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation and starting of Product.
- B. Shop drawings for motor driven equipment MUST include the following motor information:
1. Horsepower
 2. Voltage
 3. Phase
 4. Frequency
 5. Speed
 6. Maximum Temperature Rise In Continuous Service
 7. Enclosure Type
 8. Frame
 9. Service Factor
 10. Power Factor
 11. Efficiency
 12. NEMA Design Code Letter
 13. Manufacturer
 14. Full Load Amperes
 15. NEC Code Letter
 16. Insulation Class
 17. Inverter Duty Rated
- C. The equipment supplier shall submit two (2) electronic (pdf version) of shop drawings for approval. The equipment supplier shall submit six (6) sets of approved shop drawings for all equipment items furnished. Each shop submittal item must be reviewed and approved by the Engineer prior to any work commencing for the furnishing of that item.
- D. Upon completion of the installation, but prior to start-up, the equipment supplier shall furnish six (6) complete sets of loose leaf bound operation and maintenance instruction manuals covering each item of equipment, apparatus, and devices furnished or erected, to include, but not limited to:
1. Catalog data or literature
 2. Installation instructions
 3. Manufacturer's operating instructions
 4. Manufacturer's maintenance instructions
 5. Wiring diagrams
 6. Equipment operating characteristics

7. Component parts replacement, adjustments, and preventative maintenance procedures and materials.
8. Final "As-Built" shop drawings showing actual equipment, arrangement, piping and wiring installed, including all field modifications, and Engineer's comments.

1.9 COORDINATION

- A. The equipment to be pre-purchased by the Owner as part of this Contract shall be installed under a separate contract. The successful bidder shall be required to coordinate with the selected installation contractor for delivery of the equipment, supervision of equipment installation, start-up, and training.

PART 2 PRODUCTS

2.1 SECONDARY EFFLUENT PUMPS SEP – 1 THROUGH SEP – 6

A. SCOPE

1. Furnish six (6) vertical pumps. Each pump shall be equipped with an electric motor connected for operation on a 480 volt, 3 phase, 60 hertz electrical service. Each unit shall be fitted with lifting lugs of adequate strength to install and remove the complete pump assembly.
2. Motors shall be driven by Variable Frequency Drives (VFDs). Pumps SEP-1, 2, 3 and 6 are currently equipped with existing VFDs that will continue to be used on the new pumps. Pumps SEP-4 and SEP-5 will require new VFDs. VFDs shall be furnished by others under a separate contract for installation of the pumps and related appurtenances.

B. PUMP MANUFACTURERS

1. Pumps shall be as follows with "No Substitutions":
 - a. FlowServe – Model 23 SRH
 - b. Layne/Vertiline – Model 20LM
 - c. Peerless – Model 26HH-OH
 - d. American Marsh – Model 20 MFP
 - e. Cascade – Model 20 MF

C. DESIGN CONDITIONS

1. Pumps SEP-1 thru SEP-6 shall be designed to operate at a speed of 900 rpm under the following conditions:
 - a. Primary Operating Condition – 13,890 GPM @ 31' TDH (bowl), minimum bowl efficiency 81%.
 - b. Secondary Operating Condition – 12,454 GPM @ 37.5' TDH (bowl), minimum bowl efficiency 81%.
 - c. The minimum NPSH_{available} at the site is 9'.
 - d. With respect to submergence, the dimension between the wet bottom of the wet well and the normal low water surface in the wet well is 9-feet.
 - e. The pump manufacturer shall calculate friction losses based on C=100 and establish pump TDH at the design points. Calculations shall be submitted with the pump shop drawings.

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- f. Pumps shall be capable of operating throughout the entire pumping range without exceeding available NPSH. NPSH calculations shall be provided by the pump manufacturer.

D. PUMP DESIGN

1. The pumps shall be of the vertical, single stage, turbine, mixed flow or hybrid type complete with above base discharge as specified herein and as indicated on Figure 1. Pumps shall be designed for continuous operation pumping secondary effluent wastewater and shall operate without cavitation, excessive vibration or noise and shall be designed to withstand, without damage, any thrust force which may develop as a result of normal pump operation.
2. Each pump shall be complete with a sole plate, gasket and all required anchor bolts, leveling nuts, nuts and washers. Pumps and base plates shall be designed to allow removal of the entire pump assembly through the floor opening sizes indicated on the drawings. The pump base plate shall provide a gas tight seal and shall be as indicated on the Drawings. Mating surfaces of the pump base plate and sole plate shall be machined for proper fit.
3. The column pipe and pump bowl shall be made in sections which will permit ready assembly, dismantling and removal of the impeller. The minimum wall thickness of column pipe shall be in no case be less than 3/8 inch. Joints shall be of the flange type with a gasket or other suitable means to make them watertight. Vanes shall not be used in the construction of the discharge elbow.
4. After testing and final assembly of the pumps, all pieces shall be matched and marked at the factory. Pumps shall be shipped as completely assembled as possible with respect to size limitations and trucking availability.

E. PUMP CONSTRUCTION

1. Pumps shall be manufactured according to the standards of the Hydraulic Institute and to ANSI/AWWA specification E103. In addition to those general specs, the following specifics shall be included.
2. Materials
 - a. The various pump components shall be constructed of the following materials:

Discharge Head	-	Carbon Steel, ASTM A53-Grade B, 3/8" thick min.
Pipe Column	-	Carbon Steel, ASTM A53-Grade B, 3/8 thick min.
Bowl Assembly	-	ASTM A48, Class 30 cast iron, 1/2" thick min.
Suction Bell	-	ASTM A48, Class 30 cast iron, 1/2" thick min.
Impeller	-	SAE CA 927 Bronze
Pump Bowl Shaft	-	Pump shaft quality 416 SS
Pump Lineshaft	-	Carbon Steel Lineshaft 416 ss
Lineshaft Bearings	-	High lead bronze or bronze, ASTM B584, Alloy 903
Discharge Bowl Bearings	-	High lead bronze or bronze, ASTM B584, Alloy 903
Thrust Ring	-	304 Stainless steel
Thrust Ring	-	304 Stainless steel

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- b. All materials used in the construction of the equipment specified herein shall be new, high grade, of a quality best suited to the requirements of the work, and shall conform to the latest standard specifications of the American Society for Testing Materials for all cases covered by such specifications. Castings with holes, cracks or other defects shall not be accepted.
3. Impeller
 - a. The impeller shall be of the mixed flow, turbine or hybrid design and shall be secured to the pump shaft by double key and thrust collar.
 - b. The impeller shall be statically and dynamically balanced to reduce vibration and wear. Vanes shall be tapered, hand finished and machined to the identical angle of the stationary seat.
4. Discharge Bowl
 - a. The discharge bowl shall be rabbet fit to the discharge column and shall be equipped with straightening vanes to insure efficient operation. The pump bowls, including the suction bell, shall be free of blow holes, sand holes and other detrimental defects. The suction bell shall include a minimum of four ribs to support the suction bowl bearing and a flared inlet designed to reduce suction inlet velocity. The lower suction bell bearing shall be protected by a sand cap or protecting collar designed to prevent the entrance of contaminants.
5. Lineshaft
 - a. The pump lineshaft shall be of open style consisting of maximum 10'-0" long sections with threaded connections. The butting faces shall be machined square to the axis of the shaft with the maximum permissible axial misalignment of the threaded axis with the shaft axis 0.002 inch in 6 inches. The shaft dimensions and bearing spacing shall be so proportioned that no injurious deflection or whip will occur. Bearing spacing of more than five (5) feet will not be allowed. In the design and arrangement of the shaft assembly, provision shall be made for making any necessary vertical adjustment to the shaft after it has been assembled in the pump unit, and without interfering with its alignment. The column pipe, shaft tube, and shaft shall be fitted with necessary joints and couplings to permit dismantling the unit into sections of not more than ten (10) feet in length. Provision shall be made for vertical adjustment of the pump shaft and impeller. All intermediate shaft couplings shall be made for vertical adjustment of the pump shaft and impeller. All intermediate shaft couplings shall be made of high-grade steel of the threaded type.
 - b. The size of the shaft shall be no less than determined by ANSI/AWWA specification E101, section A4.15 line shaft selection and shall be such that elongation due to hydraulic thrust will not exceed the actual clearance of the impellers in the pump bowls.
 - c. The pump head shaft shall be of two piece construction and shall extend through the hollow shaft of the motor. The head shaft shall be keyed and connected at the top of the motor. The connection shall be designed to provide vertical adjustment of the pump lineshaft for impeller clearance adjustment. The pump headshaft shall include a threaded, non-adjustable coupling below the motor. The coupling shall allow the upper shaft to be removed from the top of the motor.
6. Seals

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- a. A cast iron stuffing box shall be provided with a bronze removable stuffing box bushing, galvanized split gland, T-bolts with stainless steel clips and brass nuts.
- b. Stuffing box shall utilize a minimum of five synthetic Garlock 8913 packing rings, compressed around the pump shaft and lubricated by the pumped water.
7. Motor Pedestal
 - a. The motor shall be rabbet fit to the pedestal. The motor pedestal shall be designed to provide complete access to the shaft coupling and shall be complete with safety guards.
8. Discharge Column
 - a. The discharge column assembly shall consist of 20 inch or 24 inch OD flanged pipe sections maximum 10'-0" long with rabbet fits. The bottom section shall be tapered for connection to the bowl assembly. The discharge elbow shall consist of at least three welded steel sections to provide smooth transition of the liquid from the vertical to the horizontal plane.
 - b. The column assembly shall have bronze bearing retainers retained by the butted pipe ends. Each bearing retainer shall contain a water-lubricated, cutless rubber bearing designed for vertical turbine pump service.
9. Pump Sole Plate
 - a. Each pump shall be furnished with a sole plate to be permanently mounted to the existing concrete pump pad. The sole plate shall be leveled and grouted in place as shown on the drawings, and shall include at least four support bolts on which the pump base plate will be attached.
10. Tools
 - a. The Contractor shall furnish, in a suitable metal box, a complete set of any special tools needed for operation, maintenance, assembly and disassembly of the pumping units. All wrenches and spanners shall be case hardened steel forgings and shall have a bright finish with working faces dressed to fit nuts and bolt heads.
11. Painting
 - a. All ferrous metal surfaces of the pumping units located above El. 744.50 shall be prepared in accordance with SSPC-SP6 and shall be shop primed and finish painted as follows:
 - Primer (epoxy) – Tnemec Series N69: 3 mils dft
 - Intermediate (epoxy) – Tnemec Series N69: 4 mils dft
 - Finish (Aliphatic/ Acrylic Polyurethane) – Tnemec 1075 Endurashield: 3 mils dft
 - b. All other inside and outside ferrous metal surfaces of the pumping units shall be prepared in accordance with SSPC-SP10 and shall be coated with 16 mils dft Tnemec Hi-Build Tneme Tar 46H-413 coal tar epoxy.
 - c. Surfaces to be coated with coal tar epoxy shall include but not be limited to the following:
 - 1) Bottom of base plate
 - 2) ID & OD of discharge column and elbow
 - 3) Bowl assembly (inside and outside)
 - 4) Intake vane assembly
 - d. Pump motors shall be coated with motor manufacturer's standard coating.
12. Discharge Elbow

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- a. The discharge elbows shall be of three piece fabricated miter construction. Elbows shall be 20" diameter with either plain end or flange connection to connect to either the existing plain end x flange spool piece or the existing 20" diameter swing check valve.

13. Pump Motors

- a. Pump motors shall be high thrust, vertical squirrel cage induction type, hollow shaft, 150 horsepower, nominal 900 RPM full load speed, 460 volt, 3 phase, 60 Hz motors, complete with a Open Drip Proof (ODP) enclosure, minimum 1.15 service factor, and rabbit fit to the motor pedestal.
- b. Motors shall be inverter duty rated for use with Variable Frequency Drives (VFDs), shall include an insulated upper bearing and shall include shaft grounding as manufactured by AEGIS.
- c. VFDs shall be furnished by others under a separate contract for installation of the pumps and related appurtenances.
- d. High thrust, insulated top bearing shall be designed to support motor rotor weight, weight of pump shaft and impeller and pump hydraulic thrust. Motor thrust bearing design calculations shall be based on a minimum time factor of 1.71 and shall be included with the pump shop drawings. The thrust bearing shall also be designed to withstand 30% momentary upthrust during pump start-up. Motor bearings shall have a minimum B-10 design life of not less than 44,000 hours (average life of 25 years). Bearing information shall be included on the motor nameplate. Each motor shall also be equipped with a lower steady bushing. Oil lubricated anti-friction ball bearings shall be provided for upper and lower motor bearings. Oil level gages shall be mounted on the motors.
- e. Motors shall have a Class F (150°C) insulation system suitable for operation in an ambient temperature of 40 degrees C, in accordance with IEEE standards.
- f. Motors shall have a normally closed thermal switch in each winding which will open upon detection of excessive heating of the windings. All three motor thermal switches shall be connected in series. The wiring of the three motor thermal switches shall be brought out to a separate terminal box for connection to the motor control circuit.
- g. Motors shall have all copper windings and copper rotor bars.
- h. Motors shall meet NEMA Design B characteristics.
- i. Motors shall meet EPACT/EISA values for Premium Efficient motors.
- j. Motors shall have a visible nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor code letters, ambient temperature rating, temperature rise or insulation class, NEMA design letter (integral horsepower motors), frame size, manufacturer's name and model number, service factor, power factor, and nominal efficiency. Nameplate shall be of stainless steel or other approved corrosion resistant material providing a permanent legible marking. Nominal full load efficiency shall be identified on nameplate in accordance with NEMA MG-1-12.54.2
- k. The nameplates and connection plates shall be attached to the motor frame by stainless steel rivets or screws.
- l. Motors shall be rated for continuous duty.

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- m. Motors shall include non-reverse ratchet to prevent the motor from rotating in the opposite direction. The ratchet and shall be furnished and stalled by the motor manufacturer.
- n. Motor leads shall be brought to lug posts on insulated stand-offs. All termination boxes shall be heavy gauge fabricated steel construction with bolted type covers. The motor frame shall have drain plugs.
- o. Upon receipt of the motors (or within 5 days), the Contractor shall lubricate the motors as recommended by the Manufacturer, and in the presence of the Owner's representative, and at that time, the motors shall be rotated to insure proper lubrication of the bearings.
- p. Motors shall be tested at the manufacturer's facility prior to shipment. Motors shall have a complete test as defined by IEEE 112 method B or method F. Report of test shall include data on form A2 applicable to the motor tested. Efficiency shall be based on the losses of bearings similar to those used in operation. The additional losses, due to the external thrust of the pump, will be used to correct the tested efficiency of the motor to include these thrust losses. Certified copies of test results shall be submitted and approved prior to shipment of the pumping equipment.
- q. Motors shall be manufactured by one of the following manufacturers: U.S. Motors, Baldor or General Electric.

14. Pressure Gauges

- a. Connections: Provide tapped openings with bronze plugs for installation of pressure gages on the horizontal run of the discharge elbow. Openings shall be easily accessible for installation and reading of the pressure gauges. Pressure gauges shall be provided and installed under separate contract for construction of the pumps.

15. Factory Testing – Non Witnessed

- a. The pump manufacturer shall perform the following analysis and testing at the factory:
 - 1) Reed Critical Frequency Analysis
 - 2) Hydrostatic Test
 - 3) Performance Tests
- b. The Reed Critical Frequency Analysis shall verify that the pumping units will operate without vibration. Certified copies of the analysis shall be submitted with the pump shop drawings.
- c. Pump bowls, discharge columns and discharge heads shall be hydrostatically tested at 150 percent of the maximum shut-off pressure.
- d. Each pump shall be assembled at the factory to insure fit of adjoining parts. Each pump shall be tested at the factory. Testing shall be conducted in accordance with Hydraulics Institute (HI) Pump Standards, Section 14.6-2011. Vertical Pump Tests and shall meet all criteria contained within this HI Section. The tests shall be such as to satisfy the Owner that the equipment complies with the specification requirements. The Manufacturer shall furnish six certified copies of test reports to the Owner.

16. Spare Parts

- a. The following spare parts shall be provided by the pump manufacturer:

<u>Spare Part Description</u>	<u>Quantity</u>
Lineshaft Bearings (for each pump)	1 set
Suction Bell/Discharge Bowl Assembly	1 unit

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- Complete Set of O-Rings (for each pump) 1 set
- Complete Set of Gaskets (for each pump) 1 set
- b. All parts shall be packaged for long term storage. The contents of each package shall be clearly labeled.
- 17. Equipment Storage Prior to Acceptance
 - a. The pump manufacturer shall clearly inform the Contractor of all requirements for and during temporary storage of the pumps and motors to protect them from damage while the units are temporarily stored and after the units are installed prior to final acceptance. Manufacturer's instructions include, but shall not be limited to pump/motor lubrication, manual rotation of pump/motor shafts, etc.
 - b. The responsibility for proper care and maintenance shall transition from the pump manufacturer to the Contractor upon proper unloading, checking and temporary storage of the six pumps and ancillary items.

PART 3 EXECUTION

3.1 GENERAL

- A. The pump manufacturer shall furnish and install all necessary supports, framing, hangers, shafting, motors, and all other appurtenances.
- B. The pump manufacturer shall provide certified copies of head capacity curves based on test data from similar pumps indicating pump efficiency, horse power required and NPSH required for various suction water elevations, as part of the shop drawings required for all pumps furnished under these Specifications.

3.2 TESTING

- A. Upon completion of the installation, the Contractor will be required to make performance tests of all pumps in the field. Scheduling of testing and testing procedures shall be coordinated with the Owner. The Pump Manufacturer shall have a representative or representatives present during these field tests. During the tests, the operation of the unit may be under the direction of the Pump Manufacturer's representative, if he so desires. Performance testing shall demonstrate that each pump is capable of starting, running, and stopping without cavitation, excessive noise, or excessive vibration. All observations will be made by the Owner or his authorized representatives. The Contractor shall provide competent personnel to make any necessary alterations to provide for pump performance in accordance with the Contract requirements. The Pump Manufacturer shall provide a formal test procedure and forms for recording data for review and acceptance by the Owner prior to scheduling of field testing.
- B. Vibration and Alignment Testing
 - 1. Instrumentation Requirements – Vibration measurements shall be made with a FFT type analyzer utilizing 800 line resolution. Analyzer shall be set on "auto range," unless otherwise specified, for all vibration measurements. Transducer mounting shall yield a flat response for from 0.4 x running speed to F-MAX. Measurements shall consist of four averages (linear, non-overlapping) using a Hanning window. At a minimum, vibration data shall be acquired at one axial and two radial (ninety degree

offset) locations at each bearing location. Frequencies shall be reported in terms of cpm and "running speed orders" with F-MIN = 0.4 x running speed and FMAX = 120,000 cpm unless specified otherwise. Velocity limits (measured in inches/sec./peak) are "peak amplitude acceptance limits" where the peak amplitude (RMS shall be converted to peak by a factor of 1.414) of any line contained with the band shall not contain or shall not exceed the peak amplitude band limit. Any and all testing equipment that is used to certify that the rotating equipment has met the owner's specification must have been calibrated within the past year by certified agency.

2. The displacement of rotating equipment shaft (under load) shall not exceed the specified tolerance of the bearings.

3. Motors

a. The maximum allowable vibration levels

Speed (rpm)	Displacement (inch p to p)	Velocity (inch/sec. peak)
999 and below	0.003	0.150
Band	Range	Standard
1	0.4 x rpm – 0.8 x rpm	0.04 inc/sec. peak
2	0.8 x rpm – 1.2 x rpm	0.075 inc/sec. peak
3	1.2 x rpm – 3.5 x rpm	0.04 inc/sec. peak
4	3.5 x rpm – 8.5 x rpm	0.03 inc/sec. peak
5	8.8 x rpm – 60,000 cpm	0.03 inc/sec. peak
6	60,000 cpm – 120,000 cpm	0.03 inc/sec. peak
7	accelerating	0.05 g. peak

Motors shall be free of any vibration confirmed to be at 2x line frequency.

4. Installation

a. Coupling/Assembly Keys

As final assembly, and prior to initial operation, the motor key and the driven unit key shall be co-planer.

Keys shall be of the proper length based on the formula below:

$$\text{Key length} = ((A \times C) + (B \times D)) / (C + D)$$

Where

A = shaft keyway length

B = hub keyway length

C = key depth in shaft

D = key depth in hub

5. Alignment

a. Equipment shall be inspected prior to final piping connection to ensure the equipment is in "free bolt" condition.

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- b. Any foot pad of a component shall not introduce more than 0.002-inch "soft foot" condition into the system. The total amount of soft foot introduced by any component shall not exceed 0.004-inches. Each component shall be checked for soft-foot utilizing a minimum of two (2) dial indicators prior to alignment of equipment.
- c. All rotating equipment shall be aligned prior to initial start up with a maximum parallel; misalignment of 0.002-inches at operating temperature. Angular misalignment of the two shafts shall be such that any calculated move of a component is equal or less than 0.002-inches. If thermal growth is a factor in the alignment of the equipment, initial alignment will meet the above specifications when taking into consideration the calculated growth per the manufacturer. The equipment shall then be operated until it has reached thermal stability prior to any alignment checks. Alignment of rotating equipment shall be checked with either a dual dial or laser alignment equipment. Any and all equipment is used to certify that the rotating equipment has met the owner's must have been calibrated within the past year by certified agency.
- d. All shims shall be stainless steel, manufactured with manufactured tabs. The size of the shim shall be denoted by the manufacturer on the shim. Shims shall be free of burrs or dirt as well as any foreign material such as paint.

END OF SECTION

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SECONDARY EFFLUENT PUMPS
EQUIPMENT DATA SHEET

Manufacturer: _____

Model No.: _____

Motor Manufacturer: _____

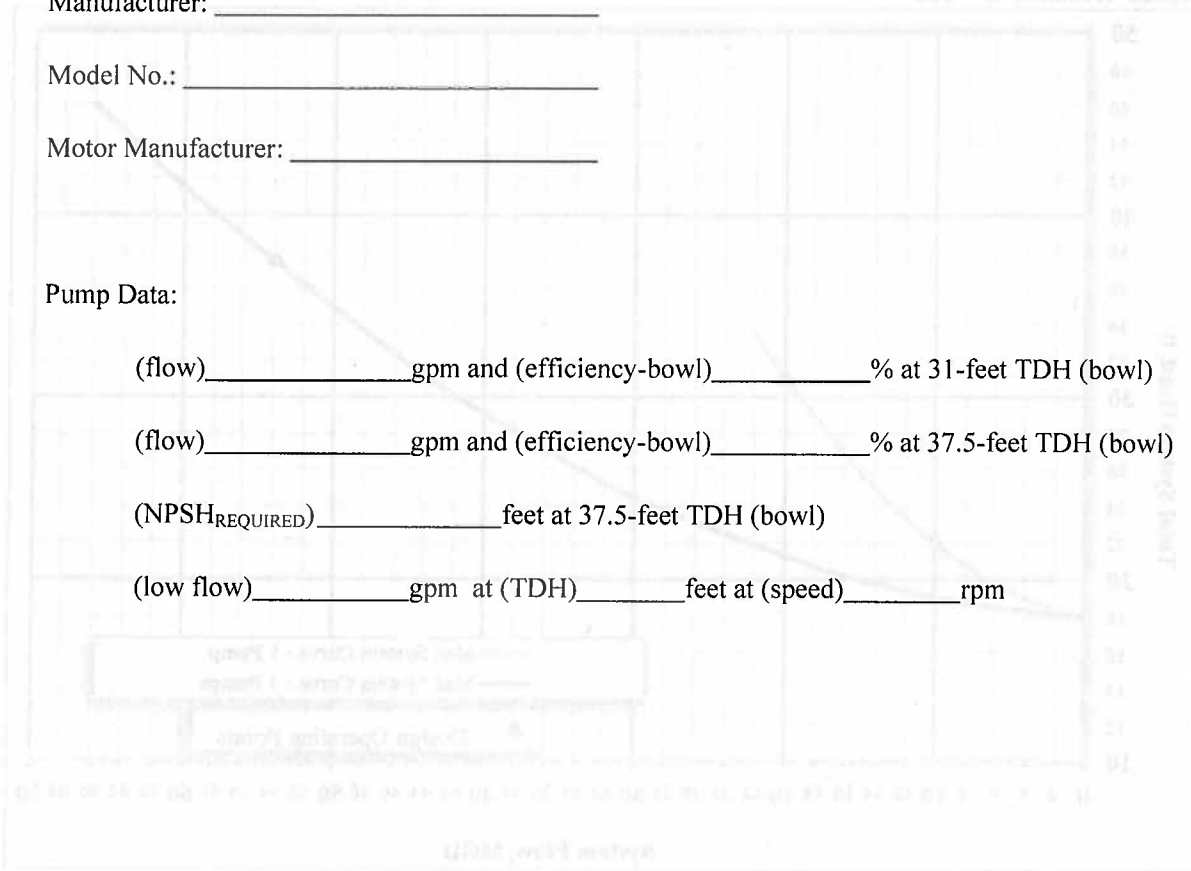
Pump Data:

(flow) _____ gpm and (efficiency-bowl) _____ % at 31-feet TDH (bowl)

(flow) _____ gpm and (efficiency-bowl) _____ % at 37.5-feet TDH (bowl)

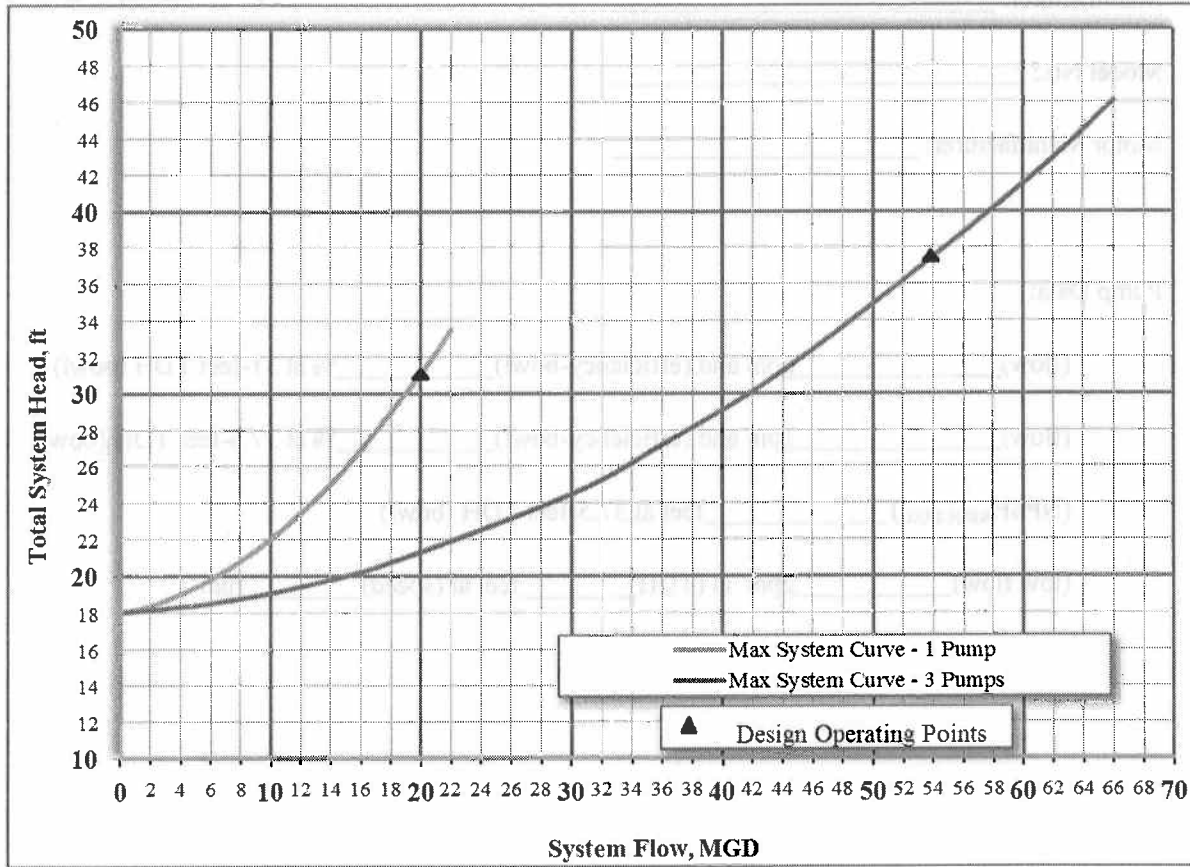
(NPSH_{REQUIRED}) _____ feet at 37.5-feet TDH (bowl)

(low flow) _____ gpm at (TDH) _____ feet at (speed) _____ rpm



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System Curves
City of Ann Arbor – Secondary Effluent Pumps Replacement
Hazen Williams C = 100



SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 01730 - Operation and Maintenance Data

1.2 NUMBER OF SUBMITTALS

- A. The Contractor shall submit .pdf file of all shop drawings.
- B. When approved, the Contractor shall submit 2 paper copies of all Shop Drawings and 2 final .pdf versions on disk.
- C. The Contractor shall submit 2 copies of all Draft O&M Manuals and when approved, shall submit 6 copies of the final documents, and one final .pdf version on disk.

1.3 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

A. General

1. The contract drawings and specifications are complete in all aspects of layout, type of equipment and materials. They do not serve as detailed fabrication, materials, or installation drawings, and the preparation of such submittals required or necessary for this purpose shall be the responsibility of the Contractor.
2. Shop Drawings, Product Data, and Samples are required for all equipment, products, materials, fasteners, shims, etc. furnished or installed by the Contractor. Therefore, no extra charge will be allowed on a claim that particular supplemental drawings or instructions differed from the Contract documents, incurring extra work, unless the Contractor has first brought the matter, in writing, to the Engineer's attention for proper adjustment before starting on the work covered by such and has received from the Engineer an order in writing to so proceed.
3. For the purposes of these documents:
 - a. Shop Drawings are fabrication, assembly and/or installation drawings, diagrams, schedules or other documents specifically prepared for the Work by the Contractor, subcontractor, manufacturer, supplier and/or distributor to illustrate some portion of the Work.
 - b. Product Data are illustrations, standard schedules, performance charts, instructions, catalog cuts, brochures, diagrams, materials lists and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.
 - c. Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.
4. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of these submittals is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to

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conform to the information given and the design concept expressed in the Contract Documents.

5. The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Engineer. Such Work shall be in accordance with approved submittals.
6. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and the Engineer has given written approval to the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in the Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof, as the Engineer's review is intended to cover compliance with the Contract Document and not to enter into every detail of the shop work.
7. The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those required by the Engineer on previous submittals.
8. When professional certification of performance criteria of materials systems or equipment is required by the Contract Documents, the Engineer shall be entitled to rely upon the accuracy and completeness of such calculations and certifications.
9. Substitutions – Whenever a particular brand or make or type of material, equipment, or other item is specified or is indicated on the Contract Drawings, it is for the purpose of establishing a standard of quality, design, and type desired and to supplement the detailed specifications.

B. Submittal Preparation

1. All drawings, information and documentation shall be prepared in English language and dimensions in American units.
2. Identify all variations from the Contract Documents. If there are none, state that in each submittal. Clearly identify any required field dimensions or existing elevations requests, coordination required to adjoining or related work.
3. Provide room and/or Building layout drawings to scale, identifying concrete pads, equipment placement, panel locations, piping, drains, etc. Identify dimensions to adjacent equipment or work. Identify any manufacturer's recommended space requirement for equipment access or maintenance.
4. Identify all equipment and component dimensions, materials, special service or maintenance access requirements, wiring diagrams, motor data, etc.
5. Provide space for Contractor and Engineer review stamps.
6. All subcontractors and manufacturers' drawings shall first be sent directly to the Contractor, who shall keep a record of the drawing numbers and the dates of receipt. The Contractor shall:
 - a. check thoroughly all such drawings, as regards measurements, sizes of members, materials, and all other details to assure himself that they conform to the intent of the drawings and the specification,
 - b. coordinate submittal with related work supplied by others, including electrical and instrumentation equipment, and
 - c. shall promptly return to the subcontractors and/or manufacturers for correction such drawings as are found inaccurate or otherwise in error.

C. Submittal Procedures

1. Transmit each submittal with Engineer approved transmittal form. Sequentially number the transmittal form. Re-submittals shall have original number and a sequential decimal suffix.
2. Identify Project, Contractor, Subcontractor and supplier; pertinent drawing and detail number, and/or specification section number on each transmittal form.
3. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.
4. Maintain a shop drawing log, separate from the Engineer's log.
5. Distribute copies of reviewed submittals to all concerned and related parties. Instruct parties to promptly report any inability to comply with provisions.
6. Revise and resubmit submittals as required and identify all changes made since previous submission.
7. The Engineer reserves the right to refuse to check or review any submittal of a subcontractor or manufacturer which is not presented in compliance with the foregoing requirements.
8. Electronic Submittals:
 - a. All electronic submittals shall follow the procedures outlined above.
 - b. Electronic submittals shall be made in a standard format the Engineer has agreed in advance to accept.
 - c. Reviewed submittals shall be returned in PDF electronic format for the Contractor's printing and distribution.
9. Shop Drawings
 - a. Submit shop drawings in the form of one reproducible transparency and one opaque reproduction. Only the reproducible transparency will be returned. Folding of reproducibles should be avoided.
 - b. Where submittal by reproducible is not possible submit the number of opaque reproductions which Contractor requires, plus four copies which will be retained by Engineer.
 - c. After review, produce copies and distribute in accordance with the Submittal Procedures article herein.

D. Submittal Review

1. The Engineer reserves the right to reject outright any submittal which is deemed incomplete or not adequately coordinated with other work elements.
2. The Engineer will review the submittals within a reasonable time after receipt thereof and will return one comment sheet or one copy with any corrections which may be necessary to meet the Contract requirements. The Contractor shall then review such notations and/or instructions and if he concurs therein, shall make or have made such required corrections, and shall resubmit corrected drawings to the Engineer as soon as possible, for final review. Such further review by the Engineer will be limited to the corrections only, and the Contractor, by such re-submission shall be held to have represented that such drawings contain no other alterations, additions or deletions, unless the Contractor (in writing) directs the Engineer's specific attention to same. Should the Contractor question, or dissent from, such notations and/or instructions, he shall so inform the Engineer and request further clarification before resubmitting the drawings.

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3. The review of Contractor's, subcontractors', and manufacturers' drawings by the Engineer is for coordination and assistance, and the Engineer does not thereby assume responsibility for errors or omissions. Such errors or omissions must be made good by the Contractor, irrespective of the receipt, review of the drawings by the Engineer, and even though the work is done in accordance with such drawings.

E. Manufacturer Certificates

1. When specified in individual sections, submit manufacturer's certification to the Engineer in quantities specified for Product Data.
2. Indicate material or Product meets or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
3. Certificates may be recent or previous test results on material or Product, but must be acceptable to the Engineer.

1.4 EQUIPMENT INSTALLATION, CALIBRATION REPORT AND SERVICE REPORT

- A. The Manufacturer shall submit a certificate to verify that the equipment has been properly installed by the Contractor and calibrated or set-up by the field technician.
- B. When a product or equipment must be checked or serviced, a service report shall be submitted identifying what was served or if any parts were replaced.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION 01300

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June 2, 2014

SENT VIA EMAIL ONLY

PRINCIPALS
George E. Hubbell
Thomas E. Biehl
Walter H. Alix
Peter T. Roth
Keith D. McCormack
Nancy M. D. Faught
Daniel W. Mitchell
Jesse B. VanDeCreek
Roland N. Alix

SENIOR ASSOCIATES
Gary J. Tressel
Kenneth A. Melchior
Randal L. Ford
William R. Davis
Dennis J. Benoit

ASSOCIATES
Jonathan E. Booth
Michael C. MacDonald
Marvin A. Olane
Robert F. DeFrain
Marshall J. Grazioli
Thomas D. LaCross
James F. Burton
Jane M. Graham
Donna M. Martin
Charles E. Hart

HUBBELL, ROTH & CLARK, INC.
OFFICE: 555 Hulet Drive
Bloomfield Hills, MI 48302-0360
MAILING: PO Box 824
Bloomfield Hills, MI 48303-0824
PHONE: 248.454.6300
FAX: 248.454.6312
WEBSITE: www.hrc-engr.com
EMAIL: info@hrc-engr.com

Premier Pump, Inc.
4891 Van Epps Road
Cleveland, Ohio 44131

Attn: Mr. Brian Sublett, Sales Manager

Re: City of Ann Arbor WWTP
Secondary Effluent Pumps Replacement
Vertical Wastewater Pumps Purchase
ITB No. 4328

HRC Job No. 20120802

Dear Mr. Sublett:

Hubbell, Roth & Clark, Inc. (HRC) is writing on behalf of the City of Ann Arbor (City) regarding your bid on the above referenced project received by the City on April 10, 2014.

After reviewing bids received for this project, City staff is prepared to recommend to City Council the award of a contract to Premier Pump Co for purchase of the pumps, but on the condition that Premier Pump Co. agrees with City staff's understanding of Premier Pump Co.'s bid and with City staff's acceptance or rejection, detailed below, of the exceptions noted on the three page Sales Quote by American-Marsh to Premier Pump Co.

City staff understands Premier Pump Co.'s bid to supply pumps as specified in ITB-4328 is listed on the bid form, Section 2 – Schedule of Prices, in the amount of \$425,682.00. City staff further understands that Premier Pump Co. is able to meet the delivery schedule as it noted on the bid form, Section 3 – Delivery, “We can meet delivery schedule.” Premier Pump Co. does not offer any time alternative for the delivery of the pumps as indicated on the bid form, Section 4 – Time Alternative.

City staff accepts or rejects the exceptions noted in the Sales Quote as follows:

A. Specification Section 11321

1. Additional Spare Parts as specified in paragraph 2.1,E,16 must be included for the bid price, namely five (5) additional sets of lineshaft bearings, and six (6) sets of O-rings and Gaskets, for a total of six (6) sets of each item. Exception: Rejected.
2. A factory representative must be provided as specified in paragraphs 1.4, A through D and must be included for the bid price. Exception: Rejected.
3. Paragraph 1.6,A, the City will accept the exception to UL/FM/CSA requirement.
4. Paragraph 2.1, E, 2, the City will accept the substitute C836 bronze material for the impeller.
5. Paragraph 2.1,E,2, the City will accept the proposed non-carbon, 416 SS lineshafts material.
6. Paragraph 2.1,E, the City will accept the non-bronze lineshaft bearings as specified in paragraph 2.1,E,6,b.
7. Paragraph 2.1,E,5,a, shaft tube, the City will accept the non-enclosed lineshaft style of pump as indicated in paragraph 2.1,E, first sentence.

8. Paragraph 2.1,E,5,a, steel lineshaft couplings, the City will accept 416 SS material for these couplings.
 9. Paragraph 2.1,E,6,b, the City will accept John Crane 1345 packing rings instead of the specified Garlock 8913 packing rings.
 10. Paragraph 2.1,E,7, motor pedestal. Three piece fabricated mitered discharge elbows specified in paragraph 2.1,E,12 must be provided as specified and must be included for the bid price. The motor pedestal is typically integrated with the mitered discharge elbows and must be included for the bid price. Exception: Rejected.
 11. Paragraphs 2.1, E, 11, a,b&c, HRC does not agree that paragraphs a &c are in conflict. Exception: Rejected.
 12. Paragraphs 2.1, E, 13, d,g and n, these motor related items will not be required.
 13. Part 3 – Execution – Factory service representation will be provided as specified in paragraphs 1.4, A through D. Exception: Rejected.
- B. Liquidated Damages – Exception: Rejected.

The City is not negotiating with Premier Pump Co. over its bid submission. The City is clarifying its understanding of Premier Pump Co.'s bid and indicating whether it accepts or rejects the proposed exceptions.

If Premier Pump Co. wishes to seek award of a contract on the basis of its bid, the City's understanding of that bid, and the City's acceptance and rejection of Premier Pump Co.'s exceptions, as specified in this letter, please respond to HRC no later than close of business June 6, 2014. If Premier Pump Co. does not agree and does not wish to go forward on that basis, a response to that effect by June 6, 2014, would be appreciated. No response by June 6, 2014, will be interpreted the same as a rejection by Premier Pump Co. of the City's position and an unwillingness on the part of Premier Pump Co. to be awarded a contract on that basis.

If you have any questions or require any additional information, please contact Roland Alix at (248) 454-6385 or Tom Grant at (616) 745-5045.

Very truly yours,

HUBBELL, ROTH & CLARK, INC.



Roland N. Alix, P.E.
Vice President



Thomas M. Grant, P.E., BCEE
Sr. Project Engineer

TMG/tmg

pc: Ann Arbor; E. Sajewski
HRC; File

Kenzie, Earl

From: Grant, Thomas [TGrant@hrc-engr.com]
Sent: Wednesday, July 30, 2014 11:03 AM
To: Amicangelo, Mike; Kenzie, Earl
Cc: Alix, Walter
Subject: FW: Premier Pump Letter 6-2-14.pdf
Attachments: Premier Pump Letter 6-2-14.pdf; ATT00001.txt

Mike,

Per your request, here is the first email I received from American Marsh responding to HRC June 2, 2014 letter. Note the attachment is our letter.

Tom

Thomas M. Grant, P.E., BCEE
Sr. Project Engineer
Hubbell, Roth & Clark, Inc.
801 Broadway NW, Suite 215
Grand Rapids, Michigan 49504
tgrant@hrc-engr.com
Cell: (616) 745-5045
Direct: (616) 432-6200
Office: (616) 454-4286
Fax: (616) 454-4278

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-----Original Message-----

From: Don Reppond [<mailto:Don.Reppond@american-marsh.com>]
Sent: Friday, June 06, 2014 3:43 PM
To: Grant, Thomas
Cc: Shane Wright; Bob Conley; Brian Sublett
Subject: Premier Pump Letter 6-2-14.pdf

Thomas Grant and the City of Ann Arbor

On behave and Premier Pump and American Marsh Pumps we accept the all terms requested in the your letter dated 6-2-14. American Marsh pump will abide by the pricing and specifications clarifications mention.

Kenzie, Earl

From: Grant, Thomas [TGrant@hrc-engr.com]
Sent: Wednesday, July 30, 2014 11:04 AM
To: Amicangelo, Mike; Kenzie, Earl
Cc: Alix, Roland
Subject: FW: City of Ann Arbor Project

Mike,

Here is the email I received from Premiere Pump regarding their acceptance of our June 2, 2014 letter.

Tom

Thomas M. Grant, P.E., BCEE
Sr. Project Engineer
Hubbell, Roth & Clark, Inc.
801 Broadway NW, Suite 215
Grand Rapids, Michigan 49504
tgrant@hrc-engr.com
Cell: (616) 745-5045
Direct: (616) 432-6200
Office: (616) 454-4286
Fax: (616) 454-4278

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-----Original Message-----

From: Brian Sublett [<mailto:bsublett@premierpump.com>]
Sent: Friday, June 06, 2014 4:06 PM
To: Grant, Thomas
Cc: Don Reppond; Phil Bowman
Subject: City of Ann Arbor Project

Good Afternoon Tom,

I would like to concur with the email sent to you earlier by Don Reppond, stating that Premier Pump Inc. and American Marsh Pumps will accept the terms defined in your letter of June 2, 2014.

Please feel free to contact me if you have any questions.

Regards,

Brian Sublett

Kenzie, East

Premier Pump Inc.

From: Grant Thomas [mailto:grant@premier-pump.com]
Sent: Wednesday, July 06, 2016 11:04 AM
To: Kenzie, East
Cc: Alex Roland
Subject: FW: City of Ann Arbor Project

Sent from my iPad

Mike,

Here is the email I received from Premier Pump regarding their acceptance of our June 2, 2016 letter.

Tom

Thomas M. Grant, P.E., BCEI
Sr. Project Engineer
Hubbell, Roth & Clark, Inc.
891 Broadway NW, Suite 212
Grand Rapids, Michigan 49504
www.hrc-inc.com
Cell: (616) 762-2042
Direct: (616) 432-8298
Office: (616) 428-4282
Fax: (616) 424-4278

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-----Original Message-----

From: Brian Sublett [mailto:brian@premier-pump.com]
Sent: Friday, June 03, 2016 4:00 PM
To: Grant, Thomas
Cc: Don Reardon; Phil Swann
Subject: City of Ann Arbor Project

Good Afternoon Tom,

I would like to concur with the email sent to you earlier by Don Reardon, stating that Premier Pump Inc. and American Hatch Pumps will accept the terms defined in your letter of June 1, 2016.

Please feel free to contact me if you have any questions.

Regards,

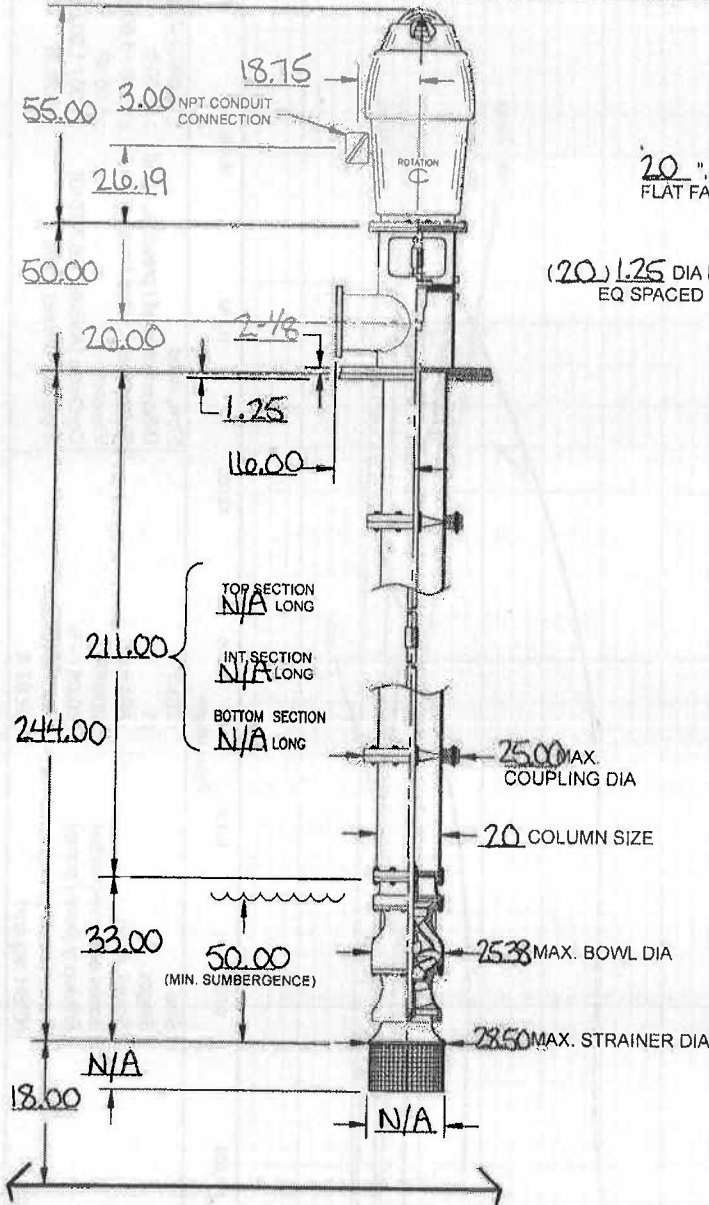


VERTICAL TURBINE

480 SERIES VT

FABRICATED DISCHARGE HEAD,
OPEN LINESHAFT, FLANGED COLUMN

NOVEMBER 2010

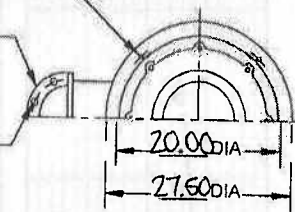


DISCHARGE HEAD

(4) 1.25 DIA HOLES THRU
EQ SPACED ON 25.00 SQ.

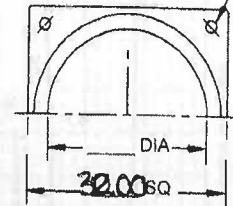
20" 150# ANSI
FLAT FACED FLANGE

(20) 1.25 DIA HOLES THRU
EQ SPACED ON 75.00 C.C.



FOUNDATION PLATE

(4) 1-1/8 DIA HOLES THRU
EQ SPACED ON 79 SQ.



NOTES:

1. ALL DIMENSIONS ARE IN INCHES ± 0.375
- THE MIN. SUBMERGENCE IS FROM THE BOTTOM OF THE BELL OR SUCT. CASE TO THE WATER LEVEL
- THIS VALUE IS REQUIRED TO PREVENT VORTEXING ONLY. THIS VALUE MAY NEED TO INCREASE TO PROVIDE ADEQUATE NPSH_a

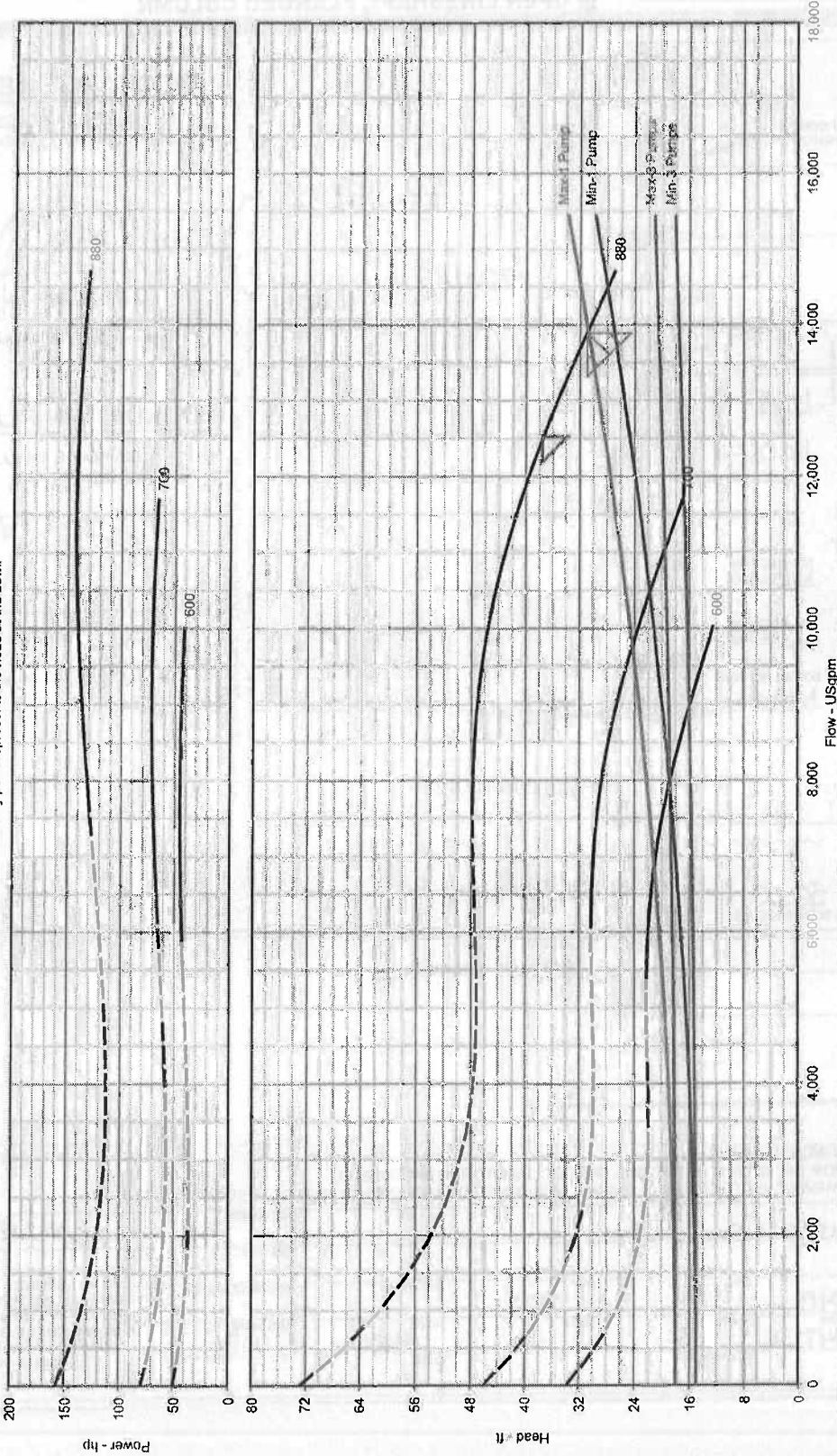
CUSTOMER Premier Pump Co		P.O. NUMBER	
JOB NAME Ann Arbor		TAG NAME	
PUMP SIZE AND MODEL 20MFP-1	GPM 13,890	TDH 31	RPM 880
MOTOR US-VHS	HP 150	FRAME 447TPA	PHASE 3
CERTIFIED FOR	CERTIFIED BY	HERTZ 60	ROTATION 460
		ENCLOSURE WPI	DISCHARGE POSITION
		DATE	

WARNING

DO NOT OPERATE THIS MACHINE WITH OUT PROTECTIVE GUARD IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARD CAN RESULT IN SEVERE BODILY INJURY.

Multi-Speed Performance Curve

Bowl performance. Adjusted for construction and viscosity.
The duty point represents the head at the bowl.

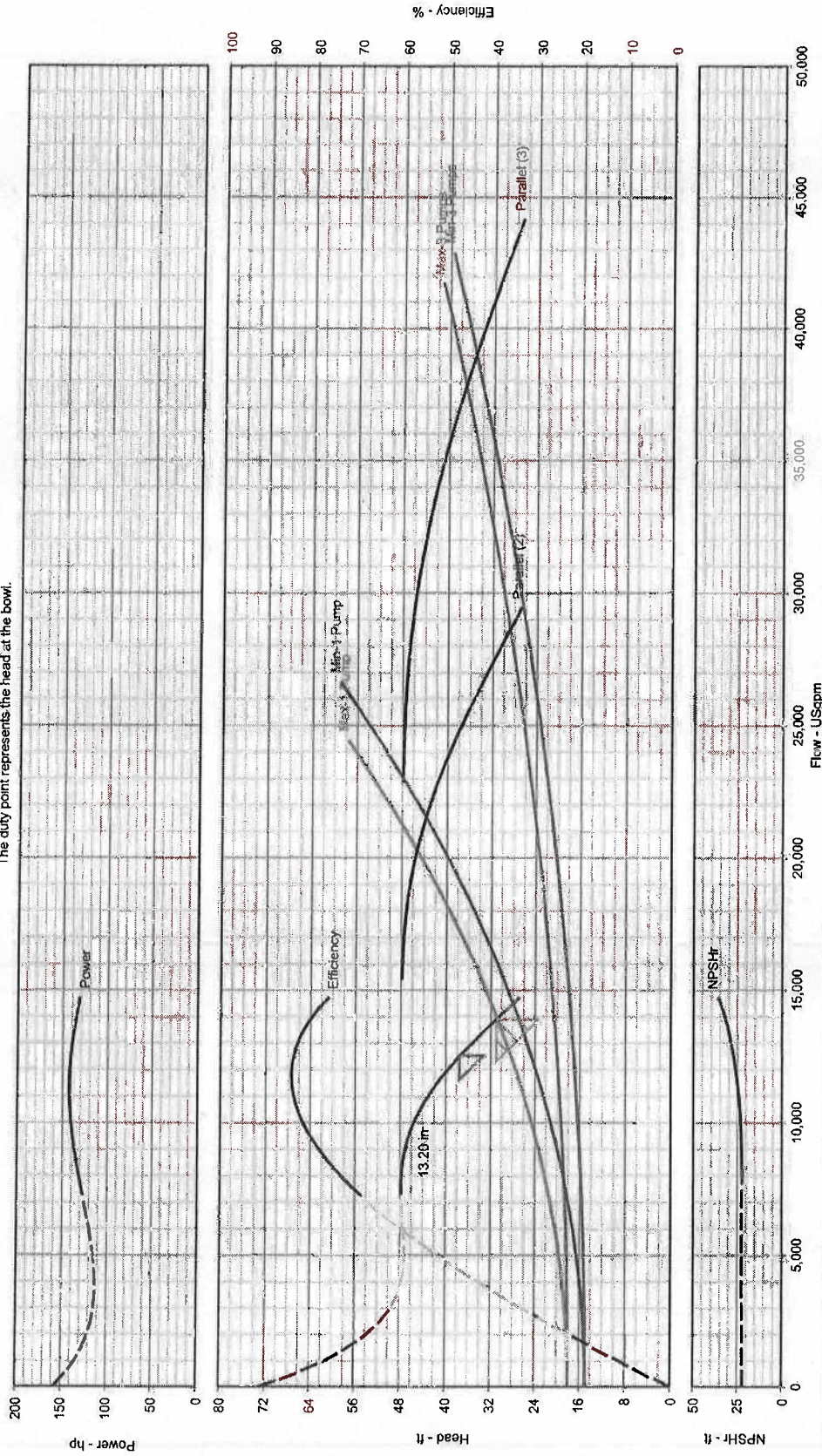


Customer reference	: 003	Flow, rated	: 13,890.0 USgpm
Item number	: 1	Differential head / pressure, rated	: 31.00 ft
Service	: 20MFP	Fluid density, rated / max	: 1.000 / 1.000 SG
Quantity	: 262869	Viscosity	: 1.00 cP
Quote number	: 21 Nov 2013 8:32 AM	Cp/Ch/Ce [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00
Date last saved		Impeller diameter, rated	: 13.20 in
		Size	: 20MFP
		Stages	: 1
		Speed, rated	: 880 rpm
		Based on curve number	: 20MFP
		Efficiency (bowl / pump)	: 80.06 / - %
		Power (bowl / pump)	: 136 / -
		NPSH required	: 32.07 ft



Pump Performance Curve

Bowl performance. Adjusted for construction and viscosity.
The duty point represents the head at the bowl.



Customer reference	: 003	Size	: 20MFP
Item number	: 1	Stages	: 1
Service	: 1	Speed, rated	: 880 rpm
Quantity	: 1	Based on curve number	: 20MFP
Quote number	: 262869	Efficiency (bowl / pump)	: 80.06 / - %
Date last saved	: 21 Nov 2013 8:32 AM	Power (bowl / pump)	: 136 / -
		NPSH required	: 32.07 ft
		Flow, rated	: 13,850.0 USgpm
		Differential head / pressure, rated	: 31.00 ft
		Fluid density, rated / max	: 1.000 / 1.000 SG
		Viscosity	: 1.00 cP
		Cq/Ch/Ce [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00

SECTION 01039

COORDINATION AND MEETINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Coordination of Work.
- B. Pre-Award Meeting.
- C. Pre-construction Meeting.
- D. Progress Meetings.
- E. Pre-installation Meetings.
- F. Pre-Start-up/Demonstration Meetings.

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01310 - Progress Schedules

1.03 COORDINATION

- A. Prior to mobilization, the Contractor shall coordinate all aspects of the Work and shall submit the Construction Schedule representing this coordination.
- B. Coordinate Contractor tool cribs, gang boxes, etc. locations in Filter Building with Owner.
- C. Coordinate Building Permit requirements, Inspections, Temporary or Final Occupancy permits and any other Related Work with the Local Building Department or appropriate agency.
- D. Coordinate scheduling, submittals and review, equipment/material procurement, storage and delivery, installation, calibration, testing and start-up/demonstration of the various specification sections and Trades to assure efficient and orderly sequence of the Work.
- E. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- F. Coordinate space requirements and installation of process mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

- G. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's occupancy.
- H. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.04 PRE-AWARD MEETING

- A. Engineer may schedule a meeting prior to issuing Notice of Award.
- B. Attendance Required: Owner, Engineer, and Contractor.
- C. Agenda:
 - 1. Review of Owner-Contractor Agreement.
 - 2. Review of Submission of bonds and insurance certificates.
 - 3. Regulatory requirements affecting the project.
 - 4. Review of Federal, State and Local contract requirements.
 - 5. Review of list of Subcontractors, list of Products, and schedule of values.
 - 6. Designation of personnel representing the parties in Contract, and the Engineer.
 - 7. Critical work sequencing.
 - 8. Use of premises by Owner and Contractor.
 - 9. Construction facilities and controls provided by Owner.
 - 10. Mobilization.
 - 11. Project Coordination.
- D. The Engineer will prepare meeting minutes and distribute copies within one week after meeting to participants, and those affected by decisions made.

1.05 PRECONSTRUCTION MEETING

- A. Engineer will schedule a meeting within 2 weeks of issuing the Notice to Proceed.
- B. Attendance Required: Owner, Engineer, major Subcontractors and Contractor.
- C. Agenda:
 - 1. Review of Execution of Owner-Contractor Agreement.
 - 2. Review of Regulatory requirements affecting the project.
 - 3. Distribution of Control Documents.
 - 4. Submission of progress construction schedule.
 - 5. Designation of personnel representing the parties in Contract, and the Engineer.
 - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 7. Critical work sequencing.
 - 8. Use of premises by Owner and Contractor
 - 9. Construction facilities and controls provided by Owner.

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10. Mobilization
11. Project Coordination
12. Temporary utilities provided by Contractor and Owner.
13. Survey and layout.
14. Security and housekeeping procedures.
15. Procedures for testing.
16. Procedures for maintaining record documents.

- D. The Engineer shall prepare meeting minutes and distribute copies to participants and those affected by decisions made.

1.06 PROGRESS MEETINGS

- A. The Engineer will schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and Suppliers, Owner, Engineer, as appropriate to agenda topics for each meeting.
- D. Agenda:
1. Overall Project Status.
 2. Construction Schedule (including any changes to Substantial and/or Final Completion dates.)
 3. Work Progress.
 4. Planned Work
 5. Submittals (Schedule and status)
 6. Critical Path items.
 7. Deliveries
 8. Field observations and problems.

1.07 PRE-INSTALLATION MEETING

- A. When required in individual specification sections, convene a pre-installation meeting at work site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Engineer four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
1. Review conditions of installation, preparation and installation procedures.
 2. Review coordination with related work.

- E. Record minutes and distribute copies within two days after meeting to participants, with copies to Engineer, Owner, participants, and those affected by decisions made.

1.08 PRE-START-UP/DEMONSTRATION MEETINGS

- A. When required, convene a Pre-Start-up/Demonstration Meeting at the work site prior to Equipment Demonstration.
- B. Coordinate and convene meetings per Section 01650.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01039

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SECTION 01215

INSTALLATION OF OWNER FURNISHED EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for installation of Owner furnished equipment. Selected materials and equipment are identified on the DRAWINGS and are listed herein that will be procured by the Owner directly. The CONTRACTOR is responsible for receiving, unloading, inspecting, storing, installing and coordination of startup of the equipment as detailed herein.

1.2 OWNER'S INSTRUCTIONS

- A. At the earliest feasible date after Contract Award, advise ENGINEER of the date when the final delivery of each product or system described herein must be completed in order to avoid delay in performance of the work.
- B. Review Shop Drawings for equipment when available and coordinate final connection locations, installation requirements and other details from the Shop Drawings which may be slightly different than shown on the Contract DRAWINGS. Advise ENGINEER immediately if Shop Drawings indicate that a change in the Contract DRAWINGS is required in order to install the equipment in accordance with the manufacturer's requirements.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 TEMPORARY OFF-SITE EQUIPMENT STORAGE FACILITY

- A. CONTRACTOR shall provide a facility for temporarily storing the equipment purchased by the OWNER. The facility must be temperature and humidity controlled. The facility can be at the CONTRACTOR'S shop or at another suitable location as approved by the OWNER.

3.2 RECEIVING

- A. The Equipment Supplier, American-Marsh Pumps, represented locally by Premiere Pump, Inc., shall ship the equipment to a location designated and furnished by the CONTRACTOR for temporary storage of the equipment.

- B. Coordinate receiving of equipment with the supplier and the OWNER. When the equipment arrives on site, unload the equipment and properly store.

3.3 INSPECTION

- A. Inspect products as they are received on site for conformance to bill of materials/DRAWINGS and the presence of any damages. Advise ENGINEER of any differences or damages.

3.4 STORAGE

- A. During temporary storage of the equipment, the CONTRACTOR shall perform all requirements as indicated by the Equipment Supplier in the Installation, Operation and Maintenance manual furnished by the Equipment Supplier.
- B. Requirements during temporary equipment storage will include but not be limited to lubrication and rotation.

3.5 INSTALLATION

- A. Install each piece of equipment in accordance with the manufacturer's recommendation and the general installation requirements of the technical specifications for similar materials.
- B. Coordinate equipment startup, installation and testing with manufacturer's representative for each piece of equipment. Provide overall coordination of startup process until equipment is operating as intended, including SCADA controls for the equipment.

SCHEDULE OF EQUIPMENT

1. Six (6) Vertical Turbine Secondary Effluent Pumps as described in Specification Section 11321 – Vertical Wastewater Pumps - Reference.

END OF SECTION

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SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 SUMMARY OF WORK

- A. Submittals for the Work include the following
1. Contractual Requirements
 2. Construction Schedule
 3. Schedule of Payments
 4. Schedule of Values
 5. Shop Drawing Schedule
 6. Construction Payment Requests
 7. Shop Drawings, Product Data, and Samples including Manufacturer's Certificates and Test Data (when required).
 8. Manufacturer's O & M Manuals
 9. Shut-down Schedule and Work Plans (when required)
 10. Equipment Installation Certification and Field Calibration Reports
 11. Maintenance Log
 12. Lists of Spare Parts
 13. Facility Start-up and Commissioning Documents
 14. As-Built Drawings
 15. Close-Out Documents

1.02 RELATED SECTIONS

- A. Section 01310 - Construction Progress Schedules
- B. Section 01400 - Quality Control
- C. Section 01650 - Facility Start-up and Commissioning
- D. Section 01700 - Contract Closeout
- E. Section 01730 - Operation and Maintenance Data
- F. Section 01800 - Maintenance of Stored Equipment

1.03 SCHEDULE FOR SUBMISSION

- A. Contractual Requirements such as bonds, insurance, etc., shall be submitted per Section 00700.
- B. The Construction Schedule shall be submitted per Section 01310.
- C. The Schedule of Payments, Schedule of Values and Schedule of Submittals, shall be submitted within 20 days of the Notice to Proceed.
- D. Shop Drawings, Product Data and Samples shall be submitted with sufficient time for Engineering review, modification, re-submittal, re-review, etc. until the submittals are approved.
- E. Manufacturer's Certificates and Test Data shall be submitted with the Shop Drawings or when performed but prior to shipping.
- F. Shut-Down Schedule Work Plan shall be submitted 15 days prior to shutdown.
- G. Maintenance Log Log shall be submitted one month prior to the first shipment of equipment and shall be updated and submitted monthly.
- H. Manufacturer's O&M Manuals shall be submitted prior to equipment shipping.
- I. List of spare parts shall be submitted 15 days prior to turnover.
- J. Facility Start-up and Commissioning documents shall be submitted in accordance with Section 01650.
- K. The Construction Schedule, Schedule of Values, and Schedule of Submittals will be reviewed by the Engineer. If rejected, these submittals must be revised and re-submitted until approval. The Engineer reserves the right to withhold the first Partial Payment Request until approval.
- L. Record drawings and Close-Out Documents shall be submitted per Section 01700.
- M. Schedule submittals to expedite the Project, and deliver to the Engineer in a manner to allow sufficient time for review and processing by the Engineer so as to not cause delays in the Work. Coordinate submission of related items.
- N. The Submittals shall not relieve the Contractor of his obligation to comply with specification requirements for items not listed on the schedule. Nothing herein shall be construed as allowing additional time for completion of the project in the event one or more resubmittals are required.

1.04 NUMBER OF SUBMITTALS

- A. The Contractor shall submit .pdf file of all shop drawings.
- B. When approved, the Contractor shall submit 3 paper copies of all Shop Drawings and the final .pdf version on disk.

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- C. The Contractor shall submit 2 copies of all Draft O&M Manuals and when approved, shall submit 5 copies of the final documents, and one final .pdf version on disk.

1.05 SCHEDULE OF VALUES

- A. The Schedule of Values shall include quantities and unit prices from the Bid Form, and lump sum prices for all remaining work by the Engineer. The lump sum items shall be segregated such that no item has a value larger than two (2) percent of the Total Bid Price unless approved by the Engineer.
- B. Each item shall include its proportionate share of the Contractor's general operating charges such as profit, overhead, supervision, insurance, bond premiums, interest, equipment cost, depreciation and rental, contingencies, expendable tools, equipment and supplies. The total cost of the items and quantities the Contractor lists in the schedule of values shall equal the lump sum Contract Price established in the Bid Form.
- C. Where required, the Schedule of Values shall include a complete set of detailed work sheets on bid take off and bid summary covering estimated general conditions expense (field overhead, general overhead, profit mark ups and revisions leading to the final bid amount.
- D. When the Schedule of Values is approved by the Engineer, it shall become part of the Agreement and shall be used as the basis for Contractor progress payments, and to establish unit prices at which extra work may be authorized or deducted from the original Agreement.

1.06 SHOP DRAWING SCHEDULE

- A. The detailed Schedule of Submittals shall include all shop drawings, Product Data, Samples and O&M Manuals.
- B. The Schedule shall identify the submittal, specification section and planned submittal date. All submittals on the Critical Path shall be identified in color or by alternate obvious means. The schedule shall be sorted by both specification section and by date.
- C. The schedule shall be revised monthly and resubmitted at monthly progress meetings.

1.07 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. General
 - 1. The contract drawings and specifications are complete in all aspects of layout, type of equipment and materials. They do not serve as detailed fabrication, materials, or installation drawings, and the preparation of such submittals required or necessary for this purpose shall be the responsibility of the Contractor.
 - 2. Shop Drawings, Product Data, and Samples are required for all equipment, products, materials, fasteners, shims, etc. furnished or installed by the Contractor. Therefore, no extra charge will be allowed on a claim that particular supplemental drawings or instructions differed from the Contract documents, incurring extra work, unless the

Contractor has first brought the matter, in writing, to the Engineer's attention for proper adjustment before starting on the work covered by such and has received from the Engineer an order in writing to so proceed.

3. For the purposes of these documents:
 - a. Shop Drawings are fabrication, assembly and/or installation drawings, diagrams, schedules or other documents specifically prepared for the Work by the Contractor, subcontractor, manufacturer, supplier and/or distributor to illustrate some portion of the Work.
 - b. Product Data are illustrations, standard schedules, performance charts, instructions, catalog cuts, brochures, diagrams, materials lists and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.
 - c. Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.
4. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of these submittals is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.
5. The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Engineer. Such Work shall be in accordance with approved submittals.
6. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and the Engineer has given written approval to the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in the Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof, as the Engineer's review is intended to cover compliance with the Contract Document and not to enter into every detail of the shop work.
7. The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those required by the Engineer on previous submittals.
8. When professional certification of performance criteria of materials systems or equipment is required by the Contract Documents, the Engineer shall be entitled to rely upon the accuracy and completeness of such calculations and certifications.

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9. Substitutions – Whenever a particular brand or make or type of material, equipment, or other item is specified or is indicated on the Contract Drawings, it is for the purpose of establishing a standard of quality, design, and type desired and to supplement the detailed specifications. Any other brand or make or type which in the opinion of the Engineer is equivalent to that specified or indicated may be offered as a substitute, subject to the provisions of Section 01600.

B. Submittal Preparation

1. All drawings, information and documentation shall be prepared in English language and dimensions in American units.
2. Identify all variations from the Contract Documents. If there are none, state that in each submittal. Clearly identify any required field dimensions or existing elevations requests, coordination required to adjoining or related work.
3. Provide room and/or Building layout drawings to scale, identifying concrete pads, equipment placement, panel locations, piping, drains, etc. Identify dimensions to adjacent equipment or work. Identify any manufacturer's recommended space requirement for equipment access or maintenance.
4. Identify all equipment and component dimensions, materials, special service or maintenance access requirements, wiring diagrams, motor data, etc.
5. Provide space for Contractor and Engineer review stamps.
6. All subcontractors and manufacturers' drawings shall first be sent directly to the Contractor, who shall keep a record of the drawing numbers and the dates of receipt. The Contractor shall:
 - a. check thoroughly all such drawings, as regards measurements, sizes of members, materials, and all other details to assure himself that they conform to the intent of the drawings and the specification,
 - b. coordinate submittal with related work supplied by others, including electrical and instrumentation equipment, and
 - c. shall promptly return to the subcontractors and/or manufacturers for correction such drawings as are found inaccurate or otherwise in error.

C. Submittal Procedures

1. Transmit each submittal with Engineer approved transmittal form. Sequentially number the transmittal form. Re-submittals shall have original number and a sequential decimal suffix.
2. Identify Project, Contractor, Subcontractor and supplier; pertinent drawing and detail number, and/or specification section number on each transmittal form.
3. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract

Documents.

4. Maintain a shop drawing log, separate from the Engineer's log.
5. Distribute copies of reviewed submittals to all concerned and related parties. Instruct parties to promptly report any inability to comply with provisions.
6. Revise and resubmit submittals as required and identify all changes made since previous submission.
7. The Engineer reserves the right to refuse to check or review any submittal of a subcontractor or manufacturer which is not presented in compliance with the foregoing requirements.
8. Electronic Submittals:
 - a. All electronic submittals shall follow the procedures outlined above.
 - b. Electronic submittal procedures are only applicable to Shop Drawings and product data submittals.
 - c. Electronic submittals shall be made in a standard format the Engineer has agreed in advance to accept.
 - d. Reviewed submittals shall be returned in PDF electronic format for the Contractor's printing and distribution.

Shop Drawings

1. Submit shop drawings in the form of one reproducible transparency and one opaque reproduction. Only the reproducible transparency will be returned. Folding of reproducibles should be avoided.
2. Where submittal by reproducible is not possible submit the number of opaque reproductions which Contractor requires, plus four copies which will be retained by Engineer.
3. After review, produce copies and distribute in accordance with the Submittal Procedures article herein and for record documents purposes described in Section 01700 – Contract Closeout.

Product Data

1. Submit the number of copies of Product Data which the Contractor requires, plus four copies which will be retained by the Engineer.
2. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
3. Product data shall be bound with an index sheet containing a space at least 5" x 8" for approval stamps and notes.
4. After review distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01700 – Contract Closeout.

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Samples

1. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
2. Submit samples of sufficient size and representative of finishes indicating textures, and patterns for Owner selection.
3. Include identification on each sample, with full Project information.
4. Submit the number of samples specified in individual specification sections; two of which will be retained by the Engineer.
5. Reviewed samples which may be used in the work are indicated in individual specification sections.
6. By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or contained within such submittals with the requirements of the Work and of the Contract Documents.

D. Submittal Review

1. The Engineer reserves the right to reject outright any submittal which is deemed incomplete or not adequately coordinated with other work elements.
2. The Engineer will review the submittals within a reasonable time after receipt thereof and will return one comment sheet or one copy with any corrections which may be necessary to meet the Contract requirements. The Contractor shall then review such notations and/or instructions and if he concurs therein, shall make or have made such required corrections, and shall resubmit corrected drawings to the Engineer as soon as possible, for final review. Such further review by the Engineer will be limited to the corrections only, and the Contractor, by such re-submission shall be held to have represented that such drawings contain no other alterations, additions or deletions, unless the Contractor (in writing) directs the Engineer's specific attention to same. Should the Contractor question, or dissent from, such notations and/or instructions, he shall so inform the Engineer and request further clarification before resubmitting the drawings.
3. The review of Contractor's, subcontractors', and manufacturers' drawings by the Engineer is for coordination and assistance, and the Engineer does not thereby assume responsibility for errors or omissions. Such errors or omissions must be made good by the Contractor, irrespective of the receipt, review of the drawings by the Engineer, and even though the work is done in accordance with such drawings.

E. Manufacturer Certificates

1. When specified in individual sections, submit manufacturer's certification to the Engineer in quantities specified for Product Data.

2. Indicate material or Product meets or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
3. Certificates may be recent or previous test results on material or Product, but must be acceptable to the Engineer.

1.08 SHUT-DOWN SCHEDULE AND WORK PLANS

- A. The Contractor shall schedule shut-downs a minimum of 15 days in advance. Such shut-downs can include bulkhead installation and removal, pump, valve or pipe replacement, hydraulic connections and electrical and instrumentation connections.
- B. The scheduled shut-downs may be weather dependent and as such may be postponed by the Owner due to weather conditions.
- C. The Contractor shall submit a Shut-Down Work Plan for each interruption, per the attached form.

1.09 EQUIPMENT INSTALLATION, CALIBRATION REPORT AND SERVICE REPORT

- A. The Manufacturer shall submit a certificate to verify that the equipment has been properly installed by the Contractor and calibrated or set-up by the field technician.
- B. When a product or equipment must be checked or serviced, a service report shall be submitted identifying what was served or if any parts were replaced.
- C. Additional demonstration submittals are detailed in Section 01650.

1.10 CONTRACT CLOSE-OUT DOCUMENTS

- A. Submit Contract Close-out Documents per Section 01700.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01300

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SHUT-DOWN WORK PLAN

1. Identify the purpose of the shutdown:

2. Identify the planned date(s): _____ Back-up Date(s): _____

3. Identify the planned time(s): _____ Back-up time(s): _____

4. List activities and procedures to be performed.

5. Identify personnel required:

	At beginning/ completion of <u>shutdown</u>	Full duration <u>of shutdown</u>
General Foreman	<input type="checkbox"/>	<input type="checkbox"/>
Mfr/Testing Specialist	<input type="checkbox"/>	<input type="checkbox"/>
Mechanical Subcontractor	<input type="checkbox"/>	<input type="checkbox"/>
Electrical Subcontractor	<input type="checkbox"/>	<input type="checkbox"/>
I&C Subcontractor	<input type="checkbox"/>	<input type="checkbox"/>
Owner's:		
Project Manager	<input type="checkbox"/>	<input type="checkbox"/>
Engineer	<input type="checkbox"/>	<input type="checkbox"/>
Operator	<input type="checkbox"/>	<input type="checkbox"/>
Mechanic	<input type="checkbox"/>	<input type="checkbox"/>
Electrician	<input type="checkbox"/>	<input type="checkbox"/>
Instrument Technician	<input type="checkbox"/>	<input type="checkbox"/>

6. List required Owner assistance (such as gate and/or valve operation, pump stoppage, temporary power disconnections, etc.).

7. Identify the need for bypass pumping, temporary power, alarms, monitoring of depth, flow, pressure, etc., during shutdown.

SECTION 01310
CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Format.
- B. Content.
- C. Revisions to schedules.
- D. Submittals.

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals: Shop drawings, product data, and samples

1.03 QUALITY ASSURANCE

- A. Any and all float shall not be used exclusively by Contractor but shall be available to both the Owner and Contractor alike.
- B. Any schedule showing completion of the Work prior to the contractual Substantial and/or Final Completion dates, nor the review of such schedule shall signify agreement and acceptance of early completion, nor shall it be a means on which to base delay claims.
- C. The Contractor shall obtain input from all sub contractors when compiling and updating the schedules.
- D. The schedule shall be prepared using Microsoft Project software.

1.04 FORMAT

- A. Prepare schedule as a horizontal bar chart with separate bar for each major portion of work or operation, identifying first work day of each week.
- B. Sequence of Listings: The chronological order of the start of each item of work.
- C. Critical path: Denote Work in red.
- D. Scale and Spacing: To provide space for notations and revisions.
- E. Sheet Size: 11 x 17 inches

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1.05 CONTENT

- A. Identify Notice to Proceed, Substantial Completion and Final Completion dates.
- B. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- C. Identify the dates and duration when processes or major equipment are taken out of service.
- D. The schedule will include submittal preparation, review, re-submittal, fabrication/assembly, delivery, installation, testing and startup for all major equipment.
- E. Include system or facility start-up,
- F. Identify the Project Float, defined as the time between early completion and final (contractual) completion.
- G. Identify each item by specification section number.
- H. Identify interdependent work elements.
- I. Identify work of separate stages and other logically grouped activities.
- J. Provide sub-schedules to define critical portions of the entire schedule.
- K. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the last day of each month.
- L. Provide separate schedule of submittal dates for shop drawings, product data, and samples, and dates reviewed submittals will be required from Architect/Engineer.

1.06 REVISIONS TO SCHEDULES

- A. The schedule shall be updated monthly.
- B. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
- C. Identify activities modified since previous submittal, including any schedule slippage, revision to Project Float, major changes in scope, and other identifiable changes.
- D. Provide narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect, on schedules of separate contractors.

1.07 SUBMITTALS

- A. Submit initial schedules within 30 days after the Notice to Proceed. After review, resubmit required revised data within ten days.
- B. Submit four color copies.

1.08 DISTRIBUTION

- A. Distribute copies of reviewed schedules to Project site file, Subcontractors, suppliers, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01310

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SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance - control of installation.
- B. Tolerances
- C. References.
- D. Mockup.
- E. Inspecting and testing laboratory services.
- F. Manufacturers' field services and reports.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals: Submission of manufacturers' instructions and certificates.
- B. Section 01600 - Material and Equipment: Requirements for material and product quality.

1.3 QUALITY ASSURANCE - CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.4 TOLERANCES

- A. Monitor tolerance control of installed Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

1.5 REFERENCES

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date specified in the individual specification sections, except where a specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. The contractual relationship, duties, and responsibilities of the parties in Contract nor those of the Architect/Engineer shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.6 MOCK-UP

- A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups are representative of the quality required for the Work.
- D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so.

1.7 INSPECTING AND TESTING LABORATORY SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspecting and testing, as required.
- B. The independent firm will perform inspections, tests, and other services specified in individual specification sections and as required by the Engineer or the Owner.
- C. Inspecting, testing, and source quality control may occur on or off the project site. Perform off-site inspecting or testing as required by the Engineer or the Owner.

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- D. Reports will be submitted by the independent firm to the Engineer, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Engineer and independent firm 48 hours prior to expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- F. Testing or inspecting does not relieve Contractor of performing Work to contract requirements.
- G. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Engineer. Payment for retesting will be charged to the Contractor by deducting inspecting or testing charges from the Contract Sum.

1.8 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Submit report in duplicate within 30 days of observation to Engineer for information.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, heat, ventilation, telephone and fax service, water supply, and sanitary facilities.
- B. Temporary Controls: Fire Protection, Barriers, enclosures and fencing, protection of the Work, and ground and surface water control.
- C. Construction Facilities: First Aid Facilities, Access roads, parking, progress cleaning, project signage, existing utilities, structures and temporary buildings.
- D. Temporary River Crossing: Construction and removal of temporary river crossing and temporary approach roads.

1.2 RELATED SECTIONS

- A. Section 01700 - Contract Closeout: Final cleaning.

1.3 TEMPORARY FIRE PROTECTION

- A. The Contractor shall follow the standards of the National Fire Protection Association during torch cutting or welding on the job site.
- B. The Contractor shall provide a suitable number of portable fire extinguishers (non-freeze type in cold weather) distributed about the job site.
- C. The Contractor shall store gasoline and other flammable liquids in U.L. listed safety containers in a location away from the building and distribute the liquids directly from the containers. Storage of flammable liquids shall not be allowed inside of any municipal or county building or structure.

1.4 BARRIERS

- A. The Contractor shall provide barricades, and adequate warning flags, signs, and lights in accordance with governing laws and ordinances to protect construction areas, existing facilities, and adjacent properties.
- B. Provide barricades and covered walkways required by governing authorities for public right-of-way and for public access to existing building.
- C. Provide protection for plant life designated to remain. Replace damaged plant life.

- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.5 ENCLOSURES

- A. The Contractor shall provide a construction plan layout showing the arrangement of temporary buildings, construction equipment, and storage and work areas. The plan must be approved by the Engineer prior to erection.
- B. The Contractor shall provide temporary insulated weather tight closure of all exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks. All access openings shall be approved by the Engineer.
- C. Provide temporary partitions and ceilings as indicated to separate work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment.
- D. The construction of partitions shall be 2 x 4 framing and sheet materials with closed joints and sealed edges at intersections with existing surfaces.

1.6 PROTECTION OF INSTALLED WORK

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

1.7 SECURITY

- A. Site security shall be provided by others.

1.8 FIRST AID FACILITIES

- A. A completely equipped, readily accessible first-aid kit shall be provided and maintained at the job site at all times.
- B. The telephone numbers for summoning aid from outside sources (e.g., Police, Fire, EMS, physicians) shall be conspicuously posted near each phone on the job site.

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1.9 PARKING

- A. Due to WWTP site restrictions from other construction projects, Contractor shall be limited to three (3) vehicles parked at the WWTP. Parking locations shall be coordinated with other Contractors and as directed by Owner.
- B. Contractor shall provide additional off-site parking as required and shall obtain all required permits, permissions, etc. for this parking. Contractor shall provide transportation from the off-site parking location(s) for all work staff required at the project site.

1.10 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.

1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01600

MATERIAL, PRODUCTS AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY OF WORK

- A. This Work includes:
 - 1. Transportation, storage, handling, and installation of all work.
 - 2. Product options and substitutions for materials and equipment supplied and installed.

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01400 - Quality Control
- C. Section 01800 – Maintenance of Stored Equipment

1.03 GENERAL PROVISIONS

- A. Products (including all materials, machinery, equipment, and systems) shall be carefully designed and installed to insure that all required functions are adequately performed within specified degrees of precision, and that each unit shall operate with every other part, furnished or existing, to provide a complete integrated system which shall operate to the satisfaction of the Engineer. Any changes or revisions of existing work made necessary by the type and dimensions of furnished products shall be made at the expense of the Contractor, and he shall furnish detail drawings showing such changes or revisions for the approval of the Engineer.
- B. All materials, equipment, and accessories shall be new and unused and shall be essentially the products of a manufacturer regularly engaged in the production of such material or equipment and shall essentially duplicate material or equipment that has been in satisfactory operation at least 5 years.
- C. The owner reserves the right to reject any material or equipment manufacturer who, although he meets the above requirements, does not provide satisfactory evidence indicating adequate and prompt post-installation repair and maintenance service as required to suit the operational requirements of Owner. Items of any one type of materials or equipment shall be the product of a single manufacturer.

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1.04 TRANSPORTATION AND HANDLING

- A. No equipment, materials or other products shall be shipped without approved O&M Manuals, or approved storage, handling and/or maintenance requirements from the manufacturer.
- B. The manufacturer shall crate all parts of equipment carefully to facilitate shipping and handling. Crates shall completely protect the equipment and be sufficiently strong to permit lifting and skidding without additional bracing or reinforcement.
- C. Transport and handle Products and equipment in accordance with manufacturer's instructions. Transport and handle all materials in such a manner to avoid breakage, inclusion of foreign materials, and/or damage by water or other causes.
- D. All shipments shall be identified on the Shipping and Maintenance Log. The Engineer shall be notified of the time of delivery and shall be present.
- E. Deliver packaged materials in original unopened shipping containers. Packages or materials showing evidence of damage or contamination regardless of cause will be rejected. The Contractor shall promptly inspect apparently undamaged shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- F. The Contractor shall repair or replace all items damaged or broken as a result of the Contractor's operation at no cost to the Owner.
- G. When specified in individual Sections, equipment shall be made available for conditional acceptance by the Engineer at the factory prior to shipment.
- H. Equipment shall not be delivered unless it can be immediately incorporated into the work or proper storage facilities are available.
- I. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.
- J. Notify the Engineer at least two days in advance of the delivery of equipment.

1.05 STORAGE AND PROTECTION

- A. Store and protect Products in accordance with manufacturers' instructions, with seals and labels intact and legible.
- B. Store sensitive Products in weather tight, climate controlled enclosures.
- C. For exterior storage of fabricated Products, place on sloped supports, above ground.
- D. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

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- E. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of Product. Provide temporary heat where required.
- F. Provide power to all motor heaters if stored outdoors or in unheated areas.
- G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store Products and equipment by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

1.06 PRODUCT OPTIONS

- A. Products specified by Reference Standards or by Description Only: Any Product meeting those standards or description.
- B. Products specified by naming one or more manufacturers with a provision for "or Equal" or "Approved Equal" Substitutions: Submit a request for substitution for any manufacturer not named in accordance with the following article.
- C. Products specified by naming one or more manufacturers with the provision "No Substitutions": Products of manufacturers named and meeting specifications, no options or substitutions allowed.

1.07 "OR EQUAL" CLAUSE

- A. Specifying an article, material, or piece of equipment by reference to a proprietary product or by using the name of a manufacturer or vendor followed by the clause "or equal" shall be understood to indicate the type, function, minimum standard of design, efficiency, and quality required and shall not be construed in such a manner as to exclude products of comparable quality, design, and efficiency.
- B. Comparable products shall be capable of performing equal function and shall be compatible with other equipment, materials, or systems to which they connect or will become an integral part of.
- C. The clause "or approved equal" which may appear elsewhere in the documents shall mean the same as "or equal".
- D. Substitutions of "or equal" products are subject to the approval of the Engineer.

1.08 SUBSTITUTIONS

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- A. Engineer will consider requests for Substitutions after the date established in Notice to Proceed.
- B. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- C. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
 - 2. Will provide the same warranty for the Substitution as for the specified Product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
- D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- E. Substitution Submittal Procedure:
 - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature and performance data together with samples of the materials where feasible to enable the Engineer to determine if the proposed substitution is equal to that specified.
 - 3. Contractor shall submit certified tests where applicable by an independent laboratory, acceptable to the Owner, attesting that the proposed substitution is equal.
 - 4. A list of installations where the proposed substitution is used.
 - 5. Requests for substitutions shall include full information concerning differences in cost, and any savings in cost resulting from such substitutions shall be passed on to the Owner. Cost to review the substitution will be borne by the Contractor.
 - 6. Where the approval of a substitution requires revision or redesign of any part of the work, all such revision and redesign and all new drawings and details required, therefore, shall be provided by the Contractor at his own cost and expense and shall be subject to the approval of the Engineer.
 - 7. In all cases, the Engineer shall be sole judge as to whether a proposed substitution is to be approved. The Contractor shall abide by the Engineer's decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the

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item specified or indicated. No substitute items shall be used in the work without approval of the Engineer.

1.09 INSTALLATION OF EQUIPMENT

A. General

1. Contractor shall have on hand sufficient personnel, proper equipment, and machinery of ample capacity to facilitate the work.
2. Contractor shall be responsible for rigging, locating, aligning, and leveling all equipment.
3. Complete manufacturer's installation instructions including permissible tolerances shall be furnished with each unit of equipment.
4. All equipment shall be installed in accordance with the approved manufacturer's specifications, drawings, and tolerances under the direct supervision of the required manufacturer's engineer.
5. Equipment shall be erected in a neat and workman-like manner on the foundations at the locations and elevations shown on the drawings unless directed otherwise by the Engineer during installation.

B. Installation

1. Special care shall be used in locating, aligning and, leveling all equipment and parts thereof to insure that each item is in the proper position relative to other equipment and that all parts are aligned within allowable tolerances. The Contractor shall be responsible for this accuracy and shall notify the Engineer of any conditions in prior work which would prevent this alignment before proceeding with the work. The Contractor shall employ a competent surveyor or millwright to set all lines and levels of equipment to the accuracy required.
2. All blocking and wedging required for the proper support and leveling of equipment during installation shall be furnished by the Contractor. All temporary supports shall be removed except stainless steel wedges and bronze shims which may be left in place. All wedges, shims, fasteners or other products left in place must be included in the Shop Drawing.
3. Each piece of equipment or supporting base bearing on concrete foundations shall be bedded in grout. The Contractor shall provide a minimum of 1/2" thick grouting or as indicated on Contract Drawings.

1.10 DAMAGE DURING TESTS AND INSTRUCTION PERIODS

- A. Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and he shall neither have or make any claim for damage which may occur to equipment prior to Substantial Completion.

1.11 SERVICES OF MANUFACTURER'S ENGINEERS

- A. The contract price shall include the cost of furnishing competent engineers or technicians from each company manufacturing equipment for the Project to:
 - 1. Assist the Contractor to install, adjust, and test the equipment in conformity with the Contract Documents.
 - 2. Supervise start-up operations and adequately instruct designated employees of the Owner in the proper operation and maintenance procedures when requested by the Owner throughout the guarantee period of the equipment. A report on each visit shall be filed by the Manufacturer's representative with the Engineer.

1.12 EQUIPMENT MANUFACTURER CERTIFICATION

- A. The Contractor will provide Engineer with written certification obtained from each Manufacturer for the Project that the equipment is installed and does operate in accordance with the Manufacturer's recommendations.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01600

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SECTION 01650

EQUIPMENT START-UP AND FACILITY COMMISSIONING

PART 1 - GENERAL

1.01 SUMMARY OF WORK

- A. This section includes all work necessary to start-up and commission the Work - or where approved by the Engineer - facilities or equipment which are part of the Work.
- B. This work includes the following:
 - 1. Equipment Set-up/Calibration
 - 2. Equipment Testing
 - 3. Equipment Demonstration
 - 4. Facility Commissioning
 - 5. Training
 - 6. Turning over Spare Parts and Special Tools
 - 7. Project documentation
- C. The cost of all work herein shall be included as part of the Work.

1.02 RELATED REQUIREMENTS

- A. General Conditions
- B. Supplementary Conditions
- C. Section 01300 – Submittals
- D. Section 01310 – Construction Schedules
- E. Section 01700 – Contract Closeout
- F. Section 01730 – O&M Data
- G. Section 01950 – Sequence of Construction & Special Project Requirements
- H. Division 11 – Equipment
- I. Division 13 – Special Construction
- J. Division 16 – Electrical

1.03 SUBMITTALS

- A. Equipment Set-up/Calibration Work Plan identified in Section 1.06.
- B. Demonstration Work Plan identified in Section 1.07.
- C. Equipment Set-up/Calibration Certification identified in Section 1.08.
- D. The Contractor shall submit resumes of the Manufacturer's representatives who will conduct the tests and training. Where additional testing consultants are required, such as vibration testing, or noise specialists, VFD technicians, etc. resumes for those representatives shall also be provided.
- E. Submit training agenda, and one copy of training materials 30 calendar days prior to training.
- F. Submit Field Calibration Reports and Manufacturer's Certification of Proper Installation prior to start-up.
- G. Submit signed Training Roster sheet following training.
- H. Submit revisions to O&M Manual (where required) following training.
- I. Submit a Spare Parts list for all parts and consumables specified for the Work.

1.04 QUALITY ASSURANCE

- A. The start-up representatives and technicians shall have at least 5 years related experience, and 3 years specific startup experience with the make and model of the installed equipment.
- B. Training materials and instructions to be provided shall be prepared by personnel trained and experienced in maintenance and operation of equipment and systems to be installed under this Contract.

1.05 SCHEDULING

- A. Start-up / Demonstration and training shall be identified in the Construction Schedule.
- B. The Engineer and Owner shall be notified fifteen (15) calendar days in advance of Demonstration.
- C. The Engineer and Owner shall be notified thirty (30) calendar days in advance of Training.
- D. Classroom and field training programs shall be conducted after satisfactory completion of Start-up, and prior to Substantial Completion.

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1.06 EQUIPMENT DEMONSTRATION WORK PLAN

- A. The Contractor shall submit a Demonstration Work Plan 10 working days prior to equipment startup.
- B. The Demonstration Plan shall list the tests necessary to verify that the system is fully functional and meets the performance standards specified. Such tests shall include but may not be limited to the following:
 - 1. Duty point operation
 - 2. Flow requirements
 - 3. Pressure conditions
 - 4. Vibration and noise levels
 - 5. Electrical performance such as motor efficiency (where required)
 - 6. Alarms and interlocks
 - 7. Automatic and manual operations and shutdown sequence
- C. Pumps performance testing shall be conducted using wet well drawdown measurements and timing.
- D. The Contractor shall verify in the Demonstration Work Plan that all required submittals have been submitted and approved.

1.07 EQUIPMENT SET-UP/CALIBRATION

- A. The Contractor shall confirm that tests for ancillary equipment be completed and accepted prior to demonstration. Tests for ancillary equipment can include pressure tests for pipe, MCCs and electrical gear tests such and megger and ground, etc.
- B. The Manufacturer's technician shall certify that the equipment was supplied as specified and installed per the manufacturer's instructions.
- C. The manufacturer's technician shall perform pre-startup services and complete equipment checklist. Provide all Equipment Field Calibration Reports and preliminary start-up reports by the Manufacturer's field representatives.
- D. Complete the attached Equipment Set-up/Calibration certificate prior to Demonstration.

1.08 EQUIPMENT DEMONSTRATION

- A. Unless noted otherwise, the Contractor and/or Manufacturer's representative shall conduct a preliminary meeting to discuss the demonstration tests, identifying data to be recorded and by whom, the role of any other technicians for ancillary equipment, and a discussion of field calibration performed prior to the start-up tests.

- B. The Contractor, other testing companies and/or manufacturer's representatives shall perform in the presence of the Engineer, those tests identified in the Demonstration Work Plan or any other tests required to verify system/equipment performance.
- C. All test data taken shall be verified by the Engineer and recorded by the Contractor.
- D. Test data shall also include the following:
 - 1. Time of startup and completion of tests
 - 2. Participants
 - 3. Weather, temperature data
 - 4. Major test apparatus information
 - 5. At the conclusion, the Engineer and Contractor shall initial all test data and make multiple copies of the data.
- E. Where required by the Owner, photos of the test apparatus or layout shall be taken by the Contractor.
- F. Contractor shall be available to promptly repair or replace all defective and/or damaged work or equipment during the start-up period so as to minimize disruption to the total facility operation.
- G. In the event a system, equipment, or component proves defective or is unable to meet the specified performance criteria, the Contractor shall replace the defective item and the one year guarantee period for the item shall start after satisfactory replacement and testing of the item.

1.09 VIBRATION TESTING

- A. **Vibration testing shall be conducted on each of the six pumps in accordance with Standard ANSI/HI 9.6.4-2009 "Rotodynamic Pumps for Vibration Measurements and Allowable Values" by a company specializing in vibration testing of pumps including vertical turbine pumps. Test results shall meet the requirements of the Standard for vertical turbine pumps.**

1.10 FACILITY COMMISSIONING

- A. The Contractor shall submit a Facility Commissioning Work Plan 15 working days prior to startup (see attached outline).
- B. The Facility Commissioning Work Plan shall list the tests necessary to verify that the facility is fully functional and meets the full intent of the plans and specifications. Facility demonstration shall demonstrate that all equipment in the facility are functioning together, including alarms, interlocks, automatic control, sequencing, shut down, etc. Such tests shall include but may not be limited to the following:
 - 1. All modes of operation including manual, automatic, local and remote.
 - 2. I/O, alarms and interlocks to a main control panel and remote SCADA terminals.

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3. Startup and shutdown sequence.
4. Any other tests necessary to verify compliance with the specifications.

1.11 TURNOVER OF SPARE PARTS AND SPECIAL TOOLS

A. Spare Parts

1. As soon as practical following equipment demonstration, the Contractor shall turn over all required spare parts, supplies and consumables specified in the Contract Documents. The Contractor shall also provide a list of additional items recommended by the manufacturer to assure efficient operation for a period of 1 year at the particular installation.
2. The foregoing shall not relieve the Contractor of any responsibilities under the guarantee provisions of these Specifications.

B. Special Tools

1. As soon as practical following start-up, the Contractor shall turn over one complete set of suitably marked special tools and appliances specified in the Contract Documents which may be needed to adjust, operate, maintain, or repair the equipment.

C. Keys

1. The Contractor shall deliver four keys for each lockset and padlock installed under this Contract.
2. The keys shall be tagged with locations, room numbers, and key numbers.

D. Delivery

1. The Contractor, or Subcontractor, shall turn over all spare parts, special tools and keys to the Owner at one time in the original shipping container unopened.
2. The approved Spare Parts list shall be used to document all items being turned over to the Owner. The Contractor and Owner shall open the shipping container and inventory each spare part and tool and mark the list as received.
3. The Contractor and Owner shall initial and date the list documenting that the spare parts, tools and keys were submitted and turned over to the Owner.

1.12 TRAINING – GENERAL

- A. The Contractor shall provide training for all equipment where specified. Training shall be a minimum of 6 hours - 2 hours for each of 3 shifts (2 daytime and 1 night time) - for each equipment specification section and the new secondary pumps unless otherwise noted.

Contractor shall coordinate and schedule with Owner. Training time does not include the time required for system startup/demonstration.

- B. Classroom and field training programs shall be conducted for each shift, after Start-up/Demonstration but prior to Substantial Completion.
- C. Prepare and submit a training package, including agenda with durations, training materials, and student notes/guides for complete classroom and hands-on training of all individuals requiring training. Agenda shall be separated into sessions for:
 - 1. Water Utility Technicians (WUTs)
 - 2. Electrical and Control System Technicians (ECSTs)
 - 3. Water Utility Supervisors (WUSs)
- D. Identify the approximate time for each session.
- E. Incorporate the following maintenance and operation data and training services into the training program.
 - 1. Shop Drawings
 - 2. Equipment Operation and Maintenance Manuals.
 - a. Troubleshooting guides.
 - b. Preventive maintenance schedule.
 - c. Lubrication schedule.
 - d. Loop diagrams.
 - e. Control logic calibration sheets.
- F. Occasionally, the training session(s) uncover discrepancies between the O&M Manual and the installed equipment. When this occurs, the Contractor shall resubmit corrected O&M documents.
- G. Where additional training is required at a later date, Contractor shall schedule a tentative future training session with the Owner.
- H. The Contractor shall provide a video tape of the Training Sessions. The video shall be performed by a Subcontractor specializing in this service.

1.13 ACCEPTANCE/SUBSTANTIAL COMPLETION

- A. The facility, or where agreed by the Engineer, the equipment will be accepted as Substantially Complete following successful completion of:
 - 1. Equipment Set-up/Calibration
 - 2. Start-up/Demonstration
 - 3. Performance and Vibration Testing of Pumps
 - 4. Spare parts turnover

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5. O&M submittals
6. Training.

- B. All documentation provided as a result of start-up shall be incorporated into the final O&M Manuals by the manufacturer's representative.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

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DEMONSTRATION WORK PLAN
(Submit 10 days prior to Demonstration)

Equipment Name: _____

Manufacturer: _____

Equipment ID No(s). _____

A. List activities and procedures to be performed.

B. Identify the technician who will record the data. _____

C. Personnel required:

	<u>Yes</u>	<u>No</u>
General Foreman	<input type="checkbox"/>	<input type="checkbox"/>
Manufacturer's Technician	<input type="checkbox"/>	<input type="checkbox"/>
Local Representative	<input type="checkbox"/>	<input type="checkbox"/>
Testing Specialist	<input type="checkbox"/>	<input type="checkbox"/>
Mechanical Subcontractor	<input type="checkbox"/>	<input type="checkbox"/>
Electrical Subcontractor	<input type="checkbox"/>	<input type="checkbox"/>
I&C Subcontractor	<input type="checkbox"/>	<input type="checkbox"/>
Engineer	<input type="checkbox"/>	<input type="checkbox"/>
Owner's:		
Engineer	<input type="checkbox"/>	<input type="checkbox"/>
Operator	<input type="checkbox"/>	<input type="checkbox"/>
Mechanic	<input type="checkbox"/>	<input type="checkbox"/>
Electrician	<input type="checkbox"/>	<input type="checkbox"/>
Instrument Technician	<input type="checkbox"/>	<input type="checkbox"/>

D. List required Owner assistance (such as gate and/or valve operation, temporary equipment shutdowns, flow interruptions, electrical interruptions, etc.).

E. Is List of I/O, Alarm and Interlocks Provided?

F. Are Performance Criteria Specified?

G. Identify the necessary field tests required to demonstrate performance criteria.

H. List the equipment required for performance tests (i.e., flow meters, pressure gages, amp/voltage/current meters, decibel recorder, etc.)

I. Are shop drawings accepted by Engineer?

J. Are O&M Manuals accepted by Engineer?

Submitted by:

_____ Date

Approved/Rejected by:

_____ Date

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EQUIPMENT SET-UP/CALIBRATION CERTIFICATION
(Submit prior to Demonstration)

Equipment Name: _____

Manufacturer: _____

Equipment ID No(s). _____

I certify that:

- | | <u>Yes</u> | <u>No</u> | <u>N/A</u> |
|---|--------------------------|--------------------------|--------------------------|
| 1. The above noted equipment was installed in accordance with the manufacturer's installation instructions. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. I have set-up and calibrated the equipment in accordance with the manufacturer's instructions. (The equipment set-up/calibration sheets are attached.) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. I have verified that all I/O and alarm conditions to the local panel are operational. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. I have verified that the I/O and alarm conditions to the remote control panel are operational. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. I have verified that the I/O and alarm conditions to the SCADA system. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. I have verified that the performance criteria was achieved. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Signature

Date

Print Name/Title

Prior to demonstration, fax or email this form to: _____

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FACILITY COMMISSIONING
(Submit 10 days prior to Commissioning)

A. Personnel required:

	<u>Yes</u>	<u>No</u>
General Foreman	<input type="checkbox"/>	<input type="checkbox"/>
Manufacturer's Technician	<input type="checkbox"/>	<input type="checkbox"/>
Local Representative	<input type="checkbox"/>	<input type="checkbox"/>
Testing Specialist	<input type="checkbox"/>	<input type="checkbox"/>
Mechanical Subcontractor	<input type="checkbox"/>	<input type="checkbox"/>
Electrical Subcontractor	<input type="checkbox"/>	<input type="checkbox"/>
I&C Subcontractor	<input type="checkbox"/>	<input type="checkbox"/>
Engineer	<input type="checkbox"/>	<input type="checkbox"/>
Owner's:		
Engineer	<input type="checkbox"/>	<input type="checkbox"/>
Operator	<input type="checkbox"/>	<input type="checkbox"/>
Mechanic	<input type="checkbox"/>	<input type="checkbox"/>
Electrician	<input type="checkbox"/>	<input type="checkbox"/>
Instrument Technician	<input type="checkbox"/>	<input type="checkbox"/>

B. List activities and procedures to be performed by each.

C. Are all equipment successfully demonstrated? Yes No

D. Is Facility Commissioning Checklist Attached?
(Required prior to commissioning) Yes No

E. Is List of I/O, Alarm and Interlocks Provided? Yes No

F. Is Performance Criteria Specified? Yes No

G. Describe the steps required to document performance.

H. List required Owner assistance (such as gate and/or valve operation, temporary equipment shutdowns, flow interruptions, electrical interruptions, etc.).

I. Identify the necessary field tests required to demonstrate performance criteria.

J. List modes of operated to be tested (manual, automatic, emergency):

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END OF SECTION

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SECTION 01700

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Closeout procedures
- B. Final cleaning
- C. Adjusting
- D. Project Record Documents
- E. Spare Parts and Special Tools
- F. Equipment Startup Services
- G. Substantial Completion
- H. Warranties

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 01650 – Equipment/Facilities Start-up and Commissioning
- C. Section 01730 - Operation and Maintenance Data

1.03 SUBMITTALS

- A. Record Drawing Set
- B. Final Change Order
- C. Final Application for Payment
- D. Contractual Statements including:
 - 1. Waiver of Lien
 - 2. Contractor's Affidavit
 - 3. Contractor's Declaration
 - 4. Release of Surety.

- E. Manufacturers' Extended Warranties, Material and Guaranty Bond (if required).
- F. Copy of Occupancy Permit and any other permits from local governing authority (if required).
- G. Start-Up and Commissioning Documents
- H. Final O&M Manuals
- I. Construction Photographs and Video(s) where specified.

1.04 CLOSEOUT PROCEDURES

- A. Submit statement certifying that all submittals have been "Accepted" and Contractor requirements are "None".
- B. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.
- C. Perform satisfactory completion of Punch List.
- D. Submit final Application for Payment identifying Total Adjusted Contract Sum, previous payments, and sum remaining due.
- E. Provide satisfactory evidence that all claims have been settled.

1.05 FINAL CLEANING

- A. Complete final cleaning and restoration prior to final project inspection.
- B. Remove all temporary labels, stains and foreign substances. Wash or clean by approved methods all surfaces on which dust and dirt has collected.
- C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- D. Clean debris from drainage systems.
- E. Clean site; sweep paved areas, rake clean landscaped surfaces.
- F. Remove waste and surplus materials, rubbish, and construction facilities from the site.
- G. Restore disturbed area. Lawn area may be seeded unless otherwise noted. Paved area shall be restored to their original condition, compatible with the surrounding area, using like materials and workmanship.
- H. Touchup painted surface. Clean and repaint with matching color all scratched, marred or otherwise damaged painted surfaces of all equipment and enclosures.

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1.06 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.07 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents:
1. Record Drawings (Red-line set)
 2. Specifications.
 3. Addenda.
 4. Change Orders and other modifications to the Contract.
 5. Correspondence Log
 6. Submittal Log
 7. Reviewed Shop Drawings, Product Data, and Samples.
 8. Manufacturer's instruction for assembly, installation, and adjusting.
- B. As the work progresses, keep a complete and accurate record of all changes in the Contract Documents (including Drawings, Shop Drawings, Product Data, and Specifications) indicating the work as actually installed. All changes shall be neatly shown on blueline prints of the drawings affected or in the specifications which shall be kept at the job site for inspection by the Owner and the Engineer.
- C. Ensure entries are complete and accurate, enabling future reference by Owner.
- D. Store record documents separate from documents used for construction.
- E. Record information concurrent with construction progress.
- F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of other floors, slabs, platforms and foundations in relation to finish main floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities, conduits, and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension, detail and placement.
 5. Details not on original Contract drawings.
 6. Conduit and wiring information changed, or not shown on drawings including home runs.
- G. On completion of the work, prior to the Contractor's application for final payment and as a condition to its approval by the Engineer and Owner, the Contractor shall arrange such site records in order in accordance with the various sections of the specifications bind them together and index them and deliver them to the Engineer. In addition the Contractor shall request a

complete set of reproducible contract Drawings, and transfer all record revisions and changes to them and deliver them to the Engineer. These drawings shall be dated and marked "Record Drawings". Record Drawings shall be provided on 24" x 36" paper (ARCH D size). The Engineer shall review these Drawings for completeness and accuracy and may require re-submittals.

- H. All reproducible tracings made by the Contractor, equipment manufacturers, and/or material suppliers shall be corrected to show the work as actually completed or installed and a reproducible copy of these drawings shall then be turned over to the Engineer.
- I. Prints in triplicate of all corrected opaque drawings shall be furnished to the Engineer prior to the issuance of the final estimate.
- J. Written approval or other evidence satisfactory to the Engineer of the final conditions of the work shall be obtained from all public authorities or agencies having jurisdiction over any portion of the work.
- K. All public authorities or agencies having jurisdiction over any part of the work shall be determined, and all the requirements of these authorities or agencies with respect to but not limited to inspection, permits, fees, approval, and the like regardless of whether they are listed above or not shall be met.
- L. Submit all documents to Engineer for approval prior to submittal of final Application for Payment.

1.08 SATISFACTION OF CLAIMS

- A. Before final payment can be made, the Contractor shall furnish satisfactory evidence that all claims for damage have been legally settled, or sufficient funds to cover such claims have been placed in escrow, or that an adequate bond to cover such claims has been obtained to secure payment therewith interest.
- B. In the event that any Contractor has trespassed upon private property in the prosecution of the work of this contract, the Owner may withhold payment for the value of such work in or on the property, but in any case, no less than a sum of \$500 for each property trespassed until the Contractor has secured a release from the property owner upon whose property the trespass was committed.

1.09 SUBSTANTIAL COMPLETION

- A. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy and utilize the facilities for its intended use.
- B. Substantial Completion is covered under Section 01650-Equipment Start-Up and Commissioning.

1.10 WARRANTIES

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- A. Provide duplicate copies of all warranties.
- B. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers and insert into the Warranty tab Section of the O&M Manuals.
- C. Submit warranty documents prior to final Application for Payment.
- D. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.
- E. All parts of the work or equipment which is in the opinion of the Engineer prove defective in material, workmanship, or operation within the warranty period shall be removed and replaced or repaired in a manner satisfactory to the Engineer and at not cost to the Owner.
- F. Any service material or equipment required because of the defect shall be supplied without charge.
- G. All work specified to be designed by the Contractor shall be guaranteed to perform as specified.
- H. The Warranty period shall be one year from the date of Substantial Completion unless:
 - 1. A greater period is specified elsewhere.
 - 2. Owner chooses to take over and use a portion of the Work as provided for in the Specifications; in which case the warranty shall be one year from said takeover and use.
- I. Equipment or work replaced and/or repaired during the warranty period shall be guaranteed for one year from the date of acceptance of the repair or replacement or until expiration of the original warranty period whichever comes later.

1.11 FINAL PAYMENT

- A. Within thirty (30) days after the completion of the work under this Contract to the satisfaction of the Owner and the Engineer, in accordance with all and singular terms and stipulations herein contained, the Owner shall make final payment, from a final estimate made by the Engineer. Before final payment is made, the Contractor shall, as directed by the Owner, furnish a Contractor's Affidavit that he has paid or satisfactorily secured all claims of every nature. Also, the Contractor shall furnish a release from the surety or sureties and permit agencies as applicable, approving payment of final estimate by the Owner. The final payment, when made, shall be considered as final approval and acceptance of the completed work herein specified.
- B. The acceptance by the Contractor of the final payment aforesaid shall operate as, and shall be, a release to the Owner and his agents, from all claim and liability to the Contractor for anything done or furnished for, relating to the work, or for any act or neglect of the Owner or of any person relating to or affecting the work.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 01700

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SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Format and content of manuals.
- B. Instruction of Owner's personnel.
- C. Submittals.

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 01400 - Quality Control
- C. Section 01600 – Material, Products and Equipment
- D. Section 01650 – Equipment/Facilities Start-up and Commissioning
- E. Section 01700 - Contract Closeout
- F. Individual Specifications Sections: Specific requirements for operation and maintenance data.

1.03 QUALITY ASSURANCE

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.04 FORMAT

- A. Prepare data in the form of an instructional manual.
- B. Electronic: Provide two (2) CDs or DVDs of the O&M manuals in PDF format with indexing activated.
- C. Binders: Commercial quality, 8-1/2 x 11 inch three D side ring binders with durable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings. Fill binders to no more than 75% capacity.

- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; Volume number, General Contractor name and address and Engineer name and address.
- E. Provide tabbed indexes for each separate product and system, with typed description of product and system.
- F. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Arrange content by process flow under section numbers and sequence of Table of Contents of this Project Manual.

1.05 CONTENTS, GENERAL FOR EACH VOLUME

- A. Table of Contents: Provide title of Projects and the names, addresses, and telephone numbers of Engineer, Subconsultants, and Contractor in the heading. Next, provide a schedule of products and systems, indexed to content of the volume.
- B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information. Identify specific model numbers, size, etc.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- F. Warranties and Bonds: Bind in copy of each.
- G. Start-up documentation. Provide a binder tab for inclusion following start-up.

1.06 MANUFACTURERS MANUALS FOR EQUIPMENT AND SYSTEMS

- A. Each Item of Equipment and Each System: Include description of unit or system, and component parts with diagrams, charts, capabilities, etc. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, complete nomenclature and model number of replaceable parts, and catalog data or literature with correct model number of equipment noted where literature covers more than one model.

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- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications, either typed or by label machine.
- C. Include color coded wiring diagrams as installed.
- D. Shipping, storage and handling: Include all necessary requirements.
- E. Storage maintenance: Include all necessary rotation, lubrication, heating or other provisions required during storage.
- F. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- G. Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions and drawings; and alignment, adjusting, balancing, calibration and checking instructions.
- H. Provide preventive maintenance recommendations servicing and lubrication schedule, and list of lubricants required. Include manufacturer's printed storage and installation instructions with alignment instructions and tolerances.
- I. Include manufacturer's printed operation and maintenance instructions. Provide trouble shooting guide for equipment and system components.
- J. Include sequence of operation by controls manufacturer.
- K. Provide original manufacturer's detailed parts list and parts drawing, illustrations, assembly/disassembly drawings and instructions, and diagrams required for maintenance. Provide a cross reference to all individual component manuals for all parts lists and illustrations provide correct parts numbers. All bearing numbers shall be listed.
- L. Provide control diagrams by controls manufacturer as installed.
- M. Provide Contractor's coordination drawings, with color coded piping diagrams as installed for equipment systems.
- N. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams for each equipment system.
- O. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage and how to obtain them.
- P. Include test and balancing reports as specified in Section 01400 and Divisions 11 through 16.
- Q. Include start-up documentation specified in Section 01650.

- R. Additional Requirements: As specified in individual Product specification sections.
- S. Provide a listing in Table of Contents for design data, with tabbed indexed and space for insertion of data.

1.07 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.
- B. For equipment requiring seasonal operation, perform instructions for other seasons.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.
- E. Refer to individual equipment specification section for instruction and training requirements.

1.08 SUBMITTALS

- A. Draft submittals must be submitted prior to shipment for review.
- B. Submit revised volumes prior to equipment start-up. These copies will be used during training. Revise content of all document sets where required following training within 60 days.
- C. Submit final annotated O&M Manuals in .pdf format on disk.
- D. Submit revisions of final documents following training where required.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF TEXT SECTION 01730

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O&M MANUAL CHECKLIST

Note to Contractor: This form must be submitted with all O&M manuals.

Equipment Name _____

Specification Number _____

I, _____ do hereby certify that the O&M Manual for the referenced equipment:

(Print / Type Name) _____
 meets requirements and specification for 01730 as noted below:

	<u>yes</u>	<u>no</u>		<u>yes</u>	<u>no</u>
Format					
Table of Contents:	<input type="checkbox"/>	<input type="checkbox"/>	Annotated Format:	<input type="checkbox"/>	<input type="checkbox"/>
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Cover/Spine					
Equip. Title:	<input type="checkbox"/>	<input type="checkbox"/>	Owner:	<input type="checkbox"/>	<input type="checkbox"/>
Project Title:	<input type="checkbox"/>	<input type="checkbox"/>	Contractor:	<input type="checkbox"/>	<input type="checkbox"/>
Date:	<input type="checkbox"/>	<input type="checkbox"/>	Engineer:	<input type="checkbox"/>	<input type="checkbox"/>
			Representative:	<input type="checkbox"/>	<input type="checkbox"/>
			Manufacturer:	<input type="checkbox"/>	<input type="checkbox"/>
General					
Design Data:	<input type="checkbox"/>	<input type="checkbox"/>	Expanded Views:	<input type="checkbox"/>	<input type="checkbox"/>
Spare Parts List:	<input type="checkbox"/>	<input type="checkbox"/>	Complete Parts List:	<input type="checkbox"/>	<input type="checkbox"/>
Equip. Drawings:	<input type="checkbox"/>	<input type="checkbox"/>			
Operations:					
Handling & Storage:	<input type="checkbox"/>	<input type="checkbox"/>	Start-Up:	<input type="checkbox"/>	<input type="checkbox"/>
Installation Procedures:	<input type="checkbox"/>	<input type="checkbox"/>	Trouble Shooting:	<input type="checkbox"/>	<input type="checkbox"/>
Maintenance					
Maintenance Procedures:	<input type="checkbox"/>	<input type="checkbox"/>	Preventive Maint. Req.:	<input type="checkbox"/>	<input type="checkbox"/>
Lubrication Specs.:	<input type="checkbox"/>	<input type="checkbox"/>	Preventive Maint. Sched.:	<input type="checkbox"/>	<input type="checkbox"/>
Electrical					
Motor Data:	<input type="checkbox"/>	<input type="checkbox"/>	Control Wiring Diagram:	<input type="checkbox"/>	<input type="checkbox"/>
Wiring Diagrams:	<input type="checkbox"/>	<input type="checkbox"/>			
Test / Field Reports					
Balance Report:	<input type="checkbox"/>	<input type="checkbox"/>	Noise (dB) Readings:	<input type="checkbox"/>	<input type="checkbox"/>
Certif. of Installation:	<input type="checkbox"/>	<input type="checkbox"/>	Pressure Tests:	<input type="checkbox"/>	<input type="checkbox"/>
Miscellaneous					
Extended Warrantee:	<input type="checkbox"/>	<input type="checkbox"/>	MSDS Sheets:	<input type="checkbox"/>	<input type="checkbox"/>

Comments: _____

Signature

Date

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SECTION 01800

MAINTENANCE OF STORED EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This Work includes maintenance of all stored and installed equipment including the vertical turbine pumps purchased by the Owner prior to Substantial Completion.

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01400 - Quality Control
- C. Section 01600 – Material, Products and Equipment
- D. Section 01650 – Equipment/Facilities Start-up and Commissioning

1.03 SUBMITTALS

- A. The Contractor shall submit a Maintenance Log as identified in Section 01300.

1.04 SEQUENCING AND SCHEDULING

- A. The Contractor shall submit the Maintenance Log one month prior to first delivery.
- B. The Contractor shall update and resubmit the Log prior to accepting delivery of all new equipment.
- C. No equipment, materials or other products shall be shipped without approved O&M Manuals, or approved storage, handling and/or maintenance requirements from the manufacturer.
- D. Notify the Engineer at least two days in advance of the delivery of equipment.

1.05 GENERAL PROVISIONS

- A. The Contractor shall transport, handle, store and protect the equipment as specified in Section 01600.
- B. The Contractor shall remain responsible for the care and maintenance of all equipment delivered to the site, warehouse or other place of storage, until such time as the equipment is accepted per Section 01650 and the Work or portion thereof, is defined as Substantially Complete.

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C. The Owner will maintain equipment following substantial completion.

1.06 MAINTENANCE

A. The Contractor shall provide and maintain a Maintenance Log. The log shall:

1. Identify when the shipments are scheduled to arrive.
2. Identify the manufacturer's maintenance requirements.
3. Identify the time and/or frequency of the required maintenance.
4. Provide for the date, time and initials for recording when the maintenance is performed.

B. The Contractor shall rotate, lubricate, heat, and otherwise maintain all equipment in accordance with the Maintenance Log until acceptance by Owner.

C. The Contractor shall record in the log, the maintenance performed and by whom, immediately after performance.

D. The Engineer shall review the log from time to time and may reject partial payment if the maintenance is not being performed as required. The Engineer may also, from time to time, inspect the maintenance being performed.

E. The log shall be turned over to the Owner prior to Substantial Completion.

PART 2 - PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION 01800

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SECTION 01850

TRAINING

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Instruct and train Owner's personnel in maintenance and operation of equipment for systems supplied and/or installed under this Contract, including the following items:
 - 1. All process, mechanical, service and other equipment as noted in the detailed specifications.
 - 2. System instrumentation.
 - 3. Primary switchgear.
 - 4. Motor control centers.
- B. Coordinate training to be provided on the vertical turbine pumps purchased by the Owner. This training will be conducted by the pump manufacturer.
- C. Incorporate the following maintenance and operation data and training services into the training program:
 - 1. Shop Drawings.
 - 2. Equipment Operation and Maintenance Manuals.
- D. Prepare instruction training materials, and student notes/guides for complete classroom and hands-on training of all individuals requiring training.

1.2 RELATED REQUIREMENTS

- A. Division 1 - General Requirements including:
 - 1. Section 01300 - Submittals.
 - 2. Section 01310 - Project Schedules.
 - 3. Section 01600 - Material and Equipment.
 - 4. Section 01700 - Contract Close Out.
 - 5. Section 01730 - Operation and Maintenance Data.
- B. Division 15 - Mechanical:
- C. Division 16 - Electrical:

1.3 QUALITY ASSURANCE

- A. Preparations of training materials and instruction to be provided shall be performed by personnel trained and experienced in maintenance and operation of equipment and systems to be installed under this Contract.

1.4 SCHEDULE OF CONDUCTING TRAINING

- A. Classroom and field training programs shall be conducted after performance testing begins but prior to substantial completion.
- B. Training programs shall be planned and conducted for:
 - 1. Water Utility Technicians (WUTs)
 - 2. Electrical and Control System Technicians (ECSTs)
 - 3. Water Utility Supervisors (WUSs)
- C. All scheduling shall be coordinated through the Owner and Engineer.

1.5 TRAINING DESCRIPTION

- A. Train the Owner's personnel as follows:
 - 1. Describe the overall function of each equipment item, instrument and control loop installed under this Contract.
 - 2. Locating the probable source of malfunction in the instrumentation equipment and control loops, determining the symptoms of the trouble, establishing the probable cause and affecting a solution.
 - 3. Taking appropriate, preventive, and corrective maintenance procedures necessary to keep the equipment and instrumentation system in proper operating condition, including calibration and testing.
 - 4. Describe the functions of the equipment installed under this Contract, including how the components of a system are controlled together and what the effects of the control methods are on the system and on other upstream and downstream processes installed under this Contract.
 - 5. Implement start-up and shutdown procedures for each piece of equipment individually, as well as the start-up and shutdown of the systems comprising the equipment. This instruction shall include normal operation, alternative operations, and emergency operations.
 - 6. Locating the probable source of system trouble, determining the symptoms, establishing the probable cause, and re-stabilizing system efficiency or systems installed under this contract.
 - 7. Demonstrate necessary precautions for safe operation of the equipment, instrumentation, and control system installed under this Contract.
 - 8. Demonstrate emergency procedures for equipment and systems installed under this Contract.
- B. Course materials to be used for training Owner's personnel shall include pertinent portions of the submittals specified in the Specifications such as loop diagrams; calibration data; trouble-shooting guides and maintenance instructions and Operation and Maintenance manuals including start-up and shutdown procedures; descriptions of equipment and instrumentation functions and modes of operations, control and monitoring; alignment tolerances; lubrication schedules,; vibration analysis instruction and parameters; trouble-shooting guides and special calibration test and procedures.

- C. Method of training Owner staff shall include the Contractor using the Owner's equipment to demonstrate a field training program at the Owner's site consisting of classroom and hands-on training using the Owner's equipment and systems; trouble-shooting; preventive and corrective maintenance procedures.
- D. The training program shall not include the time required for system start-up instructions or the field acceptance test.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01950

SEQUENCE OF CONSTRUCTION AND SPECIAL PROJECT REQUIREMENTS

PART 1 GENERAL

1.1 GENERAL

- A. The Contractor shall schedule and arrange his work so that the existing Wastewater Treatment Plant (WWTP) and related utilities will remain in service, without interruption, until the Secondary Pumps have been completely constructed and tested.
- B. In general, work on the new facilities may proceed on a schedule established by the Contractor to meet the completion date, agreed to in the Proposal. However, all scheduling shall be subject to the approval of the Owner.
- C. The Contractor shall be totally responsible for the construction of the project under scheduling conditions outlined herein and any other scheduling which may be necessary. All work shall be completed for the lump sum price submitted in the Contractor's proposal. No additional compensation will be allowed for delays in the work necessary to prevent interruption of service whether specifically spelled out in this section or not.
- D. The Contractor shall note the construction site area limitations as they impact on storage of excavated and construction materials. The Contractor shall make all necessary provisions for off-site storage as required for the project, including but not limited to the Owner furnished Vertical Wastewater Pumps. All costs for this work including permits shall be included in his lump sum price bid.

1.2 COORDINATION

- A. There are significant other projects being performed at the Ann Arbor Wastewater Treatment Plant by other contractors. The Contractor shall be totally responsible for coordination of all the Work with other contractors and with Malcolm Pirnie, the engineer for the other projects including scheduling, laydown areas, work staging, etc.
- B. There are two (2) wet wells, termed East and West. The West wet well has three (3) operating Secondary Effluent Pumps (SEP), Nos. SEP-2, SEP-4 and SEP-6. Pumps SEP-2 and SEP-6 are equipped with existing VFDs. The East wet well has two Secondary Effluent Pumps (SEP) that are in place and operable, Nos. SEP-3 and SEP-5. Pump SEP-1 has been physically removed from the Filter Building. Pump SEP-3 is equipped with a VFD and pump SEP-5 is "temporarily connected" to the VFD originally used for SEP-1.
- C. The Contractor shall remove and replace no more than (1) of the pumps from each of the two wet wells at a given time. There shall be a minimum of two (2) operating pumps in each of the wet wells at all times.

- D. The first pair of pumps to be removed and installed is SEP-2 and SEP-1. SEP-2 shall be performed first and shall connect the existing VFD for the existing pump SEP-2 to the new pump SEP-2. Pump SEP-2 shall be operational including the VFD prior to installing SEP-1. Prior to removing the pump SEP-2, the Contractor shall confirm that both pumps SEP-4 and SEP-6 are operable and that pumps SEP-3 and SEP-5 are operable. The existing VFD that is temporarily connected to pump SEP-5 shall be permanently re-connected to the new SEP-1.
- E. Upon completion of new pumps SEP-2 and SEP-1 and electrical connection/reconnection of the VFDs, the Contractor shall perform inspection of both pumps and confirm the pumps are ready to be started. Inspection shall be performed by the pump and VFD manufacturer's authorized representatives.
- F. After the pumps/VFDs SEP-1 and SEP-2 have been successfully inspected and determined ready for start-up, the Contractor and Pump and VFD Manufacturers shall perform start-up of the new pumps and VFDs. The manufacturer's authorized representatives shall be present and direct the startup of the new pumps including VFDs, perform training of the Owner's staff and perform on-site testing of the new pumps and VFDs.
- G. Upon successful completion of the installation, startup, training and testing of SEP-2 and SEP-1, both pumps shall be operated for a two (2) day period with zero failures. Failure will result in the Contractor and/or Manufacturers performing corrections to resolve the failure and restarting the two (2) day test until it passes. Upon successful completion of the tests, the pumps will be turned over to the Owner prior to beginning work on the second pair of pumps.
- H. The second pair of pumps to be removed and replaced is SEP-5 and SEP-6. The work shall include the installation and connection of the new VFD for Pump SEP-5 and connection of the existing VFD for Pump SEP-6. The procedures shown in items E through G above shall be followed for pumps SEP-5 and SEP-6.
- I. The third pair of pumps to be removed and replaced is SEP-3 and SEP-4. The work shall include the connection of the existing VFD for Pump SEP-3 and connection of the new VFD for Pump SEP-5. The procedures shown in items E through G above shall be followed.

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1.6 COORDINATION AND WORK BY OTHERS

- A. The equipment provided herein will be purchased by the City of Ann Arbor from the successful bidder of the City of Ann Arbor Wastewater Treatment Plant Secondary Effluent Pumps Replacement Vertical Wastewater Pumps Purchase contract. Coordination between parties is a requirement to both contracts. These requirements are as follows:

Description	General Contractor (GC) (1)	P2 Contractor (2)
Submittals	Review as necessary for bid, installation, start-up, and commissioning.	Prepare, submit, re-submit until approved. Provide installation instructions, including entire pump assembly from the motor to the suction bell for the GC to properly Bid, plan and install.
Shop Testing	N/A	Provide documentation of proper factory pump test procedures, data, results, submittals and certification where required.
Shipping	Coordinate delivery schedule with Contractor prior to bid. Offload pumps and ancillary items at temporary storage facility. Inspect with Contractor to confirm satisfactory shipping condition.	Ship to the site, inspect with GC to confirm proper shipment, and that there are no visible defects.
Temporary Storage	Provide temporary covered, temperature controlled storage of pumps and ancillary equipment, off-site (not at WWTP) prior to actual installation. Perform periodic pre-installation lubrication, rotation, etc. of pumps and ancillary items per manufacturer instructions.	N/A
Installation	Install equipment, coordinate all trades	Provide installation instructions, including entire pump assembly from the motor to the suction bell and provide any other assistance necessary.
Start-up	Coordinate time/place. Provide Start-up Work plan. Lead coordination of start-up.	Perform pre-start requirements, provide start-up of pumps, provide acceptance tests, assist with SCADA / I&C start-up, provide training materials, train staff, etc.
As-Builts	Provide	Provide

Notes:

1. General Contractor – GC is the successful bidder for the City of Ann Arbor Wastewater Treatment Plant Secondary Effluent Pumps Replacement, ITB No. 4351.
2. P2 Contractor is Premiere Pump Inc., the successful Purchase Bid Package vertical pump manufacturer for the City of Ann Arbor Wastewater Treatment Plant Secondary Effluent Pumps Replacement Vertical Wastewater Pumps Purchase, ITB No. 4328.
3. The responsibility for proper care and maintenance shall transition from the pump manufacturer to the Contractor upon proper unloading, checking and temporary storage of the six pumps and ancillary items.

PART 2 PRODUCTS

Not Used

PART 2 EXECUTION

Not used.

END OF SECTION

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SECTION 11321

VERTICAL WASTEWATER PUMPS (FOR REFERENCE)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Work herein specified and/or shown on the Plans consists of furnishing all labor, material, equipment, etc., for the fabrication, supply and delivery of six (6) vertical wastewater pumps, complete in all details, as shown on the Plans and/or specified herein.
- B. This Section makes reference to other supportive Sections which shall form a part of this Section and shall govern the work described herein.

1.2 RELATED WORK

- A. Section 01015 – Special Conditions
- B. Section 01300 – Shop Drawings
- C. Section 01730 – Operation and Maintenance Data
- D. Section 01850 – Training

1.3 REFERENCES

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
- D. ANSI/NEMA MG1 - Motors and Generators.
- E. ANSI/NFPA 70 - National Electrical Code.

1.4 INSPECTION AND TRAINING REQUIREMENTS

- A. A factory representative employed by the manufacturer shall visit the site prior to equipment start-up to verify the proper installation of the equipment and to instruct the Owner's operating personnel in the maintenance and operation of these units.
- B. Three (3) separate inspection and start-up visits shall be provided, one for each pair of pumps that becomes installed. A minimum of two (2), eight (8) hour days for each visit shall be included in the lump sum bid.

- C. The scheduling of this service shall be coordinated with the Owner and the cost of this service shall be included in the Contractor's bid price.
- D. Training requirements shall be a minimum 16 hours at the site, unless otherwise specified. The wastewater treatment plant is staffed with two shifts during (day and night). Training shall be provided during both of the shifts. Training shall occur during the first inspection and start-up visit.

1.5 WARRANTY

- A. The pumping units and accessories shall be guaranteed in writing to be free of defects in workmanship and material for a period of (one) 1 year from the date of acceptance.
- B. The pump warranty period shall not commence until such time as acceptable testing is performed on each pump and each pump is accepted by Owner.

1.6 REGULATORY REQUIREMENTS

- A. Furnish Products listed and classified by Underwriters' Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, and as acceptable to authority having jurisdiction, as suitable for purpose specified and indicated.
- B. All equipment and workmanship shall be in conformance with all applicable standards and requirements of the following documents:
 - 1. Any and all Federal, State, and/or local codes, ordinances, or regulations, including OSHA/MIOSHA.
 - 2. Latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories.

1.7 QUALITY ASSURANCE

- A. Monitor quality control over suppliers, manufacturers, products, services, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.8 SHOP DRAWINGS AND O&M MANUALS

- A. Shop drawings are required for the items specified in this Section of the Specifications. Each shop drawing submittal shall include as a minimum the following information:
1. Identification of the item, i.e., written description, reference to equipment schedule.
 2. Assembly drawings that identify each part of the item specified. These should include dimensions and a materials of construction list.
 3. Information which verifies that the item meets process specifications, i.e., corrosion resistance, temperature rating, pressure rating, strength, performance curve.
 4. Electrical and control information for the appropriate equipment, including motor nameplate data, wiring diagrams, and control panel layouts, where applicable.
 5. Electrical characteristics and connection requirements including layout of completed assemblies, interconnecting cabling, tubing, dimensions, weights, and external air and power requirements.
 6. Manufacturer's installation instructions including application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation and starting of Product.
- B. Shop drawings for motor driven equipment MUST include the following motor information:
1. Horsepower
 2. Voltage
 3. Phase
 4. Frequency
 5. Speed
 6. Maximum Temperature Rise In Continuous Service
 7. Enclosure Type
 8. Frame
 9. Service Factor
 10. Power Factor
 11. Efficiency
 12. NEMA Design Code Letter
 13. Manufacturer
 14. Full Load Amperes
 15. NEC Code Letter
 16. Insulation Class
 17. Inverter Duty Rated
- C. The equipment supplier shall submit two (2) electronic (pdf version) of shop drawings for approval. The equipment supplier shall submit six (6) sets of approved shop drawings for all equipment items furnished. Each shop submittal item must be reviewed and approved by the Engineer prior to any work commencing for the furnishing of that item.
- D. Upon completion of the installation, but prior to start-up, the equipment supplier shall furnish six (6) complete sets of loose leaf bound operation and maintenance instruction manuals covering each item of equipment, apparatus, and devices furnished or erected, to include, but not limited to:
1. Catalog data or literature
 2. Installation instructions

3. Manufacturer's operating instructions
4. Manufacturer's maintenance instructions
5. Wiring diagrams
6. Equipment operating characteristics
7. Component parts replacement, adjustments, and preventative maintenance procedures and materials.
8. Final "As-Built" shop drawings showing actual equipment, arrangement, piping and wiring installed, including all field modifications, and Engineer's comments.

1.9 COORDINATION

- A. The equipment to be pre-purchased by the Owner as part of this Contract shall be installed under a separate contract. The successful bidder shall be required to coordinate with the selected installation contractor for delivery of the equipment, supervision of equipment installation, start-up, and training.

PART 2 PRODUCTS

2.1 SECONDARY EFFLUENT PUMPS SEP – 1 THROUGH SEP – 6

A. SCOPE

1. Furnish six (6) vertical pumps. Each pump shall be equipped with an electric motor connected for operation on a 480 volt, 3 phase, 60 hertz electrical service. Each unit shall be fitted with lifting lugs of adequate strength to install and remove the complete pump assembly.
2. Motors shall be driven by Variable Frequency Drives (VFDs). Pumps SEP-1, 2, 3 and 6 are currently equipped with existing VFDs that will continue to be used on the new pumps. Pumps SEP-4 and SEP-5 will require new VFDs. VFDs shall be furnished by others under a separate contract for installation of the pumps and related appurtenances.

B. PUMP MANUFACTURERS

1. Pumps shall be as follows with "No Substitutions":
 - a. FlowServe – Model 23 SRH
 - b. Layne/Vertiline – Model 20LM
 - c. Peerless – Model 26HH-OH
 - d. American Marsh – Model 20 MFP
 - e. Cascade – Model 20 MF

C. DESIGN CONDITIONS

1. Pumps SEP-1 thru SEP-6 shall be designed to operate at a speed of 900 rpm under the following conditions:
 - a. Primary Operating Condition – 13,890 GPM @ 31' TDH (bowl), minimum bowl efficiency 81%.
 - b. Secondary Operating Condition – 12,454 GPM @ 37.5' TDH (bowl), minimum bowl efficiency 81%.
 - c. The minimum NPSH_{available} at the site is 9'.

- d. With respect to submergence, the dimension between the wet bottom of the wet well and the normal low water surface in the wet well is 9-feet.
- e. The pump manufacturer shall calculate friction losses based on C=100 and establish pump TDH at the design points. Calculations shall be submitted with the pump shop drawings.
- f. Pumps shall be capable of operating throughout the entire pumping range without exceeding available NPSH. NPSH calculations shall be provided by the pump manufacturer.

D. PUMP DESIGN

- 1. The pumps shall be of the vertical, single stage, turbine, mixed flow or hybrid type complete with above base discharge as specified herein and as indicated on Figure 1. Pumps shall be designed for continuous operation pumping secondary effluent wastewater and shall operate without cavitation, excessive vibration or noise and shall be designed to withstand, without damage, any thrust force which may develop as a result of normal pump operation.
- 2. Each pump shall be complete with a sole plate, gasket and all required anchor bolts, leveling nuts, nuts and washers. Pumps and base plates shall be designed to allow removal of the entire pump assembly through the floor opening sizes indicated on the drawings. The pump base plate shall provide a gas tight seal and shall be as indicated on the Drawings. Mating surfaces of the pump base plate and sole plate shall be machined for proper fit.
- 3. The column pipe and pump bowl shall be made in sections which will permit ready assembly, dismantling and removal of the impeller. The minimum wall thickness of column pipe shall be in no case be less than 3/8 inch. Joints shall be of the flange type with a gasket or other suitable means to make them watertight. Vanes shall not be used in the construction of the discharge elbow.
- 4. After testing and final assembly of the pumps, all pieces shall be matched and marked at the factory. Pumps shall be shipped as completely assembled as possible with respect to size limitations and trucking availability.

E. PUMP CONSTRUCTION

- 1. Pumps shall be manufactured according to the standards of the Hydraulic Institute and to ANSI/AWWA specification E103. In addition to those general specs, the following specifics shall be included.
- 2. Materials
 - a. The various pump components shall be constructed of the following materials:

Discharge Head	-	Carbon Steel, ASTM A53-Grade B, 3/8" thick min.
Pipe Column	-	Carbon Steel, ASTM A53-Grade B, 3/8 thick min.
Bowl Assembly	-	ASTM A48, Class 30 cast iron, 1/2" thick min.
Suction Bell	-	ASTM A48, Class 30 cast iron, 1/2" thick min.
Impeller	-	SAE CA 927 Bronze
Pump Bowl Shaft	-	Pump shaft quality 416 SS
Pump Lineshaft	-	Carbon Steel Lineshaft 416 ss
Lineshaft Bearings	-	High lead bronze or bronze, ASTM B584, Alloy 903

Discharge Bowl Bearings	-	High lead bronze or bronze, ASTM B584, Alloy 903
Thrust Ring	-	304 Stainless steel
Thrust Ring	-	304 Stainless steel

- b. All materials used in the construction of the equipment specified herein shall be new, high grade, of a quality best suited to the requirements of the work, and shall conform to the latest standard specifications of the American Society for Testing Materials for all cases covered by such specifications. Castings with holes, cracks or other defects shall not be accepted.
3. Impeller
 - a. The impeller shall be of the mixed flow, turbine or hybrid design and shall be secured to the pump shaft by double key and thrust collar.
 - b. The impeller shall be statically and dynamically balanced to reduce vibration and wear. Vanes shall be tapered, hand finished and machined to the identical angle of the stationary seat.
 4. Discharge Bowl
 - a. The discharge bowl shall be rabbet fit to the discharge column and shall be equipped with straightening vanes to insure efficient operation. The pump bowls, including the suction bell, shall be free of blow holes, sand holes and other detrimental defects. The suction bell shall include a minimum of four ribs to support the suction bowl bearing and a flared inlet designed to reduce suction inlet velocity. The lower suction bell bearing shall be protected by a sand cap or protecting collar designed to prevent the entrance of contaminants.
 5. Lineshaft
 - a. The pump lineshaft shall be of open style consisting of maximum 10'-0" long sections with threaded connections. The butting faces shall be machined square to the axis of the shaft with the maximum permissible axial misalignment of the threaded axis with the shaft axis 0.002 inch in 6 inches. The shaft dimensions and bearing spacing shall be so proportioned that no injurious deflection or whip will occur. Bearing spacing of more than five (5) feet will not be allowed. In the design and arrangement of the shaft assembly, provision shall be made for making any necessary vertical adjustment to the shaft after it has been assembled in the pump unit, and without interfering with its alignment. The column pipe, shaft tube, and shaft shall be fitted with necessary joints and couplings to permit dismantling the unit into sections of not more than ten (10) feet in length. Provision shall be made for vertical adjustment of the pump shaft and impeller. All intermediate shaft couplings shall be made for vertical adjustment of the pump shaft and impeller. All intermediate shaft couplings shall be made of high-grade steel of the threaded type.
 - b. The size of the shaft shall be no less than determined by ANSI/AWWA specification E101, section A4.15 line shaft selection and shall be such that elongation due to hydraulic thrust will not exceed the actual clearance of the impellers in the pump bowls.
 - c. The pump head shaft shall be of two piece construction and shall extend through the hollow shaft of the motor. The head shaft shall be keyed and connected at the top of the motor. The connection shall be designed to provide vertical adjustment of the pump lineshaft for impeller clearance

- adjustment. The pump headshaft shall include a threaded, non-adjustable coupling below the motor. The coupling shall allow the upper shaft to be removed from the top of the motor.
6. Seals
 - a. A cast iron stuffing box shall be provided with a bronze removable stuffing box bushing, galvanized split gland, T-bolts with stainless steel clips and brass nuts.
 - b. Stuffing box shall utilize a minimum of five synthetic Garlock 8913 packing rings, compressed around the pump shaft and lubricated by the pumped water.
 7. Motor Pedestal
 - a. The motor shall be rabbet fit to the pedestal. The motor pedestal shall be designed to provide complete access to the shaft coupling and shall be complete with safety guards.
 8. Discharge Column
 - a. The discharge column assembly shall consist of 20 inch or 24 inch OD flanged pipe sections maximum 10'-0" long with rabbet fits. The bottom section shall be tapered for connection to the bowl assembly. The discharge elbow shall consist of at least three welded steel sections to provide smooth transition of the liquid from the vertical to the horizontal plane.
 - b. The column assembly shall have bronze bearing retainers retained by the butted pipe ends. Each bearing retainer shall contain a water-lubricated, cutless rubber bearing designed for vertical turbine pump service.
 9. Pump Sole Plate
 - a. Each pump shall be furnished with a sole plate to be permanently mounted to the existing concrete pump pad. The sole plate shall be leveled and grouted in place as shown on the drawings, and shall include at least four support bolts on which the pump base plate will be attached.
 10. Tools
 - a. The Contractor shall furnish, in a suitable metal box, a complete set of any special tools needed for operation, maintenance, assembly and disassembly of the pumping units. All wrenches and spanners shall be case hardened steel forgings and shall have a bright finish with working faces dressed to fit nuts and bolt heads.
 11. Painting
 - a. All ferrous metal surfaces of the pumping units located above El. 744.50 shall be prepared in accordance with SSPC-SP6 and shall be shop primed and finish painted as follows:
 - Primer (epoxy) – Tnemec Series N69: 3 mils dft
 - Intermediate (epoxy) – Tnemec Series N69: 4 mils dft
 - Finish (Aliphatic/ Acrylic Polyurethane) – Tnemec 1075 Endurashield: 3 mils dft
 - b. All other inside and outside ferrous metal surfaces of the pumping units shall be prepared in accordance with SSPC-SP10 and shall be coated with 16 mils dft Tnemec Hi-Build Tneme Tar 46H-413 coal tar epoxy.
 - c. Surfaces to be coated with coal tar epoxy shall include but not be limited to the following:
 - 1) Bottom of base plate

- 2) ID & OD of discharge column and elbow
 - 3) Bowl assembly (inside and outside)
 - 4) Intake vane assembly
 - d. Pump motors shall be coated with motor manufacturer's standard coating.
12. Discharge Elbow
- a. The discharge elbows shall be of three piece fabricated miter construction. Elbows shall be 20" diameter with either plain end or flange connection to connect to either the existing plain end x flange spool piece or the existing 20" diameter swing check valve.
13. Pump Motors
- a. Pump motors shall be high thrust, vertical squirrel cage induction type, hollow shaft, 150 horsepower, nominal 900 RPM full load speed, 460 volt, 3 phase, 60 Hz motors, complete with a Open Drip Proof (ODP) enclosure, minimum 1.15 service factor, and rabbet fit to the motor pedestal.
 - b. Motors shall be inverter duty rated for use with Variable Frequency Drives (VFDs), shall include an insulated upper bearing and shall include shaft grounding as manufactured by AEGIS.
 - c. VFDs shall be furnished by others under a separate contract for installation of the pumps and related appurtenances.
 - d. High thrust, insulated top bearing shall be designed to support motor rotor weight, weight of pump shaft and impeller and pump hydraulic thrust. Motor thrust bearing design calculations shall be based on a minimum time factor of 1.71 and shall be included with the pump shop drawings. The thrust bearing shall also be designed to withstand 30% momentary upthrust during pump start-up. Motor bearings shall have a minimum B-10 design life of not less than 44,000 hours (average life of 25 years). Bearing information shall be included on the motor nameplate. Each motor shall also be equipped with a lower steady bushing. Oil lubricated anti-friction ball bearings shall be provided for upper and lower motor bearings. Oil level gages shall be mounted on the motors.
 - e. Motors shall have a Class F (150°C) insulation system suitable for operation in an ambient temperature of 40 degrees C, in accordance with IEEE standards.
 - f. Motors shall have a normally closed thermal switch in each winding which will open upon detection of excessive heating of the windings. All three motor thermal switches shall be connected in series. The wiring of the three motor thermal switches shall be brought out to a separate terminal box for connection to the motor control circuit.
 - g. Motors shall have all copper windings and copper rotor bars.
 - h. Motors shall meet NEMA Design B characteristics.
 - i. Motors shall meet EPACT/EISA values for Premium Efficient motors.
 - j. Motors shall have a visible nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor code letters, ambient temperature rating, temperature rise or insulation class, NEMA design letter (integral horsepower motors), frame size, manufacturer's name and model number, service factor, power factor, and nominal efficiency. Nameplate shall be of stainless steel or other approved corrosion resistant material providing a

- permanent legible marking. Nominal full load efficiency shall be identified on nameplate in accordance with NEMA MG-1-12.54.2
- k. The nameplates and connection plates shall be attached to the motor frame by stainless steel rivets or screws.
 - l. Motors shall be rated for continuous duty.
 - m. Motors shall include non-reverse ratchet to prevent the motor from rotating in the opposite direction. The ratchet and shall be furnished and stalled by the motor manufacturer.
 - n. Motor leads shall be brought to lug posts on insulated stand-offs. All termination boxes shall be heavy gauge fabricated steel construction with bolted type covers. The motor frame shall have drain plugs.
 - o. Upon receipt of the motors (or within 5 days), the Contractor shall lubricate the motors as recommended by the Manufacturer, and in the presence of the Owner's representative, and at that time, the motors shall be rotated to insure proper lubrication of the bearings.
 - p. Motors shall be tested at the manufacturer's facility prior to shipment. Motors shall have a complete test as defined by IEEE 112 method B or method F. Report of test shall include data on form A2 applicable to the motor tested. Efficiency shall be based on the losses of bearings similar to those used in operation. The additional losses, due to the external thrust of the pump, will be used to correct the tested efficiency of the motor to include these thrust losses. Certified copies of test results shall be submitted and approved prior to shipment of the pumping equipment.
 - q. Motors shall be manufactured by one of the following manufacturers: U.S. Motors, Baldor or General Electric.
14. Pressure Gauges
- a. Connections: Provide tapped openings with bronze plugs for installation of pressure gages on the horizontal run of the discharge elbow. Openings shall be easily accessible for installation and reading of the pressure gauges. Pressure gauges shall be provided and installed under separate contract for construction of the pumps.
15. Factory Testing – Non Witnessed
- a. The pump manufacturer shall perform the following analysis and testing at the factory:
 - 1) Reed Critical Frequency Analysis
 - 2) Hydrostatic Test
 - 3) Performance Tests
 - b. The Reed Critical Frequency Analysis shall verify that the pumping units will operate without vibration. Certified copies of the analysis shall be submitted with the pump shop drawings.
 - c. Pump bowls, discharge columns and discharge heads shall be hydrostatically tested at 150 percent of the maximum shut-off pressure.
 - d. Each pump shall be assembled at the factory to insure fit of adjoining parts. Each pump shall be tested at the factory. Testing shall be conducted in accordance with Hydraulics Institute (HI) Pump Standards, Section 14.6-2011. Vertical Pump Tests and shall meet all criteria contained within this HI Section. The tests shall be such as to satisfy the Owner that the equipment

complies with the specification requirements. The Manufacturer shall furnish six certified copies of test reports to the Owner.

16. Spare Parts

a. The following spare parts shall be provided by the pump manufacturer:

<u>Spare Part Description</u>	<u>Quantity</u>
Lineshaft Bearings (for each pump)	1 set
Suction Bell/Discharge Bowl Assembly	1 unit
Complete Set of O-Rings (for each pump)	1 set
Complete Set of Gaskets (for each pump)	1 set

b. All parts shall be packaged for long term storage. The contents of each package shall be clearly labeled.

17. Equipment Storage Prior to Acceptance

a. The pump manufacturer shall clearly inform the Contractor of all requirements for and during temporary storage of the pumps and motors to protect them from damage while the units are temporarily stored and after the units are installed prior to final acceptance. Manufacturer's instructions include, but shall not be limited to pump/motor lubrication, manual rotation of pump/motor shafts, etc.

b. The responsibility for proper care and maintenance shall transition from the pump manufacturer to the Contractor upon proper unloading, checking and temporary storage of the six pumps and ancillary items.

PART 3 EXECUTION

3.1 GENERAL

- A. The pump manufacturer shall furnish and install all necessary supports, framing, hangers, shafting, motors, and all other appurtenances.
- B. The pump manufacturer shall provide certified copies of head capacity curves based on test data from similar pumps indicating pump efficiency, horse power required and NPSH required for various suction water elevations, as part of the shop drawings required for all pumps furnished under these Specifications.

3.2 TESTING

- A. Upon completion of the installation, the Contractor will be required to make performance tests of all pumps in the field. Scheduling of testing and testing procedures shall be coordinated with the Owner. The Pump Manufacturer shall have a representative or representatives present during these field tests. During the tests, the operation of the unit may be under the direction of the Pump Manufacturer's representative, if he so desires. Performance testing shall demonstrate that each pump is capable of starting, running, and stopping without cavitation, excessive noise, or excessive vibration. All observations will be made by the Owner or his authorized representatives. The Contractor shall provide competent personnel to make any necessary alterations to provide for pump performance in accordance with the Contract requirements. The Pump Manufacturer shall provide a formal test procedure and forms for recording data for review and acceptance by the Owner prior to scheduling of field testing.

B. Vibration and Alignment Testing

1. Instrumentation Requirements – Vibration measurements shall be made with a FFT type analyzer utilizing 800 line resolution. Analyzer shall be set on “auto range,” unless otherwise specified, for all vibration measurements. Transducer mounting shall yield a flat response for from 0.4 x running speed to F-MAX. Measurements shall consist of four averages (linear, non-overlapping) using a Hanning window. At a minimum, vibration data shall be acquired at one axial and two radial (ninety degree offset) locations at each bearing location. Frequencies shall be reported in terms of cpm and “running speed orders” with F-MIN = 0.4 x running speed and FMAX = 120,000 cpm unless specified otherwise. Velocity limits (measured in inches/sec./peak) are “peak amplitude acceptance limits” where the peak amplitude (RMS shall be converted to peak by a factor of 1.414) of any line contained with the band shall not contain or shall not exceed the peak amplitude band limit. Any and all testing equipment that is used to certify that the rotating equipment has met the owner’s specification must have been calibrated within the past year by certified agency.
2. The displacement of rotating equipment shaft (under load) shall not exceed the specified tolerance of the bearings.

3. Motors

- a. The maximum allowable vibration levels

Speed (rpm)	Displacement (inch p to p)	Velocity (inch/sec. peak)
999 and below	0.003	0.150
Band	Range	Standard
1	0.4 x rpm – 0.8 x rpm	0.04 inc/sec. peak
2	0.8 x rpm – 1.2 x rpm	0.075 inc/sec. peak
3	1.2 x rpm – 3.5 x rpm	0.04 inc/sec. peak
4	3.5 x rpm – 8.5 x rpm	0.03 inc/sec. peak
5	8.8 x rpm – 60,000 cpm	0.03 inc/sec. peak
6	60,000 cpm – 120,000 cpm	0.03 inc/sec. peak
7	accelerating	0.05 g. peak

Motors shall be free of any vibration confirmed to be at 2x line frequency.

4. Installation

- a. Coupling/Assembly Keys

As final assembly, and prior to initial operation, the motor key and the driven unit key shall be co-planer.

Keys shall be of the proper length based on the formula below:

$$\text{Key length} = ((A \times C) + (B \times D)) / (C + D)$$

Where

A = shaft keyway length

B = hub keyway length

C = key depth in shaft

D = key depth in hub

5. Alignment
- a. Equipment shall be inspected prior to final piping connection to ensure the equipment is in “free bolt” condition.
 - b. Any foot pad of a component shall not introduce more than 0.002-inch “soft foot” condition into the system. The total amount of soft foot introduced by any component shall not exceed 0.004-inches. Each component shall be checked for soft-foot utilizing a minimum of two (2) dial indicators prior to alignment of equipment.
 - c. All rotating equipment shall be aligned prior to initial start up with a maximum parallel; misalignment of 0.002-inches at operating temperature. Angular misalignment of the two shafts shall be such that any calculated move of a component is equal or less than 0.002-inches. If thermal growth is a factor in the alignment of the equipment, initial alignment will meet the above specifications when taking into consideration the calculated growth per the manufacturer. The equipment shall then be operated until it has reached thermal stability prior to any alignment checks. Alignment of rotating equipment shall be checked with either a dual dial or laser alignment equipment. Any and all equipment is used to certify that the rotating equipment has met the owner’s must have been calibrated within the past year by certified agency.
 - d. All shims shall be stainless steel, manufactured with manufactured tabs. The size of the shim shall be denoted by the manufacturer on the shim. Shims shall be free of burrs or dirt as well as any foreign material such as paint.

END OF SECTION

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SECONDARY EFFLUENT PUMPS
EQUIPMENT DATA SHEET

Manufacturer: _____

Model No.: _____

Motor Manufacturer: _____

Pump Data:

(flow)_____gpm and (efficiency-bowl)_____ % at 31-feet TDH (bowl)

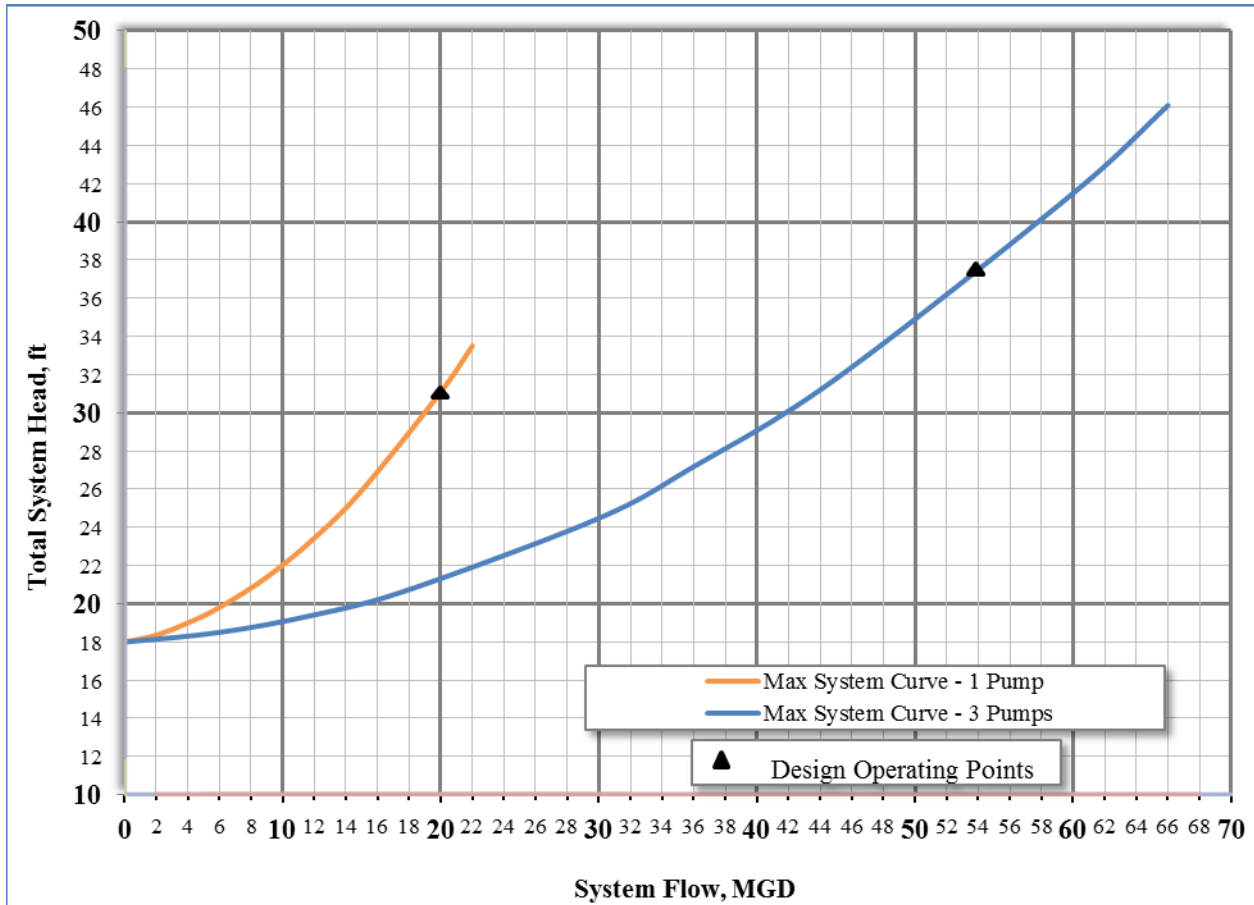
(flow)_____gpm and (efficiency-bowl)_____ % at 37.5-feet TDH (bowl)

(NPSH_{REQUIRED})_____ feet at 37.5-feet TDH (bowl)

(low flow)_____gpm at (TDH)_____ feet at (speed)_____rpm

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System Curves
City of Ann Arbor – Secondary Effluent Pumps Replacement
Hazen Williams C = 100



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SECTION 13010

GENERAL INSTRUMENTATION AND CONTROL STANDARDS

PART 1 GENERAL

1.1 GENERAL

- A. This section provides general requirements for Division 13.

1.2 STANDARDS OF CONFORMANCE

- A. Instrument Society of America, ISA-S50.1, current edition, Compatibility of Analog Signals for Electronic Industrial Process Instruments.
- B. ISA Standard -S20: Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
- C. Underwriter Laboratories, UL508, Standards for Industrial Control Equipment.
- D. National Electrical Manufacturers Association (NEMA), Pub. No. 1CS-6, enclosures for industrial controls and systems.
- E. Approvals:
1. Factory Mutual (FM) approval for explosion proof and intrinsic safety I5.

1.3 GENERAL SOFTWARE REQUIREMENTS

- A. All control logic programs to be written, tested and commissioned to meet performance and control requirements detailed in the Process Control Narratives provided with these specifications. Contractor to carry contingency for 20% modifications to PLC and HMI software for any deviations from provided PCNs requested by the Owner.
- B. All application programs in PLCs shall be completed using ladder logic.
- C. Contractor to ensure the correct programming environment revision is used when programming PLCs and HMI screens in the plant to match those standardized on by the Owner. Any costs arising due to issues with code completed with an incompatible development software revision will be bore by the Contractor.
- D. All logic and tags to be commented and described in the software program for the benefit of future users and maintenance staff.
- E. All historian and trending updates and additions to be performed by Plant staff.

1.4 SOFTWARE CONTROL REQUIREMENTS

- A. The Contractor is responsible for all software programs, including but not limited to, PLC logic, HMI screens, configuration files, scripts, databases, and standard program modules that are to be modified, in whole or in part, as per the requirements of the contract. Care and Control of these files and their contents is the responsibility of the contractor throughout the entirety of the project.
- B. Revision control is to be exercised utilizing available resources at the plant and a key contact person will be provided from Plant personnel to be the responsible party for providing and maintaining the most current software files. The Contractor is responsible for coordinating with plant staff on maintaining these files and keeping them up to date.
- C. Any piece of software, including but not limited to those items listed in paragraph A of this section that are to be modified by the contractor become the sole responsibility of the contractor in regards to the functionality of said software. If existing logic, screens, subroutines, links, or any other part of the software that are not part of the scope are found to not function as intended after modifications to the software are completed by the Contractor, the Contractor is responsible for returning full functionality as was previously available at no cost to the Owner.
- D. The standard procedure for releasing Care and Control of a software file is as follows:
 - 1. Contractor to provide a list of all software files required for modification under the contract to the Owner at least 2 weeks prior to start of programming.
 - 2. All software files will be “Checked Out” of the appropriate revision control system (if applicable) and deemed to be in the Care and Control of the Contractor. During such time, no other person shall make modifications to the software other than the Contractor.
 - 3. All files checked out to the Contractor will be date and time stamped within the software management system (if applicable).
 - 4. Should emergency maintenance by other personnel to the software arise while the software is in the Care and Control of the Contractor, all efforts will be made to alert and co-ordinate with the contractor on the changes to be required to the “Checked Out” software and to integrate those changes to ensure such changes are not lost in the final version to be installed.
 - 5. For software databases (eg: SCADA Database, Historian database) before tags can be added to the current running databases the Contractor is to backup the database files prior to adding additional tags. The database changes to be made will only be additions – **no** modifications to existing tags. If removals or modifications are required, the database files must be “Checked Out” of the file management system and Care and Control of the databases will be provided to the Contractor.
 - 6. Software is to be fully tested as per section 13600 of these specifications prior to installation, and upon successful commissioning and acceptance the software files are to be returned to the Owner and “Checked In” to the software management system. Care and Control of the software files is then returned to the owner.

1.5 SUBMITTALS

- A. Comply with the provisions of Division 1 General Requirements, Submittals Section.

- B. Comply with the requirements of Division 1 General Requirements, Submittals Section for operations and maintenance documentation.
- C. Submit software FAT and SAT test plans to Engineer for review two weeks prior to testing.
- D. Submit updated PCN which includes:
 - Site verified default control setpoints
 - SCADA tags
 - Any modifications to the control strategy as requested by the Plant
 - HMI Screenshots

1.6 WARRANTY

See the General Conditions.

PART 2 PRODUCTS

2.1 INSTRUMENT SCHEDULE

- A. No instrumentation is required to be supplied under this contract
- B. In general, normally closed contacts that open on detection of the alarm condition or loss of power are preferred for critical or safety alarms.

2.2 MANUFACTURERS

- A. Provide the following availability and local support for proposed manufacturers if different from the manufacturers cited in the individual instrument specifications:
 1. Replacement electronics, sensors and transmitters must be stocked locally, within two hours delivery.
 2. Other hardware is to be available in no longer than 5 days.
 3. On-site technical support within 24 hours is to be available.

PART 3 EXECUTION

3.1 GENERAL

- A. The contract requires the supply, installation, programming, testing and commissioning of elements of a PLC based SCADA system to monitor and control the Secondary Effluent Pumping Station.

- B. The work includes the integration of revised equipment and processes into the overall SCADA system. The Contractor is responsible for maintaining an operable Treatment Facility during the commissioning of new equipment and systems. This includes the downloading of new or modified control system software, upon which the Contractor is responsible for the proper functioning of the process area and equipment for which the revised software provides function to.
- C. The work includes but is not limited to:
 - 1. Install and configure new PLC Analog Output card as per Section 13530
 - 2. Supply and install new field wiring and conduits as shown in the design drawings and documents.
 - 3. Provide and test PLC and SCADA module programming for the new and upgraded equipment.
 - 4. Configure and integrate the new and upgraded equipment into the SCADA system for a fully functional and integrated process.
 - 5. Perform FAT and SAT testing of all programming modifications.

3.2 INSTALLATION

- 1. Install I/O card where indicated on the Contract Drawings and I/O Modifications list (Section 13020 Appendix A).
 - 2. I/O Card to be free issued by the Plant.
- A. Coordinate with Division 15 and 16 disciplines to provide power, conduits, process pipe-fittings, clearances and devices required for installation.
 - B. Route signals in flexible, armored conduit for up to a meter (as appropriate to allow removal of the sensor) and thereafter in rigid steel conduit.

3.3 TESTING

- A. Comply with all requirements of Division 13 Section 13600 – Testing and Commissioning.

3.4 TRAINING

- A. Operations and Maintenance personnel shall be trained on operation of each major component of the system as it comes online, including but not limited to:
 - 1. Secondary Effluent Pumping System
 - 2. Variable Frequency Drives
- B. Provide separate training sessions for operations and maintenance personnel, as required under Section 01650.
- C. Training shall include sessions for SCADA training on the live revised system, with ‘hands-on’ field training demonstrating control, management, and troubleshooting/diagnostic for maintenance personnel of the processes and of the equipment.

3.5 DOCUMENTATION

- A. Provide the following documentation upon project completion, finalized to as-built status with all revisions and updates completed. Contract documents will determine the format and quantity of each document to be provided.
1. Process Control Narrative.
 2. I/O lists.
 3. Tag lists.
 4. Operator and Maintenance Manual.

END OF SECTION

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SECTION 13020

PROCESS CONTROL NARRATIVE

PART 1 DESIGN

1.1 GENERAL

- A. The Process Control Narrative (PCN or “narrative”) is a written description of key control system elements. It focuses on detailing all of the manual and automatic modes of process control. Short bullet point phrases are used, rather than long descriptions.
- B. Process Control Narratives serve different purposes at different steps of the process life-cycle. The narrative is used for one or more of the following purposes:
 1. Background for planning and design of improvements.
 2. Process control software description.
 3. Operations manual.
 4. Operations practices review.
- C. Narratives are begun during the preliminary design and expanded with more detail during the detailed design, implementation, commissioning and operation.
- D. Each narrative should be identical in terms of format. The pre-design process narrative will list, in generic terms, the equipment to be controlled and the proposed methods to be used. The final process narrative will be an expansion/enhancement of the pre-design narrative and will exactly define the equipment, points, tagnames, equipment coding, methods of control and monitoring, etc.

1.2 CONTENTS

- A. The process control narrative (PCN) contains the following elements:
 1. Process description
 2. SCADA Control Configuration (PLC/HMI/Network) description
 3. Process control system description, operation and sequencing
 4. Failure Scenarios
 5. Alarming descriptions
 6. Hardwired and software interlocks, permissives
 7. Trending requirements
 8. Complex calculations used for process controls
 9. SCADA Tags

- B. The process description defines how each process is operated. The control system description describes hardware and software required to perform the control strategies including tagging information, setpoints, etc.

1.3 INTEGRATOR SCOPE

- A. The provided Process Control Narrative (PCN) defines the control strategy for the equipment in a detailed English Language Description (ELD), however it does not necessarily define all tags associated with SCADA signals, alarms, setpoints or data messaged values. It is the responsibility of the System Integrator to update the PCN to include all applicable SCADA tags for:
 - 1. Messaged data values, interlocks and permissives between PLCs
 - 2. Operator setpoint values
 - 3. SCADA Alarms
 - 4. Default Setpoint parameters
 - 5. Hardcoded timer values
 - 6. HMI Screenshots for updated screens
- B. Any modifications requested by the Owner to the control system as detailed in the provided PCNs are to be captured in the PCN and approved by the Owner.
- C. The System integrator is to supply an updated PCN to the engineer for review at the end of the contract. The intent is to have a record of the final software configurations and commission setpoints as part of the O&M manual.

1.4 ATTACHMENTS

- A. The Attached APPENDIX A - Secondary Effluent Pumping Station PLC IO Lists for Chassis 1 through 4 should be worked with this Narrative.
- B. The PCN presented in the Attached APPENDIX B - Secondary Effluent Pumping Station Narrative should be worked with the I/O Lists and the Drawings.

END OF SECTION

Ann Arbor Chassis 1 I/O List

Date: 01-Mar-2014

Platform: PLC5

Adapter: PLC-5/40E

Chassis Type: 1771-A1B

Slot	Points	Card Type	Card Model
0	0	EMPTY	
1	0	EMPTY	
2	0	EMPTY	
3	0	EMPTY	

Slot	Point	SCADA Code	PLC Description	PLC Address	Wire Number
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Ann Arbor Chassis 2 I/O List

Date: 01-Mar-2014
Platform: PLC5
Adapter: PLC-5/40E
Chassis Type: 1771-A1B

Slot	Points	Card Type	Card Model
0	16	DIGITAL INPUT	1771-IAD
1	16	DIGITAL INPUT	1771-IAD
2	16	DIGITAL INPUT	1771-IAD
3	16	DIGITAL INPUT	1771-IAD
4	16	DIGITAL INPUT	1771-IAD
5	16	DIGITAL INPUT	1771-IAD
6	16	DIGITAL OUTPUT	1771-OW16
7	16	DIGITAL OUTPUT	1771-OW16
8	16	DIGITAL OUTPUT	1771-OW16
9	16	DIGITAL OUTPUT	1771-OW16
10	8	ANALOG INPUT	1771-IFE/B
11	8	ANALOG INPUT	1771-IFE/B
12	8	ANALOG INPUT	1771-IFE/B
13	16	DIGITAL INPUT	1771-IAD
14	4	ANALOG OUTPUT	1771-OFE
15	4	ANALOG OUTPUT	1771-OFE

Slot	Point	SCADA Code	PLC Description	PLC Address	PLC Connection	Wire Number
0	0		Secondary Effluent Pump VFD No.1 Auto	I:010/0	N11:0/1	4I1000
DI	1		Secondary Effluent Pump VFD No.2 Auto	I:010/1	N11:1/1	4I1001
	2		Secondary Effluent Pump VFD No.3 Auto	I:010/2	N11:2/1	4I1002
	3		Pew Pump No.1 Auto	I:010/3	N11:9/1	4I1003
	4		Pew Pump No.2 Auto	I:010/4	N11:10/1	4I1004
	5		Pew Pump No.3 Auto	I:010/5	N11:11/1	4I1005
	6		East Plant West S.E. Gate M-10 Opened	I:010/6	N11:40/2	4I1006
	7		East Plant West S.E. Gate M-10 Closed	I:010/7	N11:40/3	4I1007
	8		East Plant East S.E. Gate M-7 Opened	I:010/10	N11:41/2	4I1010
	9		East Plant East S.E. Gate M-7 Closed	I:010/11	N11:41/3	4I1011
	10		West Plant West S.E. Gate N-10 Opened	I:010/12	N11:42/2	4I1012
	11		West Plant West S.E. Gate N-10 Closed	I:010/13	N11:42/3	4I1013
	12		Substation 4A Ground Fault	I:010/14	Not used	4I1014
	13		Substation 4B Ground Fault	I:010/15	Not used	4I1015
	14		Spare	I:010/16	Not used	4I1016
	15		I/O Power Status	I:010/17	Not used	4I1017
1	0		West Plant East S.E. Gate N-7 Opened	I:011/0	N11:43/2	4I1100
DI	1		West Plant East S.E. Gate N-7 Closed	I:011/1	N11:43/3	4I1101
	2		S.E. Isolation Valve P-9 Opened	I:011/2	N11:44/2	4I1102
	3		S.E. Isolation Valve P-9 Closed	I:011/3	N11:44/3	4I1103
	4		River Valve P-10 Opened	I:011/4	N11:45/2	4I1104
	5		River Valve P-10 Closed	I:011/5	N11:45/3	4I1105
	6		C.E. Wetwell Gate Q-9 Opened	I:011/6	N11:46/2	4I1106
	7		C.E. Wetwell Gate Q-9 Closed	I:011/7	N11:46/3	4I1107
	8		East Contact Tank Gate Q-10 Opened	I:011/10	N11:47/2	4I1110
	9		East Contact Tank Gate Q-10 Closed	I:011/11	N11:47/3	4I1111
	10		West Contact Tank Gate Q-11 Opened	I:011/12	N11:48/2	4I1112
	11		West Contact Tank Gate Q-11 Closed	I:011/13	N11:48/3	4I1113
	12		Substation 4A Single Phase	I:011/14	Not used	4I1114
	13		Substation 4B Single Phase	I:011/15	Not used	4I1115
	14		Spare	I:011/16	Not used	4I1116
	15		UPS Fail	I:011/17	Not used	4I1117
2	0		Contact Tank Interconnection Gate P-14 Opened	I:012/0	N11:49/2	4I1200
DI	1		Contact Tank Interconnection Gate P-14 Closed	I:012/1	N11:49/3	4I1201
	2		West Bypass Gate M-14 Opened	I:012/2	N11:50/2	4I1202
	3		West Bypass Gate M-14 Closed	I:012/3	N11:50/3	4I1203
	4		East Bypass Gate N-14 Opened	I:012/4	N11:51/2	4I1204
	5		East Bypass Gate N-14 Closed	I:012/5	N11:51/3	4I1205
	6		West Sump High Level	I:012/6	Not used	4I1206
	7		East Sump High Level	I:012/7	Not used	4I1207
	8		Under Drain High Sump High Level	I:012/10	Not used	4I1210
	9		System Air Pressure Low	I:012/11	Not used	4I1211
	10		Secondary Effluent VFD Pump No.1 Fault	I:012/12	N11:0/4	4I1212
	11		Secondary Effluent VFD Pump No.2 Fault	I:012/13	N11:1/4	4I1213
	12		Secondary Effluent VFD Pump No.3 Fault	I:012/14	N11:2/4	4I1214

	13		Substation 4A Over Temp.	I:012/15	Not used	4I1215
	14		Substation 4B Over Temp.	I:012/16	Not used	4I1216
	15		Substation 4A Main Trip	I:012/17	Not used	4I1217

3	0	West S.E. Sample Pump Running	I:013/0	N11:12/2	4I1300
DI	1	T.E. Sample Pump Running	I:013/1	N11:13/2	4I1301
	2	East S.E. Sample Pump Running	I:013/2	N11:14/2	4I1302
	3	C.E. Sample Pump Running	I:013/3	N11:15/2	4I1303
	4	ATS Normal Feed CP-70	I:013/4	Not used	4I1304
	5	ATS Emergency Feed CP-70	I:013/5	Not used	4I1305
	6	Clearwell Air Valve IB-73-2 Opened	I:013/6	N11:58/2	4I1306
	7	Clearwell Air Valve IB-73-2 Closed	I:013/7	N11:58/3	4I1307
	8	Pew Pump No.1 Running	I:013/10	N11:9/2	4I1310
	9	Pew Pump No.2 Running	I:013/11	N11:10/2	4I1311
	10	Pew Pump No.3 Running	I:013/12	N11:11/2	4I1312
	11	Spare	I:013/13	Not used	4I1313
	12	Spare	I:013/14	Not used	4I1314
	13	PEW Pump No.1 from US-6 Source	I:013/15	Not used	4I1315
	14	PEW Pump No.2 from US-6 Source	I:013/16	Not used	4I1316
	15	Substation 4B Main Trip	I:013/17	Not used	4I1317
4	0	Wastewater Drain Pump No.1 Running	I:014/0	N11:6/2	4I1400
DI	1	Wastewater Drain Pump No.2 Running	I:014/1	N11:7/2	4I1401
	2	Wastewater Drain Pump No.3 Running	I:014/2	Not used	4I1402
	3	Spare	I:014/3	Not used	4I1403
	4	Unit Sub. No. 4A Main	I:014/4	Not used	4I1404
	5	Unit Sub. No. 4B Main	I:014/5	Not used	4I1405
	6	Unit Sub. No. 4A Control	I:014/6	Not used	4I1406
	7	Unit Sub. No. 4B Control	I:014/7	Not used	4I1407
	8	Waste Backwash Tank Air Valve IB-73-3 Opened	I:014/10	N11:59/2	4I1410
	9	Waste Backwash Tank Air Valve IB-73-3 Closed	I:014/11	N11:59/3	4I1411
	10	Spare	I:014/12	Not used	4I1412
	11	Pew Pump No.1 Fault	I:014/13	N11:9/4	4I1413
	12	Pew Pump No.2 Fault	I:014/14	N11:10/4	4I1414
	13	Spare	I:014/15	Not used	4I1415
	14	Pew Pump No.3 Fault	I:014/16	N11:11/4	4I1416
	15	Panel Power Status	I:014/17	N11:13/10	4I1417
5	0	Spare	I:015/0	Not used	4I1500
DI	1	Spare	I:015/1	Not used	4I1501
	2	Spare	I:015/2	Not used	4I1502
	3	Spare	I:015/3	Not used	4I1503
	4	Spare	I:015/4	Not used	4I1504
	5	Spare	I:015/5	Not used	4I1505
	6	Spare	I:015/6	Not used	4I1506
	7	Spare	I:015/7	Not used	4I1507
	8	Spare	I:015/10	Not used	4I1510
	9	Spare	I:015/11	Not used	4I1511
	10	Spare	I:015/12	Not used	4I1512
	11	Spare	I:015/13	Not used	4I1513
	12	Unit Sub. Tie Breaker Trip	I:015/14	Not used	4I1514
	13	Spare	I:015/15	Not used	4I1515
	14	Spare	I:015/16	Not used	4I1516
	15	Spare	I:015/17	Not used	4I1517
6	0	Secondary Effluent VFD Pump No.1 Start/Stop	O:016/0	Used	4O1600
DO	1	Secondary Effluent VFD Pump No.2 Start/Stop	O:016/1	Used	4O1601
	2	Secondary Effluent VFD Pump No.5 Start/Stop	O:016/2	Used	4O1602
	3	Wastewater Drain Pump No.1 Start/Stop	O:016/3	Used	4O1603
	4	Spare	O:016/4	Not used	4O1604
	5	Spare	O:016/5	Not used	4O1605
	6	Spare	O:016/6	Not used	4O1606
	7	Spare	O:016/7	Not used	4O1607
	8	Washwater Drain Pump No.3 Start/Stop	O:016/10	Used	4O1610
	9	Pew Pump No.1 Start/Stop	O:016/11	Used	4O1611
	10	Spare	O:016/12	Not used	4O1612
	11	Spare	O:016/13	Not used	4O1613
	12	Spare	O:016/14	Not used	4O1614
	13	Spare	O:016/15	Not used	4O1615
	14	Clearwell Air Valve IB-73-2 CLOSE	O:016/16	Used	4O1616
	15	Spare	O:016/17	Not used	4O1617

7	0	Secondary Effluent VFD Pump No.3 Start/Stop	O:017/0	Used	4O1700
DO	1	Secondary Effluent Pump No.4 Start/Stop	O:017/1	Used	4O1701
	2	Secondary Effluent Pump No.6 Start/Stop	O:017/2	Used	4O1702
	3	Wastewater Drain Pump No.2 Start/Stop	O:017/3	Used	4O1703
	4	Spare	O:017/4	Not used	4O1704
	5	Spare	O:017/5	Not used	4O1705
	6	Spare	O:017/6	Not used	4O1706
	7	Spare	O:017/7	Not used	4O1707
	8	Wastewater Drain Pump No.4 Start/Stop	O:017/10	Not used	4O1710
	9	PEW Pump No.2 Start/Stop	O:017/11	Used	4O1711
	10	PEW Pump No.3 Start/Stop	O:017/12	Used	4O1712
	11	Spare	O:017/13	Not used	4O1713
	12	Spare	O:017/14	Not used	4O1714
	13	Spare	O:017/15	Not used	4O1715
	14	Waste Backwash Tank Air Valve IB-73-3 CLOSE	O:017/16	Used	4O1716
	15	Spare	O:017/17	Not used	4O1717
8	0	West S.E. Sample Pump Start/Stop	O:020/0	Used	4O2000
DO	1	T.E. Sample Pump Start/Stop	O:020/1	Used	4O2001
	2	Gate MCC-M-10 Open	O:020/2	Used	4O2002
	3	Gate MCC-M-10 Close	O:020/3	Used	4O2003
	4	Gate MCC-N-10 Open	O:020/4	Used	4O2004
	5	Gate MCC-N-10 Close	O:020/5	Used	4O2005
	6	River Valve MCC-P-10 Open	O:020/6	Used	4O2006
	7	River Valve MCC-P-10 Close	O:020/7	Used	4O2007
	8	Gate MCC-Q-9 Open	O:020/10	Used	4O2010
	9	Gate MCC-Q-9 Close	O:020/11	Used	4O2011
	10	Gate MCC-Q-11 Open	O:020/12	Used	4O2012
	11	Gate MCC-Q-11 Close	O:020/13	Used	4O2013
	12	Gate MCC-M-14 Open	O:020/14	Used	4O2014
	13	Gate MCC-M-14 Close	O:020/15	Used	4O2015
	14	Spare	O:020/16	Not used	4O2016
	15	Spare	O:020/17	Not used	4O2017
9	0	East S.E. Sample Pump MCC-M-11 Start/Stop	O:021/0	Used	4O2100
DO	1	C.E. Sample Pump MCC-Q-14 Start/Stop	O:021/1	Used	4O2101
	2	Gate MCC-M-7 Open	O:021/2	Used	4O2102
	3	Gate MCC-M-7 Close	O:021/3	Used	4O2103
	4	Gate MCC-N-7 Open	O:021/4	Used	4O2104
	5	Gate MCC-N-7 Close	O:021/5	Used	4O2105
	6	Isolation Valve MCC-P-9 Open	O:021/6	Used	4O2106
	7	Isolation Valve MCC-P-9 Close	O:021/7	Used	4O2107
	8	Gate MCC-Q-10 Open	O:021/10	Used	4O2110
	9	Gate MCC-Q-10 Close	O:021/11	Used	4O2111
	10	Gate MCC-P-14 Open	O:021/12	Used	4O2112
	11	Gate MCC-P-14 Close	O:021/13	Used	4O2113
	12	Gate MCC-N-14 Open	O:021/14	Used	4O2114
	13	Gate MCC-N-14 Close	O:021/15	Used	4O2115
	14	Spare	O:021/16	Not used	4O2116
	15	Turbidity Sample Pump Start/Stop	O:021/17	Used	4O2117
10	0	Flow to River	N15:4	F13:3	4I2201
AI	1	River Level	N15:5	F17:13	4I2202
	2	Spare	N15:6	F17:23	4I2203
	3	Pew Pump No.1 Spd Inc.	N15:7	F17:33	4I2204
	4	Pew Pump No.2 Spd Inc.	N15:8	F17:43	4I2205
	5	Aeration Flow Control Valve Pos.	N15:9	F17:53	4I2206
	6	Pew Pump No.3 Spd Inc.	N15:10	F17:63	4I2207
	7	Outfall Level	N15:11	F17:73	4I2208

11	0	Filters Influent Flow	N15:61	F17:83	4I2301
AI	1	PEW System Pressure	N15:62	F17:93	4I2302
	2	PEW Flow to North Distribution	N15:63	F17:103	4I2303
	3	Outfall Level	N15:64	F17:113	4I2304
	4	Backwash Water Recycle Flow	N15:65	F17:123	4I2305
	5	East Sec effluent Wetwell level	N15:66	F17:133	4I2306
	6	Substation 4A Power	N15:67	F17:143	4I2307
	7	Substation 4B Power	N15:68	F17:153	4I2308
12	0	PEW Flow to South Distribution	N15:118	F17:163	4I2401
AI	1	Waste Wash Water Reservoir Level	N15:119	F17:173	4I2402
	2	West S.E. Wetwell Level	N15:120	F17:183	4I2403
	3	Filter Influent Level	N15:121	F17:193	4I2404
	4	Spare	N15:122	F17:203	4I2405
	5	Process Blower Air Flow	N15:123	F17:213	4I2406
	6	Filter Air Flow	N15:124	F17:223	4I2407
	7	Waste Wash Water Level	N15:125	F17:233	4I2408
13	0	Secondary Effluent Pump No.6 Auto	I:025/0	N11:5/1	4I2500
DI	1	Spare	I:025/1	Not used	4I2501
	2	Spare	I:025/2	Not used	4I2502
	3	Secondary Effluent Pump No.4 VFD Fault	I:025/3	N11:3/4	4I2503
	4	Secondary Effluent Pump No.5 Fault	I:025/4	N11:4/4	4I2504
	5	Secondary Effluent Pump No.6 Fault	I:025/5	N11:5/4	4I2505
	6	S.E. Pump No.1 Running L-701	I:025/6	N11:0/2	4I2506
	7	S.E. Pump No.2 Running L-702	I:025/7	N11:1/2	4I2507
	8	S.E. Pump No.3 Running L-703	I:025/10	N11:2/2	4I2510
	9	S.E. Pump No.4 Running L-704	I:025/11	N11:3/2	4I2511
	10	S.E. Pump No.5 Running L-705	I:025/12	N11:4/2	4I2512
	11	S.E. Pump No.6 Running L-706	I:025/13	N11:5/2	4I2513
	12	Spare	I:025/14	Not used	4I2514
	13	Spare	I:025/15	Not used	4I2515
	14	Spare	I:025/16	Not used	4I2516
	15	Spare	I:025/17	Not used	4I2517
14		SE Pump No. 1 Spd Control Output	N18:5	Used PID	4O2601
AO		PEW Pump No.1 Spd Control Output	N18:6	Used PID	4O2602
		PEW Pump No.2 Spd Control Output	N18:7	F8:91	4O2603
		Air System Modulating Valve Control Output	N18:8	Not used	4O2604
15		SE Pump No. 2 Speed Control Output	N18:23	Used PID	4O2701
AO		SE Pump No. 6 Speed Control Output	N18:24	Used PID	4O2702
		PEW Pump No.3 Speed Control Output	N18:25	F8:92	4O2703
		Process Blower Mod. Valve Control Output	N18:26	Used PID	4O2704

* Yellow Indicates existing I/O which pertains to the logic modifications
* Orange indicates existing I/O point being rewired to new VFD locations

Ann Arbor Chassis 3 I/O List

Date: 01-Mar-2014
Platform: PLC5
Adapter: PLC-5/40E
Chassis Type: 1771-A1B

Slot	Points	Card Type	Card Model
0	16	DIGITAL INPUT	1771-IAD
1	16	DIGITAL INPUT	1771-ID16
2	16	DIGITAL INPUT	1771-ID16
3		EMPTY	
4		EMPTY	
5	16	DIGITAL INPUT	1771-IFE/B
6	16	DIGITAL OUTPUT	1771-IFE/B
7		EMPTY	

Slot	Point	SCADA Code	PLC Description	PLC Address	PLC Connection	Wire Number
	0		Pew Pump No.1 Running	I:030/0	Not Used	4I3000
DI	1		Pew Pump No.2 Running	I:030/1	Not Used	4I3001
	2		Spare	I:030/2	Not Used	4I3002
	3		Pew Pump No.3 Running	I:030/3	Not Used	4I3003
	4		West Contact Tank Gate Opened	I:030/4	Not Used	4I3004
	5		West Contact Tank Gate Closed	I:030/5	Not Used	4I3005
	6		East Contact Tank Gate Opened	I:030/6	Not Used	4I3006
	7		East Contact Tank Gate Closed	I:030/7	Not Used	4I3007
	8		Contact Tank Inter connection Gate Opened	I:030/10	Not Used	4I3010
	9		Contact Tank Inter connection Gate Closed	I:030/11	Not Used	4I3011
	10		C.E. Wetwell Gate Opened	I:030/12	Not Used	4I3012
	11		C.E. Wetwell Gate Closed	I:030/13	Not Used	4I3013
	12		River Valve Opened	I:030/14	Not Used	4I3014
	13		River Valve Closed	I:030/15	Not Used	4I3015
	14		E. SE Sample Pump Running	I:030/16	Not Used	4I3016
	15		W. SE Sample Pump Running	I:030/17	Not Used	4I3017
1	0		C.E. Sample Pump Running	I:031/0	Not Used	4I3100
DI	1		T.E. Sample Pump Running	I:031/1	Not Used	4I3101
	2		Unit Substation 4A Main Pos.	I:031/2	Not Used	4I3102
	3		Unit Substation 4B Main Pos.	I:031/3	Not Used	4I3103
	4		Spare	I:031/4	Not Used	4I3104
	5		Spare	I:031/5	Not Used	4I3105
	6		Tie Position	I:031/6	Not Used	4I3106
	7		Unit Substation 4A Ground Fault	I:031/7	Not Used	4I3107
	8		Unit Substation 4B Ground Fault	I:031/10	Not Used	4I3110
	9		Unit Substation 4A Single Phase	I:031/11	Not Used	4I3111
	10		Unit Substation 4B Single Phase	I:031/12	Not Used	4I3112
	11		Unit Substation 4A Over Temp.	I:031/13	Not Used	4I3113
	12		Unit Substation 4B Over Temp.	I:031/14	Not Used	4I3114
	13		Spare	I:031/15	Not Used	4I3115
	14		Spare	I:031/16	Not Used	4I3116
	15		Spare	I:031/17	Not Used	4I3117

2	0		FY-10 Open	I:032/0	Not Used	413200
DI	1		FY-10 Closed	I:032/1	Not Used	413201
	2		Turbidity Sample Pump Running	I:032/2	N11:16/2	413202
	3		Turbidity Sample Pump Remote	I:032/3	N11:16/1	413203
	4		Spare	I:032/4	Not Used	413204
	5		Spare	I:032/5	Not Used	413205
	6		Spare	I:032/6	Not Used	413206
	7		Spare	I:032/7	Not Used	413207
	8		Spare	I:032/10	Not Used	413210
	9		Spare	I:032/11	Not Used	413211
	10		Spare	I:032/12	Not Used	413212
	11		Spare	I:032/13	Not Used	413213
	12		Spare	I:032/14	Not Used	413214
	13		Spare	I:032/15	Not Used	413215
	14		Spare	I:032/16	Not Used	413216
	15		Spare	I:032/17	Not Used	413217
3						
Empty						
4						
Empty						
5	0		Substation 4A Power	N15:175	F17:243	413501
AI	1		Substation 4B Power	N15:176	F17:253	413502
	2		Spare	N15:177	F17:263	413503
	3		Spare	N15:178	F17:273	413504
	4		PEW Water Pressure	N15:179	F17:283	413505
	5		PEW Flow to North Distribution	N15:180	F17:293	413506
	6		PEW Flow to South Distribution	N15:181	F17:303	413507
	7		River Level	N15:182	F17:313	413508
6	0		Backwash Waste Reservoir Level (LIT-886)	N15:232	F17:323	413601
AI	1		Recycle Flow (FIT-892)	N15:233	F17:333	413602
	2		Flow to River	N15:234	F17:343	413603
	3		Filter Influent Flow (FIT-872)	N15:235	F17:353	413604
	4		Spare	N15:236	F17:363	413605
	5		Spare	N15:237	F17:373	413606
	6		Spare	N15:238	F17:383	413607
	7		Spare	N15:239	F17:393	413608
7						
Empty						

Ann Arbor Chassis 4 I/O List

Date: 01-Mar-2014

Platform: PLC5

Adapter: 1771-ASB Series

Chassis Type: 1771-A1B

Slot	Points	Card Type	Card Model
0	4	ANALOG OUTPUT	1771-OFE
1	8	ANALOG INPUT	1771-IFE/B
2		ANALOG OUTPUT (NEW)	1771-OFE
3		EMPTY	
4		EMPTY	
5		EMPTY	
6		EMPTY	
7		EMPTY	

Slot	Point	SCADA Code	PLC Description	PLC Address	Wire Number
0	0		FIT-872 Remote ReadOut	N18:41	4O4001
AO	1		FIC-230 CP-20 S.P. Control Output	N18:42	4O4002
	2		SE Pump No. 3 Speed Control Output	N18:43	4O4003
	3		SPARE 4 Control Output	N18:44	4O4004
1	0		Sec.Eff. Pump No.1 Spd. Ind.	N15:289	4I4101
AI	1		Sec.Eff. Pump No.2 Spd. Ind.	N15:290	4I4102
	2		Sec.Eff. Pump No.3 Spd. Ind.	N15:291	4I4103
	3		Sec.Eff. Pump No.6 Spd. Ind.	N15:292	4I4104
	4		Sec. Eff. Pump No.4 Spd. Ind.	N15:293	4I4105
	5		Backwash Turbidity	N15:294	4I4106
	6		Eff. Flow to River Accusonics Flowmeter	N15:295	4I4107
	7		Sec. Eff. Pump No.5 Spd. Ind.	N15:296	4I4108
2	0		SE Pump NO. 4 Speed Control Output	N18:45	4O4201
AO	1		SE Pump No. 5 Speed Control Output	N18:46	4O4202
	2		SPARE 3	N18:47	4O4203
	3		SPARE 4	N18:48	4O4204

* Yellow Indicates existing I/O which pertains to the logic modifications

* Green indicates new I/O and/or I/O Cards to be added.

City of Ann Arbor
WASTEWATER TREATMENT PLANT



PROCESS CONTROL NARRATIVE

**SECONDARY EFFLUENT PUMPING
STATION**

Version 1.0
Prepared by



REVISION HISTORY

Version	Date	City Approval	Description of Revisions
Version 1.0	March 2014		Secondary Effluent P.S. Pump Replacement Project

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Introduction

Secondary effluent from the east and west plant is normally routed to the secondary effluent pumping station located in the northwest corner of the Tertiary Filter Building. The pumping station lifts the wastewater up to an elevation which allows for gravity flow through the rapid sand filters.

The pumping station wet well is divided into two halves with both east plant and west plant secondary effluent able to flow to either half. The two halves of the wet well are normally interconnected by opening the interconnection sluice gate.

The six secondary effluent pumps draw from the wet well and discharge to the filter influent piping. Four of the five currently operable pumps are equipped with variable speed drives. The number of pumps in operation and the speed of the pumps are determined by the level in the wet wells. Pump sequencing is maintained through a set of duty tables, adjustable from the HMI.

During periods of high river conditions, the secondary effluent pumping station is also used to discharge final effluent to the Huron River. In this mode of operation, the east and west halves of the wet well are operated independently. The east half is used to lift secondary effluent to the rapid sand filters while the west half is used to pump final effluent from the U.V. Reactor Tank to the Huron River.

Equipment List

The major equipment associated with the Secondary Effluent Pumping Station is summarized in the following table. A brief description of the major process equipment is included in the following sections.

Table 1: Equipment List

Equipment Tag	Function	Comments
Gates and Valves		
S-2-1	West plant wet well influent isolation sluice gate No.1	36" diameter, motor driven
S-2-2	West plant wet well influent isolation sluice gate No.2	36" diameter, motor driven
S-6-1	East plant wet well influent isolation sluice gate No.1	48" diameter, motor driven
S-6-2	East plant wet well influent isolation sluice gate No.2	48" diameter, motor driven

S-3-1	Wet well interconnection sluice gate	36" x 36" crank driven
S-1-1	Wet well overflow – tertiary effluent connection sluice gate No.1	42" diameter, motor driven
S-1-2	Wet well overflow – tertiary effluent connection sluice gate No.2	42" diameter, motor driven
S-11-1	North chlorine contact tank wet well connection sluice gate	48" diameter, motor driven
CC-1-1	Secondary effluent pump discharge cushion check valve No.1	20" check valve
CC-1-2	Secondary effluent pump discharge cushion check valve No.2	20" check valve
CC-1-3	Secondary effluent pump discharge cushion check valve No.3	20" check valve
CC-1-4	Secondary effluent pump discharge cushion check valve No.4	20" check valve
CC-1-5	Secondary effluent pump discharge cushion check valve No.5	20" check valve
CC-1-6	Secondary effluent pump discharge cushion check valve No.6	20" check valve
B-1-1	Secondary effluent pump discharge isolation butterfly valve No.1	20" handwheel
B-1-2	Secondary effluent pump discharge isolation butterfly valve No.2	20" handwheel
B-1-3	Secondary effluent pump discharge isolation butterfly valve No.3	20" handwheel
B-1-4	Secondary effluent pump discharge isolation butterfly valve No.4	20" handwheel

B-1-5	Secondary effluent pump discharge isolation butterfly valve No.5	20" handwheel
B-1-6	Secondary effluent pump discharge isolation butterfly valve No.6	20" handwheel
B-3-1	Pumping station discharge to river isolation butterfly valve	42" diameter, motor driven
B-2-1	Pumping station discharge splitting butterfly valve	48" diameter, motor driven
B-4-1	Pumping station discharge to filters isolation butterfly valve	42" diameter chainwheel driven
Pumps and Drives		
SEP-1	Wet well Effluent pump No.1 (East Cell)	Allen-Bradley VFD
SEP-2	Wet well Effluent pump No.2 (East Cell)	Allen-Bradley VFD
SEP-3	Wet well Effluent pump No.3 (West Cell)	Allen-Bradley VFD
SEP-4	Wet well Effluent pump No.4 (West Cell)	Allen-Bradley VFD
SEP-5	Wet well Effluent pump No.5 (East Cell)	Allen-Bradley VFD
SEP-6	Wet well Effluent pump No.6 (West Cell)	Allen-Bradley VFD
Instrumentation		
LIT-707	Wet Well (West Cell) Level Transmitter	Milltronics
LIT-708	Wet Well (East Cell) Level Transmitter	Milltronics
FE-872	Flow from pumps to filters	TBD
TBD	High level switch in west cell	TBD
TBD	High level switch in east cell	TBD
PLC		

CP-70	Tertiary Filter System PLC	Allen-Bradley PLC-5
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Standard Equipment Control Modes

Four (4) control modes are implemented for equipment control:

- i. Remote Automatic (select at Operator Interface);
- ii. Remote Manual (select at Operator Interface);
- iii. Local Manual (select at individual piece of equipment or MCC panel); and,
- iv. Backup Control Mode (operational when device is in Remote at device)

Local Manual

When the Local/Off/Remote switch in the field area is in the Local position or the Hand/Off/Remote switch is in the Hand position at the MCC, the operator can control the equipment locally. Local control has priority over Remote control, i.e. when the Local or Hand mode is selected in the field; commands from the PLC have no effect, however some hardwired interlocks may still affect the device (if applicable, see interlock listings per device).

The Local/Off/Remote selector in the field always has priority over all other control locations. The MCC selectors have the second highest priority, hence the PLC has the lowest priority and is only functional when the equipment selector switch is set to Remote and the MCC selector (if any) is set to Remote.

SCADA Auto/SCADA Manual Control (from Operator Interface)

The PLC monitors the Local/Off/Remote switch (Control Mode) on most equipment. When the switch at the equipment is in the Remote or Auto position, the Operator can select between two (2) modes of operation at the Operator interface: SCADA-Manual and SCADA-Auto. For motors with starters in the MCC, the Hand/Off/Remote selector must also be set to Remote to allow for SCADA Auto and SCADA Manual control.

The operator may start/stop pumps that are selected as SCADA Manual through a control pop-up display on the Operator Interface. For VFDs, the operator also enters a pump speed setpoint through the control pop-up. The PLC program outputs the desired pump speed to the pump VFD; the pump VFD holds the pump speed to the desired output. The SCADA system will alarm if the pump speed feedback is +/- 5% from setpoint, indicating a possible miscalibration between the drive setpoint and feedback signals from the VFD.

For valves, the operator may open/close each valve independently through a control pop-up display on the Operator Interface. The operator places the valve in SCADA Manual mode and enters a valve position setpoint (for modulating valves) or triggers open/close commands (for discrete valves) through the control pop-up. The PLC program will set and hold the valve to the desired valve position. The SCADA system will alarm if the valve position is +/- 5% from setpoint (for modulating valves).

In SCADA-Manual mode, the PLC only makes changes to the process (or related equipment) that are operator initiated. From the SCADA Operator Interface, the operator is able to remote-manually control the process equipment with all hardware and software process interlocks engaged.

In SCADA Auto mode the PLC controls all aspects of the process, adjusting the process based on process inputs and predefined algorithms. The PLC automatic logic program monitors and controls process equipment with all hardware and software process interlocks are engaged in this mode.

Switching from SCADA Auto to SCADA Manual is always a bumpless transfer, in other words, if the device was running in SCADA Auto mode it will continue to run when switched to SCADA Manual until a stop command is given when in SCADA Manual. This is also true for speed or position setpoints, as the PLC will track the analog value of the device and use the last recorded value as the starting manual setpoint when the transition from SCADA Auto to SCADA Manual takes place. This analog bumpless transfer is required to prevent unwanted sudden changes in process parameters. When switching from SCADA Manual to SCADA Auto the transition will not always be bumpless, as the device may start, stop or change speed/position/direction depending on the requirements of the auto control logic at that point in time.

Alarming

Software Interlocks

Software interlocks are initiated through the PLC and are programmed into the software logic. These interlocks can be in effect in both SCADA Manual and SCADA Auto modes, depending on the nature of the interlock. These PLC interlocks are typically not in effect when controlling the equipment locally. Hardwired interlocks may or may not be in effect, depending on the particular device.

Alarm Reset

The PLC locks out some equipment to prevent Remote/Auto operation when the PLC determines the equipment has failed. The PLC will not allow the equipment to operate under SCADA Manual or SCADA Auto until the Operator executes an alarm reset through the Operator Interface (typically from the device popup or setpoints screens).

Alarms

Analog alarms indicate a condition when a measured value has risen above or fallen below an operator defined range. Unless noted otherwise, the following virtual alarm points will be provided for each analog signal. Individual process areas will have an alarm setpoints page that will display the alarm setpoints. Out of Range alarms become active when the physical analog signal rises above 20mA or falls below 4mA, indicating an electrical or device fault is present and that the signal is not reliable. The following virtual alarms will be provided for all analogs:

- i. High High;
- ii. High;
- iii. Low;
- iv. Low Low; and,
- v. Out of Range.

In addition to field wired device alarms the PLC can generate virtual alarms based on the expected feedback from process commands. The following virtual alarm points are provided for each piece of major equipment monitored and/or controlled through the SCADA system:

- i. Fail to Start/Open;
- ii. Fail to Stop/Close;
- iii. Uncommanded Start/Open;
- iv. Uncommanded Stop/Close;

Automatic Process Control Logic

The following section describes the PLC automatic control logic for the Secondary Effluent Pumping Station. The SCADA AUTO control logic for normal and failure modes of operation are defined for the equipment.

Wet Well Modes of Operation

In the normal operating mode, the two halves of the pumping station wet well are hydraulically interconnected (interconnecting sluice gate open) and, therefore, operate as one wet well. East and

west plant secondary effluent enters both halves of the well through the two influent pipes from each plant.

The six secondary effluent pumps pump the wastewater to the rapid sand filter influent piping. These pumps operate the number of pumps required and their speed based on the wet well level. During periods of high river conditions and/or high plant flows, it may become necessary to use the west half of the pumping station wet well to pump flow to the river. In this mode, the wet well interconnection gate must be closed. In addition, east and west plant secondary effluent flows must be diverted to the east half of the wet well only. This is accomplished by closing the appropriate isolation sluice gates in the west half of the wet well and in the effluent well of secondary clarifier number eleven. Also, the valving on the pumping station discharge header must be appropriately adjusted to route west half discharge to the river and east plant discharge to the filters. In this case, the east half of the wet well and its associated pumps will pump all secondary effluent flows to the rapid sand filters.

When the river is high enough, it may become necessary to isolate the U.V. Reactor tanks from the river. When this is done, disinfected effluent can be pumped into the river by the secondary effluent pumps associated with the west half of the pumping station wet well. The sluice gate connecting the north chlorine contact tank to the west half of the wet well must be open during this operation. In addition, the wet well interconnection must be closed.

During high flow periods to the plant, the level in either half of the wet well may continue to rise even though all available pumps are running. If this occurs, the wastewater will overflow weirs in each half of the wet well at Elevation 737.5 ft, and flow directly to the U.V. Reactor Tanks (formerly the north chlorine contact tank), thus bypassing the rapid sand filters. This bypass flow route can also be used in emergency conditions by opening the appropriate sluice gate connecting each half of the wet well to the filter bypass piping.

During extreme emergency conditions when the north U.V. Reactor tank is non-operational, secondary effluent can be routed directly to the river through the secondary effluent pumping station.

Either half of the pumping station wet well can be isolated from flow by closing the appropriate west plant secondary effluent sluice gate in the wet well or the appropriate east plant secondary effluent sluice gate in the effluent well of secondary clarifier number eleven. In addition, when isolating the west half of the wet well, the connection to the north chlorine contact tank must also be closed. It must also be noted that there is a permanent interconnection between the two halves of the wet well above Elevation 737.5 ft. This interconnection window cannot be closed and must be considered when attempting to isolate one-half of the wet well.

Each secondary effluent pump can be isolated by closing its associated discharge isolation valve.

Pump Control Algorithm

The proposed Secondary Effluent Pumping Station consists of six single-stage vertical pumps that are normally tasked to elevate secondary effluent water from a wet well to the rapid sand filters. All six pumps are to be equipped with Variable Frequency Drives (VFDs) and are capable of variable or constant speed operation. The pumps are served from MCC-M, N, P and Q in the Tertiary Filter Building, which in turn is fed from Unit Substation No.4.

The wet well is segregated into two halves which are normally interconnected so that they operate as one. Levels in the west and east cells are independently measured with Ultrasonic level transmitters (LIT-707 and LIT-708 correspondingly) which transmit their respective level to panel CP-70. High and low wet well level events are alarmed at SCADA, and the overflow channel prevents flooding at the building itself. In the event that the river is high, thus necessitating closing of the river isolation valve, the Secondary Effluent Pumping Station is operated as two independent stations. The east half pumps to the filters while the west half pumps chlorinated effluent up to the river.

Level Reading

The Secondary Effluent Pumping Station is equipped with a level transmitter in each wet well and the HMI displays the individual readings of both levels. In normal mode, the two wet wells are hydraulically linked through a normally opened gate and one of the transmitters is used for automatic control of the effluent pumps with the other level transmitter being backup. The lead level transmitter can be selected by operations from the HMI. When the duty sensor or transmitter fails, an alarm will be initiated in SCADA and the duty sensor will automatically switch to the other available level transmitter. If neither level transmitter is available, automatic operation of the wet well pumps will not be available.

A pair of capacitive level probes are also utilized, one per wet well, to provide high level alarms should the Milltronics level transmitter fail. These level switches generate high priority alarms on the HMI only; they do not activate any interlocks or trigger automatic control of pumps.

Proportional Speed Sewage Pump Control

The effluent pump VFD speed(s) are modulated proportionally based on the wet well level in an attempt to maintain a constant level in the wet well. The VFD speed will modulate in a linear slope with the Start Level Setpoint being the VFD minimum speed and the next pump stages stop setpoint or Maximum Speed Level Setpoint being the top of the slope with the VFD running at 100%..

Automatic Pump Operation – Together Mode (Normal Operation)

Generally, As the level in the wet well rises to the Duty 1 start level setpoint as entered by the operator via HMI, Duty 1 pump is called to start. The speed of the Duty 1 pump will start at the VFD minimum speed (set within the VFD) and will increase speed linearly with a corresponding increase of the level in the wet well until it reaches its maximum speed at the Duty 2 stop level setpoint. Once the level begins

to fall in the wet well the Duty 1 pump speed will decrease linearly until the speed of the pump reaches the minimum speed at the Duty 1 start level setpoint. The pump will run with minimum speed until level falls down to the Duty 1 stop setpoint.

In the event that Duty 1 pump has reached its maximum speed and still cannot keep up with volume in the wet well and the level continues to rise past the Duty 2 start setpoint, the Duty 2 pump will be called to start and the speed setpoint of both Duty 1 and Duty 2 pumps will be set to minimum speed. Both pumps will then operate using the same speed setpoint to control the level in the wet well. The speed of the Duty 1 and Duty 2 pumps will continue to increase linearly with the increase of well level until the speed of both pumps reaches maximum speed at the Duty 3 stop setpoint. Once the level begins to fall in the wet well Duty 1 pump and Duty 2 pump speed will decrease linearly until the speed of the pump reaches the minimum speed at the Duty 2 start level setpoint. A decreasing well level that reaches the Duty 2 stop setpoint will cause Duty 2 pump to stop. The Duty 1 pump speed will increase and then operate as before with the maximum speed being reached at the Duty 2 pump stop setpoint and the minimum speed being reached at the Duty 1 start setpoint.

If the level increases past the Duty 3 start level setpoint Duty 3 pump will be called to start and operate in a similar fashion as the two pump operation, all pumps ramping up and down together with the maximum speed being reached at the Duty 4 stop level setpoint and the minimum speed being reached at the Duty 3 start setpoint. If the level continues to rise the Duty 4 pump will be called to start causing the pumps to operate between the respective pump stop level setpoints. Duties 5 and 6 will respond to the level change in similar manner.

For a better explanation, the sequence is presented on the following table, the Graph in Figure 1, and flow chart diagram:

Table 2: Pump Sequence Logic

Well Level Changes	Pump Response
Level is above or equal to Duty 1 Start Level Setpoint	Duty 1 Pump is called to run at minimum speed after at least 15 seconds.
Level is above "Duty 1 Start Setpoint" but less than "Duty 2 Stop Setpoint"	Duty 1 Pump is running with speed proportionally modulated between minimum (Duty 1 Start Level) and maximum (Duty 2 Stop Level) speed setpoints.
Level drops below Duty 1 Stop	Duty 1 Pump is called to stop.

Setpoint	
Level is above "Duty 2 Stop Setpoint" but less than "Duty 2 Start Level Setpoint"	Duty 1 Pump is running with maximum speed.
Level is above or equal to Duty 2 Start Level Setpoint	Duty 2 pump is called to run. Duty 1 and Duty 2 pumps are running at the minimum speed waiting at least 15 seconds.
Level is above "Duty 2 Start Level Setpoint" but less than "Duty 3 Stop Setpoint"	Duty 1 and Duty 2 Pumps are running with speed proportionally modulated between minimum and maximum speed setpoints.
Level drops below Duty 2 Stop Level Setpoint	Duty 2 Pump is called to stop. Duty 1 Pump ramps up to maximum speed setpoint.
Level is above "Duty 3 Stop Setpoint" but less than "Duty 3 Start Setpoint"	Two pumps, Duty 1 and Duty 2, are running with maximum speed.
Level is above or equal to Duty 3 Start Level Setpoint	Duty 3 pump is called to run. Three pumps are running at the minimum speed waiting at least 15 seconds.
Level is above "Duty 3 Start Level Setpoint" but less than "Duty 4 Stop Setpoint"	Duty 1, Duty 2 and Duty 3 pumps are running with speed proportionally modulated between minimum and maximum speed setpoints.
Level drops below Duty 3 Stop Level Setpoint	Duty 3 Pump is called to stop. Duty 1 and 2 Pumps ramp up to maximum speed setpoint.
Level is above the "Duty 4 Stop Setpoint" but less than "Duty 4 Start Level Setpoint"	All three, Duty 1, Duty 2 and Duty 3, pumps are running with maximum speed.
Level is above or equal to the Duty 4 Start Level Setpoint	Duty 4 pump is called to run. All four pumps are running at the minimum speed waiting at least 15

	seconds.
Level is above the "Duty 4 Start Level Setpoint" but less than "Duty 5 Stop Setpoint"	Duty 1, Duty 2, Duty 3 and Duty 4 pumps are running with speed proportionally modulated between minimum and maximum speed setpoints.
Level drops below Duty 4 Stop Level Setpoint	Duty 4 Pump is called to stop. Duty 1, 2, and 3 Pumps ramp up to maximum speed setpoint.
Level is above the "Duty 5 Stop Setpoint" but less than "Duty 5 Start Level Setpoint"	All four, Duty 1, Duty 2, Duty 3 and Duty 4, pumps are running with maximum speed.
Level is above or equal to the Duty 5 Start Level Setpoint	Duty 5 pump is called to run. All five pumps are running at the minimum speed waiting at least 15 seconds.
Level is above the "Duty 5 Start Level Setpoint" but less than "Duty 6 Stop Level Setpoint"	Duty 1, Duty 2, Duty 3, Duty 4 and Duty 5 pumps are running with speed proportionally modulated between minimum and maximum speed setpoints.
Level drops below Duty 5 Stop Level Setpoint	Duty 5 Pump is called to stop. Duty 1, 2, 3, and 4 Pumps ramp up to maximum speed setpoint.
Level is above the "Duty 6 Stop Level Setpoint".	All five pumps, Duty 1, Duty 2, Duty 3, Duty 4 and Duty 5, are running with maximum speed.
Level is above or equal to the Duty 6 Start Level Setpoint	Duty 6 pump is called to run. All six pumps are running at the minimum speed waiting at least 15 seconds. (See NOTE below.)
Level is above the "Duty 6 Start Level Setpoint" but less than "Duty 6 Max Speed Level Setpoint"	All 6 pumps are running with speed proportionally modulated between minimum and maximum speed setpoints. (See NOTE below.)

Level is above the "Duty 6 Max Speed Level Setpoint".	All 6 pumps are running with maximum speed. (See NOTE below.)
Level drops below Duty 6 Stop Level Setpoint	Duty 6 Pump is called to stop. Duty 1, 2, 3, 4, and 5 Pumps ramp up to maximum speed setpoint. (See NOTE below.)

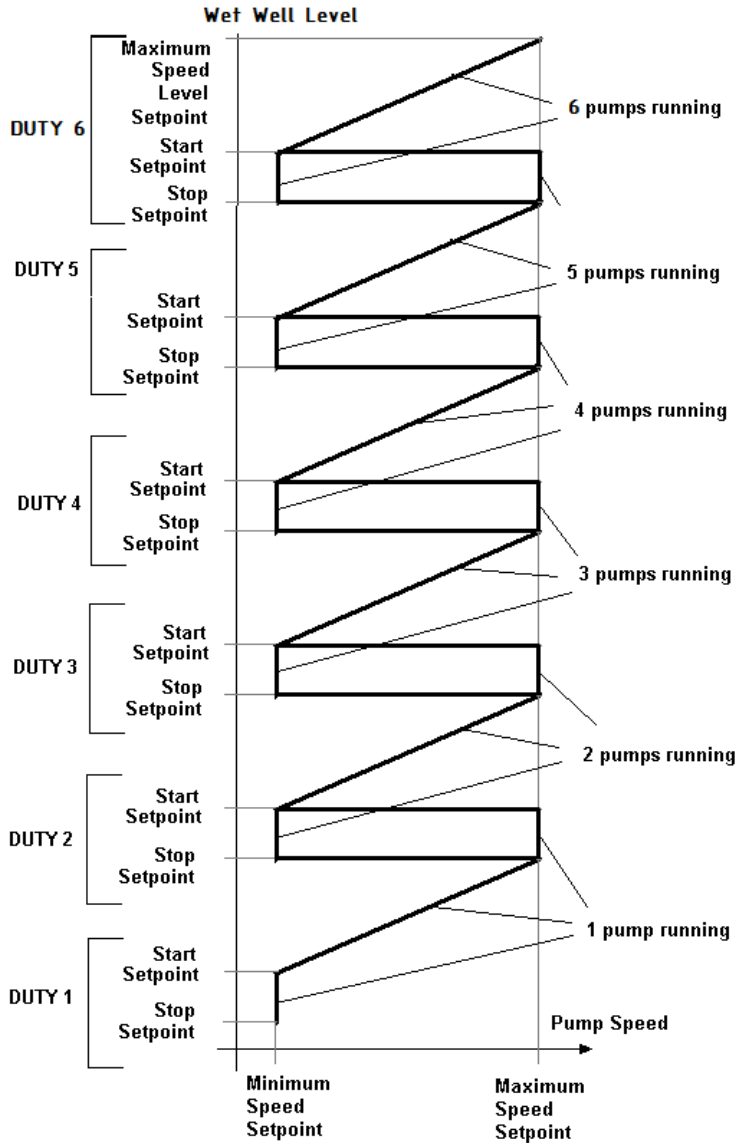
NOTE: Simultaneous operation of all six (6) Pumps is beyond normal design.

The default operational setpoints for this control mode are listed in the table below.

Table 3: Together Mode Pump Setpoints

Duty Position	Pump Start Level (Trip)	Pump Stop Level (Reset)
Duty 1	10.0 ft	9.0 ft
Duty 2	10.5 ft	10.3 ft
Duty 3	11.0 ft	10.7 ft
Duty 4	11.5 ft	11.3 ft
Duty 5	12.0 ft	11.7 ft
Duty 6	12.5 ft	12.3 ft

Figure 1: Pumping Stages for Together Mode



Automatic Pump Operation – Separate Mode (Abnormal Operation)

In times of high river level when the two wet wells must be isolated from each other, the control system must be switched on the HMI from “Together” mode to “Separate” mode. This changes the pump duty

tables and separates pumps 1, 3 and 5 to operate only off of the East well level signal in a 3 pump duty table, and pumps 2, 4 and 6 to operate only off the West well level signal in a different 3 pump duty table. The process control strategy of pumps starting at a duty start setpoint, ramping up speed from minimum to maximum between one duties start setpoint and the next duties stop setpoint is the same, however will be based on a separate start/stop level setpoint table per wet well, as shown below:

Table 4: Separate Mode Pump Setpoints

Duty Position	Pump Start Level (Trip)	Pump Stop Level (Reset)
East Well		
Duty 1	10.0 ft	9.0 ft
Duty 2	10.5 ft	10.3 ft
Duty 3	11.0 ft	10.7 ft
West Well		
Duty 1	10.0 ft	9.0 ft
Duty 2	10.5 ft	10.3 ft
Duty 3	11.0 ft	10.7 ft

Setpoint Error Checking

The setpoints are entered by an operator via SCADA HMI screen. All setpoints have to be entered within valid ranges. If setpoints overlap they can cause pumps to get stuck on indefinitely or never run. Thus, the PLC will perform value error checking on setpoints:

- Every Stop setpoint has to be lower than the same pump band Start setpoint.
- Each duty band start and stop setpoints must be higher than the previous band
- Unavailable pumps occupy the last duty positions

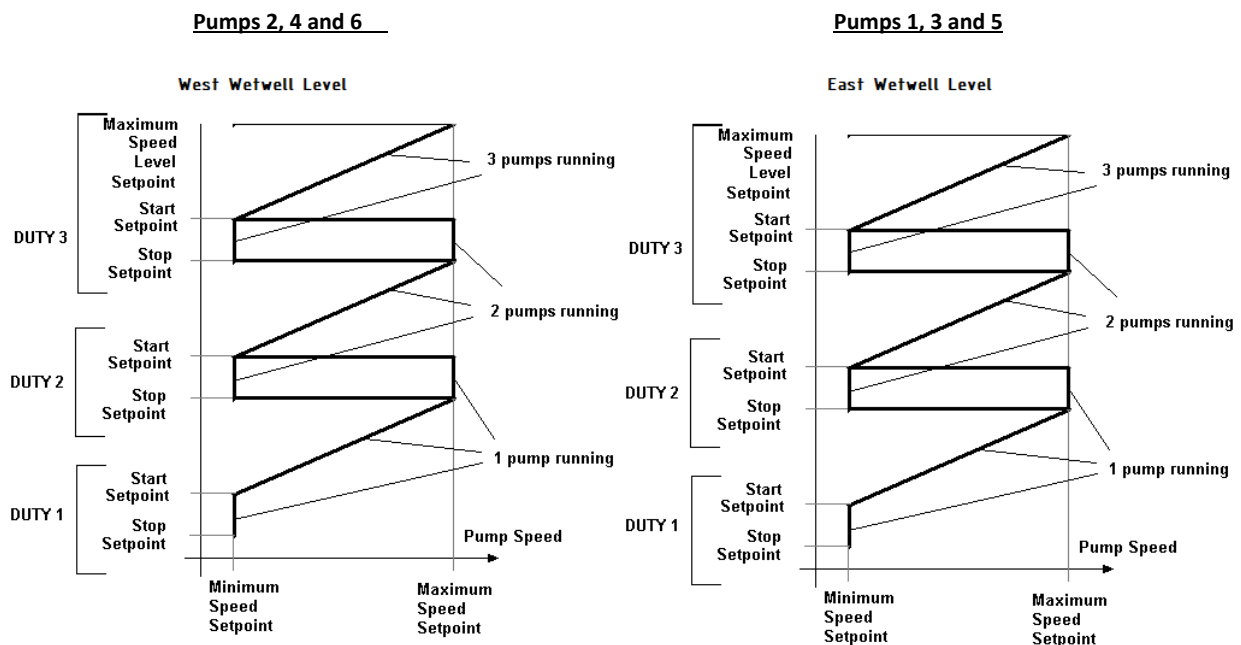
The HMI will display a “Current Values” and a “New Entry values” table. New setpoints will be entered into the “New Entry Values” table which will write values to temporary registers in the PLC. Once entered, the user will click the “Update Table” button at which point the PLC will check the new values against the rules described above. If values overlap, an error message displaying the exact error will be shown on the setpoint screen and the values will not be accepted. These errors include such examples as “Stage 2 Start less than Stage 2 Stop” or “Stage 4 Start less than Stage 3 Start” or “Pump X

Unavailable” if pump “X” is unavailable for auto control and is placed in a duty position ahead of an available pump. If there are multiple errors, all errors will be listed on screen next to the duty table entry. If none of the new values conflict with the error checks, they will be moved to the Current Values table which will be used by the PLC to control the pumps. This error checking of control level setpoints prior to use in the logic ensures no accidental bumps to process control while the user is finalizing any new setpoints. The “Current Values” table will update with any automatic duty rotations based on failure or unavailability of pumps to ensure the most up to date duty table is always displayed.

The following diagram details the level control stages and how pump speed operation works:

This same strategy is applied to the “Separate Well” pump mode as well, however it is split into 2 tables of 3 pumps each, each with separate start and stop setpoints, as per the graphic below:

Figure 2: Pumping Stages for Separate Mode



Minimum Speed Override

Typically the pumps will run from minimum speed (set in the VFD) to Maximum speed (100% = 60 Hz) within each pumping stage. The minimum speed is set at commissioning as the lowest speed the pump will run and still produce adequate flow. Should the operator wish to override the minimum speed for each pump stage, a setpoints screen is provided (accessible by supervisor login only from the main Wet Well Setpoints page) which shows an override minimum speed setpoint (in % speed) for each pump

stage. There is a separate setpoint for each of the 6 stages in 'Together' mode and a separate set of two tables for each wet well in 'Separate' mode. A toggle button is provided to enable or disable the minimum speed override for either Together or Separate wet well modes. When enabled, all pumps running in a given stage will share the new minimum pump speed. This is above the minimum speed programmed into the VFD drives and as such must be higher than the hard-set minimum speed programmed at the drives. Also note that this new minimum speed does not change the 'hard-set' VFD minimum speed programmed within the VFD and as such this new minimum speed will not be reflected when running the VFD in Local. It is likely that the minimum speed set for each stage will be set higher than the previous stage as pumps are being pushed to a different pumping curve by the increasing discharge pressure in the common headers. These minimum speeds are to be determined on site during testing and the default values to be recorded and entered into this narrative upon completion of testing.

Duty Logic

In the "Together" mode of wet well operation six pumps are configured as Duty 1, Duty 2, Duty 3, Duty 4, Duty 5 and Duty 6 at the HMI SCADA screen. Each pump is assigned to one spot in the duty table. The operator can manually assign each pump to duty at SCADA HMI screen. In "Separate" mode of wet well operation, pumps 1, 3 and 5 can be assigned to Duties 1, 2 and 3 for the East Well and pumps 2, 4 and 6 can be assigned Duties 1, 2 and 3 for the West Well.

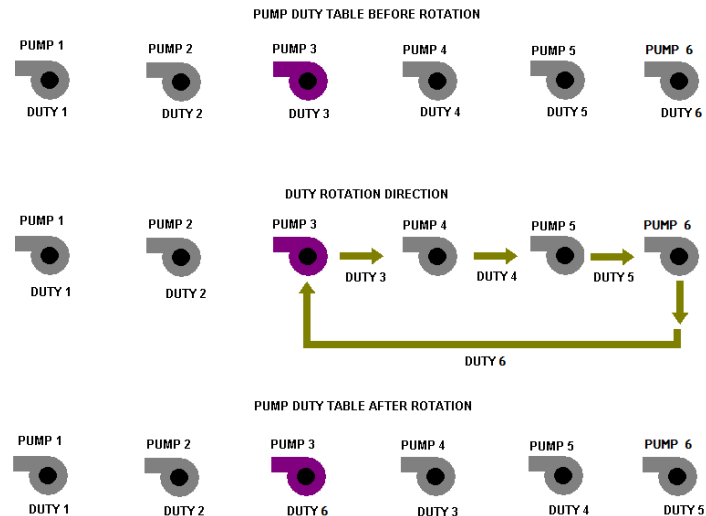
Duty rotation will occur automatically if any of the duty pumps fails, becomes unavailable for automatic operation, the Duty 1 pump stops at its stop level setpoint (i.e. no pumps running), or the Duty 1 pump run time has exceeded the 'Duty 1 Runtime' setpoint. Switching a duty pump out of the SCADA Auto mode into SCADA Manual or local modes will make the pump unavailable in the duty operation and will be considered unavailable, rotating the device out of its higher duty position (e.g. Duty 1) to a lower duty position (e.g. Duty 6). Upon rotation, if the auto duty logic is requesting that duty position to run, the pump will be started and ramped to the appropriate speed based on the auto control algorithm.

When a rotation occurs the higher duty order raw sewage pump is replaced with the next lower order pump. For example, the Duty 1 pump is moved to be the Duty 6, while the Duty 2 pump becomes Duty 1, Duty 3 becomes Duty 2, Duty 4 comes Duty 3 and so on.

In this situation, when the middle priority device is failed, this particular device moves to the end of duty line and next available lower duty pump moves into this place. For example, if Duty 3 pump is switched to Local control mode, this pump is assigned as "unavailable" and moved to Duty 6 position, while Duty 4 pump becomes Duty 3, Duty 5 pump becomes Duty 4, and Duty 6 becomes Duty 5.

Following figure shows the Duty Rotation Schedule initiated by faulted pump 3.

Figure 3: Rotation initiated by a faulted pump.



This duty structure works in a similar fashion for the Separate well mode, utilizing the two duty tables of 3 pumps each. In each case, a failure of a duty pump in either well will move it to the end of that well's duty table.

If multiple pumps are not available, those unavailable pumps already at the end of the duty table are not rotated into new positions. In this case, the newly unavailable pump moves to the next lowest duty table position. Example: As above, Pump 3 has failed and is moved to the Duty 6 position. Should pump 2 (Duty 2) also fail, it will be moved to Duty 5, ahead of the already failed pump 3 in the Duty 6 position. Pump 4 (Duty 3) would then take the Duty 2 position, Pump 5 (Duty 4) would take the Duty 3 position, Pump 6 (Duty 5) would take the Duty 4 position. Pump 3 (Duty 6) would stay where it is, and the newly failed pump 2 would move to the Duty 5 position. If there are no more available pumps to move into duty positions when requested, no substitutions are made and the system maintains all available pumps in their current order.

This arrangement always insures that pumps that are available occupy the higher priority duty positions.

Operations can also set the pump Duty Rotation to Manual mode at the HMI where the Operator can assign any pump to any duty including failed pumps in higher order duty positions. However it is recommended that the duty rotation be set to Automatic mode under normal operation. Furthermore, the Operator may force an automatic duty rotation by pressing the 'Rotate Duty' button on the HMI

when the Duty Rotation is set to Automatic mode. This will force a duty rotation in conformance with the philosophy outlined above. For instance if all pumps are available and in SCADA Auto the Duty assignments will shift by one (i.e. Duty 1 → Duty 2, Duty 2 → Duty 3) with Duty 6 rotating up around to become Duty 1.

Fault Operation

As mentioned in the duty rotation section, the failed or not available devices (Not in remote/auto) will be rotated to the end of duty table. The following situations are considered to be failure situations:

- a) Any virtual pump alarms - Fail to Start/Stop and Uncommanded Start/Stop,
- b) Field alarms, such as VFD Fault, Thermal/Leakage Alarm, Etc.

In case of PLC failure, pumps will stop because PLC run command outputs and control signals to the pumps will be released and/or drop to below 4mA. However, it is possible that in the extremely rare event the PLC should 'lock-up' control outputs to the drive may also freeze and therefore the pumps will not stop.

A pump 'Speed Deviation' alarm indicates a significant difference between pump speed output setpoint and speed reading from the VFD unit has occurred. If a variation of +/- 5% between the speed output signal and returned speed feedback signal for each pump is registered, an alarm is generated. No action will be performed by the PLC (ie: does not cause pump duty rotation) as this indicates a miscalibration of signals only but does not necessarily constitute improper performance of the system.

When restarting pumps under generator power or from any no power state, pump starts are staggered (ie: first pump starts then next pump cannot start until the first pump's running status is active).

Wet Well Level Alarms & Setpoints

The following table indicates the default setpoints for wet well level alarms:

Table 5: Wet Well Alarm Setpoints

Condition	Depth	Tag
High High Alarm	TBD	TBD
High Alarm	TBD	TBD
Low Alarm	TBD	TBD
Low Low Alarm	TBD	TBD
Signal Error	N/A	TBD

The following table outlines the operator setpoints available from the HMI:

Note: Signal tags are to be developed by the systems integrator based on existing format used on SCADA. Contractor is to confirm proposed tags with plant SCADA staff and update the narrative upon completion.

Table 6: HMI Setpoints List

Signal Tag	Signal Description	Range	Default
TBD	Together Mode Duty 1 Start Setpoint	0 – 15 ft	10.0 ft
TBD	Together Mode Duty 1 Stop Setpoint	0 – 15 ft	9.0 ft
TBD	Together Mode Duty 2 Start Setpoint	0 – 15 ft	10.5 ft
TBD	Together Mode Duty 2 Stop Setpoint	0 – 15 ft	10.3 ft
TBD	Together Mode Duty 3 Start Setpoint	0 – 15 ft	11.0 ft
TBD	Together Mode Duty 3 Stop Setpoint	0 – 15 ft	10.7 ft
TBD	Together Mode Duty 4 Start Setpoint	0 – 15 ft	11.5 ft
TBD	Together Mode Duty 4 Stop Setpoint	0 – 15 ft	11.3 ft
TBD	Together Mode Duty 5 Start Setpoint	0 – 15 ft	12.0 ft
TBD	Together Mode Duty 5 Stop Setpoint	0 – 15 ft	11.7 ft
TBD	Together Mode Duty 6 Start Setpoint	0 – 15 ft	12.5 ft
TBD	Together Mode Duty 6 Stop Setpoint	0 – 15 ft	12.3 ft
TBD	Separate Mode East Well Duty 1 Start Setpoint	0 – 15 ft	10.0 ft
TBD	Separate Mode East Well Duty 1 Stop Setpoint	0 – 15 ft	9.0 ft
TBD	Separate Mode East Well Duty 2 Start Setpoint	0 – 15 ft	10.5
TBD	Separate Mode East Well Duty 2 Stop Setpoint	0 – 15 ft	10.3
TBD	Separate Mode East Well Duty 3 Start Setpoint	0 – 15 ft	11.0
TBD	Separate Mode East Well Duty 3 Stop Setpoint	0 – 15 ft	10.7
TBD	Separate Mode West Well Duty 1 Start Setpoint	0 – 15 ft	10.0 ft
TBD	Separate Mode West Well Duty 1 Stop Setpoint	0 – 15 ft	9.0 ft

Signal Tag	Signal Description	Range	Default
TBD	Separate Mode West Well Duty 2 Start Setpoint	0 – 15 ft	10.5
TBD	Separate Mode West Well Duty 2 Stop Setpoint	0 – 15 ft	10.3
TBD	Separate Mode West Well Duty 3 Start Setpoint	0 – 15 ft	11.0
TBD	Separate Mode West Well Duty 3 Stop Setpoint	0 – 15 ft	10.7
TBD	Separate Mode Duty Table Update Button	N/A	N/A
TBD	Separate Mode Duty Table Mode	Automatic/Manual	Automatic
TBD	Together Mode Duty Table Update Button	N/A	N/A
TBD	Together Mode Duty Table Mode	Automatic/Manual	Automatic
TBD	Separate / Together Mode Toggle Button	Together/Separate	Together
TBD	Together Mode Level Transmitter Duty Toggle Button	East/West	East
TBD	Stage 1 Minimum Speed Override (Together Mode)	0 – 60 Hz	TBD
TBD	Stage 2 Minimum Speed Override (Together Mode)	0 – 60 Hz	TBD
TBD	Stage 3 Minimum Speed Override (Together Mode)	0 – 60 Hz	TBD
TBD	Stage 4 Minimum Speed Override (Together Mode)	0 – 60 Hz	TBD
TBD	Stage 5 Minimum Speed Override (Together Mode)	0 – 60 Hz	TBD
TBD	Stage 6 Minimum Speed Override (Together Mode)	0 – 60 Hz	TBD
TBD	Stage 1 East Well Minimum Speed Override (Separate Mode)	0 – 60 Hz	TBD
TBD	Stage 2 East Well Minimum Speed Override (Separate Mode)	0 – 60 Hz	TBD
TBD	Stage 3 East Well Minimum Speed	0 – 60	TBD

Signal Tag	Signal Description	Range	Default
	Override (Separate Mode)	Hz	
TBD	Stage 1 West Well Minimum Speed Override (Separate Mode)	0 – 60 Hz	TBD
TBD	Stage 2 West Well Minimum Speed Override (Separate Mode)	0 – 60 Hz	TBD
TBD	Stage 3 West Well Minimum Speed Override (Separate Mode)	0 – 60 Hz	TBD
TBD	Minimum Speed Override Enabled	Enabled /Disable d	Enabled

Failure Modes

The following section lists the standard operation of equipment and processes under abnormal or fault conditions not already covered by previous sections.

PLC Panel Power Failure

Upon loss of PLC panel power failure the PLC will continue to operate under UPS power. A “Panel Power Status” alarm will be generated on SCADA. The UPS will maintain PLC operation until power resumes or until UPS power is exhausted. If UPS power is exhausted or the UPS fails before normal or emergency generator power is restored to the panel, the PLC will power down and all control and SCADA visibility of the system will be lost. All pumps will shut off as their run commands from the PLC will be released. Pumps can still be controlled from local control

Communications Failure

Should communications be lost to the PLC, visibility and Remote Manual operation of the process on the HMI will be lost, however the PLC may still continue to operate the pumps based on process variables if they are in the Remote Auto mode of control. A PLC Communications alarm will be generated on SCADA.

PLC Failure

Upon a hardware failure of the PLC’s CPU or backplane all automatic control over the process will be lost. Depending on the nature of the failure all pumps may stop or may be stuck in their last state. A full failure will generally generate a PLC Communications alarm as network communications may be halted as well. Pumps can still be controlled from local control.

I/O Card Failure

Upon a hardware failure of an I/O card, erroneous process control may be detected. Pump alarms such as Pump Fail to Start/Stop or Uncommanded Start/Stop may be generated as command outputs and status feedbacks may not be updated properly within the PLC. Analog values may stop changing or drop to signal error. I/O card replacement may be required.

Wet Well Level Transmitter Failure

Under normal conditions in Together Mode the PLC will control the pumps based on the assigned Duty LIT (see Table 6 above). In the event the Duty LIT fails (i.e. signal fault) the wet well LIT Duty will alternate. In Separate mode, wet well pumps will be control by the LIT level reading from the same wet well cell for which those pump draw from (pumps 1, 2, 5 will use the east cell LIT). However in the event an LIT should fail while in separate mode, **operators must assume immediate SCADA Manual/Local control of the pumps in the affected cell as the PLC will no longer be able to operate those pumps automatically.**

Pump/VFD Failure

Provided Duty Rotation is set to Automatic mode, failed pumps will be rotated out a lower duty with available pumps assuming the high duty assignments. Refer to Duty Logic section above.

Gate/Valve Failure

Gate and valve failures require operator intervention manually (i.e. hand wheel) set equipment to the required orientation.

HMI Displays

To be inserted upon completion of upgrades.

SECTION 13305

FIELD WIRING

PART 1 GENERAL

1.1 FIELD WIRING

Field Wiring is the wiring that connects the field equipment (instruments, control stations, control panels, MCC) to the Main Process Control Unit. Use only UL approved and labelled cables and conductors.

Provide field cables as per Division 16 - Electrical.

PART 2 PRODUCTS

2.1 ANALOG SIGNALS

- A. Definition: Analog signals are 4-20 mA inputs received from field instruments.
- B. Single Pair Cable: For individual instrument circuits use single-pair, two inch lay, twisted, foil 100% shielded with drain wire, #16 AWG, 19 strand copper conductors CSA labelled tray cable at 600 volts.
- C. Multi-Pair Cables: For multiple instrument circuits, use multi-pair cables made up of individual single pair, two inch lay, twisted, foil 100% shielded with suitable drain wire, #16 AWG, 19 strand copper conductors tray cable at 600 volts.
- D. Shields: Signal shields should have one ground point located at the power source unless otherwise recommended by the instrument/equipment manufacturer. Shields should be continuous through cabinets, panels and junction boxes.

2.2 DC DIGITAL SIGNALS

- A. DC digital signals are at 24VDC originating from contact inputs.
- B. Single Pair Cable: For individual contact closure circuits use single pair, two inch lay, twisted #16 AWG, 19 strand copper conductors tray cable at 600V with RW90 insulation with PVC jacket.
- C. Multi-pair Cable: For multiple contact closure circuits use multi-pair cables made up of individual single pair two inch lay, twisted, #16 AWG, 19 strand copper conductors tray cable at 600V with RW90 insulation with PVC jacket.

2.3 AC DIGITAL SIGNALS

- A. AC digital signals are 120VAC and less than 15 amperes, and received from contact outputs used for controlling 120V devices such as motor starters, push-buttons, pilot lights, and the like.
- B. Single Conductor: For single circuit use single conductor #14 AWG, 19 strand copper conductor at 600V with RW90 insulation with PVC jacket.
- C. Multi-Conductor: For multiple circuits use multiple conductor #14 AWG, 19 strand copper conductor at 600V with RW90 insulation with PVC jacket.

PART 3 INSTALLATION

3.1 GENERAL

- A. Avoid running cables inside or under power cable trays. Where field wiring is in power cable trays, insulation must be equal to or greater than the highest voltage in the cable tray.
- B. Where power or signal cables must cross, make them cross at an angle of 90 degrees.
- C. Communication cables will not be mixed with power or signal cables.

3.2 SIGNAL SEPARATION

- A. Analog and 24VDC Discrete Signals: Analog 4-20mA signals and 24VDC discrete signals should normally be in separate conduits. An exception to this standard may be made in cases where it would cause parallel conduit runs to the same device and combining signals would eliminate one conduit. In cases where the exception is used, both the analog and discrete signals should be twisted shielded pairs as described for analog signals previously. This exception will be limited to 10 feet only.
- B. AC Digital and Control: AC digital signals and AC control wiring may occupy the same conduit but all instrument power circuits should be isolated by a separate conduit from all AC digital and control circuits.
- C. All conduits for signal cables shall be rigid metallic conduit unless indicated otherwise with the last meter flexible connecting to the field instrument with condensation loop.

3.3 MISCELLANEOUS

- A. Spare Conductors: Spare conductors in each conduit should be equal to 15% of the number required for both present and (defined) future conditions, but in no case less than two spare wires or one pair, should be installed. Each cable should have 10% spare conductors but not less than two conductors. Spare conductors should be terminated on a marked terminal strip or connector pin at each end.

3.4 CABLE IDENTIFICATION NUMBERING

- A. This section defines the cable identification requirements. A block of numbers to be used for control cable identification will be assigned for each new project or contract. Follow similar tagging pattern as exists in the control panels for all new wiring. **Confirm with plant maintenance staff any additional wire tagging required, prior to pulling wires or cables.**
- B. Each single conductor wire shall be numbered at each end with a full wire number of the area, panel, and terminal, matching and coordinating with the existing numbering system, to which the wire is to be connected. The wires shall be identified near the connecting terminal with the number of the terminal it is to be connected to one inch back from the first tag. The tag number of the terminal on the opposite end of the wire shall be applied.
- C. Multiple conductor (unshielded) cable assemblies shall all be marked with its designated cable number where it enters the panel at each end, and shall also be marked at each pull or junction box it passes through, as described below. The identification number tag shall be round plastic with the identification number engraved on the plastic tag. Groups of wires shall be separated and marked with #18 insulated twisted wire of the same color as group tracer. Individual wires shall be tagged as described above.
- D. Large multiple conductor (shielded) cable assemblies and cable groups shall be marked as described above. Small cable assemblies (i.e., 1 pair through 3 pair cables) shall be marked with the designated cable/wire number(s). All cable assemblies shall all be marked with its designated cable number where it enters the panel at each end, and shall also be marked at each pull or junction box it passes through, as described below.
- E. Individual wires shall be marked at each end near the terminal with the full wire number per the above. One inch back from the first tags, on marked sleeves, the number of the cable from which it was taken shall be marked.
- F. Cables that have intermediate termination points in junction boxes, pull boxes, or feed through points in manholes shall be identified by engraved 1" x 3" plastic tags. The tags shall be white laminated plastic with engraved black 5/32" high characters. The tags shall be attached to cables with plastic tie wraps.

END OF SECTION

SECTION 13530

PROGRAMMABLE LOGIC CONTROLLERS (PLC)

PART 1 GENERAL

1.1 GENERAL

- A. Install and configure Programmable Logic Controller (PLC) analog output (AO) card as specified in the design drawings. The Analog Output card is to be inserted into the existing I/O racks in Control Panel CP-70, as per the I/O Modifications listing in Section 13020 Appendix A.
- B. PLC card to be free issued by the Plant for installation and wiring by the contractor.
- C. The Contractor shall submit the proposed configuration and part numbers as part of the submittals for approval by Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Allen-Bradley.
- B. The following table provides part numbers for acceptable components (To be free-issued by the Plant):

Item #	Description	Part No	Series
1	Analog Output module, 4 channels current output	1771-OFE	Allen-Bradley PLC 5

2.2 SOFTWARE

- A. PLCs to be programmed using RSLogix software. Confirm current version with Owner for suitability.

END OF SECTION

SECTION 13600

TESTING AND COMMISSIONING

PART 1 GENERAL

1.1 GENERAL TESTING REQUIREMENTS

- A. The testing requirements entail that the contractor demonstrate that the system was fully tested during development and installation and is a functioning, integrated, and reliable SCADA system before final payments are released. The testing requirements shall require a comprehensive and progressive series of contractor conducted tests, contractor certifications, and witnessed demonstrations. For projects that involve reuse of major portions of existing SCADA components, i.e. PLCs, the contractor shall provide a test plan and perform the FAT for only the new SCADA components.
- B. The basic testing requirements shall require the contractor to provide tests for all equipment and software. All software and all equipment including mechanical, instrumentation, electrical, and all other equipment related to the SCADA system shall be tested both individually and together as a system.

1.2 SUBMITTALS

- A. Comply with the provisions of Division 1 General Requirements, Submittals Section.
- B. For each state of testing provide the following (if applicable):
 - 1. Submit the test plan: testing forms, procedures and schedules of work, not less than two (2) weeks prior to the scheduled test date.
 - 2. Submit copies of the PLC program, HMI graphics, and/or simulation software on CD or via email. This submittal should also include any Active X or other controls required allowing full simulation to be presented at the Plant during the FAT.
 - 3. Submit copies of the current Process Control Narratives and New Tag Lists.
 - 4. The test plan must be approved in writing by the Engineer, prior to commencement and should show the schedule of work to include dates.
 - 5. Prior to beginning the Software Factory Acceptance Testing (FAT), the elements shall be subjected to system deliverable configuration and serialization verification. No equipment replacement or substitutions shall be permitted without Owner and/or Engineers approval.
 - 6. On completion of a FAT, a listing of any requested changes or deficiencies will be recorded and a subsequent FAT may be scheduled if required. Only upon signed acceptance by the Owner will hardware or software be deemed ready for installation.
 - 7. On completion of a SAT, a listing of any requested changes or deficiencies will be recorded and a subsequent SAT may be scheduled if required. Only upon signed acceptance by the Owner will hardware or software be deemed ready for acceptance by operations.

1.3 QUALITY ASSURANCE

- A. SCADA system providers shall maintain quality control over suppliers, manufacturers, products, equipment, software, services, site conditions, and workmanship, to produce Work of specified quality.
- B. The SCADA system provider shall maintain adequate records to provide evidence of quality and accountability. These records shall include results of inspections, tests, certification of processes and personnel, discrepant material (including records of disposition) and other quality requirements defined in the project requirements. These records shall be maintained and made available to the Plant at all times during the performance of the project and for the retention period as specified in the project.
- C. Inspection and testing records shall, as a minimum, indicate the nature of the observations, the number of observations made, and the number and types of deficiencies found. Records for monitoring work performance, inspection, and testing shall indicate the acceptability of work or products and the action taken to correct deficiencies

PART 2 EXECUTION

2.1 GENERAL

- 1. Testing and acceptance of all SCADA hardware and software is a multi-tiered approach required to ensure errors are caught early and that the desired process control and functionality is provided to the end user.

2.2 FACTORY ACCEPTANCE TESTING (FAT)

- A. The overall objectives of a Software Factory Acceptance Test are to:
 - 1. Confirm and document that the PLC I/O matches the type and quantity identified in the control schematics. Perform I/O checks to confirm the tag number.
 - 2. Confirm and document that the individual device logic operates all field equipment correctly and safely, as described in the detailed process narrative, logic flow charts and HMI functionality.
 - 3. Confirm and document that the software is fully integrated into the treatment process and plant/facility-wide control logic and operates correctly and safely, through the HMI (where applicable) as described in the detailed process narratives and logic flow charts.
- B. A FAT and verification for all deliverable equipment, software, and associated documentation shall be performed prior to the shipment of subsystems or major components.
- C. The equipment FATs shall be performed to verify that the equipment is manufactured and assembled correctly, is operating as designed, and is in compliance with the contractual requirements for the deliverables.

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- D. The FAT shall be performed to verify that the software and hardware will meet the functional and performance requirements of the SCADA system project.
- E. The contractor shall submit a FAT test plan to the Engineer for approval prior to the start of the FAT.

2.3 PANEL ACCEPTANCE TESTING (PAT)

2.4 I/O POINT CHECKOUT

- A. The SCADA system supplier shall perform a complete, end-to-end checkout for every I/O point from the field wiring terminal strip to a SCADA workstation. The I/O Point Checkout shall be witnessed by Owner's and Engineer's Representatives.
- B. Test signals shall be injected to verify the operation of each Analog Input (AI) and Discrete Input (DI). Each Analog Output (AO) and Discrete Output (DO) shall be also tested for proper operation.
- C. The SCADA system contractor shall develop a complete I/O Point Checkout Test Procedure. The test procedure shall identify the method to be used by the SCADA system supplier for injecting test signals for each input point type and the method to be used for verifying the appropriate output signals for each output point type.
- D. The SCADA system supplier shall program the PLCs to demonstrate that signals reporting under 4 mA and over 20 mA warn if negative or out of range values are detected.
- E. The SCADA system contractor shall develop a point checkout form for each I/O point. The point checkout form shall include the point ID, description, all checks performed for the point, date and time of the check, and a signoff block for the SCADA system contractor's representative, and the owner's representative. For each item checked, the form shall include both the expected value/result and the actual value/result witnessed.

2.5 SITE ACCEPTANCE TESTING (SAT)

- A. The SAT shall be performed to verify complete operation of the system, requiring a repeat of much of the factory acceptance tests but with the equipment installed at the permanent sites, and shall include additional tests required to verify field installed equipment which was not available at the factory.
- B. For projects that involve reuse of major portions of existing SCADA components, i.e., PLCs, the contractor shall provide a test plan and perform the Site Acceptance Test for the SCADA system including portions that could not be tested prior to equipment installation. The Owner must approve all testing on installed equipment.
- C. The SCADA system contractor shall:
 - 1. Verify the facility installation.

2. Demonstrate each functional requirement identified by the specification. This demonstration shall repeat the tests used during FAT, but using real rather than simulated conditions.
3. Demonstrate all equipment control functions, including the operation of automatic control strategies. Actuation of field devices shall be closely coordinated with Owner's staff.
4. Verify system performance parameters and system responses under field operational conditions.
5. Verify accuracy of documentation, especially operator's manuals, software documentation, and site operating instructions.

2.6 SITE AVAILABILITY DEMONSTRATION (SAD)

- A. Site Availability Demonstration (SAD) – At the completion of system SAT, the Plant will conduct a SAD test utilizing all equipment, software, and services provided under the project in the normal day-to-day operation of the system.
- B. The system shall be subjected to System Availability Demonstration evaluation for 30 days (720 consecutive hours). If at the end of the 30 days, the system availability is determined to be less than that required, the test shall continue on a day-by-day basis, dropping off the oldest day's test results. This sliding window concept shall continue until the system passes the test or until 45 days time has passed, at which time the Ann Arbor WWTP shall have the right to pursue other alternatives as specified under the project contract.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL, INSTRUMENT, AND CONTROL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General requirements for electrical power, instrumentation, and controls systems.

1.2 RELATED SECTIONS

- A. Section 00700 – General Conditions.
- B. Section 00800 – General Supplementary Conditions.
- C. Division 1 – General Requirements.
- D. Section 01000 – General Specifications.
- E. Section 16050 – Basic Electrical Materials and Methods.
- F. Division 13 – Special Construction.

1.3 SUBMITTALS

- A. Wiring Diagrams
- B. Master List of Spare Parts.

1.4 REFERENCES

- A. All equipment and workmanship shall be in conformance with the following documents:
 - 1. National Electrical Code, latest approved edition.
 - 2. Any and all Federal, State, and/or local codes, ordinances, or regulations.
 - 3. Latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories.
- B. All equipment shall be designed, constructed, installed, and tested in conformity with all requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, and OSHA, except as modified herein.

1.5 GENERAL REQUIREMENTS

- A. Unless otherwise specified, provide tools, equipment, apparatus, transportation, labor, and supervision to complete and place in satisfactory operation the work indicated on the Drawings

and specified herein. Where permits or inspection fees are required in connection to the work under this Specification, the Contractor shall secure such permits and pay all fees.

- B. Where any public or private utilities are encountered, the Contractor shall be responsible for any damages thereto resulting from his operations. Any existing lines or utilities damaged during the construction and which are not to be abandoned or removed, shall be replaced or repaired. The Contractor shall be responsible for determining the exact location of all underground or otherwise concealed utilities, conduit runs, piping, etc. which may interfere with construction or which require modifications.
- C. All work shall be done in conformity with the applicable requirements of the codes, rules, and regulations of public utilities and all others having jurisdiction.
- D. Where the Specifications describe or the Drawings show materials of higher quality than required by the above rulings and codes, the Drawings and Specifications shall govern the quality of materials which shall be furnished.
- E. The wire, conduit, and equipment sizes shown on the Contract Drawings are based on estimated ratings. If ratings of equipment as furnished under the Contract exceed the estimated ratings, the wire, conduit, and equipment sizes shall be adjusted to meet NEC requirements at no additional cost to the Owner.
- F. The phrase "below grade," when used in reference to the interior of buildings, rooms, or other structures in these Specifications and on the Drawings, shall apply to the entire internal volume of the room, area, or structure where 50% or more of the volume is actually below the average of the exterior finished grade elevations. In all other cases, the phrase shall only apply to the volume of space actually below finished grade.
- G. Dry locations are defined as interior; above grade; heated rooms, structures, buildings, cabinets, enclosures, etc. not normally subject to dampness or wetness. Damp locations are defined as interior; above grade; unheated rooms, structures, and buildings. Wet locations are defined as all outdoor areas; all underground rooms, structures, building areas, vaults, etc.; whether heated or unheated. Refer to National Electrical Code Article 100, "Location:" for additional definitions.

1.6 PROJECT CONDITIONS

- A. Before submitting his proposal, this Contractor shall be held to have examined the site and satisfied himself as to the existing conditions under which he will be obliged to work. The Contractor will be allowed no claim(s) for extra(s) due to his failure to make the above examination.

1.7 INSPECTION

- A. At the proper time, the Contractor shall file application for inspection of his work with the local, State, or National authority having jurisdiction and shall deliver to the Owner all required certificates attesting to approval by such authorities.

1.8 GUARANTEE

- A. The equipment and installation furnished under this Section shall be guaranteed for a period of one (1) year as specified under Section 01700, Contract Closeout, except as modified by the Division 16 Specifications.
- B. Repair and maintenance for the guarantee period is the responsibility of the Contractor and shall include all repairs and maintenance other than that which is considered as routine. (This is replacement of lamps, oiling, greasing, etc.) The Owner shall be the judge of what shall be considered as routine maintenance.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. All materials and equipment shall be new, except where specifically identified otherwise.
- B. All materials and equipment shall be listed or labeled by Underwriters' Laboratories, Inc., except for materials and equipment not available from any source with such listing and/or labeling, or as specifically required by the Division 16 Sections.
- C. All conductor terminations, lugs, and connectors on all equipment supplied under this Contract shall be 75°C rated for copper conductors.
- D. Concrete for electrical work shall be as specified in Section 03310. Concrete shall have a compressive strength, after twenty eight (28) days, of 3,500 psi (minimum).

2.2 LOOSE AND DETACHABLE PARTS

- A. The Contractor shall retain all loose and small detachable parts of the apparatus and equipment furnished under his Contract, until the completion of his work, and shall then turn same over to the Owner or his representative delegated to receive them and obtain from the Owner an itemized receipt, therefore, in triplicate, the Owner retaining the original. The Contractor shall retain one copy of this receipt for his files and shall attach the other two to any request for final payment for the work.

2.3 STANDARDS

- A. All materials shall be new and shall conform as a minimum with NEMA, ANSI, and Underwriters' Laboratories, Inc. (UL) in every case where such a standard has been established for the particular type of material in question.

2.4 SPARE PARTS

- A. Spare parts shall be provided for electrical equipment supplied under this Contract, as specified in individual Specification Sections, and shall be furnished and delivered to the Owner. Spare fuses are specified under Section 16477.

- B. Spare parts shall be packed and individually boxed for storing with each box labeled with the part's description including its part or catalog number, its use, and the equipment for which it is a part. Parts used during startup shall be replaced prior to acceptance.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All floor mounted equipment shall be provided with a 4 inch concrete pad, unless shown otherwise on the Drawings.
- B. Material and equipment furnished and installed by the Contractor shall be completely protected against damage, pilferage, dampness, or abuse until turned over and accepted by the Owner.
- C. Concrete shall be maintained in moist condition for at least five (5) days after placement, by means approved by the Owner.
- D. The installation of all electrical, instrumentation, and control equipment shall meet the requirements of the State and Federal Occupational Safety and Health Statutes.

3.2 DRAWINGS AND MEASUREMENTS

- A. Drawings shall be submitted in accordance with Sections 01300 and 01700 of these Specifications and as specified hereinafter. No work shall be undertaken until the Engineer has reviewed and approved the shop drawings. Only approved materials shall be installed and only approved installation methods shall be used.
- B. The Drawings show the arrangement, general design, and extent of the systems. The work is shown on the Drawings by symbols, as shown in a legend on the Drawings. Equipment is shown in its general location, except where in certain cases the Drawings may include details giving the exact location and arrangement. Existing, underground or otherwise concealed utilities, piping, conduit runs, etc. indicated on the Drawings are shown in approximate locations and orientations only; the Contractor shall field verify exact locations.
- C. The Drawings are not intended to be scaled for roughing-in measurements nor to serve as shop drawings. Where drawings are required for these purposes or have to be made from field measurements, they shall be prepared by the Contractor. Field measurements necessary to determine the required quantities of materials and fitting the installation of all materials and equipment into the building construction shall be taken by the Contractor.
- D. Installation drawings and manufacturer's shop drawings are required for all electrical, instrumentation, and control work. Installation drawings shall show panel layout, conduit connection sizes, and location and equipment foundations, details, and locations, accurately dimensioned. Exposed runs of conduit need not be dimensioned. Conduit layout and installation drawings shall be submitted for approval and shall show all conduit runs, complete from origination to termination, and shall indicate conduit sizes and fills, raceway system components, methods and spacing of supports, etc.

- E. Control schematics shall be provided for all new and modified existing control circuits. Control schematics shall use the ladder diagram type format incorporating line numbers, operation function statements, contact location line numbers with underlines indicating normally closed contacts. A description of operation of each device and complete written sequence of operation shall be provided with all control schematics, except MCC schematic diagrams. Format and symbols shall be as approved by the Owner. Wire and terminal numbers shall be clearly shown.
- F. Upon completion of the work, complete "As-Built" drawings shall be provided. For additional requirements see Section 01700, Contract Closeout, and Project Record Documents.

3.3 STORING OF EQUIPMENT

- A. All equipment shall be stored in accordance with the manufacturer's recommendations. A letter from the manufacturer shall be provided stating those recommendations.
- B. All equipment which has been set in place but not in operation shall be protected from damage or deterioration from whatever causes in accordance with the manufacturer's recommendations until the equipment has been accepted by the Owner.
- C. All wire and cable shall be stored on the original, manufacturer's reels, protected from the weather, and all cable end seals shall be maintained intact until the cable is installed.
- D. During construction, all electrical equipment insulation shall be protected against absorption of moisture and metallic components shall be protected against corrosion by strip heaters, lamps, or other acceptable means. This protection shall be provided immediately upon receipt of the equipment and maintained continuously.

3.4 CLEANUP

- A. After substantial completion and prior to final acceptance, all electrical equipment shall be cleaned up, interior and exterior, to be free of dust and other foreign matter. Internal components shall be vacuumed, including windings of dry type transformers, and wiped free of dust.
- B. De-energization of equipment to accomplish the cleaning work shall be done at a time as approved by the Owner.

3.5 PAINTING

- A. The exterior of all enclosures shall be cleaned and touched up with matching paint where scratched or marred so that the exterior presents an "as new" appearance.
- B. All factory finished equipment shall be protected from damage during erection, thoroughly cleaned after erection, and touched up as required. If the factory finish has, in the opinion of the Owner, been seriously damaged, the equipment shall be refinished as specified in Section 09900, Painting.

3.6 INSTALLATION OF OWNER FURNISHED EQUIPMENT

- A. Certain items of equipment will be furnished and delivered to the job site by the Owner for installation by the Contractor. The Contractor shall receive, move, rig, inspect, unpack, and otherwise handle the Owner furnished equipment at time of delivery to the job site. He shall thereafter provide protection against weather, pilferage, and other hazards, being fully responsible until completion of his Contract.
- B. At the time of receipt of Owner furnished equipment and accessories, the Contractor shall visually inspect the equipment and report any damage to the Owner's representative.
- C. After putting the equipment in place and making all connections, the Contractor shall test the equipment and accessories as specified under Section 16960.

3.7 SALVAGED ELECTRICAL EQUIPMENT

- A. All electrical equipment in the existing pump station that is removed and not reused shall be turned over to the Owner or disposed of as directed by the Owner. See the Drawings for additional demolition and renovation work requirements.

3.8 SUBSTANTIAL COMPLETION

- A. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete, in accordance with the Contract Documents, such that the Owner can occupy the facilities and/or utilize the system for its intended use.
- B. Substantial Completion shall be determined by the Owner and/or the Engineer based on completion of Testing, Start-up, and Demonstration requirements as specified in Sections 01650, 16960, 16970, and 16980.

END OF SECTION

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SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General electrical equipment and installation requirements.

1.2 RELATED SECTIONS

- A. Section 00700 – General Conditions.
- B. Section 00800 – General Supplementary Conditions.
- C. Section 01000 – General Specifications.
- D. Division 1 – General Requirements.
- E. Section 16010 – General Electrical, Instrument, and Control Requirements.
- F. Section 16195 – Electrical Identification

1.3 WORK INCLUDED

- A. The Contractor shall furnish all labor, material, and equipment required for the installation of the electrical systems, modifications to existing electrical systems, and the completion of the work as herein specified and/or indicated on the Drawings. It is the intent that the Drawings and Specifications, which are general only, shall provide for finished, first-class work, and that the equipment and appurtenances thereto shall be of such construction and details, and of such materials, as to function completely and properly, and so as to be of long life; and such as not to require excessive upkeep or maintenance; and that operation shall be simple and control convenient. Any items omitted therefrom which are clearly necessary for the completion of the work or its appurtenances shall be considered a portion of the work though not directly specified or shown. All work shall conform with NECA 1-2010, Good Workmanship in Electrical Contracting.
- B. The Contractor shall install and wire all remote mounted heating and ventilating thermostats, electrical components, and control panels furnished by the equipment suppliers under Division 15 of these Specifications.
- C. The Contractor shall provide and install all conduit and wire connections required between components of equipment and systems supplied under other Sections of these Specifications, where shown or indicated on the Drawings.

- D. The Contractor shall furnish and install complete secondary power distribution systems and modifications to existing secondary power distribution systems.
- E. The Contractor shall furnish and install complete auxiliary systems and existing auxiliary system modifications, as specified herein and as shown on the Drawings.

1.4 DESCRIPTION OF SYSTEMS

- A. Secondary power is 480Y/277 volts, 3 phase, 4 wire plus ground, 60 Hertz.
- B. Lighting system is 208Y/120 volts, three phase, 4 wire plus ground, 60 Hertz.

1.5 SUBMITTALS

- A. Short Circuit and Flash Hazard Analyses.
- B. Conduit and Equipment lay-out drawings.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. The Contractor shall furnish and install complete modifications to the existing secondary power supply system, together with all necessary supports, framing, hangers, and all other appurtenances. He shall furnish and arrange for the setting of anchor bolts, channels, etc. which are to be set in the concrete or in masonry walls. The work shall include, but is not limited to, the following major items:
 - 1. Raceway System
 - 2. Secondary Cables
 - 3. Grounding System
- B. The Contractor shall furnish and install complete modifications to the existing power distribution system, together with all necessary supports, framing, hangers, and all other appurtenances. He shall furnish and arrange for the setting of anchor bolts, channels, etc. which are to be set in the concrete. He shall connect and make operable any and all electrical equipment whether or not it was furnished under this section of the Specifications, except as stated in Division 15. The work shall include, but is not limited to, the following items:
 - 1. Variable Frequency Controllers (By Rockwell only)
 - 2. Electrical Equipment and Devices
 - 3. Raceway System
 - 4. Power Feeder and Branch Circuit Wiring
 - 5. Modifications to Existing Motor Control Centers
- C. The Contractor shall furnish and install complete modifications to the existing auxiliary systems, together with all necessary supports, framing, hangers, outlets, fixtures, panels, and all other appurtenances. He shall furnish and arrange for the setting of anchor bolts, concrete

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inserts, etc. which are to be set in the concrete or in masonry walls. The work shall include, but is not limited to, the following items:

1. Wire, Cable, and Raceways for all Auxiliary Systems
2. Alarm Devices
3. Warning Devices

PART 3 EXECUTION

3.1 DRAWINGS AND MEASUREMENTS

- A. Power feeders shall be run in individual conduits, from source to load, as indicated in schedules, wiring diagrams, or by home runs on the Drawings.

3.2 SHORT CIRCUIT AND FLASH HAZARD ANALYSES

- A. A revised power system short circuit analysis shall be provided by the Contractor to analyze the electrical system and verify the correct application of the power system devices and other power system components provided under this Contract. This and the following flash hazard and coordination analysis shall be carried from Unit Substation No. 4 through the five Motor Control Centers, the branch circuit protective devices and new VFDs within the existing Filter Building. The analyses shall include all existing electrical distribution system components to remain in service. An existing Short Circuit and Protective Device Coordination Study provided by Greeley and Hanson LLP, Revision 1, October 2001 shall be used as a basis for the required study of the portion of the electrical system in the Filter Building. A copy of this study will be provided to the Contractor after award of the Contract.
- B. A flash hazard analysis shall be provided by the Contractor to determine the flash protection boundary and the level of personal protective equipment (PPE) required for each switch enclosure, panel, device, and equipment containing electrical circuits per NFPA 70E. The results of this analysis shall be used to prepare arc-flash and shock hazard warning labels for new and existing electrical equipment enclosures, where required by the National Electrical Code.
- C. Provide six (4) bound documents and one (1) on a compact disk in an electronically readable format (e.g., PDF), each of which shall include complete short circuit and flash hazard analyses.
- D. In the short circuit analysis, provide calculation methods and assumptions, the base quantities selected, one-line diagram, source impedance data, impedance diagrams or data tables, typical calculations, tabulations of calculated quantities and results, conclusions, and recommendations. Provide calculated short circuit interrupting and momentary duties for an assumed three phase bolted fault at the main low voltage (480 volt) switchgear, motor control centers, variable frequency drives, branch panelboards, and other significant locations throughout the modified distribution system. Include in the tabulations: fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit kVA, and symmetrical and asymmetrical fault currents. Calculations shall be of the per unit impedance method on a 100 MVA or 1,000 kVA base.

- E. The flash hazard analysis shall include calculations of the flash protection boundary and incident energy for each piece of electrical equipment utilizing the formulas in NFPA 70E-2000 and IEEE Standard 1584. The analysis results shall include the following for each piece of electrical equipment:
1. Flash hazard boundary in inches.
 2. Incident energy of 18 inches from arc in calories per square centimeter (cal/cm²).
 3. PPE level.
 4. Limited approach distance (when door or cover is open) in inches.
 5. Restricted approach distance (when door or cover is open) in inches.
 6. Prohibited approach distance (when door or cover is open) in inches.
- F. The short circuit and flash hazard analyses may be prepared with a digital computer or by written calculations, but must include complete fault tabulations from the sources shown on the Drawings.
- G. The short circuit and flash hazard analyses shall be provided by an electrical power distribution equipment manufacturer or an electrical distribution systems analyst. Analyses shall be prepared by persons experienced in the work.
- H. The Drawings and Specifications indicate the general requirements for the electrical equipment being provided and existing electrical power equipment to remain and a one-line diagram is provided with the Greeley and Hanson study. Changes and additions to equipment characteristics may be suggested by the results of the short circuit and flash hazard analyses. Submit any such proposed changes and additions as a part of the analyses document. Necessary field settings of devices, adjustments, and modifications to equipment to accomplish conformance with the approved short circuit and flash hazard analyses shall be carried out by the particular manufacturer or by the Contractor at no additional cost to the Owner.

3.3 SEQUENCE OF CONSTRUCTION AND DEMOLITION

- A. The Contractor shall schedule his work in accordance with the following conditions:
1. Minimize the amount of time each pump is out of service by installing new equipment and wiring to the fullest extent possible prior to de-energizing circuits for modifications and re-energization.
 2. A maximum of one of the pumping system's equipment and associated controls may be out of service for any extended period of time (longer than sixteen hours); each pumping system includes new and/or refurbished process equipment and associated electrical equipment.
 3. The work shall be performed such that the pump station retains operation at the existing capacity, without interruption, and in such a way as to minimize the amount of time that any redundant equipment or system is out of service.
 4. Interruption and reconnection of power distribution and branch circuit conductors shall be scheduled and accomplished one at a time. For each pair of Pumps being replaced, the associated pump VFDs and the pump motor feeders shall be reconnected, tested, energized and run successfully prior to starting work on the next pair of pumps.
 5. Only one load or redundant process system may be out of service at any time and the work shall be accomplished in such a way as to minimize the amount of time that each load or system is out of service. Temporary equipment, connections, or systems may

be utilized to maintain pump station operations during construction, where approved by the Owner.

- B. The Contractor shall be responsible for coordinating and scheduling his work to minimize disruption of the Owner's operations. The Contractor shall schedule all service interruptions at times as approved by the Owner and shall obtain Owner approval, at least 72 hours in advance, of any scheduled power interruption during construction.
- C. The Contractor shall include all details of the sequencing of the above work in a schedule of work. The schedule of work shall include work to be performed relative to time of material delivery and length of time for installation and shall be coordinated with permissible outage times as determined by the Owner. The schedule shall be submitted for approval prior to the start of work.
- D. See Section 01950 for additional requirements.

END OF SECTION

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SECTION 16110

RACEWAYS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal conduit.
- B. Liquidtight flexible metal conduit.
- C. Fittings and conduit bodies.

1.2 RELATED SECTIONS

- A. Section 01600 – Materials, Products and Equipment.
- B. Section 16010 – General Electrical, Instrument, and Control Requirements.
- C. Section 16050 – Basic Electrical Materials and Methods.
- D. Section 16130 – Boxes.
- E. Section 16170 – Grounding and Bonding.
- F. Section 16190 – Supporting Devices.
- G. Section 16195 – Electrical Identification.

1.3 REFERENCES

- A. ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.
- B. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- C. ANSI/NFPA 70 – National Electrical Code.
- D. NECA 101-2006, Steel Conduits (Rigid, IMC, EMT).
- E. UL 6 Standard for Rigid Metal Conduit.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate materials, finishes, dimensions, listings, and standards compliance.

- C. Product Data: Provide data for conduit, tubing, duct, fittings, and accessories.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 01600.
- B. Accept conduit on site. Inspect for damage.
- C. Conduit shall be delivered at the construction site in not less than ten foot lengths; each length of conduit to have approval label of the Underwriters.
- D. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.6 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations, unless dimensioned. Route as required to complete the raceway system.

PART 2 PRODUCTS

2.1 CONDUIT AND FITTINGS

- A. Provide all conduit, conduit fittings, outlet boxes, pull boxes, supports, hangers, plates, and such other items as are incidental to or required for a complete installation, all of which shall be made of cast iron, malleable iron, or galvanized steel, unless indicated otherwise.
- B. No threadless couplings or running threads will be permitted on rigid conduits.
- C. No conduit smaller than 3/4 inch shall be used, unless otherwise indicated or specified.
- D. All raceways shall be marked with the manufacturer's name or trademark as well as type of raceway and size. This marking shall appear at least once every 10 feet and shall be of sufficient durability to withstand the environment involved.
- E. Wherever conduits cross building, or other structural expansion joints, the Contractor shall provide and install conduit expansion/deflection fittings as manufactured by O.Z./Gedney Type DX, Crouse-Hinds, Thomas & Betts, or equal, unless indicated on the Drawings as requiring an expansion fitting.

- F. Expansion fittings with copper, ground bonding jumpers shall be installed where indicated on the Drawings and shall be O.Z./Gedney Type AX with Type BJ bonding jumper, Crouse-Hinds, or equal.

2.2 RIGID METAL CONDUIT

- A. Rigid steel conduits shall consist of heavy wall, mild steel tube, hot-dipped galvanized with threads electrogalvanized after cutting, and especially selected with reference to uniformity of thickness and freedom from defects. All fittings shall be suitable and approved for use in rigid steel conduit systems.
- B. Manufacturers:
 - 1. Wheatland Tube Company
 - 2. Allied Tube & Conduit Corporation
- C. Rigid Steel Conduit: ANSI C80.1, UL 6.
- D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; UL Standard 514B; all steel fittings.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Anaconda "Sealtite" Type LA
 - 2. Electriflex
 - 3. AFC
 - 4. Thomas & Betts Corp.
- B. Description: Interlocked steel construction with PVC jacket.
- C. Fittings: ANSI/NEMA FB 1.
- D. All fittings used with this conduit shall be of the liquidtight type and shall be equipped with approved type grounding devices to insure continuity between the conduit and the connection. The fittings shall seal out vapors, coolants, oil, water, dust, and other foreign matter and shall be installed with a sealing O-ring between the fitting and the box. The fittings shall be "ST" series connections as manufactured by Appleton Electric Co., Ideal Industries 75-000 Series, or equal.

2.4 LIQUID TIGHT FLEXIBLE NON-METALLIC CONDUIT

- A. Manufacturers:
 - 1. Anaconda "Sealtite" Type CNP
 - 2. Electriflex Liqueatite Type LNMP
 - 3. AFC Type LFNC-A
 - 4. Thomas & Betts Corp.
- B. Description: Layered Type A construction with PVC jacket.
- C. Fittings: Non-metallic with UL marking "FNMC-A" or "LFNC-A".

- D. Liquidtight flexible non-metallic conduit shall consist of a water or oil resistant and flame retardant material. It shall be constructed of a seamless liner and cover, bonded together with one or more layers of flexible, braided, reinforcing cords.

2.5 MISCELLANEOUS FITTINGS AND MATERIALS

- A. Insulated grounding bushings shall be Type HBLG as manufactured by O.Z./Gedney, American Fittings Corp., Thomas & Betts, or equal.
- B. Insulating bushings shall be high impact resistant, thermoset plastic, 150°C rated, Type A as manufactured by O.Z./Gedney, American Fittings Corp., Thomas & Betts, or equal.
- C. All locknuts shall be of the sealing type, O.Z./Gedney Type SLG, Appleton, American Fittings Corp., Thomas & Betts, or equal.
- D. Liquidtight hubs shall have a sealing ring between the fitting and the box and an insulated throat to insure protection of the wires as pulled. Hubs shall be made of nodular or malleable iron steel, zinc plated for corrosion resistance, UL listed, and shall meet or exceed the requirements of UL test 514B. Liquidtight hubs shall be Bridgeport, O.Z./Gedney Type CHM, Ideal Industries 75-000 Series, American Fittings Corp., Thomas & Betts, or equal.
- E. Sealing fittings shall be Crouse-Hinds Co. Type EYS, Appleton, or equal. Sealing fittings used as water stops shall have an integral drain and shall be Crouse-Hinds Type EYD, Appleton, Thomas & Betts, or equal.
- F. Link seal for sealing conduits into sleeves and cored openings shall be Thunderline Corp. Model No. S, Metraflex Co. Metraseal, Calpico, or equal.

PART 3 EXECUTION

3.1 INSTALLATION OF RACEWAYS

- A. Install conduit in accordance with NECA 101-2006, Steel Conduits (Rigid, IMC, EMT).
- B. Arrange supports to prevent misalignment during wiring installation.
- C. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- D. Do not attach conduit to ceiling support wires.
- E. Arrange conduit to maintain headroom and present neat appearance.
- F. Identify raceway systems under provisions of Section 16195.
- G. Joints shall be made tight with standard couplings and corners turned with elbows or long radius bends in pipe.

- H. Exposed multiple runs of conduit indoors shall be supported on hangers suspended from concrete inserts or structural steel. Single runs of conduit may be attached to ceilings or walls by means of approved type anchors. Conduit and other equipment may be attached to structural steel only where approved by the Owner. All conduit shall be secured to the supports by means of galvanized malleable iron clamps using two bolts or machine screws. Conduit supports, hangers, and anchors shall be as specified under Section 16190.
- I. The use of wood plugs for anchoring raceways to concrete or masonry will not be permitted.
- J. All conduits installed exposed shall be run vertically or horizontally and shall be parallel or at right angles to the building or structure walls.
- K. The Contractor shall provide and install, where required, the additional steel to adequately support all conduits, boxes, and all other electrical equipment.
- L. All conduit shall be dry, clean, and free of obstructions before conductors are pulled in. If there is evidence of moisture, obstructions, or foreign matter in the conduit when the conductors are installed, the wiring shall be removed and the conduit cleaned to the satisfaction of the Owner. All wiring showing evidence of damaged insulation shall be replaced.
- M. All steel conduit run exposed shall be supported at intervals not exceeding 8 feet, unless shown otherwise on the Drawings. Multiple runs of conduit shall be mounted with steel supports so arranged that each individual conduit is clamped in place.
- N. Conduit installed on walls shall be mounted on spacers to provide not less than 1/4 inch space between the conduit and the wall.
- O. All conduit entrances through below grade walls and poured-in-place concrete roofs shall be installed through sleeves poured in place or through core drilled opening, unless poured in place.
- P. Sleeves for passage of conduits through below grade walls shall be constructed of heavy wall steel pipe with full circle continuously welded water stop plate. Sleeves shall be sized to accommodate the conduit and link seal combination as specified hereinbefore.
- Q. All conduits passing through openings or sleeves in below grade walls or floors shall be sealed in place and made watertight with link seal.
- R. All conduit stubs for future use shall be terminated with pipe caps.
- S. Conduit runs installed horizontally overhead shall allow a minimum of 7 feet of headroom, except where installed along structures, piping, equipment, or in other areas where headroom cannot be maintained because of other considerations.
- T. Field bends in conduit shall not be of a lesser radius than that of manufactured elbows of the same trade size and shall show no flattening of the conduit. Conduit bends shall be held to as large a radius as possible for ease in pulling of conductors and to provide a neatly installed appearance. Generally, conduits 1" and smaller shall be bent in the field. Other conduit bends

shall conform to the following: 2" and 2½" conduit, 24" radius, 3" and larger with a minimum radius of 36". Except where conduit runs are shown in exact detail on Drawings, the maximum length of straight conduit runs shall be 200 ft. between pull boxes, with 50 ft. deducted for each 90 degree bend and 25 ft. deducted for each 45 degree bend, reduction in length for all other angle bends shall be figured on a similar basis.

- U. Conduit parallel to or crossing uninsulated hot water or steam pipes shall be separated from same by 12", if parallel, or 7", if crossing. Where hot water or steam pipe lines are insulated, conduit shall clear the insulation surface by 2". Conduit shall not run directly under cold water lines.
- V. Conduit stub-ups into the bottom of NEMA Type 12, floor mounted enclosures, including motor control centers, shall enter the enclosure through individual holes in the bottom plate or sheet steel bottom and the openings shall be sealed around each conduit to maintain the enclosure's NEMA Type 12 rating.
- W. All conduits and sleeves passing through openings in walls above grade or floors shall be sealed in place and made watertight with non-shrink grout or other Owner approved sealant. Non-shrink grout used in floor or wall openings shall be of the non-metallic type. All openings in fire rated walls and floors shall also be sealed with a fire barrier sealing system capable of maintaining the designed fire rating of the wall or floor and suitable for sealing out smoke and fumes. The fire barrier sealing system shall be capable of passing the ASTM E-814 (UL 1479) fire test and shall be subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory; provide products by Hilti Construction Chemicals, Inc.; 3M™ Fire Protection Products; or equal.
- X. Openings in boxouts through floors or walls or in the bottom of electrical equipment shall be closed using split insulating blocks or non-shrink grout in a manner as approved by the Owner. All unused sleeves shall be capped or plugged at both ends with approved fittings.
- Y. Metallic sleeves containing a ground conductor shall be bonded at each end to the ground conductor.
- Z. The ends of all metallic conduits or elbows shall be cut square, reamed, and threaded.
- AA. The threads of all steel conduit connections concealed in concrete shall be coated at the time of installation with No. B69A45 Zinc clad primary coating, as manufactured by Sherwin William's Corp., Ideal Industries No. 40-630, CRC Chemicals Zinc-It, or equal.
- BB. The threads (metallic) of all below grade equipment connections including conduit, conduit fittings, pull and junction box covers, wiring device boxes, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly. Coating compound shall be NO-OX-ID "A Special" by Sanchem, Inc., Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, or equal.
- CC. Ground and bond metallic raceway systems under provisions of Section 16170.

- DD. All metallic conduits, except those terminated in metal boxes or enclosures without knockouts and secured with double locknuts, integral hubs, or liquidtight hubs, shall be terminated with insulated grounding bushings. Conduits terminated in metal boxes or enclosures without knockouts and secured with double locknuts shall be terminated with an insulating bushing.
- EE. All conduits and sleeves, metallic and non-metallic, intended for the passage of wire or cable and not terminated with a fitting, shall be terminated with a bushing or end bell.
- FF. All connections between metallic conduits and NEMA Type 1 or NEMA Type 12 steel boxes shall be made with double locknuts. All connections between conduits and NEMA Type 3, 3R, 4, and 4X boxes shall be made with watertight connections. Watertight connections shall consist of integral hubs or liquidtight hubs.
- GG. Electrical metal tubing or so called "Thin Wall" conduit and fittings shall not be used.
- HH. Raceway systems, in general, shall consist of Rigid Metal Conduit and fittings.
- II. Flexible conduit may be used only where rigid conduit is impracticable or where indicated on the Drawings.
- JJ. Liquidtight, PVC coated, flexible metal conduit and associated fittings shall be installed as follows:
1. All sections of flexible conduit larger than 1¼ inches in diameter shall be paralleled with a braided copper bonding strap connected between the last section of rigid conduit and the frame of the equipment to ensure a continuous ground.
 2. Liquidtight, PVC coated, flexible metal conduit shall be installed with watertight connectors and in minimum lengths without sharp bends.
- KK. All final conduit connections to motors and other machinery, equipment, and devices which may be subject to movement or vibration shall be made with 15" to 18" of flexible, liquidtight, metallic conduit.

END OF SECTION

SECTION 16123

WIRE AND CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building wire.
- B. VFD load wire.
- C. Instrumentation cable.
- D. Communications cables.
- E. Wiring connectors and connections.

1.2 RELATED SECTIONS

- A. Section 16050 – Basic Electrical Materials and Methods.
- B. Section 16110 – Raceways.
- C. Section 16130 – Boxes.
- D. Section 16190 – Supporting Devices.
- E. Section 16195 – Electrical Identification.

1.3 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code.
- B. Underwriters' Laboratories Standard UL-83.
- C. Federal Specification JC-30A.
- D. ANSI Standard C33.80.
- E. ICEA – Insulated Cable Engineers Association.
- F. ASTM – American Society for Testing and Materials.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.

- B. Product Data: Provide for all wire and cable.
- C. Test Reports: Indicate procedures and values obtained.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.

1.5 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Wire and cable routing shown on Drawings is approximate. Route wire and cable as required to meet Project Conditions.
- C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.6 COORDINATION

- A. Coordinate Work under provisions of Section 01039.
- B. Determine required separation between cable and other work.
- C. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.1 GENERAL

- A. All wires and cables shall be permanently identified, at intervals not exceeding 3 feet, indicating type, size, voltage rating, and manufacturer's name.
- B. All wires and cables shall be continuous and shall be delivered in reels or in coils. Reels and coils shall be plainly marked for complete identification, including the wire or cable size, the number of conductors, the type of wire or cable, length, weight, thickness and character of the insulation, and the name of the manufacturer.
- C. All coils and reels of wires or cables shall carry original date perforated inspection labels of the Underwriter's laboratories, Inc. showing the number of feet and type of wire contained.

2.2 MANUFACTURERS – BUILDING WIRE

- A. General Cable
- B. Southwire Corporation

2.3 BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor: Annealed, uncoated copper. All conductors shall be stranded. ASTM designation B-3.
- C. Conductor Temperature Rating: 90°C in wet locations; 90°C in dry locations.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation: ANSI/NFPA 70, Type THWN; high temperature polyvinyl chloride with nylon jacket.

2.4 MANUFACTURERS-VFD LOAD WIRE

- A. Southwire Corp.
- B. General Cable
- C. Okonite Okoguard-Okolon
- D. Prysmian Cables & Systems

2.5 VFD LOAD WIRE

- A. Description: Single conductor, ANSI/NFPA 70 Type RHW-2.
- B. Conductor: Annealed copper. All conductors shall be stranded. ASTM designation B-8, B-33, B-172 or B-174.
- C. Conductor temperature rating: 90°C in wet or dry locations; 130°C emergency overload rating.
- D. Insulation voltage rating: 1000 volts minimum.
- E. Insulation: Type RHW-2, Cross-linked Polyethylene (XLPE).

2.6 MANUFACTURERS – INSTRUMENTATION CABLE

- A. Single Pair Cable:
 - 1. Belden No. 8760
 - 2. Southwire Corporation
 - 3. General Cable/Carol Brand No. C2534.
- B. Multiple Pair Cable:
 - 1. Belden No. 9773 through No. 9777
 - 2. Southwire Corporation
 - 3. General Cable/Carol Brand No. C6047-C6051.

- C. Three Conductor Cable:
 - 1. Belden No. 8770.
 - 2. Southwire Corporation
 - 3. General Cable/Carol Brand No. C2535.

2.7 INSTRUMENTATION CABLE

- A. Description, general:
 - 1. Single pair cable shall be a single twisted pair, No. 18 gauge, stranded conductors with shield, drain wire, and overall jacket.
 - 2. Multiple pair cable shall be two or more individual twisted pair, No. 18 gauge, stranded conductors, each pair with shield and drain wire, and an overall jacket.
 - 3. Three conductor cable shall be three No. 18 gauge, stranded conductors with shield, drain wire, and overall jacket.
- B. Underground and General Use Cables:
 - 1. Conductors: Tinned copper.
 - 2. Insulation voltage rating: 300 volts.
 - 3. Insulation material:
 - a. Single pair cable – polyethylene.
 - b. Multiple pair cable – polyethylene or polypropylene.
 - c. Three conductor cable – polyethylene.
 - 4. Shield material: 100 percent aluminum polyester.
 - 5. Drain wire: Stranded, tinned copper.
 - 6. Jacket: Chrome vinyl (PVC).
- C. Riser and Plenum Use Cables:
 - 1. These cables shall be similar to the underground and general use cables specified above, except that the insulation and the overall jacket materials shall be either FEP or PVDF.

2.8 MANUFACTURERS – COMMUNICATIONS CABLE

- A. RS-232/422, RS-485/DH-485, Ethernet (Category 5), DH+ (Twinaxial), Unshielded twisted pair (UTP), and telephone cables shall be as manufactured by: Belden; Alpha; or Manhattan.
- B. Fiber optic Cables shall be 62.5/125 micron, multi-mode, tight-buffered, breakout type rated for indoor/outdoor use, shall be as manufactured by Optical Cable Corp. Ultra-Fox B-Series, Siecor, or AT&T.

2.9 COMMUNICATIONS CABLE

- A. Wire type communications cables shall meet all applicable standards of EIA/TIA, IEEE, and the NEC.

- B. Fiberoptic cable shall meet all applicable standards of EIA/TIA-4292.AAAA-1989, IEEE, and the NEC.
- C. Riser and Plenum Use Cables:
 - 1. These cables shall be similar to the underground and general use cables specified above, except that the insulation and the overall jacket materials shall be either FEP or PVDF.

2.10 MANUFACTURERS – WIRING CONNECTORS AND ASSOCIATED MATERIALS

- A. Solderless Pressure Connectors:
 - 1. 3M™ Company Model Scotchlok
 - 2. Thomas & Betts Model Sta-Kon
 - 3. Burndy Model Insulug Type TN
- B. Spring Wire Connectors:
 - 1. 3M™ Company Model Scotchlok
 - 2. Ideal Model Wing-Nut
- C. Compression Connectors:
 - 1. 3M™ Company Model Scotchlok
 - 2. Thomas & Betts Model Color-Keyed
 - 3. Burndy Model Hylug
- D. Tap Connectors:
 - 1. Thomas & Betts Model Color-Keyed
 - 2. Burndy Model Crimpit
 - 3. Anderson Model Crimptaps
- E. Watertight, Twist-On Connectors:
 - 1. 3M™ Company Direct Bury Splice Kits
 - 2. King Innovation “DryConn”
 - 3. Ideal Industries, Inc. Twister DB Plus
- F. Watertight, Insulated Connector Blocks:
 - 1. Utilco Type USPA-SS, Type PSA-SS, or Type PED-SS
 - 2. IlSCO Type USPA-SS
- G. Electrical Insulating Tape:
 - 1. 3M™ Company “Scotch” No. 33+
 - 2. Plymouth “Premium Black”
- H. High Temperature Tape:
 - 1. 3M™ Company “Scotch” No. 70
 - 2. Plymouth “Plysil”
- I. Fireproofing Tape:
 - 1. 3M™ Company “Scotch” No. 77

- 2. Plymouth No. 50
- J. Woven Fiberglass Tape:
 - 1. 3M™ Company “Scotch” No. 69
 - 2. Plymouth “Plyglas”
- K. Color Coding Tape:
 - 1. 3M™ Company “Scotch” No. 35
 - 2. Plymouth “Slipknot” No. 45
- L. Insulating and Watertight Sealing Materials:
 - 1. 3M™ Company “Scotchcast” kits
 - 2. Raychem WCS Series heat shrinkable sleeves
 - 3. 3M™ Company 8400 Series cold shrink materials
 - 4. 3M™ Company “Scotchkote” sealant
- M. Watertight Cord Grip Fittings:
 - 1. Crouse-Hinds CGB-SG Series
 - 2. Appleton Electric Co.
 - 3. Thomas & Betts
- N. Cable or Cord Strain Relief:
 - 1. Hubbell-Kellems
 - 2. Daniel Woodhead Co.
- O. Cable Pulling Lubricant:
 - 1. American Polywater “Dyna-Blue”
 - 2. Ideal “Aqua Gel”
 - 3. Minerallac “Golden Glide”
 - 4. 3M™ Company “GEL”

2.11 WIRING CONNECTORS AND ASSOCIATED MATERIALS

- A. All wiring connectors shall be 75°C rated and suitable for use on copper conductors.
- B. Cable or cord strain reliefs shall consist of stainless steel wire mesh with support bale. Strain reliefs shall be of the split rod type where required or indicated on the Drawings.
- C. Cable Pulling Lubricant:
 - 1. Lubricant shall be UL listed and approved for use on the cable jacket or insulation.
 - 2. Lubricant shall be polymer based and shall dry completely when exposed to air.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.

- B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

A. Interior Locations:

1. Wire for general power, light, and control shall be building wire, Type THWN insulation, in raceway.
2. Cables for instrumentation signals shall be single or multiple pair Instrumentation Cable.
3. All wire for connections between Variable Frequency Controllers and associated motors shall be VFD Load Wire.

- B. Use wiring methods indicated on Drawings.

C. Color Coding:

The color schedule for the conductor insulation of wire and cable shall conform to the following unless determined otherwise by the plant's ECSTs:

1. Three phase lighting and power, 208Y/120 VAC-Black, Red, Dark Blue, White or Gray, and Green ground.
2. Three phase lighting and power, 480 VAC-Brown, Orange, Yellow, and Green ground.
3. Three phase lighting and power, 480Y/277 VAC-Brown, Orange, Yellow, Gray, and Green ground.
4. DC power – Red with White stripe (+) and Light Blue with White stripe (-).
5. Single conductor control, AC voltage – Red.
6. Single conductor control, DC voltage – Blue.
7. Interlock control circuits in panels, energized from an external source – Yellow.
8. Alarm, annunciator, instrumentation, and telemetering (if not shielded), AC voltage – Pink.
9. Alarm, annunciator, instrumentation, and telemetering (if not shielded), DC voltage – Light Blue.
10. On wire sizes larger than Number 8 AWG and/or where authorized by the Owner, coding may be identified by taping with the appropriate colored self-adhesive vinyl color coding tape.
11. Grounding conductors shall be continuous green or bare for power systems.
12. DC signal grounding conductors shall be green with a white stripe
13. Neutral conductors shall be continuous white or gray for all systems.

D. Wiring Connections:

1. Dry location splices and tap connections shall consist of compression connectors or tap connectors, taped to 150 percent of insulation rating of the conductors.
2. Final connections to equipment wire leads for No. 8 AWG and smaller wire in dry locations only, except 480 volt motor leads, may be made with spring wire connectors.
3. Wet and damp location splices and tap connections shall consist of compression connectors or tap connectors with insulating and watertight sealing materials; water

4. tight, twist-on connectors for wire sizes up to three No.10 AWG; or watertight, insulated connector blocks; providing watertight connections suitable for direct burial.
4. All conductor terminations at screw terminals shall consist of solderless pressure connectors, except where conductor terminations are included with the equipment being connected.
5. Insulation of connections in lighting fixture and high temperature equipment shall consist of silicone rubber type high temperature tape with a woven fiberglass tape over-wrap.
6. Electrical insulating tape (plastic type) shall be used on all splice and tap connections, unless wire manufacturer's recommendations require otherwise.

3.4 INSTALLATION

- A. The installation of communication cables shall meet the requirements of NECA/BICSI 568-2001, Telecommunications.
- B. The installation of fiber optic cables shall be per NECA/FOA 301-1997, Fiber Optic Cables, requirements.
- C. All wiring shall be run in rigid metal raceway systems, underground conduit systems, or non-metallic FRP conduit systems, unless noted otherwise.
- D. Install products in accordance with manufacturer's instructions.
- E. The minimum size of conductors shall be No. 12 AWG, unless specifically approved and/or shown otherwise on the Drawings.
- F. Use stranded conductors for control circuits, No. 14 AWG minimum, unless shown otherwise on the Drawings.
- G. Use No. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 60 feet.
- H. Use No. 8 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet.
- I. Use No. 6 AWG conductors for 20 ampere, 120 volt branch circuits longer than 170 feet.
- J. Use No. 4 AWG conductors for 20 ampere, 120 volt branch circuits longer than 270 feet.
- K. Use No. 3 AWG conductors for 20 ampere, 120 volt branch circuits longer than 420 feet.
- L. Where conductors or cables are to be installed in non-metallic raceway systems, the Contractor shall allow 24 hours, minimum, for all solvents to evaporate after cementing the last joint before pulling wires or cables.
- M. Pull all conductors into raceway at same time. Cable pulling tensions shall not exceed manufacturer's recommended values.
- N. Use suitable wire pulling lubricant for wire, No. 4 AWG and larger, and for all cables. No soap flakes, vegetable oils, clays, or grease shall be permitted in raceways.

- O. Use suitable cable fittings and connectors.
- P. Neatly train and lace wiring inside boxes, equipment, and panelboards. Wires and cables shall be bundled and laced as specified in Section 16190.
- Q. All wires and cables routed through manholes, handholes, cable vaults, large pull boxes, and terminal cabinets shall be looped to provide two to three feet (minimum) of slack within the enclosure, where practical.
- R. Clean conductor surfaces before installing lugs and connectors.
- S. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- T. Wire and cable shall be supported in vertical runs by insulated clamps so that wire or cable weight will not be unduly supported from conductor terminations.
- U. Spade or fork tongue lugs shall not be used, except where approved by the Owner.
- V. Conductor terminations and tap splices within lighting fixture pole shall be suitable for wet or damp locations.
- W. Wires and cables shall, in general, be run continuously, without splicing, from origination to termination. No splices shall be permitted in any feeder circuit, except in outlet, junction, and/or pull boxes, or where specifically noted on the Drawings. Use sufficient length of wire for connecting to equipment without straining. All methods of splicing shall meet cable manufacturer's recommendations. All splices shall be carefully placed in outlet boxes, etc. without crowding. No splicing shall be permitted in signal cables.
- X. Splices and tap connections shall be made in junction boxes only; conduit type fittings shall not be used as junction boxes.
- Y. Wires and cables shall be installed in raceways, as indicated on the Drawings or required, and shall provide a complete and operating system.
- Z. All wires and cables shall be tagged as specified in Section 16195.
- AA. Motor control center feeder circuits and distribution panelboard branch circuits shall each be run in individual raceways from source to motor or other load.
- BB. Vertical lengths of wire and cable shall be supported as required by Article 300.19 of the National Electrical Code. Cable weight shall not be unduly supported from conductor terminations.
- CC. Vertical lengths of exposed cable or cord runs over ten feet long shall be supported with a strain relief.
- DD. Where an exposed run of cable or cord enters a box or enclosure, provide a watertight cord grip fitting suitable for the cable or cord diameter.

- EE. All 120 VAC, single phase loads shall be connected to provide a balanced load on the lighting transformers. All 480 VAC, single phase loads shall be connected to provide a balanced load on the 480 VAC, three phase system.
- FF. Make conductor length for parallel feeders identical on each phase leg.
- GG. Feeders shall be connected for correct phase rotation. Where possible, busses shall be connected to result in the "A" or "X" phase being in the north, east, or top position with the other phases following in sequence. The terminals H1, H2, and H3 of transformers shall be connected to A, B, and C; 1, 2, and 3; or X, Y, and Z conductors, respectively, of incoming feeders.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 16195.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.6 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Sections 01400 and 16960.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.
- E. Verify continuity of each feeder conductor.
- F. All communication cables shall be tested and certified by a qualified third-party after installation in accordance with industry standards, and copies of the certified test results turned over to the Owner.

END OF SECTION

SECTION 16130

BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.
- C. Wireways.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16110 - Raceways.
- D. Section 16140 - Wiring Devices.
- E. Section 16160 - Cabinets and Enclosures.
- F. Section 16190 - Supporting Devices.
- G. Section 16195 - Electrical Identification.

1.3 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- D. NEMA OS 2 - Non-metallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.

- B. Shop Drawings: Indicate materials, finishes, dimensions, listings, and standards compliance.
- C. Product Data: Provide data for boxes, wireways, and accessories.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Section 01700 - Contract Closeout: Submittals for Project closeout.
- B. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70, National Electrical Code.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to the authority having jurisdiction, as suitable for the purpose specified and indicated.
- C. All boxes shall be sized per Article 314 of the National Electrical Code as a minimum.

PART 2 PRODUCTS

2.1 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Non-metallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- D. Covers for boxes containing wiring devices shall be as specified in Section 16140.

2.2 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 16160.

- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Single and two gang pull boxes and junction boxes shall be rust proof, cast metal, Type FD boxes with gasketed covers.
- E. Larger boxes and raceways shall be NEMA Type 12, in indoor, above grade locations, or stainless steel NEMA Type 4 or non-metallic NEMA Type 4X with stainless steel hardware in all other locations or where indicated on the Drawings, built of Code gauge steel, with angle iron supports and braces. Cable support racks shall be provided where required. Access shall be by means of removable, gasketed screw covers fastened with machine screws.
- F. NEMA Type 4X boxes shall be of corrosion resistant, stainless steel suitable for surface mounting. Barriers shall be provided where indicated on the Drawings or required.
- G. All pull boxes installed below grade within the structures shall be provided with a drain, Crouse-Hinds ECD Universal Series, Appleton, or equal mounted on a bolt-on, gasketed hub or Stahlin Drain Vent on NEMA Type 4X boxes.
- H. In-line pull boxes, where shown on the Drawings, shall be Appleton Type PTC with solid gasket or equal.
- I. Threaded conduit fittings with gasketed covers shall be used for all exposed conduit outlets and boxes.
- J. Conduit bodies and fittings shall be of cast iron, malleable iron, and/or galvanized steel.

2.3 WIREWAYS

- A. Wiring ducts shall be NEMA Type 12 galvanized steel in indoor, above grade locations; non-metallic, NEMA Type 4X in corrosive locations; or stainless steel, NEMA Type 4 in all other locations or where indicated on the Drawings. Metallic wireways shall be 14 gauge steel raceways and all wireways shall be provided with removable covers held with captive screws. All fittings shall be designed to be used with the ducts to result in an unobstructed system. The ducts and fittings shall be sized as shown on the Drawings. All hardware on stainless steel and non-metallic wiring ducts shall be made of stainless steel.
- B. The wiring ducts shall be as manufactured by Keystone, Hoffman Engineering Co., B-Line, or equal.

2.4 MISCELLANEOUS COMPONENTS

- A. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID "A Special", or equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify locations of floor boxes and outlets in all work areas prior to rough-in.

3.2 INSTALLATION

- A. Install boxes in accordance with NECA "Standard of Installation."
- B. Install pull boxes and junction boxes in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Pull boxes and/or junction boxes shall be used in any conduit run where a splice is required. Pull boxes shall be provided every 200 feet of straight run, every 150 feet after 90 degrees of bends, every 100 feet after 180 degrees of bends, and every 50 feet after 270 degrees of bends. More than 270 degrees worth of bends shall not be installed between pulling points in any conduit run.
- D. Pull boxes, auxiliary pull fittings (slip joints), and cable raceways for the pulling, nesting, or concealment of wires or cables shall be provided where indicated on the Drawings and also where required, though not indicated, as specified above.
- E. Mark or label all boxes as specified in Section 16195.
- F. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- G. Enough room shall be supplied in boxes for insulating joints, wires, and bushings, and deep boxes shall be installed where required by the type of fixture or outlet called for on the Drawings.
- H. Wire and cable splices and tap connections shall be made in junction boxes only; conduit type fittings shall not be used as junction boxes.
- I. Electrical boxes are shown on Drawings in approximate locations, unless dimensioned. Adjust box location up to 8 feet, if required to accommodate intended purpose.
- J. Orient boxes to accommodate wiring devices oriented as specified in Section 16140.
- K. Maintain headroom and present neat mechanical appearance.
- L. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.
- M. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- N. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

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- O. At each concealed outlet in slabs or walls in dry locations only, a galvanized, pressed steel box of the knockout type, of not less than No. 12 B & S gauge, shall be placed and securely fastened. The conduits shall be fastened to these boxes with lock nuts, inside and outside, and bushings. All unused knockouts or holes must be left sealed.
- P. Support boxes independently of conduit.
- Q. Use gang box where more than one device is mounted together. Do not use sectional box.
- R. Use cast outlet box in exterior locations and wet locations.
- S. Set floor boxes level.
- T. Wall and ceiling mounted pull and junction boxes shall be spaced 1/2 inch minimum out from the wall or ceiling using corrosion resistant channel: Unistrut; Grinnell "Power-Strut", or other approved corrosion resistant spacers.
- U. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.
- V. The threads of all and below grade equipment connections including conduit, conduit fittings, pull and junction box covers, wiring device boxes, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.

3.3 ADJUSTING

- A. Section 01700 - Contract Closeout: Adjusting installed work.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused box openings.

3.4 CLEANING

- A. Section 01700 - Contract Closeout: Cleaning installed work.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 16160

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hinged cover enclosures.
- B. Cabinets.
- C. Terminal boxes.
- D. Accessories.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16110 - Raceways.
- D. Section 16130 - Boxes.
- E. Section 16190 - Supporting Devices.
- F. Section 16195 - Electrical Identification.

1.3 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
- C. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

- D. Certified shop drawings and diagrams shall be furnished by the Contractor and delivered to the Owner for approval as follows:
 - 1. General dimensions and outline drawings showing the principal dimensions of the equipment and the location and size of electrical conduit connections.
 - 2. Detailed drawings, descriptive data, and other data sheets showing design information which verified that the equipment meets the technical requirements of the Specifications.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.6 EXTRA MATERIALS

- A. Furnish under provisions of Section 01700.
- B. Provide three (3) of each cabinet key.

PART 2 PRODUCTS

2.1 CABINETS AND HINGED COVER ENCLOSURES

- A. Manufacturers: Manufacturers and model numbers of cabinets, enclosures, and associated components shall be as follows:
 - 1. Cabinets and Enclosures: Hoffman Engineering Co., Saginaw Controls, or Hammond.
 - 2. Anti-condensation Heaters: Saginaw Control & Engineering No. SCE-AHC50 or equal.
 - 3. Terminal Blocks: Allen-Bradley No. 1492-CA1, CA3, or -CD8.
 - 4. Substitutions: Items of equal function and performance are acceptable, if in conformance with all sections of this Specification.
- B. Cabinets and enclosures in dry locations shall be dust and oil tight, rated NEMA Type 12, and of 14 gauge (minimum) painted sheet steel construction.
- C. Cabinets and enclosures in wet locations shall be watertight, rated NEMA Type 4, and of 14 gauge (minimum) painted sheet steel construction.
- D. Cabinets and enclosures in corrosive areas shall be water, dust, and sleet tight, rated NEMA Type 4X, and of stainless steel construction.
- E. Doors shall be equipped with a padlockable latch or padlock hasp and shall be provided with one (1) padlock with three keys.
- F. The top, sides, and doors of outdoor cabinets and enclosures shall be insulated with a 2-inch thick layer of extruded polystyrene material.

- G. The doors shall be gasketed.
- H. Provide an internal, mild steel sub-plate for mounting of internal components.
- I. Provide and install two (2) minimum, 120 volt, anti-condensation heaters within each outdoor cabinet or enclosures. The heaters shall be of the self-limiting type, 50 watts, 120 VAC.
- J. Cabinets and enclosures shall be provided with full-length door hinges. Hinges shall be stainless steel and the doors shall have a one point latch.
- K. All interior cabinet or enclosure surfaces, except fittings, shall be painted with two coats of primer and two coats of white, high gloss, baked epoxy enamel paint. The exterior shall be painted with one coat of primer, two coats of ANSI 61 gray paint, and a final coat of clear polyurethane. All paint colors shall be reviewed and approved by the plant engineer.
- L. Terminal blocks shall be provided for all wiring entering cabinets and enclosures from external devices. Provide 10 percent spare terminals, in addition to those required.
- M. Terminal boxes shall be similar to cabinets and enclosures, except they shall have screw covers in lieu of hinged and latched doors.

2.2 ENCLOSURE ACCESSORIES

- A. All hardware on the exterior of NEMA Type 4 and NEMA Type 4X enclosures, including hinge pins, screws, bolts, nuts, washers, etc., shall be made of 300 series stainless steel.
- B. Combination drain and breather shall be Crouse-Hinds ECD Combination Series, Appleton, or equal. Combination drain and breather shall be Stahlin Drain Vent or equal on NEMA Type 4X enclosures.
- C. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID "A Special", or equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify installation conditions under provisions of Section 01039.
- B. Verify that surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.

- C. Install cabinet fronts plumb.
- D. NEMA Type 4 and Type 4X enclosures in other than corrosive areas shall be equipped with a combination drain and breather. The drain shall be mounted on a bolt-on, gasketed hub.
- E. All internal cabinet and enclosure components shall be mounted on the sub-plate positioned for easy access, convenient wiring, and for easy removal.
- F. Convenience receptacle mounted within cabinets and enclosures shall be mounted in a handy box with a cover plate.
- G. See Section 16110, Raceways for conduit entrance to cabinets and enclosures requirements.
- H. Mark or label all boxes, cabinets, and enclosures as specified in Section 16195.
- I. The threads of all corrosive area, hazardous area, outdoor, and below grade equipment connections including conduit, conduit fittings, pull and junction box covers, cable fittings, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.
- J. Cabinets and enclosures shall be mounted to walls, columns, machine frames, etc., with 1/2" separation from same, and all necessary spacers, brackets, structural pieces, inserts, anchors, and bolts shall be provided.

END OF SECTION

SECTION 16170

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Equipment grounding conductors.
- B. Bonding.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16960 – Electrical Testing and Equipment.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data for grounding electrodes and connections.
- C. Test Reports: Indicate facility's overall resistance to ground.
- D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Accurately record actual locations of grounding electrodes.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 MECHANICAL CONNECTORS

- A. All compression connectors, lugs, etc., used in grounding circuits in any location shall have bolts, nuts, etc., of silicon bronze alloy equal to "Everdur" metal. Grounding connections, clamps, etc., shall be as manufactured by Burndy Engineering Company, Thomas and Betts Company, Delta-Star Electric Company, or equal.
- B. Fittings for bonding a grounding conductor to metallic conduit shall be Thomas and Betts Series 3900BU or equal. Fittings for bonding a grounding conductor to its own conduit shall be Burndy Engineering Company GAR-BU Series, Thomas and Betts Series 3900, or equal.

2.2 EXOTHERMIC CONNECTIONS

- A. Connections to steel, between conductors, and for water stops shall consist of exothermic welding similar and equal to Burndy Engineering Company's "Thermoweld", Erico Products, Inc. "Cadweld Kits", or Thomas & Betts Corp. "Furseweld".

2.3 CONDUCTORS

- A. Grounding conductors, loops, and risers shall be bare, stranded, soft-drawn copper and shall be of the sizes indicated on Drawings.
- B. All bonding jumpers shall be copper and of a cross-sectional area at least equal to their corresponding grounding conductors.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Provide bonding to meet Regulatory Requirements.
- C. The non-current carrying parts of all electrical equipment installed under this Contract, including but not limited to raceways, raceway supports, and equipment enclosures, shall be bonded by means of bare copper cable or copper strap to the grounding system as shown on the Drawings and specified hereinafter.
- D. All exposed, including painted or coated, structural and architectural metal shall be bonded to the grounding system or rigidly secured to and in good electrical contact with grounded metal.
- E. All grounding cables, bus, etc., in locations where subject to mechanical damage, shall be protected by rigid metal conduit, steel guards, non-metallic conduit, or other suitable shield. In all cases, where conduit or other metallic encasement of grounding conductors is required, the conductor shall be permanently and effectively grounded to the enclosure at both ends of its length. This requirement applies to all such enclosures regardless of their length.

- F. Where grounding conductors pass through floor slabs, building walls, etc., and are not encased in the concrete pour, sleeves of rigid metal conduit or non-metallic conduit of the required size, shape, and length shall be provided with both ends of the sleeve sealed with duct seal after installation of the grounding conductor.
- G. Where attached to equipment, conduits, cabinets, etc., suitable approved solderless lugs, compression connectors, or clamps shall be used. No soldered connections shall be used on grounding circuits at any point.
- H. Where a grounding cable is to be bonded to structural or architectural metal, the exact location of each bond shall be approved by the Owner. The location of such grounding connections shall be at points where they will not be subject to mechanical damage and, if possible, shall be accessible for inspection.
- I. Where welding to steel is prohibited, the grounding conductor shall be bolted directly to the steel as approved by the Owner. The contact surfaces of all bolted connections shall be thoroughly cleaned and coated with Alcoa No. 2 Electrical Joint Compound or equal.
- J. All metal ducts, conduits, starters, panels, switches, etc., which are not rigidly secured to and in good electrical contact with the grounded structural metal frame of the building or grounded conduit system, or which are subject to excessive vibration and loosened ground contacts, shall be securely bonded to grounded building steel or to the grounded conduit system by means of stranded copper jumpers. This jumper shall have a circular-mil cross section of not less than 50 percent of that of the largest conductor entering the enclosure being grounded, with a minimum size of No. 8 AWG stranded copper being used in any jumper.
- K. Conduits which run to boxes or cabinets having concentric or eccentric knockouts which partially perforate the metal around the conduit and impair the electrical connection to ground shall be provided with approved bonding jumpers. Jumpers shall consist of a stranded, braided copper wire at least No. 8 AWG with solderless indent type lugs. Jumper shall be connected from a grounding type locknut or bushing on the conduit inside the box to a stud or silicon bronze alloy bolt in the cabinet frame.
- L. All metal support racks for electrical equipment and enclosures shall be securely bonded to grounded building steel or the grounding system with a No. 2 AWG grounding conductor.
- M. A copper ground conductor shall be carried for each power, lighting at 120 volts and higher, and receptacle circuit with the circuit conductors. The ground conductor shall have the same type insulation as the circuit conductors and shall be green in color through No. 10 AWG and bare copper wire for larger sizes.
- N. Motor control center and distribution panelboard grounding shall consist of ground connections to feeder conduits, ground busses, etc. as required or as indicated on the Drawings.
- O. Splices in wire or cable ground leads shall not be permitted.

3.2 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.2 REFERENCES

- A. NECA - National Electrical Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance. See Section 01600 for additional requirements.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

- C. Conduit and equipment supports and hangers shall be made of galvanized structural steel, with welded or bolted joints. Conduit and equipment supports and hangers shall be fabricated from "Unistrut" Series P1000 galvanized channels and fittings, as manufactured by the Unistrut Products Company, Superstrut A-1200 Series, Grinnell "Power-Strut" PS-200, or equal.
- D. All conduit and equipment supports, hangers, beam clamps (no "C" clamps shall be allowed), and other similar devices made of steel shall be hot dipped galvanized after fabrication. All hanger rods, U-bolts, bolts, nuts, and other threaded support components shall be electro-galvanized (per ASTM-B633 Type III SC1). Field cuts and all welds shall be coated with an approved cold or hot galvanizing compound: Z.R.C., CRC Chemicals Zinc-It, or equal. All hanger rods shall be 3/8 inch diameter minimum.
- E. Concrete inserts shall be of the continuous channel or spot type. The channel type shall be No. 12 gauge steel with integral anchors, Super Strut No. C-302, Kindorf No. D-990, or equal. Spot inserts shall be Super Strut No. 452, Kindorf No. D-255, or equal.
- F. Threaded anchors for use in concrete shall be self-drilling type expansion anchors made of case hardened and drawn carburized steel. The anchors and expander plugs shall be furnished with a rustproof finish. The expansion anchors shall be concrete fasteners as manufactured by the ITW "Red Head", Ideal Industries Co., or equal.
- G. Threaded anchors for heavy loads (i.e.: panels, transformers, disconnect switches) supported from masonry or precast concrete panels shall be epoxy based adhesive anchors with threaded rod and screen tube. Adhesives shall match the application, as recommended by the anchor manufacturer. Threaded rods, nuts, and washers shall be furnished with a rustproof finish. Adhesive anchors shall be Hilti Type HIT or equal.
- H. Anchors for light loads (i.e.: conduit clamps, outlet boxes, small pull and junction boxes) supported from masonry or precast concrete panels shall be lead type or plastic expansion anchors with corrosion resistant screws.
- I. Threaded rods, nuts, washers, screws, and bolts for anchors used in corrosive areas shall be made of 316 stainless steel. Also expansion anchors for light loads used in masonry or precast concrete panels in these areas shall be plastic only.
- J. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID "A Special", or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions. Tighten all bolted connections to manufacturer's recommended torque values with compensation for lubricated threads (anti-seize, lubricating and protective compound applied) to avoid over-torquing.

- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Do not anchor supports from pipes, ducts, mechanical equipment, or conduit.
- D. Do not use spring steel clips and clamps.
- E. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- I. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch (25 mm) off wall.
- J. All electrical enclosures, including raceways, boxes, panelboards, motor control equipment, etc., shall be securely attached to the building or structure walls by means of concrete inserts or expansion anchors, unless indicated as rack mounted on the Drawings or of free standing design. Unless otherwise indicated, all electrical enclosures, except conduit and outlet boxes, shall be spaced at least 1/2 inch from the wall or ceiling with Unistrut, Grinnell "Power-Strut", or equal.
- K. The use of wood plugs for anchoring raceways, cabinets, enclosures, or equipment to concrete or masonry will not be permitted.
- L. The Contractor shall provide and install, where required, the additional steel to adequately support all conduits, boxes, and all other electrical equipment.
- M. All wires and cables shall be laced when entering or leaving pull or junction boxes, and at each termination. Wires and cables shall be laced so that the wires of the individual circuits are laced together by circuit. All wiring entering and exiting electrical enclosures shall be bundled into groups. Power, lighting, control, alarm, annunciator, and instrumentation wiring shall be bundled and laced as specified herein.
- N. The threads of all below grade support connections shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.

1.2 RELATED SECTIONS

- A. Section 09900 - Painting.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide catalog data for nameplates, labels, signs, diagrams, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.

PART 2 PRODUCTS

2.1 NAMEPLATES AND LABELS

- A. The nameplates for Equipment Name / Designation shall be shall be 2-1/2" high by 6" wide (minimum), while detailed information nametags shall be 1-1/2" high by 3" wide (minimum), except pushbutton and selector switch stations and other enclosures where space is limited may have smaller plates of suitable size, and shall be attached to the equipment by means of corrosion resistant screws. Nameplates may be attached to equipment located in dry, interior areas by means of pressure sensitive, firm acrylic adhesive tape, 3M "Scotch" No. 468 or equal. The plates shall be white laminated plastic with engraved black letters, and shall be approximately 3/32" thick with beveled edges. Engraved letters on Equipment Name /

Designation nameplates shall be 3/4" high (minimum), block type, while detailed information nametags shall be 1/4" high (minimum), block type.

- B. Circuit number markers shall consist of self adhesive vinyl cloth or polyvinyl fluoride film markers with 1/8" high (minimum), black lettering on a yellow background, W. H. Brady Co. 3410 Series, Ideal Industries 44-500 Series and 44-600 Series, or equal. Circuit number markers may also consist of computer or typewriter generated, vinyl cloth, permanent, non-smearing, self-adhesive markers such as Brady Datab, BradyMarker XC Plus, 3M Scotchcode SCS or STS, or equal. Circuit number markers for panelboard circuit breakers may be the manufacturer's standard.

- C. Arc flash and shock hazard warning labels shall consist of self-adhesive vinyl or polyester signs, 3-1/2" by 5" minimum, with "! WARNING" header (black letters on orange field), "Arc Flash and Shock Hazard" subheader and write-in spaces for the following information:
 - ___ Flash Hazard Boundary
 - ___ cal/cm² Flash Hazard at 18 inches
 - ___ PPE Level _____
 - ___ Shock Hazard When Cover is _____
 - ___ Limited Approach
 - ___ Restricted Approach _____
 - ___ Prohibited Approach _____Equipment Name: _____

Warning labels shall be in compliance with NEC 110.16 requirements. Warning labels shall be Brady Signmark No. 89220, Lab Safety Supply Co. No. 68691, Seton Style No. M0548, or equal.

2.2 WIRE MARKERS

- A. Wire and cable tags for use in large pull boxes, large junction boxes, and handholes shall be made of minimum 1/8" thick white laminated plastic, 1-1/4" by 3-1/2", with black engraved identification in letters 3/64" deep by 3/16" high minimum. Tags shall be drilled at each end and secured twice to each cable by 3/32" minimum diameter polyethylene cord. Tags shall be engraved with the circuit number, equipment served, and associated nominal voltage level.

- B. Wire and cable number tags for use in pull or junction boxes and at termination points shall be computer or typewriter generated, vinyl cloth, permanent, non-smearing, self-adhesive markers such as Brady Datab, Brady Marker XC Plus, or 3M Scotchcode. Pre-printed, vinyl cloth, plastic coated, self-adhesive, tape markers as manufactured by W. H. Brady Co. or 3M Company shall also be acceptable.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive nameplates and labels.

3.2 INSTALLATION

- A. Nameplates shall be installed on the doors or covers of all panels, panelboards, starters, contactors, relays, control devices, signaling devices, and all other electrical equipment furnished under this Contract, except remote mounted pushbutton and selector switch stations, mounted adjacent to identified and associated disconnect switches or other control devices, need not be identified as described herein.
- B. Nameplate engraving for equipment and devices associated with motor control center, motor starters, panelboard, or control panel circuits shall match the engraving indicated in schedules on the Drawings, except nameplates for spare units and devices shall be furnished blank. All other nameplates shall be engraved as follows and shall be included on nameplate schedules submitted to the Owner for approval:
 - 1. First Line - Process description, equipment served, or area served (if applicable).
 - 2. Second Line - Equipment or device description.
 - 3. Third Line - Equipment or device designation number and power source circuit number.
 - 4. Abbreviations shall be used only where full wording will not fit. See the Drawings for nameplate details.
- C. All devices and equipment powered from lighting panelboards shall be marked with the appropriate circuit number(s). Lighting circuits shall be identified on switch cover plates, receptacles on cover plates, and other devices on enclosure door or on associated disconnect switch door or cover.
- D. The entire raceway system for intrinsically safe circuits shall be labeled "Intrinsic Safety Wiring" per National Electrical Code Article 504.80(B).
- E. All pull boxes shall be marked with the type of system within them, i.e.: 480V power, alarm, 120V control, etc.
- F. All wires and cables within control panels, motor starters, motor control centers, terminal boxes, etc. shall be tagged at each termination.
- G. The wires and cables of each circuit in pull boxes and junction boxes larger than 12" by 12" by 8" and handholes shall be bundled together, neatly arranged, and clearly identified with a tag secured with polyethylene cabling twine indicating circuit number, equipment served, and nominal voltage level.
- H. A system shall be developed and submitted to prevent duplication of wire numbers for all wiring external to equipment. Equipment numbers or designations may be used as prefixes. Interconnecting diagrams shall clearly show wire numbers, originating terminal numbers, and destination terminal numbers.
- I. All enclosures, panels, boxes, and devices containing electrical components and circuits with exposed, energized parts when the door is open, shall have an arc flash and shock hazard warning label affixed to the door. All label blank fields shall be filled in with permanent

markers according to the results of the Short Circuit, Flash Hazard, and Protective Devices Coordination Analyses, in Section 16050.

- J. Label or otherwise clearly identify all panelboard branch circuit breakers feeding emergency lighting and exit fixtures as required by National Electrical Code Article 700.12(E).

END OF SECTION

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SECTION 16477

FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fuses.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.

1.3 REFERENCES

- A. NFPA 70 - National Electric Code.
- B. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data sheets showing electrical characteristics including time-current curves and fuse let-through values for fault current available.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Submit series ratings for fuse and circuit breaker combinations, where applicable.
- C. Provide type II documents for motor starters.
- D. Record actual fuse sizes.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.7 MAINTENANCE MATERIALS

- A. Provide maintenance materials under provisions of Section 01700.

1.8 EXTRA MATERIALS

- A. Furnish under provisions of Section 01700.
- B. Provide ten (10) spare fuses of each size and type, rated 600 VAC and lower, installed.
- C. For additional spare parts requirements, see Section 16010.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bussmann
- B. Mersen
- C. Edison
- D. Littelfuse

2.2 FUSE REQUIREMENTS

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. Fuses shall be dual element or current limiting type, Class R, or as otherwise required for installation in existing equipment or in the equipment furnished, and as shown on the Drawings. Fuses shall provide type II protection for motor circuits.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fuses in accordance with manufacturer's instructions.
- B. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- C. All fuse holders shall be provided with fuses.

- D. The Contractor shall replace all blown fuses and the quantities specified above shall be turned over to the Owner at the time of completion.
- E. Spare fuses shall, be packed and boxed for storing with each box labeled with fuse rating, class, etc.

END OF SECTION

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SECTION 16482

MOTOR CONTROL CENTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Modifications to existing motor control centers.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16195 - Electrical Identification: Engraved nameplates.
- D. Section 16477 - Fuses.
- E. Section 16960 – Electrical Testing and Equipment.
- F. Section 16970 – Calibration and Start-up of Systems.
- G. Section 16980 - Demonstration and Training.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type.
- C. UL 198E - Class R Fuses.
- D. NECA 402-2007 – Motor Control Centers (ANSI).
- E. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Wiring diagrams shall be provided as specified under Section 16010.
- C. Test Reports: Indicate field test and inspection procedures and test results.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700.
- B. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NEMA ICS 2.3.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600.
- B. Deliver in shipping splits, individually wrapped for protection, and mounted on shipping skids.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with NEMA ICS 2.3. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Conform to NEMA ICS 2 service conditions during and after installation of motor control centers.

1.10 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on the Drawings.

1.11 EXTRA MATERIALS

- A. Furnish under provisions of Section 01700.
- B. For additional spare parts requirements, see Section 16010.

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PART 2 PRODUCTS

2.1 MODIFICATIONS TO EXISTING MOTOR CONTROL CENTERS

- A. The existing motor control centers shall be modified by the addition of new devices and by wiring revisions as shown on the Drawings.
- B. Nameplates shall be installed on the door of each unit and shall be attached by means of corrosion resistant screws. The plates shall be 1-1/4" high by 3-1/2" wide (minimum), white laminated plastic with engraved black letters. Letters shall be 1/8" high (minimum), block type. Nameplate engraving shall be as indicated in schedules on the Drawings, except nameplates for spare units shall be furnished blank. See the Drawings for nameplate details.
- C. Branch feeder protection shall be current limiting fuses of sizes as indicated on the Drawings and compatible with the existing fuse holders in the motor control center.
- D. The number and size of starters to be modified in each motor control center shall be as indicated on the Drawings.
- E. Each modified starter/fused switch shall have a reduced size, approved, "as-built," schematic wiring diagram, inside each unit, indicating all 480 volt power wiring, and all external components and wiring (shown dotted).
- F. Terminal blocks shall be installed, where required, to provide terminal block connections for all wiring to devices external to the motor control centers. All power feeder terminals or lugs shall be 75°C rated for copper conductors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify conditions under the provisions of Section 01039.

3.2 INSTALLATION

- A. Install motor control center components in accordance with manufacturer's instructions and per NECA 402-2007 Standards.
- B. Install fuses in fusible switches.
- C. Provide labels and engraved plastic nameplates under the provisions of Section 16195.
- D. Arc flash and shock hazard warning labels shall be provided on an upper door of each vertical section and shall be marked as specified in Section 16195.

3.3 FIELD QUALITY CONTROL

- A. Field inspection and testing shall be performed under provisions of Sections 01400 and 16960.

- B. Inspect and test motor control center and each added or modified controller to NEMA ICS 2.

END OF SECTION

SECTION 16483

VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Six (6) pulse variable frequency controllers.

1.2 RELATED SECTIONS

- A. Section 03310 – Concrete Work: Concrete Pads and Foundations.
- B. Section 16010 – General Electrical Instrument, and Control Requirements.
- C. Section 16050 – Basic Electrical Materials and Methods.
- D. Section 16170 – Grounding and Bonding.
- E. Section 16195 – Electrical Identification.
- F. Section 16960 – Electrical Testing and Equipment.
- G. Section 16970 – Calibration and Start-up of Systems.
- H. Section 16980 – Demonstration and Training.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Include front and side views of enclosures with overall dimensions and weights shown; conduit entrance and exit locations and requirements; and nameplate legends.
- C. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, schematic diagram, component list and enclosure details.

- D. Test Reports: Indicate field test and inspection procedures and test results.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Manufacturer's Field Reports: Indicate start-up inspection findings.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700.
- B. Operation Date: Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.
- C. Maintenance Data: Include routine preventive maintenance schedule.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten (10) years documented experience, and with service facilities within 100 miles of project.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600.
- B. Accept controllers on site in original packing. Inspect for damage.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

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1.10 EXTRA MATERIALS

- A. Furnish under provisions of Section 01700.
- B. Furnish one (1) set of replaceable contacts for each type of relay installed in variable frequency controllers furnished under this Contract.
- C. Furnish one (1) control switch assembly of each type installed in variable frequency controllers furnished under this Contract.
- D. Furnish two (2) of each air filter element installed.
- E. Furnish one (1) of each size cooling fan installed.
- F. For additional spare parts requirements, see Section 16010 and Section 16477.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Rockwell PowerFlex 753.
- B. No substitutions.

2.2 VARIABLE FREQUENCY CONTROLLERS (VFD) DESCRIPTION

- A. General
 - 1. The variable frequency drive (VFD) motor controller shall convert 460 Volt, three-phase, 60 Hertz utility power to adjustable voltage (0 - 460V) and frequency (0 - 60 Hz) three-phase, AC power for stepless motor speed control with a capability of 10:1 speed range. All general options and modifications shall mount within the adjustable frequency controller enclosure.
 - 2. The VFD shall be rated 460V as shown on the Drawings. The VFD shall provide a microprocessor-based adjustment of three phase motors. The variable frequency and voltage output shall provide constant volts per Hertz excitation for the motor up to 60 hertz. The controllers shall be rated as shown on the Drawings. As a minimum the full load output current of the drive shall be 243 amps equal to the equivalent motor horsepower plus a 1.15 service factor as listed by National Electric Code Table 430.150.
 - 3. The VFDs shall be capable of operating any NEMA B squirrel cage induction motor, regardless of manufacturer, with a load rating within the capacity of the VFDs.
 - 4. The VFD package shall include control and time delay relays and other control components required for pump control, as indicated on the Drawings.
 - 5. The VFDs shall utilize a Voltage Source Pulse Width Modulated (PWM) technique for producing adjustable frequency speed control.
 - 6. The VFD shall include output short circuit protection for line-to-line and line-to-ground faults.

- B. Specific Design Requirements for VFD Units.
 - 1. VFD shall be sinusoidal input VFD control shall also include transient voltage suppression to allow reliable operation on a typical industrial power distribution system.
 - 2. VFD shall be of the six (6) pulse rectifier and pulse width modulated (PWM) design, and shall provide microprocessor based, software programmable protection and operation of a three phase motor.
 - 3. A NEMA Type 12 enclosure shall be provided for the VFD unit.
 - 4. Provide an input circuit breaker, interlocked with the enclosure door, with flange-mounted handle to provide positive disconnect of incoming AC power. The circuit breaker shall be rated for 42,000 AIC minimum.
 - 5. Provide an integrally mounted input line reactor, sized for the VFD load and designed to limit harmonics on the power distribution circuit.

2.3 DESIGN OF VFD UNIT

- A. Employ microprocessor based inverter logic, isolated from power circuit.
- B. Employ switching power supply operating off DC link.
- C. Design for ability to operate controller with motor disconnected from output.
- D. Design to attempt five (5) automatic restarts, following fault conditions, before lock-out.
- E. Speed droop shall reduce the speed of the drive on transient overload.
- F. Critical speed avoidance circuit.
- G. A door mounted keypad with operational and diagnostic messages display unit (2-line, 24-character min., LCD display).
- H. "Self-Test" software program to verify proper keypad operation.
- I. Minimum efficiency of 96 percent at full load and speed and 80% at 50% speed and load.
- J. Displacement power factor between 1.0 and 0.95 lagging, over entire range of operating speed and load.
- K. Output voltage regulator to maintain correct output v/Hz ratio despite incoming voltage variations.
- L. Password security to protect drive parameters from unauthorized personnel.
- M. All program settings shall be stored in non-volatile memory to prevent loss during power outages.
- N. AC input line current limiting fuses rated 200,000 AIC or circuit breaker rated 65,000 AIC for fault current protection of AC and DC converter section.

- O. The controller shall be designed and constructed to operate within the following service conditions:
1. Elevation: 0 to 3300 feet.
 2. Ambient Temperature Range: 0°C to 40°C.
 3. Atmosphere: Non-Condensing relative humidity 0 to 95%.
 4. AC Line Voltage Variation: -5% to +10%.
 5. AC Line Frequency Variation: ± 3 Hertz.
 6. AC power: 480V, 3 phase, 60 Hz power supply.

2.4 PRODUCT FEATURES

- A. Display: Provide integral display to indicate output voltage, output frequency in hertz, output current, speed demand in percentage, control mode: (manual/automatic), total three-phase kW, time, date, drive temperature, elapsed time meter, motor RPM.
- B. Status indicators for protective functions: Separate indicators for overcurrent, over voltage, under voltage, over frequency, phase loss, over temperature, ground fault, etc.
- C. Volts per Hertz Adjustment: plus or minus ten percent.
- D. Current Limit Adjustment: 60 to 110 percent of rated.
- E. Acceleration Rate Adjustment: 0.5 to 30 seconds.
- F. Deceleration Rate Adjustment: 1 to 30 seconds.
- G. Provide “Hand - Off - Auto” control selector switch, “Auto” – “Manual” speed signal selector switch, manual speed control potentiometer, and LED type pilot lights for “Running”, “Fault”, and “Auto Ready” on the VFD control panel door.
- H. Input signals: 4-20 MADC and start/stop signal (120 VAC) from PLC.
- I. Output signals: Contact closure outputs for “In Auto/Ready”, “Fault”, and “Running”.
- J. Safety Interlocks: Provide terminals for remote contacts to inhibit starting under both manual and auto mode.
- K. Input line fuses or breaker for circuit protection.
- L. An “Emergency Stop” circuit shall utilize dynamic braking.
- M. Motor control circuit shall incorporate control, protective relay, and alarm circuits as required to coordinate with the ancillary, protective, and alarm devices supplied by the pump or motor manufacturer.
- N. Output signals from VFD:
1. Analog output signal 4-20 MADC proportional to output frequency.
 2. Run relay with two isolated sets of form C contacts.

3. Dry contacts (2 amps at 120 VAC) to indicate VFD ready, running, and fail on a remote panel. Running contacts shall indicate that the motor is running. Fail contacts shall indicate VFD trouble or motor shutdown due to protective circuits.
- O. Laminated plastic nameplate engraved with the drive's designation, as indicated on the Drawings.
- P. Each controller shall have a reduced size, approved, "as-built," schematic wiring diagram, in ladder diagram format, inside each unit, indicating all internal components and wiring terminal strip connections, all 480 V. power wiring, all 120 V. control and power wiring, all instrument wiring, and all external components and wiring (shown dotted). Wiring diagrams shall have a plasticized coating to protect them from dirt, heat, and normal wear and tear.
- Q. VFD shall include digital communications. Ethernet/IP protocol port shall be provided to allow direct communication with a programmable logic controller, or a psetup diagnostic computer.

2.5 FABRICATION

- A. The VFD systems shall be fabricated by the same VFD manufacturer, to assure a properly coordinated system.
- B. All VFD components shall be factory mounted and wired. Free-standing enclosures shall be suitable for mounting on a concrete housekeeping pad.
- C. Enclosures shall be not less than 16-gauge steel with surface thoroughly cleaned and phosphatized prior to painting. They shall be primed with a corrosion-resisting coating. Cabinet finish paint to be ANSI 61 Gray.
- D. Overall dimensions of fabricated VFD units shall fit within the available space indicated on the Drawings.

2.6 VFD SOFTWARE

- A. The VFD systems shall be supplied with setup, programming and maintenance software furnished by the same VFD manufacturer, to assure a properly coordinated system.
- B. One (1) copy, with media and license, of the Rockwell Automation Bulletin 9303 DriveTools SP Software Suite shall be provided and installed on an Owner's computer as directed by the Owner.

PART 3 EXECUTION

3.1 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment provided under this Section. All tests shall be in accordance with the latest version of UL and NEMA standards.

- B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.2 EXAMINATION

- A. Verify conditions under provisions of Section 01039.
- B. Verify that surface is suitable for controller installation.
- C. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

3.3 PREPARATION

- A. Provide concrete housekeeping pad under the provisions of Section 03310, for VFD units.

3.4 INSTALLATION

- A. Install controller where indicated, in accordance with manufacturer's written instructions and NEMA ICS 3.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Install fuses.
- D. Provide labels and engraved plastic nameplates under the provisions of Section 16195.
- E. Provide neatly typed label inside each controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.
- F. Arc flash and shock hazard warning labels shall be provided on the door of each vertical section and shall be marked as specified in Section 16195.
- G. Install the motor leads in grounded metal conduit or provide shielded cable motor leads with the shield grounded.

3.5 FIELD QUALITY CONTROL

- A. The following Services shall be provided for all new and all existing /reconnected VFDs.
- B. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this Section, and the re-startup of the existing VFDs. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.
- C. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative.
 - 1. Inspection and final adjustments.
 - 2. Operational and functional checks of VFDs and spare parts.

- D. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- E. The Contractor shall provide three (3) copies of the manufacturer's field start-up report.

3.6 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Sections 01400 and 16970.

3.7 ADJUSTING

- A. A qualified factory-trained manufacturer's representative shall assist the Contractor in the setting, and adjustment of all drive parameters to assure proper operation of pump system. Obtain performance requirements from installer of driven loads.
- B. ALL VFD Parameter settings shall be documented in both printed format, and in electronic files suitable for use with the drive manufacturer's software specified above.
- C. ALL VFDs, new and existing, shall be set up to automatically reset and restart after a power failure. Power failure shall be any complete loss, undervoltage, phase imbalance, phase loss, or phase reversal. Drive shall not 'lock-out' under these conditions, shall not require manual reset after these conditions clear, but shall automatically reset and restart/re-enable after the power failure clears.

3.8 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.

3.9 DEMONSTRATION

- A. Provide systems demonstration under provisions of Section 16980.
- B. Demonstrate operation of controllers in automatic and manual modes.

3.10 TRAINING

- A. Training may not be scheduled until startup and operation of the equipment has been completed and documented per Section 01650.
- B. The Contractor shall provide multiple training sessions for Owner's personnel as described and required under Section 01650. Each training session shall be held during the normal working hours for the shift, or as coordinated in advance with the Owner.
- C. The training sessions shall be conducted by a manufacturer's qualified representative. And shall address all new and reconnected existing VFDs.
- D. The training program shall consist of instructions on the proper maintenance of the equipment, and in the operation of the equipment.

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END OF SECTION

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SECTION 16960

ELECTRICAL TESTING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Division 16 testing requirements.
- B. Sample forms.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control: Manufacturer's Field Reports.
- B. Division 13 – Special Construction.
- C. Section 16010 - General Electrical, Instrument, and Control Requirements.
- D. Section 16050 - Basic Electrical Materials and Methods.
- E. Section 16970 – Calibration and Start-up of Systems.

1.3 REFERENCES

- A. All testing methods shall be in conformance with the following documents:
 - 1. National Electrical Code, latest approved edition.
 - 2. Any and all Federal, State, and/or local codes, ordinances, or regulations.
 - 3. NETA Acceptance and Maintenance Specifications and Safety Guidelines.
- B. All equipment shall be tested in conformity with all requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, UL, and OSHA, except as modified herein.

1.4 SUBMITTALS

- A. Submit on Products under provisions of Section 01300.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit test results under provisions of Section 01650.

1.6 QUALIFICATIONS

- A. Cable testing shall be performed by technicians trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must

evaluate the test data and make an informed judgment on the continued serviceability or non-serviceability of the specific equipment.

PART 2 PRODUCTS

None.

PART 3 EXECUTION

3.1 TESTING

- A. The Contractor shall perform all testing necessary to ensure that the work performed under the Contract is satisfactory and in conformity with the requirements of the Contract Documents.
- B. All testing shall be performed prior to start-up of equipment or systems as specified under Section 16970.
- C. All tests shall be witnessed by the Owner's Representative and four (4) copies of all field tests, as specified herein and in other Sections, shall be submitted to the Owner. Twenty-four (24) hours (minimum) written notice shall be given the Owner prior to performing the tests. Such tests shall be scheduled at a time agreed upon by the Owner and the Contractor.
- D. Testing shall include, but shall not be limited to, the following tests:
 - 1. Insulation resistance to ground of all conductors and equipment.
 - 2. Continuity, connections, and integrity of the facility's entire grounding system.
 - 3. Continuity, polarity, phase sequence, and connection of all current carrying conductors and equipment.
 - 4. Temperature rise of all connections which show evidence of abnormal heating.
 - 5. Ground fault detection systems shall be tested in accordance with the NEC, UL, and manufacturer's recommendations.
 - a. Wire insulation tests shall be made with a 1000 volt megger on 480 volt power distribution cables and/or wires. Each test shall be continued for a time sufficient to charge the cable or wire.
 - 6. The following information shall be included in a test report on each cable:
 - a. Complete identification of cable, including approximate length.
 - b. Approximate average cable temperature.
 - c. Megger readings versus time data, including converted values (480 volt cables only).
 - 7. In order to be acceptable, the cable must have satisfactory megger readings.
- E. All improper connections, or materials, and equipment not adapted to the purpose for which it is intended, or material, or equipment found to be faulty while performing the tests, shall be corrected; and any changes or repairs necessary to put the work in satisfactory condition and operation shall be done by the Contractor and re-tested at no additional cost to the Owner.

3.2 CONTRACTOR'S ASSISTANCE

- A. Testing of Package equipment, as described in Section 16010, shall be as required in other Sections of this Specification.
- B. The Contractor shall provide the services of an electrician to assist either the Contractor or the equipment manufacturer's service representatives on any and all field test and adjustments as may be made or required by equipment manufacturers or the Contractor as the equipment is put into service. The Contractor shall make equipment manufacturers' service representatives available as required to assist in testing or putting equipment into operation.

END OF SECTION

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CABLE TEST CERTIFICATE

1.0 TECHNICIAN INFORMATION

Company Name: _____ Contact Person: _____
 Address: _____ Phone No.: _____

2.0 CABLE IDENTIFICATION

Cable Designation or Circuit No.: _____
 Cable Source _____ Air Temperature _____
 Termination Point _____ Humidity _____
 Connected Equipment _____ Equipment Temperature _____

Test Voltage _____ No. of Conductors _____ Age _____
 Length _____ Size _____ Operating Voltage _____
 Cable Type _____ Rated Voltage _____ Ground Type _____

Manufacturer _____ Insulation Type _____
 Insulation Thickness _____ Installed In _____
 Conductor Material _____

Phase Color Identification

Phase A: _____ Phase B: _____ Phase C: _____

3.0 TEST INSTRUMENT

Manufacturer _____ Model No. _____

4.0 POWER CABLE TEST – MEGGER TEST

Time Minutes	Phase A Megohms		Phase B Megohms		Phase C Megohms	
	Before	After	Before	After	Before	After
.25						
.50						
.75						
1.00						
1.25						
1.50						
1.75						
2.00						
2.25						
2.50						
2.75						
3.0						
4.0						
5.0						

5.0 CERTIFICATION

I certify that the above information is correct and that the cable installation and condition conforms to manufacturer and Contract Specification requirements, unless otherwise noted.

Technician Signature: _____ Date: _____

6.0 ENGINEER REVIEW

Test Witnessed: Yes No Reviewer Signature: _____ Date: _____

SECTION 16970

CALIBRATION AND START-UP OF SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for Setup and Calibration of devices and instruments.
- B. Requirements for Start-up of Systems furnished/installed under this Contract.
- C. Calibration equipment requirements.
- D. Sample Forms.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control: Manufacturer's Field Reports.
- B. Section 01650 – Equipment Start-up Demonstration and Facility Commissioning.
- C. Division 13 – Special Construction.
- D. Section 16010 - General Electrical, Instrument, and Control Requirements.
- E. Section 16050 - Basic Electrical Materials and Methods.
- F. Section 16960 - Electrical Testing and Equipment.

1.3 REFERENCES

- A. All setup, calibration, and workmanship shall be in conformance with the following documents:
 - 1. National Electrical Code, latest approved edition.
 - 2. Any and all Federal, State, and/or local codes, ordinances, or regulations.
- B. All equipment shall be designed, constructed, installed, tested and calibrated in conformity with all requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, UL, and OSHA.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Provide start-up demonstration documents per Section 01650.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit calibration, setup and programming documentation under provisions of Section 01650.

PART 2 PRODUCTS

None.

PART 3 EXECUTION

3.1 START-UP REQUIREMENTS

- A. Setup, calibration and start-up of equipment and/or systems shall be performed as described below, and per the requirements of the Section under which the equipment/system was furnished.
- B. The Contractor shall also verify operation of the facility's main control and monitoring systems, as specified under Division 13, and coordination with all other equipment and sub-systems.
- C. Prior to scheduling Start-up of any equipment and/or system, the Contractor shall have complied with the requirements of Section 16960, Electrical Testing and Equipment, and shall have submitted reports indicating successful completion of testing for the equipment/system being started.
- D. Prior to energizing and operating any equipment or system, the Contractor shall arrange for the manufacturer's representative to inspect the installation for compliance to the manufacturer's recommendations. As a part of this inspection, the Contractor and/or the manufacturer's service personnel shall set all protective devices as required by the Short Circuit, Flash Hazard, and Protective Devices Coordination Analyses specified under Section 16050.
- E. The Contractor shall energize the equipment/system and perform all setting of equipment limit and safety switches. The calibration of all sensing relays, and all timer/sequencer, etc. settings, along with any programming required for proper operation shall be made at this time. The Contractor shall then start-up the equipment/system and verify the proper operation of all features and functions as required by the Specifications and Drawings.
- F. After completing the above items, the Contractor shall schedule a "Witnessed" Start-up. Coordinate Start-up Demonstration per Section 01650. Start-up shall be scheduled at a time agreed upon by the Owner and the Contractor.
- G. Start-up and operation of the equipment and/or system shall be performed using the manufacturer's Operation and Maintenance Manual. Any deficiencies in the O & M Manual noted during Start-up shall be corrected prior to scheduling the Owner's Demonstration as specified under Section 16980. Start-up will be witnessed by the Owner's Representative.
- H. Verification of the start-up performance of the equipment and/or system shall be provided in the form of a start-up report, indicating that the Owner's Representative witnessed all functions and

operations required of the equipment and/or system. Four (4) copies of all Start-up reports, as specified herein and in other Sections, shall be submitted to the Owner.

- I. All improperly functioning equipment not adapted to the purpose for which it is intended, or material, or equipment found to be faulty while performing the tests, shall be corrected; and any changes or repairs necessary to put the work in satisfactory condition and operation shall be done by the Contractor at no additional cost to the Owner. Start-up of the repaired equipment/system shall be witnessed by the Owner's Representative.
- J. Successful and approved completion of the Start-up requirements is a prerequisite to determining whether the Work or a portion of the Work is Substantially Complete as specified under Section 01650.

3.2 CONTRACTOR'S ASSISTANCE

- A. Setup, calibration, and Start-up of Package Equipment as described in Section 16010 shall be as required in other Sections of this Specification.
- B. The Contractor shall provide the services of an electrician to assist either the Contractor or the equipment manufacturer's service representatives on any and all field tests and adjustments as may be made or required by equipment manufacturers or the Contractor as the equipment is started up. The Contractor shall make equipment manufacturers' service representatives available as required to assist in putting equipment into operation.

END OF SECTION

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INSTRUMENT CALIBRATION CERTIFICATE

1.0 INSTRUMENT IDENTIFICATION

Tag Number _____
Instrument Name _____
DCS Point Reference _____
Manufacturer _____
Model Number _____
Part Number _____
Cal. Range _____
Serial Number _____

2.0 CALIBRATION / TEST EQUIPMENT IDENTIFICATION

Description _____
Manufacturer _____
Model Number _____
Part Number _____
Serial Number _____
Calibration Date _____
Accuracy _____

3.0 INSTRUMENT INSTALLATION

Installed per manufacturers instructions: _____ Yes _____ No
Installed per Contract Specifications: _____ Yes _____ No
Discrepancy Description _____
Wiring Continuity from Instrument to Instrument: _____ N/A _____ OK
Wiring Continuity from Instrument to RIO Cabinet: _____ N/A _____ OK

4.0 INSTRUMENT CALIBRATION – ANALOG / DIGITAL

<u>Level</u>	<u>Input Units</u>	<u>Value at Indicator</u>	<u>Value at DCS/PLC</u>		
0 %	_____	_____	_____		
10 %	_____	_____	_____		
50 %	_____	_____	_____		
80 %	_____	_____	_____		
100 %	_____	_____	_____		
	<u>Setting</u>	<u>Deadband</u>	<u>Activation at Device</u>	<u>Activation at DCS</u>	
Point 1	_____	_____	_____	_____	
Point 2	_____	_____	_____	_____	
Point 3	_____	_____	_____	_____	

5.0 INSTRUMENT ADJUSTMENT SEALED

Adjustment Device Sealed With Colored Lacquer _____

6.0 CERTIFICATION

I certify that the above information is correct and that the instrument installation conforms to manufacturer and Contract Specifications, unless otherwise noted.

Technician Signature _____ Date: _____

7.0 ENGINEER REVIEW

Calibration Witnessed: Yes No Reviewer Signature _____ Date: _____

**DEVICE SETTINGS CERTIFICATE
 FOR VARIABLE FREQUENCY CONTROLLER**

1.0 TECHNICIAN INFORMATION

Company Name: _____ Contact Person: _____
 Address: _____ Phone No.: _____

2.0 EQUIPMENT IDENTIFICATION

VFD Designations: _____

3.0 DEVICE SETTINGS

Attach manufacturer's form(s), with settings filled in, whenever available.

SETTINGS						
Device ID:	VFD #	VFD #	VFD #	VFD #	VFD #	VFD #
Manufacturer						
Model No.						
Accel Time (seconds)						
Decel Time (seconds)						
Minimum Speed (Hz)						
Maximum Speed (Hz)						
Current Limit (%)						
Manual Torque Boost (%)						
V/Hz Base Speed (Hz)						
RPM at Base Speed						
Output Relay Configured to						
Carrier Frequency (kHz)						
Remote Reference Gain (%)						
Remote Reference Offset (%)						
Electronic Thermal Overload (%)						
Electronic Thermal Overload Trip (on/off)						
Coast Stop Feature (on/off)						
Reverse (on/off)						
RPM Setpoint Feature (on/off)						
Power-Up Start Feature (on/off)						
Password Lockout Feature (on/off)						
Avoidance Frequency (Hz)						
Avoidance Bandwidth (Hz)						
Multi-Speed Preset 1 (Hz)						
Multi-Speed Preset 2 (Hz)						
Multi-Speed Preset 3 (Hz)						
Auto-Restart Number of Attempts						
Auto-Restart Retry Wait Time (seconds)						
Analog Output Configured to						

4.0 CERTIFICATION

I certify that the above information is correct and that the device installation and settings conform to manufacturer and Contract Specification requirements, unless otherwise noted.

Technician Signature _____ Date: _____

5.0 ENGINEER REVIEW

Setting Witnessed: Yes No Reviewer Signature _____ Date: _____

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SECTION 16980

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for Demonstration of equipment and/or systems for the Owner's personnel.
- B. Requirements for Training of Owner's personnel in the operation and maintenance of the equipment/system.
- C. Acceptance requirements.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control: Manufacturer's Field Reports.
- B. Section 01700 - Contract Closeout.
- C. Section 01800 - Training.
- D. Division 13 – Special Construction.
- E. Section 16010 - General Electrical, Instrument, and Control Requirements.
- F. Section 16050 - Basic Electrical Materials and Methods.
- G. Section 16960 - Electrical Testing and Equipment.
- H. Section 16970 – Calibration and Start-up of Systems.

1.3 REFERENCES

- A. All equipment and workmanship shall be in conformance with the following documents:
 - 1. National Electrical Code (NEC), latest approved edition.
 - 2. Any and all Federal, State, and/or local codes, ordinances, or regulations.
- B. All equipment shall be designed, constructed, installed, and tested in conformity with all requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, UL and OSHA, except as modified herein.

PART 2 PRODUCTS

None.

PART 3 EXECUTION

3.1 DEMONSTRATION OF EQUIPMENT

- A. Demonstration of equipment and systems, and training of the Owner's personnel in the proper operation and maintenance of the equipment and systems, shall be performed as required under Section 01650, as described below, and per the requirements of the Section under which the equipment/system was furnished.
- B. The following shall occur prior to scheduling demonstration and training of any equipment and/or system:
 - 1. The Contractor shall have fully complied with the requirements of Section 16970, Calibration and Start-up of Systems, and shall have submitted reports indicating successful completion of start-up for the equipment/system being started.
 - 2. Any deficiencies in the manufacturer's Operation and Maintenance (O&M) Manuals and/or "As-Built" drawings, noted during Start-up shall be corrected prior to scheduling the Owner's Demonstration and Training, as required per Section 16970.
 - 3. The Contractor shall submit for approval a proposed agenda for said demonstration/training, and shall adhere to the approved agenda for the demonstration and training session(s).
 - 4. Any and all test equipment, maintenance equipment, tools, or devices, and/or spare parts required to be furnished under Division 16 shall be turned over, and stored as required under Sections 01700 and 16010.
- C. After completing the above items, the Contractor shall schedule the Owner's Demonstration and Training. Seventy-two (72) hours (minimum) written notice shall be given the Owner's Representative prior to performing any Demonstration and/or Training. Such sessions shall be scheduled at a time agreed upon by the Owner and the Contractor. Multiple sessions shall be scheduled to allow attendance by all Owner's Personnel.
- D. The Demonstration shall instruct the Owner's personnel in all facets, features, and functions of the operation of the equipment and/or system. Training shall be performed using the manufacturer's Operation and Maintenance Manual and "As-Built" drawings, and shall familiarize the Owner's personnel in identifying improper operation, troubleshooting for the cause(s), and performing repair, replacement, and recalibration/setup necessary to correct the mis-operation. Use of any test equipment necessary, and a review of any recommended and/or provided spare parts shall be included in the Training.
- E. Verification of the Demonstration and Training for the equipment and/or system shall be provided in the form of a report, indicating that the Owner's personnel attended and witnessed all functions and operations required of the equipment and/or system, and received the required instruction. Demonstration and Training will be witnessed by the Owner's Representative and four (4) copies of all demonstration and training reports, as specified above and in other Sections, shall be submitted to the Owner.
- F. Successful and approved completion of the Demonstration and Training requirements is a prerequisite to determining whether the Work or a portion of the Work is Substantially Complete as specified under Section 16010.

3.2 CONTRACTOR'S ASSISTANCE

- A. Demonstration and Training of Package Equipment, as described in Section 16010, shall be as required in other Sections of this Specification.
- B. The Contractor shall provide the services of an electrician to assist either the Contractor or the equipment manufacturers' service representatives on any and all field set-ups and adjustments as may be required to demonstrate operation of the equipment or system. The Contractor shall make equipment manufacturers' service representatives available as required to assist in demonstrating equipment operation.

3.3 CLEANUP

- A. Cleanup shall occur as required under Section 01700, and as specified under Section 16010.

3.4 ACCEPTANCE

- A. Acceptance shall occur after all the above requirements have been satisfied, and as per Section 01650.
- B. Acceptance of equipment and/or systems shall be signified by execution of Guarantees as described below.

3.5 GUARANTEES

- A. The equipment and installation furnished under Division 16 shall be guaranteed for a period of one (1) year as specified under Section 01700, Contract Closeout.
- B. The Contractor's Guarantee shall be furnished as follows:
 - 1. Execute for Owner's signature a certificate of Contractor's guarantee, listing date of acceptance as start of warranty period (except where indicated otherwise under the detailed equipment specifications), for all work and materials provided and installed under this Division.*
 - 2. Execute and assemble any and all transferable warranty and/or license documents from Subcontractors, suppliers, and manufacturers.
 - 3. Provide Table of Contents and assemble in three D, side ring binder with durable plastic cover.
- * For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of Owner's acceptance as start of warranty period.
- C. The Owner's dated signature on these documents shall constitute acceptance for warranty purposes.

END OF SECTION