SPECIFICATIONS

FOR

2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT

CORNING MUNICIPAL UTILITIES
CORNING, IOWA

VEENSTRA & KIMM, INC.

SPECIFICATIONS
FOR

2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT

CORNING MUNICIPAL UTILITIES
CORNING, IOWA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Signed: Date:

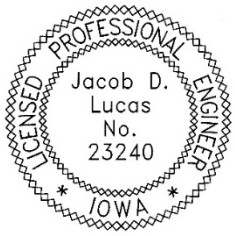
April 9, 2024

Michael J. Shoup, P.E.
Iowa License No. 16922
My license renewal date is December 31, 2025

Detailed parts covered by this seal:

Divisions 0 through 13

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.



Signed: Date:

April 9, 2024

Jacob Lucas
Iowa License No. 23240
My license renewal date is December 31, 2025

Detailed parts covered by this seal:

Divisions 16-17

Prepared by
VEENSTRA & KIMM, INC.
West Des Moines,
Iowa

INDEX

2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT

CORNING MUNICIPAL UTILITIES
CORNING, IOWA

DIVISION 11 - EQUIPMENT

DIVISION 13 – SPECIAL CONSTRUCTION

DIVISION 16 - ELECTRICAL

DIVISION 17 - INSTRUMENTATION

NOTICE OF PUBLIC HEARING

NOTICE OF PUBLIC HEARING ON PLANS AND SPECIFICATIONS, PROPOSED FORM OF CONTRACT AND ESTIMATE OF COST FOR CONSTRUCTION OF THE 2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT FOR THE CORNING MUNICIPAL UTILITIES, CORNING, IOWA.

At 9:00 A.M. on the 9th day of May, 2024, the Board of Trustees of the Corning Municipal Utilities will, in the Council Chambers at City Hall, 601 6th Street, Corning, Iowa 50841, hold a hearing and said Board proposes to adopt plans, specifications, form of contract and estimate of cost and, at the time, date and place specified above, or at such time, date and place as then may be fixed, to act upon proposals and enter into a contract for the construction of the following improvements:

2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT

Construct 2024 Lake Icaria Raw Water Pump Station Replacement project including all labor, materials and equipment, necessary for construction of a complete and operable raw water pump station including pumps and associated piping, fittings and valves and electrical controls; and miscellaneous associated work. Owner will provide underground piping, building foundation, building, and site work.

The project is located at State of Iowa owned properties in the Lake Icaria Recreational Area in Adams County, Iowa.

At said hearing, the Board of Trustees will consider the plans, specifications, proposed form of contract, and estimated total cost for the project, the same now being on file in the office of the Secretary, reference to which is made for a more detailed and complete description of the proposed improvements, and at said time and place the said Board will also receive and consider any objections to said plans, specifications, estimate of cost and form of contract made by any interested party.

This notice is given by order of the Board of Trustees of Corning Municipal Utilities, Corning, Iowa.

BOARD OF TRUSTEES
CORNING MUNICIPAL UTILITIES
CORNING, IOWA

Linda England Corning Municipal Board Chair

Attest:
Dean Lammers, Corning Municipal Board Secretary

NPH-1

5866

NOTICE TO BIDDERS

NOTICE OF TAKING BIDS FOR THE CONSTRUCTION OF THE 2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT FOR THE CORNING MUNICIPAL UTILITIES, CORNING, IOWA.

Sealed proposals be filed with the Engineer representing the Corning Municipal Utilities in the office of the Engineer located at Veenstra & Kimm, Inc., 3000 Westown Parkway, West Des Moines, Iowa before 2:00 P.M. local time on the 2nd day of May, 2024 for the construction of the 2024 Lake Icaria Raw Water Pump Station Replacement, and work incidental thereto, as described in the plans and specifications therefor, now on file in the office of the Secretary. Proposals will be opened and the amount of the bids announced in said Engineer's office by the Secretary at the time and date specified above.

Proposals will be acted upon by the Board of Trustees of Corning Municipal Utilities at 9:10 A.M. on the 9th day of May, 2024, or at such later time and place as then may be fixed.

The work to be done is as follows:

2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT

Construct 2024 Lake Icaria Raw Water Pump Station Replacement project including all labor, materials and equipment, necessary for construction of a complete and operable raw water pump station including pumps and associated piping, fittings and valves and electrical controls; and miscellaneous associated work. Owner will provide underground piping, building foundation, building, and site work.

All work and materials are to be in accordance with the proposed plans, specifications, form of contract and estimate of cost now on file in the office of the Secretary of said Utilities and by this reference made a part thereof as though fully set out and incorporated herein.

All proposals and bids in connection therewith shall be submitted to the Engineer's office of said Utilities on or before the time herein set for said receipt of bids. All proposals shall be made on official bidding forms furnished by the Engineer, and any alterations in the official form of proposal will entitle the Board, at its option, to reject the proposal involved from consideration. Each proposal shall be sealed and plainly identified.

Each proposal shall be made out on a blank form furnished by the Engineer and must be accompanied by bid security, as follows: a certified or cashier's check, drawn on a solvent Iowa bank or a bank chartered under the laws of the United States or a certified share draft drawn on a credit union in Iowa or chartered under the laws of the United States, in an amount equal to five percent (5%) of the bid, or a bid bond executed by a corporation authorized to contract as a surety in the State of Iowa in a penal sum of five percent (5%) of the bid.

The bid security should be made payable to the CORNING MUNICIPAL UTILITIES. The bid security must not contain any conditions either in the body or as an endorsement thereon. The bid security shall be forfeited to the Board as liquidated damages in the event the successful bidder fails or refuses to enter into a contract within 10 days after the award of contract and post bond satisfactory to the Board insuring the faithful fulfillment of the contract and the maintenance of said work, if required, pursuant to the provisions of this notice and the other contract documents. Bidders will use the bid bond form included in the specifications.

In accordance with Iowa statutes, a resident bidder shall be allowed a preference as against a nonresident bidder from a state or foreign country if that state or foreign country gives or requires any preference to bidders from that state or foreign country, including but not limited to any preference to bidders, the imposition of any type of labor force preference, or any other form of preferential treatment to bidders or laborers from that state or foreign country. The preference allowed shall be equal to the preference given or required by the state or foreign country in which the nonresident bidder is a resident. In the instance of a resident labor force preference, a nonresident bidder shall apply the same resident labor force preference to a public improvement in this state as would be required in the construction of a public improvement by the state or foreign country in which the nonresident bidder is a resident.

Failure to submit a fully completed Bidder Status Form with the bid may result in the bid being deemed nonresponsive and rejected.

The Board of Trustees reserves the right to reject any or all bids, to waive informalities or technicalities in any bid and to accept the bid which it deems to be to the best interest of the Utility.

The Board reserves the right to defer acceptance of any proposal for a period not to exceed thirty (30) calendar days from the deadline for submission of proposals.

The successful bidder will be required to furnish a bond in an amount equal to one hundred percent (100%) of the contract price, said bond to be issued by responsible surety approved by the Board and shall guarantee the faithful performance of the contract and the terms and conditions therein contained, and shall guarantee the prompt payment for all materials and labor and protect and save harmless the Board from claims and damages of any kind caused by the operations of the Contractor, and shall guarantee the work against faulty workmanship and materials for a period of two (2) years after its completion and acceptance by the Board of Trustees.

The work will commence within ten (10) calendar days after the date set forth in written Notice to Proceed and shall be completed by May 30, 2025.

Liquidated damages in the amount of One Hundred Dollars ($250.00) per calendar day will be assessed for each day the work shall remain uncompleted after the end of the contract period with due allowance for extensions of the contract period due to conditions beyond the control of the Contractor.

A sales tax exemption certificate will be available for all material purchased for incorporation in the project.

Payment for said improvements will be made in cash from sale of general obligation bonds or notes, water revenue bonds or notes, or from such funds as are legally available for said purposes. Any combination of the above methods of payment may be used at the discretion of the Board of Trustees.

Payment to the Contractor will be on the basis of monthly estimates equivalent to ninety-five percent (95%) of the contract value of the work completed and payments made to material suppliers for materials ordered specifically for the project and delivered to the site during the preceding calendar month. Estimates will be prepared each month by the Contractor, subject to the approval of the Engineer, who will certify to the Board for payment each approved estimate on or before the tenth (10th) day of the following month. Such monthly payments shall in no way be construed as an act of acceptance for any part of the work partially or totally completed. Upon completion of the work and its acceptance by the Board, the Contractor will be paid an amount which, together with previous payments, will equal ninety-five percent (95%) of the contract price of the contract. Final payment of the remaining five percent (5%) will be made not less than thirty-one (31) days after completion and acceptance by resolution of the Board of Trustees of the completed contract, subject to the conditions and in accordance with the provisions of Chapter 573 of the Code of Iowa. No such partial or final payments will be due until the Contractor has certified to the Secretary that the materials, labor and services involved in each estimate have been paid for in accordance with the requirements stated in the specifications.

Plans and specifications governing the construction of the proposed improvements, and also the prior proceedings of the Board of Trustees referring to and defining said proposed improvements are hereby made a part of this notice and the proposed contract by reference and the proposed contract shall be executed in compliance therewith.

Copies of said plans and specifications and form of contract are now on file in the office of the Secretary. Copies may be obtained from VEENSTRA & KIMM, INC., 3000 Westown Parkway, West Des Moines, Iowa 50266, at no charge.

Notice to Bidders

This notice is given by order of the Board of Trustees of the Corning Municipal Utilities, Corning, Iowa.

BOARD OF TRUSTEES
CORNING MUNICIPAL UTILITIES
CORNING, IOWA

Linda England, Corning Municipal Board Chair

Attest:
Dean Lammers, Corning Municipal Board Secretary

INSTRUCTIONS TO BIDDERS

2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT

CORNING MUNICIPAL UTILITIES
CORNING, IOWA

INDEX

1. DEFINITION OF TERMS

1.1 "Owner" or "Water Works" shall mean the Corning Municipal Utilities, Corning, Iowa, acting through the Board of Trustees or an authorized representative of Board of Trustees.

1.2 "Person" shall mean any individual partnership, society, association, joint stock company, corporation, estate, receiver, trustee, assignee or referee, whether appointed by a court or otherwise, and any combination of individuals.

1.3 "Bidder" shall mean any person who submits a proposal to furnish the work described in the Contract Documents.

1.4 "Contractor" shall mean the person with whom the Owner may enter into contract for the execution of the work specified.

1.5 "Subcontractor" shall mean the person supplying materials, labor, equipment and appurtenances for the work, such person having contractual relations with the Contractor, but not with the Owner.

1.6 "Engineer" shall mean Veenstra & Kimm, Inc., West Des Moines, Iowa.

1.7 "Standard Drawings" shall mean construction detail drawings bound with these specifications.

1.8 "Work" shall mean the work to be done and the equipment, supplies and materials to be furnished under the contract, unless some other meaning is indicated by the context.

1.9 "Or Equal" shall follow manufacturers' names used to establish standards and, if not stated, is implied.

1.10 “NSF Certification” shall mean per Iowa Code 567 Chapter 43.3(8).

1. Current regulation with proposed changes:
    a. 43.3(8) Drinking water system components. Any Drinking water system component which comes into contact with raw, partially treated, or finished water must be suitable for the intended use in a potable water system. The component must be certified by an American National Standards Institute (ANSI) accredited third party for conformance with American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 specifications, if such specification exists for the particular product, unless approved components are not reasonably available for use in accordance with guidance provided by the department. Component materials generally excluded from NSF 61 requirements include concrete, stainless steel, and aluminum. If the component is not certified to ANSI/NSF Standard 61 specifications or no specification is available, the person seeking to supply or use the component must prove to the satisfaction of the department that the component is not toxic or otherwise a potential hazard in a potable public water supply system.

2. CONTRACT DOCUMENTS

2.1 The Contract Documents, sometimes referred to as the "plans and specifications," shall mean and include the following parts as used herein:

2.1.1 Notice to Bidders
2.1.2 Instructions to Bidders
2.1.3 Proposal
2.1.4 Contract
2.1.5 Bond
2.1.6 General Conditions
2.1.7 Special Conditions
2.1.8 Plans List

2.1.9 Detailed Specifications
2.1.10 Plans listed in the Specifications
2.1.11 Addenda issued to the foregoing.

3. METHOD OF BIDDING

3.1 Bidders shall submit unit and lump sum prices for the work covered by the plans and specifications. Prices shall cover complete work and include all costs incidental thereto, unless indicated otherwise.

3.2 Bids will be computed using quantities shown in proposal. Unit price quantities are approximate and only for comparison of bids. Engineer retains right to change location, quantities and combination of units as may be required during progress of construction. Compensation due Contractor will be computed on basis of final quantities of completed work.

3.2.1 In the event of discrepancies between unit prices and unit price extensions listed in bidder's proposal, unit prices shall govern and unit price extensions and total bid shall be corrected, as necessary, for agreement with unit prices. The total price will be determined on the basis of corrected extensions of the unit prices.

3.2.2 In the case of an obvious and serious clerical or entry error in the Proposal where the Utility is able to clearly determine the bidder’s intent from the Proposal the Utility may waive irregularities that are in the best interest of the Utility as long as the integrity of the bidding process is not affected by waiving the clerical or entry irregularity.

3.3 Unit prices for payment items included in the specifications, but not listed in the PROPOSAL, will be negotiated, if needed.

4. QUALIFICATIONS OF BIDDERS

4.1 Bidders shall be prepared to satisfy Owner as to integrity, experience, adequacy of equipment, personnel and financial ability to perform work specified.

4.2 If successful bidder is a non-Iowa corporation, it shall submit proof to Owner prior to execution of contract that it has been authorized by Secretary of State to do business in Iowa.

5. SUBMISSION OF BIDS

5.1 Bidders shall submit the Proposal stamped "Official Bid". The Proposal stamped "Official Bid" is considered the original Proposal and shall be used for bidding. Submit in a sealed envelope. Envelope shall bear return address of the bidder and shall be addressed as follows:

To:
Veenstra & Kimm, Inc.
c/o Corning Municipal Utilities
3000 Westown Parkway
West Des Moines, Iowa 50266

Proposal for:
2024 Lake Icaria Raw Water
Pump Station Replacement

5.2 Bids shall be signed by a legally authorized representative of bidder.

5.3 Bidders shall submit with Proposal the following documents:

5.3.1 Bid Bond.

5.3.2 Iowa Reciprocal Preference

5.3.2.1 In accordance with the requirements of the Iowa Department of Labor all bidders must submit a fully completed Bidder Status Form. The Bidder Status Form must be included with and is considered an essential attachment to the Proposal. Any Proposal that does not include a fully completed Bidder Status Form may result in the Proposal being determined non-responsive.

6. EVALUATION OF BIDS

6.1 Award of contract will be made to the lowest responsive, responsible bidder. The Board of Trustees reserves the right to reject any and all bids and to waive informalities and technicalities and to enter into such contract as it shall deem for the best interest of the Corning Municipal Utilities.

7. WITHDRAWAL OF BIDS

7.1 A bidder may withdraw his bid at any time prior to scheduled closing time for a receipt of bids, but no bid shall be withdrawn for a period of 30 calendar days thereafter.

8. BID SECURITY

8.1 Each bid shall be accompanied by bid security in the form and amount as set out in the Notice to Bidders.

8.2 Bid security shall be enclosed in the sealed envelope with the bid, or in a separate sealed envelope.

8.3 The bid security shall be forfeited and become the property of the Owner in case the bidder fails or refuses to enter into contract and to furnish bond within 10 calendar days after his proposal shall have been accepted.

8.4 Bid security of the unsuccessful bidders will be returned as soon as the successful bidder is determined and has entered into a contract; bid security of successful bidder will be returned upon execution of contract and furnishing of bond.

8.5 Bidders shall use bid bond form included with specifications.

9. EXAMINATION OF WORK

9.1 Bidders shall familiarize themselves with the specifications and with all conditions which will affect construction. It will be assumed that bidders have made a personal examination of the job and the physical conditions affecting the work.

10. EXECUTION OF CONTRACT

10.1 The successful bidder shall enter into a written contract with the Owner, within 10 days after acceptance of his proposal on the forms included with these specifications, for the performance of the work awarded to him.

10.2 The contract, when executed, shall be deemed to include the entire agreement between the parties hereto, and the Contractor shall not claim any modification thereof resulting from any representation or promise made at any time by any representative of the Owner or any other person.

11. CONTRACT TERMINATION

11.1 Provisions of law, as contained in Chapter 573A of the Code of Iowa shall apply to and be a part of this contract. Chapter 573A provides for termination of contracts for construction of public improvements when construction or work thereon is stopped because of a national emergency. The provisions of Chapter 573A shall be binding upon all parties thereto, including subcontractors and sureties upon any bond given or filed in connection therewith.

12. TAXES

12.1 The Utility will issue a sales tax exemption certificate for all materials purchased on the project. The Utility will issue the appropriate tax exemption certificates and authorization letters to the Contractor and all subcontractors completing work on the project. Tax exemption certificates are applicable only for the specific project for which the tax exemption certificate is issued.

12.2 Contractor shall provide a listing to the Utility identifying all appropriate subcontractors qualified for use of the tax exemption certificate. Contractor and subcontractors may make copies of the certificate and provide, to each supplier providing construction material, a copy of the tax exemption certificate.

12.3 Income tax:

12.3.1 Successful bidder is subject to payment of Iowa income tax on income from this work in amounts prescribed by law.

12.3.2 If successful bidder is a non-Iowa partnership, individual or association, he shall furnish evidence prior to execution of contract, that bond or securities have been posted with the Iowa Department of Revenue in the amount required by law.

13. PREFERENCE FOR LABOR AND MATERIALS

13.1 By virtue of statutory authority, preference will be given to products and provisions grown and coal produced within the State of Iowa, and to Iowa domestic labor, to the extent lawfully required under Iowa Statutes; provided that the award of contract will be made to the lowest responsible bidder submitting the lowest responsive bid.

14. PAYMENT

14.1 Payment will be made as set forth in Notice to Bidders.

14.2 Payment will be made on the basis of estimates prepared by Contractor and approved by Engineer, solely for the purpose of payment; approval by Engineer shall not be deemed approval of workmanship or materials.

15. APPROVAL OF MATERIALS

15.1 Approval of substitutions of any materials or equipment other than that specified shall be obtained in writing from Engineer. Otherwise, it will be assumed Contractor will furnish materials or equipment specified.

16. PERIOD OF GUARANTEE AND BOND

16.1 Contractor shall guarantee work for a period of two (2) years from date of final acceptance. Surety bond furnished by Contractor shall run for a like period.

PROPOSAL

2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT
CORNING MUNICIPAL UTILITIES
CORNING, IOWA

Name of Bidder _____

Address of Bidder _____

To: Board of Trustees
Corning Municipal Utilities
601 6th Street
Corning, Iowa 50841

The undersigned bidder submits herewith bid security amounting to five percent (5%) of the total amount of the bid which shall become the property of the Corning Municipal Utilities, Corning, Iowa, should the undersigned fail or refuse to execute a contract and to furnish bond as called for in the specifications within the time provided.

The undersigned bidder, having examined the contract documents, and having familiarized himself with the nature and location of the work to be done and the conditions under which the work will be performed, hereby proposes to provide the required labor, services and materials and to perform the work described in the specifications, and addenda _____, _____, _____ and _____, within the time and for the sum or sums stated hereinafter on attached proposal schedule which is hereby made a part of this proposal.

The undersigned bidder certifies that this proposal is made in good faith, without collusion or connection with any other person or persons bidding on the work.

The undersigned bidder states that this proposal is made in conformity with the specifications and agrees that in the event of any discrepancies or differences between any conditions of his proposal and the specifications prepared by VEENSTRA & KIMM, INC. that the provisions of the latter shall prevail.

Bidder _____

By _____

Title _____

PROPOSAL SCHEDULE

2024 Lake Icaria Raw Water Pump Station Replacement

1. Construct 2024 Lake Icaria Raw Water Pump Station Replacement project including all labor, materials and equipment, necessary for construction of a complete and operable raw water pump station including pumps and associated piping, fittings and valves and electrical controls; and miscellaneous associated work necessary for a complete and operable system including cleanup for the lump sum of

   _____

   _____ ($_____).

2. Specific Items of Equipment:

   2.1 Total lump sum bid stated includes furnishing and installing all specific items of the manufacturer designated as "BASE BID ITEM" in the following tabulation:

      2.1.1 Number of items required shown in parentheses after "BASE BID ITEM".

   2.2 The bidder agrees to furnish and install alternate items selected from the following tabulation for a contract price equal to the total lump sum bid stated above adjusted by the difference between the sum of the installed prices for "BASE BID ITEM" and the sum of the installed prices for the selected alternate items.

   2.3 If awarded a contract, all items selected from the following tabulation will be guaranteed by the bidder and his surety to meet the requirements of the specifications.

   2.4 The bidder states that all items offered in the following tabulation fully comply with the contract specifications.

Proposal

No.	Section Number	Item	Manufacturer	Installed Price
(1)	11330 11312	Horizontal Centrifugal Pump (2)		
		BASE BID ITEM	Fairbanks Morse Flowserve	$ _____
		Alternate Items	(a) _____	_____
			(b) _____	_____
			(c) _____	_____

3. The work will commence within ten (10) calendar days after the date set forth in written Notice to Proceed and shall be completed by May 30, 2025.

4. Liquidated damages in the amount of One Hundred Dollars ($250.00) per calendar day will be assessed for each day the work shall remain uncompleted after the end of the contract period with due allowance for extensions of the contract period due to conditions beyond the control of the Contractor.

5. Required attachment:
   - Bidder Status Form
   - Bid Bond

Bidder Status Form

To be completed by all bidders — Part A

Please answer "Yes" or "No" for each of the following:

☐ Yes ☐ No My company is authorized to transact business in Iowa.
(To help you determine if your company is authorized, please review the worksheet on the next page).

☐ Yes ☐ No My company has an office to transact business in Iowa.

☐ Yes ☐ No My company's office in Iowa is suitable for more than receiving mail, telephone calls, and e-mail.

☐ Yes ☐ No My company has been conducting business in Iowa for at least 3 years prior to the first request for bids on this project.

☐ Yes ☐ No My company is not a subsidiary of another business entity or my company is a subsidiary of another business entity that would qualify as a resident bidder in Iowa.

If you answered "Yes" for each question above, your company qualifies as a resident bidder. Please complete Parts B and D of this form.

If you answered "No" to one or more questions above, your company is a nonresident bidder. Please complete Parts C and D of this form.

To be completed by resident bidders — Part B

My company has maintained offices in Iowa during the past 3 years at the following addresses:

Dates: _____ /_____ /_____ to _____ /_____ /_____ Address: _____

City, State, Zip: _____

Dates: _____ /_____ /_____ to _____ /_____ /_____ Address: _____

City, State, Zip: _____

Dates: _____ /_____ /_____ to _____ /_____ /_____ Address: _____

You may attach additional sheet(s) if needed. City, State, Zip: _____

To be completed by non-resident bidders — Part C

1. Name of home state or foreign country reported to the Iowa Secretary of State:

_____

2. Does your company's home state or foreign country offer preferences to resident bidders, resident labor force preferences or any other type of preference to bidders or laborers? ☐ Yes ☐ No

3. If you answered "Yes" to question 2, identify each preference offered by your company's home state or foreign country and the appropriate legal citation.

_____

_____

You may attach additional sheet(s) if needed.

To be completed by all bidders — Part D

I certify that the statements made on this document are true and complete to the best of my knowledge and I know that my failure to provide accurate and truthful information may be a reason to reject my bid.

Firm Name: _____

Signature: _____ Date: _____

You must submit the completed form to the governmental body requesting bids per 875 Iowa Administrative Code Chapter 156. This form has been approved by the Iowa Labor Commissioner.

Worksheet: Authorization to Transact Business

This worksheet may be used to help complete Part A of the Resident Bidder Status form. If at least one of the following describes your business, you are authorized to transact business in Iowa.

☐ Yes ☐ No My business is currently registered as a contractor with the Iowa Division of Labor.

☐ Yes ☐ No My business is a sole proprietorship and I am an Iowa resident for Iowa income tax purposes.

☐ Yes ☐ No My business is a general partnership or joint venture. More than 50 percent of the general partners or joint venture parties are residents of Iowa for Iowa income tax purposes.

☐ Yes ☐ No My business is an active corporation with the Iowa Secretary of State and has paid all fees required by the Secretary of State, has filed its most recent biennial report, and has not filed articles of dissolution.

☐ Yes ☐ No My business is a corporation whose articles of incorporation are filed in a state other than Iowa, the corporation has received a certificate of authority from the Iowa secretary of state, has filed its most recent biennial report with the secretary of state, and has neither received a certificate of withdrawal from the secretary of state nor had its authority revoked.

☐ Yes ☐ No My business is a limited liability partnership which has filed a statement of qualification in this state and the statement has not been canceled.

☐ Yes ☐ No My business is a limited liability partnership which has filed a statement of qualification in a state other than Iowa, has filed a statement of foreign qualification in Iowa and a statement of cancellation has not been filed.

☐ Yes ☐ No My business is a limited partnership or limited liability limited partnership which has filed a certificate of limited partnership in this state, and has not filed a statement of termination.

☐ Yes ☐ No My business is a limited partnership or a limited liability limited partnership whose certificate of limited partnership is filed in a state other than Iowa, the limited partnership or limited liability limited partnership has received notification from the Iowa secretary of state that the application for certificate of authority has been approved and no notice of cancellation has been filed by the limited partnership or the limited liability limited partnership.

☐ Yes ☐ No My business is a limited liability company whose certificate of organization is filed in Iowa and has not filed a statement of termination.

☐ Yes ☐ No My business is a limited liability company whose certificate of organization is filed in a state other than Iowa, has received a certificate of authority to transact business in Iowa and the certificate has not been revoked or canceled.

BID BOND

KNOW ALL MEN BY THESE PRESENTS: That we, _____

_____, of, _____,

as Principal, and _____

of _____,
as Surety, are held and firmly bound unto the Corning Municipal Utilities, Corning, Iowa, hereinafter defined as Obligee, in the penal sum of five percent (5%) of the total amount of the bid ($_____), for which payment said Principal and Surety bind themselves, their heirs, executors, administrators, successors, and assigns jointly and severally, firmly by these presents.

The condition of the above obligation is such that whereas the Principal has submitted to the Corning Municipal Utilities, Corning, Iowa, a certain bid, in a sealed envelope, and hereby made a part hereof to enter into a contract in writing, for: 2024 Lake Icaria Raw Water Pump Station Replacement.

NOW THEREFORE, if the said bid by said Principal be accepted, and the Principal shall enter into a contract with the Obligee in accordance with the terms of such bid, and give such bond as may be specified in the contract documents with good and sufficient surety for the faithful performance of such contract, for the prompt payment of labor and material furnished in the prosecution thereof, and for the maintenance of said improvements as may be required therein, then this obligation shall become null and void or in the event of the failure of the Principal to enter such contract and give such bond, the Principal shall pay to the Obligee the full amount of the bid bond, together with court costs, attorney's fees, and any other expense of recovery.

Signed and sealed this_____ day of _____, 20___.

_____
Principal

By_____
Contractor's Signature

_____
Surety

By_____
Attorney-in-Fact

CONTRACT

THIS AGREEMENT, made and entered into this _____ day of _____, 20___, by and between the Corning Municipal Utilities, Corning, Iowa, party of the first part, hereinafter referred to as the "Owner", and

_____,

party of the second part, hereinafter referred to as the "Contractor".

WITNESSETH: THAT WHEREAS, the Owner has heretofore caused to be prepared certain plans, specifications and proposal blanks, dated the _____ day of _____, 20___, for the 2024 Lake Icaria Raw Water Pump Station Replacement under the terms and conditions therein fully stated and set forth, and,

WHEREAS, said plans, specifications and proposal blanks accurately and fully describe the terms and conditions upon which the Contractor is willing to perform the work specified:

NOW, THEREFORE, IT IS AGREED:

1. That the Owner hereby accepts the proposal of the Contractor for the work, as follows:

2024 Lake Icaria Raw Water Pump Station Replacement

Construct 2024 Lake Icaria Raw Water Pump Station Replacement project including all labor, materials and equipment, necessary for construction of a complete and operable raw water pump station including pumps and associated piping, fittings and valves and electrical controls; and miscellaneous associated work necessary for a complete and operable system including cleanup for the lump sum of _____

_____ Dollars ($_____).

2. That this contract consists of the following component parts which are made a part of this agreement and contract as fully and absolutely as if they were set out in detail in this contract:

   2.1 Contract Documents, including:

   2.1.1 Notice to Bidders
   2.1.2 Instructions to Bidders
   2.1.3 Proposal
   2.1.4 Contract
   2.1.5 Bond
   2.1.6 General Conditions
   2.1.7 Special Conditions
   2.1.8 Plans List
   2.1.9 Detailed Specifications
   2.1.10 Plans listed in the Specifications
   2.1.11 Addenda issued to the foregoing.

   2.2 This Instrument.

   2.3 The above components are complementary and what is called for by one shall be as binding as if called for by all.

3. That payments are to be made to the Contractor in accordance with and subject to the provisions embodied in the documents made a part of this contract.

4. That this contract is executed in triplicate.

IN WITNESS WHEREOF, the parties hereto have hereunto set their hand and seals the date first written above.

CONTRACTOR:

_____

By _____

Title _____

ATTEST:

_____

Title _____

CORNING MUNICIPAL UTILITIES
CORNING, IOWA

By _____
Chairperson, Board of Trustees

ATTEST:

_____
Secretary

BOND

KNOW ALL MEN: That we, _____
of _____, hereinafter called the Principal, and
_____,
hereinafter called the Surety, are held and firmly bound unto the Corning Municipal Utilities, Corning, Iowa, hereinafter called the Owner, in the sum of
_____
Dollars ($_____), for the payment whereof the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly, by these presents.

WHEREAS, the Principal has, by means of a written Agreement dated_____, 20_____, entered into a Contract with the Owner for the 2024 Lake Icaria Raw Water Pump Station Replacement, which Agreement includes a guarantee of all work against defective workmanship and materials for a period of two (2) years from the date of final acceptance of the work by the Owner, a copy of which Agreement is by reference made a part hereof;

Now Therefore, the condition of this Obligation is such that, if the Principal shall faithfully perform the Contract on his part and shall fully indemnify and save harmless the Owner from all cost and damage which he may suffer by reason of failure so to do and shall fully reimburse and repay the Owner all outlay and expense which the Owner may incur in making good any such default,

And Further, that if the Principal shall pay all persons who have contracts directly with the Principal for labor or materials, failing which such persons shall have a direct right of action against the Principal and Surety under this Obligation, subject to the Owner's priority,

Then this Obligation shall be null and void, otherwise it shall remain in full force and effect.

Provided, however, that no suit, action or proceeding by reason of any default whatever shall be brought on this Bond after three (3) years from the date of final acceptance of the work.

And Provided, that any alterations which may be made in the terms of the Contract, or in the work to be done under it, or the giving by the Owner of any extension of time for the performance of the Contract, or any other forbearance on the part of either the Owner or the Principal to the other shall not in any way release the Principal and the Surety, or either of them, their heirs, executors, administrators, successors or assigns from their liability hereunder, notice to the Surety of any such alteration, extension or forbearance being hereby waived.

And Further Provided, the Principal and Surety on this Bond hereby agree to pay all persons, firms, or corporations having contracts directly with the Principal or with subcontractors all just claims due them for labor performed or material furnished, in the performance of the Contract on account of which this Bond is given, when the same are not satisfied out of the portion of the contract price which the Owner shall retain until completion of the improvements, but the Principal and Surety shall not be liable to said persons, firms, or corporations unless the claims of said claimants against said portions of the contract price shall have been established as provided by law.

The Surety on this Bond shall be deemed and held, any contract to the contrary not withstanding, to consent without notice:

a. To the extension of time to the Principal in which to perform the Contract.

b. To changes in the plans, specifications, or Contract, when such changes do not involve an increase of more than twenty percent (20%) of the total contract price, and shall then be released only as to such excess increase.

c. That no provision of this Bond or of any other contract shall be valid which limits to less than three (3) years from the date of final acceptance of the work the right to sue on this Bond for defects in workmanship or materials not discovered or known to the Owner at the time such work was accepted.

The Bond is executed in triplicate.

Signed and Sealed this _____ day of _____,20_____.

PRINCIPAL:

_____
Contractor

_____
Signature

_____
Title

SURETY:

_____
Surety Company

_____
Signature, Attorney-in-Fact

_____
Name of Attorney-in-Fact

_____
Company Name

_____
Company Address (Including Zip Code)

_____
Company Telephone Number

GENERAL CONDITIONS

INDEX

1. CONTRACT DOCUMENTS

1.1 All documents listed or identified as part of contract are each and all essential and component parts of agreement between Owner and Contractor.

1.2 Contract Documents shall be signed in triplicate by Owner and Contractor.

1.3 Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. The intention of documents is to include all labor and materials, equipment and transportation necessary for proper execution of work. It is not intended that materials or work not covered by or properly inferable from any heading, branch, class or trade of the specifications shall be supplied unless distinctly noted. Materials or work described in words, which have a well known technical or trade meaning, shall be held to refer to such recognized standards.

2. SURETY BOND

2.1 Contractor shall furnish a good and sufficient surety bond in full amount of contract prior to signing contract. Surety bond shall guarantee faithful performance of all provisions of contract and payment of all bills and obligations arising from said contract. Should surety become irresponsible during time contract is in force, Owner may require additional and sufficient sureties. Contractor shall furnish said additional sureties to satisfaction of Owner within ten (10) days after written notice to do so. In default thereof, contract may be suspended as hereinafter provided.

3. CONTRACTOR'S RESPONSIBILITY

3.1 Contractor shall assume full responsibility for safekeeping of all materials and equipment and for all unfinished work until final acceptance by Owner. Materials and equipment which are damaged or destroyed from any cause shall be replaced at Contractor's expense.

3.2 Contractor shall indemnify and save harmless Owner against any liens filed for non-payment of Contractor's bills in connection with contract work. Contractor shall furnish Owner satisfactory evidence that all persons who have done work or furnished materials, equipment, or service of any type, under the contract have been fully paid prior to acceptance of work by Owner.

3.3 Contractor shall erect and maintain such barriers and lights as will prevent accidents as a consequence of its work. It shall indemnify and save harmless the Owner and its agents from all suits brought against Contractor for any injuries received or sustained by any person or persons by or through Contractor, its servants, or agents, in construction of work, or by or in consequence of any acts or omissions or negligence in performing contract work.

3.4 Without limiting GENERAL REQUIREMENTS of Contract Documents, protect flag poles, sidewalks, streets, pavements, fences, pipe, conduit, utilities, trees, shrubs and structures not shown for removal.

3.5 Cooperate with Owner, Engineer, and representative of utilities in locating underground utility lines and structures; incorrect, inaccurate or inadequate information concerning location of utilities or structures shall not relieve Contractor of responsibility for damage thereto caused by his operations.

4. SUBCONTRACTS

4.1 Contractor shall not assign, sub-let or transfer the whole or any part of work herein specified without written consent of Owner. Assignment, sub-letting or transfer shall not relieve Contractor from its responsibilities set forth herein.

4.2 Detailed specifications are separated into titled parts for convenience or reference and to facilitate letting of contracts and subcontracts. Such arrangement shall not obligate Engineer to establish limits on contracts between Contractors and subcontractors.

5. CONTRACTOR'S EMPLOYEES

5.1 Contractor shall personally supervise its work or provide a capable superintendent satisfactory to Engineer. Superintendent shall be authorized to receive instructions from Engineer.

5.2 Incompetent or incorrigible employees shall be dismissed by the Contractor or its representative when requested by Engineer. Such dismissed persons shall not be permitted to return to work without written consent of Engineer.

5.3 Contractor shall give preference to local labor in execution of this contract, insofar as is practicable.

6. PERMITS AND REGULATIONS

6.1 In execution of work specified herein, Contractor shall conform to regulations and ordinances of any governmental body which may apply in execution of specified work. Contractor shall obtain such permits and licenses as may be required for construction of work.

7. PATENTS

7.1 All fees or royalties for patented inventions, equipment or arrangements used in construction or erection of work, or any part thereof, shall be included in contract price. Contractor shall protect and hold harmless Owner against any and all claims or litigation by reason of infringement of any patent rights on any materials, equipment of construction furnished by Contractor.

8. GUARANTEE

8.1 Contractor shall guarantee all work against faulty workmanship and materials for the period specified after date of final acceptance of work by Owner unless otherwise set out in "SPECIAL CONDITIONS" or "INSTRUCTIONS TO BIDDERS." Contractor shall repair or replace any defective workmanship and materials in a manner acceptable to Owner, without expense to Owner, within ten (10) days after written notification by Owner of such defect. If said repairs or replacements are not made within ten (10) days, Owner may make said repairs or replacements and charge the cost to Contractor.

8.2 Contractor shall provide Owner with a good and sufficient surety maintenance bond in the full amount of contract prior to signing contract. Maintenance bond shall run for the period specified from time of acceptance to protect Owner from faulty workmanship and materials as outlined in preceding paragraph.

9. SHOP DRAWINGS

9.1 Contractor shall provide Engineer with drawings, data and information regarding materials or equipment specified, or as may be called for by Engineer, for its review, within a reasonable time after award of contract. After review, Engineer shall return to Contractor one copy within a reasonable time after receipt.

9.1.1 Submit 5 copies of all shop drawing submittals.

9.2 Fabrication and shipment of materials or equipment prior to Engineer's review of drawings, data and information mentioned above shall be at Contractor's risk.

10. THE ENGINEER

10.1 Engineer shall make general observation of work as agent of Owner. Engineer's general observation shall not be construed that it shall direct or control operations of Contractor.

11. PLANS AND SPECIFICATIONS

11.1 Engineer shall provide Contractor with five sets of plans and specifications after execution of contract. If additional plans and specifications are required, Contractor shall compensate Engineer for costs of printing.

11.2 Engineer shall provide Contractor with additional and supplemental plans as may be required to show details of construction after approval of manufacturers' drawings and data on materials and equipment.

11.3 Engineer will provide Contractor with such revised plans and specifications as may be required to show any authorized changes or extra work.

12. INTERPRETATION OF PLANS AND SPECIFICATIONS

12.1 Plans and specifications shall be interpreted by Engineer. Its decision shall be final and binding on all parties concerned.

12.2 Contractor will not be allowed to take advantage of errors or omissions in plans and specifications. Engineer will provide full instructions when errors or omissions are discovered.

13. LINE AND GRADE

13.1 Engineer shall provide stakes showing line and grade from bench marks, base lines and other reference points. Contractor shall provide competent men and tools, stakes and other materials as required to establish temporary or permanent reference marks in connection with the work. Contractor shall perform such detailed measurements and transfer elevations as required to properly lay out and construct work.

13.2 Contractor shall carefully preserve all stakes and reference points against destruction and shall promptly notify Engineer of any stakes which have been disturbed. In case of willful or careless destruction, Contractor will be charged for expense and damage from such destruction.

14. DECISIONS BY ENGINEER

14.1 Engineer shall make decisions, in writing, on claims between Contractor and Owner within a reasonable time after presentation. Such decisions shall be regarded as final except for appropriate legal recourse.

15. WORKMANSHIP AND MATERIALS

15.1 All work done and all materials and equipment furnished by Contractor shall conform to plans and specifications. Competent laborers and tradespersons shall be used on all work. Experienced manufacturers' representatives shall be used to supervise installation of equipment.

15.2 In absence of detailed specifications in other sections, all materials shall conform to standards of American Society for Testing Materials.

15.3 Wherever items of materials or equipment are specified by a manufacturer's name and type, or equal, it is the intent that materials or equipment of other manufacturers, equal in quality and performance, may be substituted. Such substitution may be made only with written authorization of Engineer.

15.4 Wherever items of materials or equipment are specified by a manufacturer's name and type, or equal, and additional features of items are specifically required by specifications, additional features specified shall be provided whether or not they are normally included in standard manufacturer's items listed.

15.5 Wherever items of materials or equipment are specified by a manufacturer's name and type, or equal, and specified items are or become obsolete and no longer available, Contractor shall provide acceptable equal items which are currently available at no change in contract price.

15.6 When proposing "or equal" items or substitutions, Contractor shall furnish general arrangement drawings, full descriptive data, manufacturer's specifications and such performance data as required to satisfy Engineer that materials or equipment proposed are equal to that specified. Burden of proof of equality shall be responsibility of Contractor.

15.7 Whenever items of materials or equipment are specified by a manufacturer's name and type and 'or equal" is not listed, Contractor shall provide specified equipment without substitution, unless prior approval of Engineer is obtained for any substitution.

15.8 Contractor shall abide by Engineer's decision when proposed substitutes of material or equipment are deemed to be unacceptable and in such an event Contractor shall furnish items of equipment or materials specified.

15.9 Engineer reserves right to consider such factors as overall project arrangement, overall project cost, and similar factors in determining whether proposed substitutions will be acceptable.

16. ON-SITE REVIEW OR OBSERVATION

16.1 All materials used and all work done by Contractor shall be subject at all times to review, observation, tests and approval by Engineer. Contractor shall furnish samples of materials for observation and tests as requested by Engineer. Contractor shall furnish any information required concerning nature or source of any proposed materials or equipment.

16.2 Construction, fabrication and manufacture of equipment or materials specified herein may be observed by Engineer at plant or factory.

16.3 Materials, equipment or work which do not satisfactorily meet specifications may be condemned by Engineer by written notice to Contractor. Condemned materials, equipment or work shall be promptly removed and replaced.

16.4 Defective materials, equipment or work may be rejected by Engineer at any time prior to final acceptance by Owner even though said defective items may have been previously overlooked.

17. RESIDENT ENGINEER AND/OR ENGINEER TECHNICIANS

17.1 Resident engineer and/or engineer technicians may be appointed by Engineer or Owner to insure that work is performed in accordance with plans and specifications.

17.2 Resident engineer and/or engineer technicians shall have authority to notify Contractor in writing of work which is not being properly performed. Contractor shall be liable for any work determined by Engineer as not being properly performed.

17.3 Resident engineer and/or engineer technicians shall have no authority to permit deviation from plans and specifications and Contractor shall be liable for any deviations made without written order from Engineer.

18. TESTS

18.1 Tests shall be performed by Contractor upon materials and equipment specified, to determine if the materials and equipment meet requirements of specifications, conditions of operation and guarantees of Contractor.

18.2 Equipment shall be subject to factory tests specified herein. Certified evidence of tests shall be furnished when requested by Engineer.

18.3 Tests shall be made in accordance with standards of American Society of Mechanical Engineers, Institute of Electrical and Electronic Engineers, American Society for Testing Materials, and other recognized standards.

19. TIME

19.1 Contractor shall commence work within time specified and shall complete work within time specified in contract.

20. DELAYS

20.1 Delays caused by injunction or legal actions, damages by elements, or other causes beyond control of Contractor (of which Owner shall be sole judge) shall entitle Contractor to a reasonable extension of time within which to complete work.

20.2 Application for extension of time shall be made to Owner by Contractor and shall state reasons for request for extension of time.

20.3 No extension of time shall be valid unless made in writing by Owner.

20.4 Normal weather conditions shall not form the basis of request for extension of time. Abnormal weather conditions shall form basis of request for extension of time only to the delay in excess of that resulting from normal weather conditions.

21. CHANGES

21.1 Engineer shall have the right to make changes in location and quantities of work as may be deemed advisable with consent of Owner and without notice to sureties on Contractor's bond.

21.2 No change shall be made under this paragraph which will increase or decrease total contract amount more than twenty percent (20%) of original contract price and no changes shall be made in plan of improvement that would necessitate additional or different construction processes and equipment.

21.3 Amount due Contractor shall be adjusted for changes in following manner:

21.3.1 Where unit prices have been bid, these unit prices shall be used to compute adjustment in compensation.

21.3.2 Where no such unit prices have been bid, Engineer and Contractor shall negotiate a reasonable adjustment in Contractor's compensation. Limitations on compensation in 21.2 of "21. EXTRA WORK" shall apply to changes where compensation is negotiated.

21.3.3 No changes shall be authorized unless they are shown on revised plans or in written instructions of Engineer.

21.3.4 Authorized changes which require additional time to complete shall entitle Contractor to proportionate extension of time to completion which shall be determined by Engineer.

22. EXTRA WORK

22.1 Required extra work not specified under this contract shall be done at an agreed price satisfactory to Contractor and Owner, or on basis of actual cost of work plus not more than fifteen percent (15%) for Contractor's overhead and profit. Actual cost shall include expense for equipment, materials, and labor and shall include no overhead items or profit. Where extra work is done by a subcontractor, with approval of Owner, there may be included in Contractor's actual cost, ten percent (10%) for subcontractor's profit.

22.2 The term "extra work" as used herein shall not be construed to apply to changes described in "20. CHANGES".

22.3 No compensation shall be allowed Contractor for extra work unless such work has been authorized in writing by Engineer and approved by Owner.

22.4 Contractor shall submit a statement of costs to Engineer for approval when extra work is performed on an actual cost plus basis. After such a statement is approved, Engineer shall certify its correctness to Owner.

23. OWNERSHIP OF MATERIALS

23.1 All materials and work covered by partial payments shall become sole property of Owner, but this provision shall not be construed as relieving Contractor from sole responsibility for all materials and work for which payments have been made, for restoration of damaged work, or as a waiver of rights of Owner to require fulfillment of all terms of contract.

24. OTHER CONTRACTS

24.1 Owner reserves right to let other contracts in connection with this work. Contractor shall afford other contractors reasonable opportunity for introduction and storage of their materials and execution of their work, and shall properly connect and coordinate its work with theirs.

24.2 When proper execution of Contractor's work depends upon work of another contractor, it shall inspect other work and report any defects to Engineer. Contractor's failure to inspect and report shall constitute an acceptance of other contractor's work except for defects which may develop in work after completion.

24.3 To ensure proper execution of its subsequent work, Contractor shall measure work already in place and shall at once report to the Engineer any discrepancy between the executed work and drawings.

25. OWNER'S RIGHT TO DO WORK

25.1 If Contractor neglects to prosecute work properly or fails to perform any provision of this contract, Owner, after three (3) days' written notice to Contractor, may, without prejudice to any other remedy it may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor, provided, however, that Engineer shall approve both such action and amount charged to Contractor.

26. OWNER'S RIGHT TO TERMINATE CONTRACT

26.1 Owner, upon certification of Engineer that there is sufficient cause to justify termination of contract, may, without prejudice to any other right or remedy, and after giving Contractor seven (7) days' notice may terminate employment of Contractor for any of following reasons:

26.1.1 Contractor makes a general assignment for benefit of its creditors, or if adjudged a bankrupt.

26.1.2 Receiver is appointed on account of Contractor's insolvency.

26.1.3 Contractor persistently or repeatedly fails or refuses, except when extension of time to complete is granted, to provide enough skilled workmen or proper materials.

26.1.4 Contractor fails to make prompt payment to subcontractors for material or labor.

26.1.5 Contractor persistently disregards laws and ordinances or instructions of Engineer.

26.1.6 Contractor violates a provision of contract.

26.2 If Owner terminates employment of Contractor, it shall take possession of premises and all materials, tools and appliances thereon. It shall finish work by whatever method it may deem expedient. In such case Contractor shall not be entitled to receive any further payment until work is finished.

26.3 If unpaid balance of contract price exceeds expense of finishing the work including compensation for additional managerial and administrative services, excess shall be paid to Contractor. If expense exceeds unpaid balance, Contractor shall pay difference to Owner. Expense incurred by Owner as herein provided, and damage incurred through Contractor's default, shall be certified by Engineer.

27. CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE CONTRACT

27.1 If Engineer fails to issue any certificate for payment within fifteen (15) days after it is due, or if Owner fails to pay to Contractor within thirty (30) days of its maturity and presentation, any sum certified by Engineer, then Contractor may, upon seven (7) days simultaneous written notice to Owner and Engineer, stop work or terminate this contract. If Contractor elects to stop work by written notice, work shall be resumed promptly upon payment by Owner. If Contractor elects to terminate this contract by written notice it shall recover from Owner payment for all work executed to date of notice and any loss sustained upon any plant or materials plus a reasonable profit.

28. PAYMENTS WITHHELD

28.1 Engineer may withhold or nullify the whole or a part of payment certificate, on account of subsequently discovered evidence, to such extent as may be necessary to protect Owner from loss on account of:

28.1.1 Defective work not remedied.

28.1.2 Claims filed or reasonable evidence indicating probable filing of claims.

28.1.3 Failure of Contractor to make payments properly to subcontractors or for materials or labor.

28.1.4 A reasonable doubt that contract can be completed for balance then unpaid.

28.1.5 Damage to another contractor.

28.1.6 Claims of Owner for liquidated damages.

28.2 Payments shall be made for amounts withheld when above grounds are removed.

29. ACCEPTANCE AND FINAL PAYMENT

29.1 When work has been satisfactorily completed, Engineer will certify Contractor's final estimate stating that work has been completed in accordance with terms and conditions thereof with qualifications, if any, as stated. Balance found to be due Contractor according to the terms of payment shall be paid by Owner as provided in contract, provided, however, that any state laws which designate manner of final payment shall be followed in lieu of manner of final payment outlined above. Prior to receipt of final payment, Contractor shall file with Owner a receipt in full from each manufacturer, subcontractor, and dealer for all equipment and materials used on the work and a complete release of all liens, including tax liens, which may have arisen from this contract and required statements from Contractor and all subcontractors of sales and use tax paid. In lieu thereof, Owner, at its option, may accept from Contractor a statement showing balance due on all accounts.

29.2 Making and acceptance of final payment shall constitute a waiver of all claims by Owner, except those arising from unsettled liens, from faulty work or materials appearing after final payment or from requirements of the specifications, and of all claims by Contractor, except those previously made and still unsettled.

30. SUSPENSION OF WORK

30.1 Owner may suspend the work, or any part thereof, at any time, by giving ten (10) days' written notice to Contractor. The work shall be resumed by Contractor within ten (10) days after date fixed in written notice from Owner to Contractor to do so.

30.2 If work, or any part thereof, shall be suspended and if Owner does not give written notice to Contractor to resume work within one (1) year of date of suspension, Contractor may abandon suspended portion of work. Contractor will be entitled to estimates and payments for all work done on the portions so abandoned, if any.

31. CLEANING UP

31.1 Contractor shall keep premises free from accumulations of waste material or rubbish caused by its employees or work. After completion of work it shall remove all its rubbish and all its tools, scaffolding and surplus materials from work site. It shall leave its work "broom clean" or its equivalent, unless more exactly specified. In case of dispute the Owner may remove rubbish and charge costs to Contractor as Engineer shall determine to be just.

32. HAZARDOUS MATERIALS

32.1 The use of Asbestos Construction Building Materials (ACBM) is specifically prohibited. The Contractor, suppliers, and subcontractors shall warrant that all products used are asbestos free. In the event that a specified product contains asbestos, it shall be the responsibility of the Contractor to notify the Owner so that an appropriate substitution can be made in a timely manner so as not to delay the project.

32.2 The Contractor shall provide the Owner a certificate that warrants that no materials, products, items or equipment contains any asbestos upon completion of the work of this Contract. If asbestos is found to exist in any of the materials, products, items or equipment provided as part of this Contract, the Contractor shall be financially responsible for all costs resulting from removal in accordance with an Owner approved method and replacement of an asbestos free condition to finished drawings and specifications. The financial responsibility of the Contractor shall not terminate with the end of the surety maintenance bond period, but shall continue through the life of the facility.

33. IOWA HAZARDOUS CHEMICAL RISKS RIGHT-TO-KNOW LAW

33.1 Owner's responsibility:

33.1.1 Owner shall provide to the Contractor a list of known hazardous chemicals within the project site to which their employees may be exposed and suggestions for appropriate protective measures.

33.2 Contractor's responsibility:

33.2.1 Contractor shall inform his/her employees of the Iowa Hazardous Chemical Risks Right-to-Know Law.

33.2.2 Contractor shall provide to the Owner a list of known hazardous chemicals that they anticipate will be used on site as well as all pertinent information relating to employee protection. Contractor's Material Safety Data Sheets (MSDS) shall be available to Owner upon request.

SPECIAL CONDITIONS

2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT
CORNING MUNICIPAL UTILITIES
CORNING, IOWA

INDEX

1. INTENT

1.1 To supplement the provisions of the GENERAL CONDITIONS by outlining special conditions applicable to project.

2. LOCATION

2.1 Work is located in State of Iowa owned properties in the Lake Icaria Recreational Area in Adams County, Iowa.

2.2 Transportation facilities:

2.2.1 Iowa Highway 148.

2.2.2 U.S. Highway 34.

3. ORDER OF CONSTRUCTION

3.1 Provide Engineer with proposed schedule of construction showing dates of starting and completing various portions of work.

3.2 Coordinate work with Owner and Engineer to assure orderly and expeditious progress of the work.

3.3 Contractor shall establish schedule of working hours for construction, subject to approval of Engineer.

3.4 Schedule construction to minimize use of street barricades and detours; clean up each portion of work as it is completed; schedule work to allow vehicular access for public access to parking area north of the project site.

4. INTERRUPTIONS TO SERVICE

4.1 Existing utilities shall remain in substantially continuous operation during construction.

5. SERVICE FACILITIES

5.1 Water, electricity, compressed air, and other services shall be furnished by Contractor to meet his own requirements.

6. STORAGE OF MATERIALS AND EQUIPMENT

6.1 Coordinate on site storage space for materials and equipment with Engineer.

6.2 Storage areas shall be subject to approval of Engineer.

6.3 Store materials and equipment in manner which will preserve their quality and fitness.

7. CONSTRUCTION FACILITIES BY CONTRACTOR

7.1 Provide suitable storage buildings necessary for proper storage of materials and equipment.

7.2 Provide telephone at which Contractor can be reached by Owner or Engineer at all times during the working day; provide liaison between telephone and construction personnel for expeditious handling of messages.

7.2.1 Provide Owner and Engineer with at least 2 telephone numbers where Contractor's representative can be reached evenings, weekends and holidays in event of emergency.

7.3 Location of all construction facilities, including project construction plant and yard, subject to approval by Engineer; remove all construction facilities upon completion of work.

7.4 Provide and maintain suitable sanitary facilities for construction personnel for duration of work; remove upon completion of work.

7.5 Provide fence, barricades, and/or watchmen to prevent access of unauthorized persons to site where work is in progress.

8. INSURANCE BY CONTRACTOR

8.1 Provide and maintain insurance throughout construction period in the following minimum amounts:

8.1.1 Workmen's compensation and occupational disease insurance in accordance with the laws of the State of Iowa covering all employees who perform any obligations assumed under the contract.

8.1.2 Public liability and property damage liability insurance covering all operations under the contract; limits of bodily injury or death not less than $500,000 for one person and $1,000,000 for each accident; for property damage, not less than $250,000 for each accident and $500,000 aggregate for accidents during the policy period.

8.1.3 Automobile liability insurance on all self-propelled vehicles used in connection with the contract, whether owned, non-owned, or hired; public liability limits of not less than $500,000 for one person and $1,000,000 for each accident; property damage limit of $500,000 for each accident.

8.1.4 Umbrella liability (applying directly in excess above liability coverages); $1,000,000 combined single limit; $1,000,000 aggregate.

8.1.5 Name the Corning Municipal Utilities as an additional insured under all policies.

8.2 Owner reserves right to approve insurance company.

8.3 Owner shall have right at any time to require public liability insurance and property damage liability insurance greater than required in above paragraphs. Additional premiums payable solely as result of such additional insurance shall be added to bid price.

8.4 Furnish certificates of insurance to Engineer made in favor of Owner showing compliance with foregoing requirements.

8.5 Notification in event of liability or damage: upon the occurrence of any event, the liability for which is herein assumed, the Contractor agrees to forthwith notify the Owner, in writing, such happening, which notice shall forthwith give the details as to the happening, the cause as far as can be ascertained, the estimate of loss or damage done, the names of witnesses, if any, and stating the amount of any claim.

9. CONTRACTOR'S RESPONSIBILITY

9.1 There shall be no liability upon public officials, Engineer or his authorized assistants, either personally or as an official of the Owner, it being understood that in such matters he acts as an agent and representative of the Owner in carrying out any of the provisions of the contract or in exercising any power or authority granted him thereby.

9.2 Contractor agrees to hold harmless and indemnify the Owner and Engineer and their employees or agents against any liability sustained by reason of the work or the handling or storing of materials therefor when such liability arises out of negligent acts, errors or omissions of the Contractor, its employees or agents; failing to do so, any judgment against or settlements resulting therefrom shall become a lien against any funds due Contractor.

9.3 In the event any provisions in the contract are violated by the Contractor or any of its subcontractors, the Owner may serve written notice upon the Contractor and its surety of their intention to terminate such contract. Such notice shall contain a statement of the reasons for such action and unless within 10 days after the serving of such notice upon the Contractor such violation shall cease and satisfactory arrangements for correcting be made, the contract shall, upon expiration of said 10 days cease and terminate.

9.3.1 In the event of such termination, the Owner shall immediately serve notice thereof upon the surety and Contractor and the surety shall have the right to take over and perform the contract, provided, however, that if the surety does not commence the performance thereof within 30 days, the Owner may take over the work and prosecute the same to completion by contract for the account and at the expenses of the Contractor and the Contractor and its surety shall be liable to the Owner for any excess cost occasioned the Owner thereby; in such event, the Owner may take possession of and utilize such materials and appliances as may be on the site of the project and necessary in completing the work.

9.4 If suit is brought by the Owner for the breech of any provisions of this contract, the Contractor agrees to pay all costs in connection with suit, including reasonable attorney fees, whether or not the suit proceeds to judgment.

10. EMPLOYMENT PRACTICES

10.1 Contractor, or his subcontractors, shall not employ any person whose physical or mental condition is such that his employment will endanger the health and safety of himself or others employed on the project.

PLANS LIST

2024 LAKE ICARIA RAW WATER PUMP STATION REPLACEMENT
CORNING MUNICIPAL UTILITIES
CORNING, IOWA

1. PLANS

1.1 The work shall conform to the following drawings and Standard Drawings (bound herein), all of which constitute the "Plans" and are an integral part of the Contract Documents:

Title	Drawing Number	Revision Number
TITLE & INDEX SHEET	01-G-1	
LEGENDS	01-G-2	
SITE PLANS		
OVERALL EXISTING SITE PLAN	02-C-1	
REMOVAL SITE PLAN	02-C-2	
PROPOSED SITE PLAN	02-C-3	
STRUCTURE 10 – PUMP STATION		
PROCESS		
PLAN & SECTIONS	10-P-1	
SECTION	10-P-2	
ELECTRICAL		
ELECTRICAL PLAN	10-E-1	
STANDARD DETAILS		
PROCESS		
PROCESS DETAILS	99-P-1	
ELECTRICAL		
ELECTRICAL ONE-LINE DIAGRAM	99-E-1	
ELECTRICAL SCHEMATICS	99-E-2	
ELECTRICAL SCHEDULES	99-E-3	
ELECTRICAL DETAILS	99-E-4	

DETAILED SPECIFICATIONS

SECTION 01010

GENERAL PROVISIONS

INDEX

PART 1 - GENERAL

1.01 FORM

A. Detailed specifications are in outline form and include incomplete sentences. Omission of words or phrases is intentional. Supply omitted words or phrases by inference.

1.02 INTENT

A. To set forth requirements of performance, type of construction desired and standards of materials and construction.

B. To require Contractor to furnish and install materials and perform all work and services described in Contract Documents, unless otherwise specifically indicated.

C. To require Contractor to perform complete work in spite of omission of specific reference to any minor component part.

D. To provide for new materials and equipment unless otherwise indicated.

1.03 INTERPRETATION

A. Report any errors or ambiguities in specifications to Engineer as soon as detected; Engineer will answer questions regarding and interpret intended meaning of specifications; his interpretation shall be accepted as final.

1.04 WORK INCLUDED

A. Furnish labor, materials and equipment to construct 2024 Lake Icaria Raw Water Pump Station Replacement as set out in Notice to Bidders.

1.05S STARTING AND COMPLETION DATES

A. Commence work within 10 calendar days after date set forth in written Notice to Proceed. Complete within time set forth in Notice to Bidders.

B. Provide adequate personnel and equipment to perform work within time or before completion dates set out in Notice to Bidders.

C. Order all material and equipment immediately after award of contract. Notify Owner and Engineer of scheduled delivery dates for all materials and equipment. Promptly act to accomplish one of the following if Owner and Engineer, in consultation with Contractor, determine delivery dates to be unsatisfactory:
   1. Substitute alternate materials and equipment with approval of Owner and Engineer.
   2. Expedite delivery of materials and equipment.

D. Extensions of contract period will be given consideration upon written request of Contractor. Request must include clear, concise reasons for requesting extension and provide data and relevant information to support reasons for extension.
   1. Owner expects work to be complete and ready for final acceptance within completion time prior to completion date specified.
   2. No extension of contract period will be granted for problems caused by deliveries of materials or equipment.
   3. The phrase "complete and ready for final acceptance" is interpreted to mean all items of construction, surface restoration and clean-up have been accomplished to the satisfaction of the Owner and Engineer prior to the completion date for the contract. So-called "punch list" items are included in this definition and must be completed prior to the completion date for the contract.

1.06 PLANS AND SPECIFICATIONS

A. Engineer will furnish 5 sets of plans and specifications after award of contract. Contractor shall compensate Engineer for printing costs for additional copies required. Contractor clarify size plans to be printed. CAD drawings of site can be provided if requested.

B. Subcontractors and suppliers will be furnished copies of plans and specifications only at request of Contractor.

C. Provide one set of plans and specifications for each foreman or superintendent in charge of each crew on job.

1.07 STANDARDS AND CODES

A. Do work in accordance with best present day construction practices.

B. Unless specifically noted to contrary, conform with and test in accordance with applicable sections of latest revisions of codes and standards of following:
   1. Air Moving and Conditioning Association (AMCA).
   2. American Association of State Highway and Transportation Officials (AASHTO).
   3. American Concrete Institute (ACI).
   4. American Gas Association (AGA).
   5. American Gear Manufacturers Association (AGMA).
   6. American Institute of Steel Construction (AISC).
   7. American National Standards Institute (ANSI).
   8. American Plywood Association (APA).
   9. American Society of Civil Engineers (ASCE).
   10. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
   11. American Society of Mechanical Engineers (ASME).
   12. American Society for Testing and Materials (ASTM).
   13. American Standards Association (ASA).
   14. American Water Works Association (AWWA).
   15. American Welding Society (AWS).
   16. Anti-friction Bearing Manufacturers Association (AFBMA).
   17. Architectural Woodwork Quality Standards (AWI).
   18. California Redwood Association (CRA).
   19. Factory Mutual Corporation (FM).
   20. Federal Specifications (FS).
   21. Hoist Manufacturer's Institute (HMI).
   22. Hydraulic Institute (HI).
   23. Industrial Fasteners institute (IFI).
   24. Industrial Risk Insurers (IRI).
   25. Institute of Electrical and Electronic Engineers (IEEE).
   26. Insulated Power Cable Engineers Association (IPCEA).

27. Internal Combustion Engine Institute (ICEI).
28. Iowa Department of Transportation (IDOT); latest edition of standard specifications and addenda.
29. Iowa Occupational Safety and Health Act of 1972 (Chapter 88, Code of Iowa 2019 (IOSHA).
30. Manual of Accident Prevention in Construction by Associated General Contractors of America, Inc. (AGC).
31. Mining Enforcement and Safety Administration (MESA).
32. National Association of Architectural Metal Manufacturers (NAAMM).
33. National Electrical Manufacturers Association (NEMA).
34. National Electrical Safety Code (NESC).
35. National Fire Protection Association, Inc. (NFPA).
36. National Fire Protection Associations' National Electrical Code (NEC).
37. National Fluid Power Association (NFPA).
38. National Institute for Occupational Safety and Health (NIOSH).
39. National Lumber Manufacturers Association (NLMA).
40. National Safety Council (NSC).
41. National Woodwork Manufacturers Association (NWMA).
42. Occupational Safety and Health Act of 1970 (Public Law 91-596) (OSHA).
43. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
44. Society of Automotive Engineers (SAE).
45. Steel Door Institute (SDI).
46. Steel Structures Painting Council (SSPC).
47. Underwriters' Laboratories, Inc. (UL).
48. West Coast Lumber Inspection Bureau (WCLB).
49. Western Wood Products Association (WWPA).
50. Standards and codes of the State of Iowa and applicable local standards and codes of the City of Osceola.
51. Other standards and codes which may be applicable to acceptable standards of the industry for equipment, materials and installation under the contracts.

1.08 MATERIALS TESTS

A. Includes all materials tests or tests specified hereinafter.

B. Employ approved testing laboratory to show that construction materials comply with specifications.

C. Provide samples of materials required for laboratory tests and pay cost of all tests including transportation charges on samples.

D. Incorporate no materials in work until laboratory tests have been furnished which show materials comply with specifications.

E. All materials subject to testing, inspection and rejection at the site by Engineer.

F. Pay all costs of retesting when test results indicate non-compliance with contract requirements.

G. Laboratory tests specified herein include the following:
   1. Aluminum-alloy: certify that properties conform to specifications.
   2. Galvanizing: certify that zinc coatings conform to specifications for all equipment.
   3. Cement: bin sample for entire requirement, ASTM C150.
   4. Concrete aggregates: one sample of each, ASTM C33.
   5. Two concrete compression cylinders from trial batch for each proposed mix, ASTM C39; test one at 7 days, one at 28 days; test cylinders during construction as defined in Section 03300 - Cast-in-Place Concrete.
   6. Reinforcing steel: certify that steel conforms to ASTM A615 for grade specified.
   7. Ductile iron pipe: certify that pipe conforms to ANSI/AWWA C151/A21.51.
   8. Polyvinylchloride pipe: certify that pipe conforms to ASTM D1785, ASTM D1248 and AWWA C900.
   9. Other pipe: certify that pipe conforms to applicable specifications.

H. Concrete Components:
   1. Test or verify in writing make up of concrete in each concrete truck load delivered and poured at site.
   2. Verify gallons of water per sack of cement.
   3. Verify sacks of cement per cubic yard of concrete.
   4. Verify admixtures used per ASTM designations listed in Section 03300 – Cast-in-Place Concrete.
   5. Test for inches of slump per ASTM C143 and C172.
   6. Test for percent air content per ASTM C231 or C173 and C172.

I. Reinforcing steel: furnish original and 1 copy of certified test report by manufacturer.

J. Welded wire fabric: furnish original and 1 copy of certified test report by manufacturer.

K. Provide sampling and testing of excavated materials to determine moisture-density relations of soils and perform moisture and density tests during construction as specified hereinafter.

L. See Section 01300 - Submittals, for other requirements.

1.09 FIELD TESTS

A. Notify Engineer when installation is considered complete, in operating condition and ready for testing.

B. Test piping and valves as specified hereinafter.

C. Test all fill materials for density and moisture content as directed by Engineer, tests conducted by independent testing laboratory; moisture-density tests required for granular subbase and fill, structure backfill and trench backfill.

D. Moisture-density test locations and depths subject to approval of Engineer.

E. See Section 02200 - Sitework, for testing requirements.

F. If performance guarantees or requirements are not met during tests, make necessary corrections, repairs or replacements; demonstrate to Engineer that work meets performance guarantees or requirements.

G. See Section 03300 - Cast-in-Place Concrete, for testing requirements for placement of concrete.

H. Contractor responsible to pay all costs for all field tests including transportation charge on samples and providing concrete and soil samples. Field tests include granular and soil moisture and density tests and concrete compression, air, temperature and slump tests.

1.10 DEFECTIVE EQUIPMENT

A. Owner retains right to operate equipment until defects are corrected and guarantees satisfied.

B. Owner reserves right to operate rejected equipment or other work until replaced, without cost for depreciation, use or wear.

C. Remove equipment or other work from operation for examination, adjustment or change at times approved by Engineer.

1.11 RESPONSIBILITY OF CONTRACTOR

A. Protection of his work.

B. Protection of all property from injury or loss resulting from his operations.

C. Replace or repair objects sustaining damage, injury or loss to satisfaction of Owner and Engineer.

D. Without limiting GENERAL REQUIREMENTS of Contract Documents, protect fences, sidewalks, street, pavements, alleys, pipe, conduit, utilities, trees, shrubs and structures.

E. Cooperate with Owner, Engineer and representative of utilities in locating underground utility lines and structures. Incorrect, inaccurate or inadequate information concerning location of utilities or structures shall not relieve Contractor of responsibility for damage thereto caused by his operations.

F. Keep cleanup current with construction operations.

G. Comply with all federal, State of Iowa and Clarke County, Iowa, laws and ordinances.

H. Provide and maintain sanitary facilities for construction personnel for duration of work; remove upon completion of work.

I. Notify Engineer 48 hours prior to expected time for operations requiring construction observation services.

J. Cooperate with independent testing firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.

K. Building permit is required. No building permit fees will be assessed. Contractor responsible for obtaining building permit.

1.12 BARRICADES AND LIGHTS

A. Erect and maintain barricades and lights and/or provide watchmen for protection and warning of pedestrians; all barricades, lights and/or watchmen at expense of Contractor.

B. Location and arrangement: conform to ordinances and laws; meet approval of Owner and Engineer.

C. Install snow fence as specified.

1.13 PRECONSTRUCTION CONFERENCE

A. Soon after award of contract and prior to the start of construction, attend a preconstruction conference with representative of the Owner to define the requirements for contract administration and construction operation.

B. Contact the Engineer who will determine the time, date and place of the conference.

1.14 MONTHLY CONSTRUCTION PROGRESS MEETINGS

A. Attend monthly construction progress meetings. Provide construction schedule progress report at each meeting.

1.15 FINAL REVIEW AND ACCEPTANCE

A. Notify Engineer when installation is considered to be complete and ready for final review.

B. Owner will accept work and make final payment to Contractor.
   1. When Engineer has certified that he has reviewed the work of Contractor and stated that the work is complete and in substantial conformance with specifications.
   2. When Contractor has filed with Owner and Engineer documents called for in specifications.
   3. When all governmental agencies involved have indicated, in writing, that work is complete and acceptable.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

Not Applicable.

END OF SECTION

SECTION 01040

SPECIAL CONSTRUCTION

INDEX

PART 1 – GENERAL

1.01 DESCRIPTION

A. Procedures outlined below are not intended to fully cover all special procedures or emergencies which may arise during construction but are offered as an aid to Contractor in planning work; Contractor will cooperate with Owner and Engineer to minimize inconvenience, construction delays and interruptions to continuous operation water lines and other existing utilities.

B. Determine location of underground utilities and piping before starting work; locations of underground appurtenances shown are approximate and not guaranteed by Owner or Engineer.

C. Remove and replace all signs which interfere with construction operations; replace damaged signs at no cost to Owner.

D. Arrange with operating utilities for relocation or temporary removal of utilities in conflict with construction and for services needed during construction.

E. Submit complete schedule after award of contract for planning, controlling and completing construction of project. Include list of promised delivery dates for major equipment items. Schedule project on basis of promised delivery dates for major equipment items.
   1. Contractor will be expected to provide adequate personnel and equipment to perform work within specified time of construction.

2. If delays in delivery of major equipment become apparent, notify Owner and Engineer promptly; take action to accomplish one of the following:
   a. Substitute alternate equipment with approval of Owner and Engineer.
   b. Expedite delivery of equipment.
3. Extensions of contract period will be given consideration upon written request of Contractor; request must include valid supporting data and bona fide reasons for requesting extension; inclement weather is not justification for extending contract period; Owner expects work to be complete and ready for final acceptance within completion time specified.

1.02 COOPERATION WITH OTHERS

A. Cooperate with state and federal regulatory agencies in matters under their jurisdiction over construction operations.

B. Cooperate with local governmental agencies; secure necessary building permits and arrange for inspections at proper times.

C. Advise all utilities prior to excavating; arrange for field locates of utilities by utility representatives.

1.03 DEMOLITION AND REMOVAL

A. Items of demolition and removal shown on plans or specified elsewhere are set out to assist Contractor in determining scope of work; items shown may not be complete; demolish or remove items shown on plans, described in specifications or as may be necessary for expediting work.

B. Remove items in workmanlike manner; cut reinforcing steel flush with concrete; blasting not permitted without written approval from Owner and Engineer.

C. Remove waste, rubble and debris from site; dispose of in accordance with all State and Federal regulations.

1.04 ORDER OF WORK

A. Prepare detailed construction procedure schedule after award of contract.

B. Work with Owner and Engineer to establish workable construction schedule after award of contract.

C. Facilities must remain in continuous operation during construction except as required to make connections to new facilities and as discussed in Part 1.04.F below. The construction sequence shown below is to aid the Contractor in planning the work. The sequence of events is a suggestion and is not intended to direct the Contractor's means, methods, and techniques or approach to completing the work. Other construction sequences could be acceptable. Also, the condition of the existing piping and valving may be such that it cannot be used as described below and additional temporary piping may be required.

D. Schedule required interruptions to facilities with Owner and Engineer.

E. Provide Owner 48 hours' notice of any interruption of operation; coordinate with Waterworks.

F. 2024 Lake Icaria Raw Water Pump Station Replacement Construction Sequence:
   1. Owner will excavate for new building, install underground piping, make connections to existing suction and discharge pipe, install building foundation, floor and new building.
   2. Contractor will supply and install pumps, interior piping, including all valves and fittings, electrical, controls, and painting.
   3. Owner will disconnect existing pump station from service. Contractor will demolish existing pump station and abandon pipe as shown on the plans.
   4. Contractor will perform start-up services and clean up.
   5. Owner will perform site grading and seeding.

1.05 UNSTABLE SOILS

A. Provide material and equipment required to permit installation of structures and piping through all soils encountered.

B. Excavation of all soils encountered is incidental to construction except rock and rubble excavation as defined in Section 02200 – Sitework.

C. Contractor responsible for dewatering excavation as provided in Section 02200 – Sitework to ensure stable bottom of trench and structures to allow normal bedding material to support pipe and structures; use of stabilizing material or additional bedding rock in lieu of or as substitute for dewatering permitted at Contractor's option at no additional cost.

D. Owner will only pay for excavation bottom stabilization after contractor has provided dewatering by means of well points and/or deep wells extending a minimum of 10' below the bottom elevation in addition to dewatering pumps and is not capable of providing a stable bottom using customary practices for dewatering by use of dewatering pumps, well points, and/or deep wells.

1.06 EROSION CONTROL

A. Owner shall be responsible for ensuring that all discharges of water from the site shall comply with State and Federal requirements.

PART 2 – PRODUCTS
Not Applicable.

PART 3 – EXECUTION
Not Applicable.

END OF SECTION

SECTION 01150

MEASUREMENT AND PAYMENT

INDEX

PART 1 – GENERAL

1.01 SCOPE

A. No separate payment will be made for work covered in the specifications except as set forth below. Include all work in lump sum bid for constructing 2024 Lake Icaria Raw Water Pump Station Replacement.

B. If items not included in lump sum bid for constructing Pump Station Improvements are required during construction, contract price shall be adjusted on basis of unit price negotiated between Engineer and Contractor and approved by Owner.

1.02 QUANTITY VARIATIONS

A. No separate payment will be made for changes in quantities of items included in lump sum bid for construction of Booster Station Improvements except as set forth below. Contract unit prices shall include all costs for each item of work.

B. If quantities of items are changed from those upon which bid is based, contract price shall be adjusted on basis of unit price negotiated between Engineer and Contractor and approved by Owner. Soil quantities shall not be adjusted unless design contours are changed by the Engineer.

1.03 OPERATION AND MAINTENANCE MANUALS

A. O&M Manuals for all equipment shall have preliminary submittal as soon as available after shop drawings are approved.
   1. Final O&M Manuals are to be available 3 months prior to plant start-up.

1.04 SCHEDULE OF VALUES

A. Submit to Engineer Schedule of Values allocated to various portions of work.

B. Upon request of Engineer, support values with data which will substantiate their correctness.

C. Schedule of Values shall be used only as basis for Contractor's application for progress payment.

D. Type schedule on 8-1/2" x 11" white paper; Contractor's standard forms and automated printout will be considered for approval by Engineer upon Contractor's request. Identify schedule with:
   1. Title of project and location.
   2. Engineer and Engineer's project number.
   3. Name and address of Contractor.
   4. Contract designation.
   5. Date of submission.

E. Schedule shall list installed value of component parts of work in sufficient detail to serve as basis for computing values for progress payments during construction.

F. Follow table of contents of this project manual as format for listing component items.
   1. Identify each line item with number and title of respective specification section.

G. For each specification division, list sub-values of major materials, equipment or operation under division.

H. Provide separate listing of items of General Requirements (Division 1), such as bonds, insurance premiums, job mobilization, field supervision and layout, construction facilities and temporary controls, contingency allowance, construction schedule, O&M data, record drawings, and submittals.

I. For various portions of work:
   1. Each item shall include directly proportional amount of Contractor's overhead and profit.
   2. For items on which progress payments will be requested for stored materials, break down value into:
      a. Cost of materials, delivered and unloaded, with taxes paid.
      b. Total installed value including Contractor's overhead and profit.

J. Sum of values listed in schedule shall equal total contract sum.

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

Not Applicable.

END OF SECTION

SECTION 01300

SUBMITTALS

INDEX

PART 1 – GENERAL

1.01 INFORMATION FOR ENGINEER

A. After award of contract submit following information and drawings for Engineer's review. Total number of reviewed copies required for distribution: 5 plus copies required by Contractor.
   1. Certified materials tests as described in Section 01010 – General Provisions.
   2. Certified outline, general arrangement, assembly, installation, foundation arrangement and anchor bolt detail drawings for all major equipment listed in proposal and for other equipment where specified.
   3. Manufacturer's specifications and catalog data for all items of equipment including electrical controls, heating and ventilating equipment, plumbing fixtures, valves, pipe, fittings, castings and appurtenances and other special items.
   4. Certified performance data and operating characteristics for pumps prior to delivery to job site from shop tests performed on pumps furnished in accordance with Hydraulic Institute.
   5. Shop drawings showing reinforcing steel details, structural steel and aluminum, beams, roof systems, steel joists, grating, supports prefabricated piping, metal building and other items.
   6. Schematic diagrams of all control circuits.
   7. Detailed wiring diagrams.
   8. Such other information as Engineer may request and information as specified with equipment.

B. Within 15 days after award of contract, provide construction schedule, showing dates of starting and completing various portions of work and dollar value of each portion of work.

C. Within 30 days after initiation of construction, provide written schedules of estimated monthly payments for contractor and subcontractors; revise schedules whenever variations exceed 10%.

D. Provide 2 copies of following information:
   1. Contract price breakdown of lump sum bid for use in preparation of periodic payment estimates.
   2. Purchase orders and subcontracts without prices.
   3. Shipping papers for all materials.
   4. All materials test reports.
   5. Concrete mix designs; submit 8 days before proposed mix is to be used.

1.02 SHOP DRAWINGS

A. Intent of Engineer's review: to assist Contractor in interpreting plans and specifications.

B. Contractor's responsibility: to check drawings prior to submission for coordination and conformance with contract; do not submit without checking.

C. Equipment checking is only for general conformance with design concept of project and general compliance with information given in contract documents. Any action shown is subject to requirements of plans and specifications. Contractor is responsible for dimensions which must be confirmed and correlated at job site; fabrication processes and techniques of construction; coordination of work with that of all other trades; and satisfactory performance of work.

D. Prior to submission of shop drawings and catalog data to Engineer: affix Contractor's stamp with signature of responsible person to show that material submitted has been checked and approved by Contractor. Shop drawings submitted without appropriate stamp and signature will be returned unreviewed.

E. Do not install or otherwise incorporate any equipment on project until shop drawings, if required, have been reviewed and so designated by Engineer.

F. Contractor's responsibility for errors and omissions in submittals is not relieved by Engineer's review of submittals.

G. Whenever items of materials or equipment are specified by a manufacturer's name and type and "or equal" is not listed, Contractor shall provide specified equipment without substitution, unless prior approval of Engineer is obtained for any substitution.

H. Contractor shall abide by Engineer's decision when proposed substitute of material or equipment are deemed to be unacceptable and in such an event Contractor shall furnish items of equipment or materials specified.

I. Engineer reserves right to consider such factors as overall project arrangement, overall project cost, and similar factors in determining whether proposed substitutions will be acceptable.

J. Upon Engineer's determination that a drawing must be returned as "Revise and Resubmit" or "Rejected", Engineer's review of the shop drawing will cease and no additional marking will be made. Resubmittals will be reviewed as new drawing of equipment or materials. As such, Engineer may provide comments on items which were included with initial submittal even if those items did not change from initial submittal to resubmittal.

K. Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost to the Owner, for the Engineer to recheck and handle the additional shop drawing submittals.

L. No guarantee of review time is made by Engineer. Review time is dependent on number and complexity of submittals received. When multiple drawings are submitted, provide priority for order of review to Engineer. Failure of Contractor to allow time to review of submittals by Engineer does not constitute basis for compensation due to delays.

1.03 SUBMITTAL REQUIREMENTS

A. Binding - submittals 1/4" thickness or less may be securely stapled in the upper left hand corner. Submittals thicker than 1/4" shall be bound in commercial grade cardboard or plastic folders, wire or plastic binders, or 3-ring binders as appropriate. Individual papers bound with paper clips are not acceptable.

B. Cover sheet - each submittal shall have a cover sheet providing the following information. The Contractor's transmittal letter is not an acceptable cover sheet.
   1. Project name.
   2. Supplier's name, address, and telephone number.
   3. Engineer's name and location.
   4. General Contractor's name and location.
   5. Specification section applicable to submittal contents.
   6. A 4" square blank space for Engineer's review stamp.

C. Where more than one model is shown on a manufacturer's sheet, clearly indicate exactly which item and which data is relevant to the work.

D. Where the manufacturer lists multiple part numbers or options on a single data sheet, the part number and options to be used shall be clearly set apart from other part numbers shown on that sheet.

E. Failure to comply with the above shall be reason to resubmit shop drawing.

1.04 INSTRUCTION MANUALS, PARTS LISTS AND TOOLS

A. Furnish 5 complete sets of manufacturer's instructions for installation, operation and maintenance of equipment furnished; include assembly drawings and parts lists with exploded views of equipment parts and identification symbols or part numbers for all replaceable parts and assemblies, recommended spare parts list, lubricant guide, preventative maintenance and troubleshooting procedures; submit manuals to Engineer within 30 days after return of shop drawings by Engineer to Contractor; manuals subject to Engineer's review.

B. Furnish special tools, jigs and fixtures necessary for installation, operation, lubrication, repair, preventative maintenance, or troubleshooting of equipment.

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

Not Applicable.

END OF SECTION

SECTION 01310

CONSTRUCTION PROGRESS SCHEDULES

INDEX

PART 1 – GENERAL

1.01 DESCRIPTION

A. Prepare and submit to Engineer for review, estimated construction progress schedule.

B. No work shall be performed between 7:00 P.M. and 7:00 A.M., nor on legal holidays without permission of Owner.

C. Night work may be established by Contractor as regular procedure with permission of Owner. Such permission, however, may be revoked at any time by Owner if Contractor fails to maintain adequate equipment and supervision for proper prosecution and control of work at night.

1.02 FORM OF SCHEDULE

A. Prepare schedule in form of horizontal bar chart.
   1. Provide separate horizontal bar for each trade, activity or operation.
   2. Horizontal time scale: identify first work day of each week.
   3. Scale and spacings to allow space for notations and future revisions.

B. Format of listings: chronological order of start of each item of work.

C. Identification of listings: by major specification section numbers.

1.03 CONTENT OF SCHEDULE

A. Construction Progress Schedule:
   1. Show complete sequence of construction by activity.
   2. Coordinate progress schedule with submittal schedule.
   3. Show dates for beginning and completion of each major element of construction and installation dates for major items of equipment. Elements shall include, but not be limited to:
      a. Material and equipment order, manufacturer, delivery, installation, and checkout, including allowance items.
      b. Performance tests and supervisory services activity.
      c. Piping.
      d. Concrete pour sequence.
      e. Structural steel erection.
      f. Precast concrete erection.
      g. Backfilling, grading, seeding, sodding, landscaping, fence construction, and paving.
      h. Electrical work activity.
      i. Plumbing work activity.
      j. Subcontractor's items of work
      k. Final cleanup.
      l. Allowance for inclement weather.
      m. Miscellaneous concrete placement.
   4. Show projected percentages of completion for each item as of first day of each month.

1.04 SCHEDULE REVISIONS

A. Revise construction progress schedule every 30 days to reflect changes in progress of work.

B. Indicate progress of each activity at date of schedule revision.

C. Show changes occurring since previous revised submittal.
   1. Major changes in scope.
   2. Activities modified since previous submittal.
   3. Revised projections of progress and completion.
   4. Other identifiable changes.

D. Provide narrative report defining:
   1. Problem areas, anticipated delays, and impact on schedule.
   2. Corrective action recommended and its effect.

E. Submit to Engineer.

1.05 DELAYS AND RECOVERY

A. If, at any time during project, Contractor fails to complete activity by its latest scheduled completion date, Contractor shall, within 3 working days, submit to Engineer written statements as to how and when work force will be reorganized to return contract to current construction schedule.

B. Whenever it becomes apparent from progress evaluation and updated schedule data that milestone completion dates or contract completion dates will not be met, Contractor shall take some or all of the following actions.
   1. Increase construction staffing in such quantities and crafts as shall substantially eliminate backlog of work.
   2. Increase number of working hour per shift, shifts per work day, work days per week, amount of construction equipment or combination of foregoing sufficient to substantially eliminate backlog of work.
   3. Reschedule work items to achieve concurrency of accomplishment.

C. Addition of equipment or construction forces, increasing working hours or any other method, manner or procedure to return to current construction progress schedule not considered justification for amending contract documents or treated as acceleration.

1.06 SUBMITTAL REQUIREMENTS

A. For initial submittal of construction schedule and subsequent revisions thereof, furnish 5 copies of schedule to Engineer.

B. Failure to submit construction schedule on timely basis as previously noted shall be considered cause for withholding progress payments otherwise due under contract.

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

Not Applicable.

END OF SECTION

SECTION 01400

SPECIAL INSPECTIONS

INDEX

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes inspection and testing requirements to comply with special inspection requirements of the International Building Code (IBC), current edition.

B. The Owner will designate the Engineer or a special inspector with testing agency prior to project award.

1.02 PAYMENT

A. The Owner will hire and pay for services of the Engineer or a special inspector and independent testing laboratory.

B. The Contractor shall pay for all testing described in the individual sections of the contract specifications.

1.03 SPECIAL INSPECTOR RESPONSIBILITIES

A. Observe the work assigned for conformance with the approved plans and specifications.

B. Submit inspection reports to the building official, the Engineer of Record, and the Owner.

C. Bring non-conforming items to the immediate attention of the Contractor for correction. If uncorrected, report non-conforming items to the Engineer of Record and the Building Official.

D. Submit a final signed report stating whether the work requiring special inspection was, to the best of their knowledge, in conformance with the approved plans and specifications and the applicable workmanship provision of the IBC.

1.04 TESTING AGENCY RESPONSIBILITIES

A. Test the work assigned for conformance with the approved plans and specifications.

B. Submit reports of the test results to the Building Official, the Engineer of Record, and the Owner.

C. Bring non-conforming items to the immediate attention of the Contractor for corrections. If uncorrected, report non-conforming items to the Engineer of Record and the Building Official.

D. Submit a final signed report stating whether the work requiring special inspections was, to the best of their knowledge, in conformance with the plans and specifications.

1.05 CONTRACTOR RESPONSIBILITIES

A. Post the Special Inspection and Testing Schedule within the office at the project site.

B. Provide not less than 24 hour notification to the parties designated on the schedule for inspection and testing.

C. Provide the special inspector and testing agent access to the approved plans and specifications at the project site.

D. Retain at the project site, all reports submitted by the special inspector and testing agent.

E. Correct in a timely manner, all deficiencies identified by the special inspector and testing agent.

F. Provide the special inspector and testing agent safe access to the work requiring observation or testing.

1.06 FABRICATOR RESPONSIBILITIES

A. Submit a Certificate of Compliance to the Building Official and the Engineer of Record that all work was performed in accordance with the approved plans and specifications.

1.07 SPECIAL INSPECTION AND TESTING SCHEDULE

A. Concrete Formwork:
   1. Conform to Section 03100 - Concrete Formwork.
   2. Special Inspector:
      a. Inspect all formwork prior to placing concrete.

B. Concrete Reinforcement:
   1. Conform to Section 03200 - Concrete Reinforcement.
   2. Special Inspector:
      a. Inspect placement of all reinforcing steel prior to placing concrete.

C. Cast-in-Place Concrete:
   1. Conform to Section 03300 - Cast-in-Place Concrete.
   2. Special Inspector:
      a. Inspect placement of concrete.
   3. Testing Agency:
      a. Test all concrete in accordance with Section 03300.

D. Bolts Installed in Concrete:
   1. Conform to Section 03300 and Section 05120 - Structural Steel.
   2. Special Inspector:
      a. Inspect installation of all bolts prior to placing concrete.
      b. Inspect placement of concrete around all bolts.

E. Precast Concrete:
   1. Conform to Section 03421 - Precast Concrete.
   2. Special Inspector:
      a. Inspect installation of precast units.
      b. Inspect installation of connections.
   3. Fabricator:
      a. Submit certificate of compliance.

F. Masonry:
   1. Conform to Section 04200 - Unit Masonry.
   2. Special Inspector:
      a. Inspect placement of reinforcing steel.

b. Verify proportions for mortar and grout.
c. Verify grout space is clean prior to grouting.

G. Structural Steel:
1. Conform to Section 05120.
2. Special Inspector:
a. Verify AWS certification of all welders.
3. Testing Agency:
a. Visual inspection of all field welding.
b. Radiographic testing of all full penetration butt welds.
4. Fabricator:
a. Submit Certificate of Compliance and verification of AWS certificates for all welders.

H. High Strength Bolting:
1. Conform to Section 05120.
2. Special Inspector:
a. Inspect tension indicating device for all high strength bolts.

I. Sitework
1. Conform to Section 02200 - Sitework and plans.
2. Testing Agency:
a. Verify materials below footings are adequate to achieve the design bearing capacity.
b. Verify excavations have extended to proper depth and have reached proper material.
c. Verify backfill materials are acceptable.
d. Conduct moisture-density compaction tests.

END OF SECTION

SECTION 01410

TESTING LABORATORY SERVICES

INDEX

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. Owner will employ and pay for services of testing laboratory to perform specified services and testing as described in specifications.

B. Related requirements in other parts of Project Manual:
   1. Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities: Conditions of Contract.

1.02 QUALIFICATION OF LABORATORY

A. Meet basic requirements of ASTM E329-77 - Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

B. Authorized to operate in state in which project located.

C. Testing equipment:
   1. Calibrated at reasonable intervals by devices of accuracy traceable to either:
      a. National Bureau of Standards.
      b. Accepted values of natural physical constants.

1.03 LABORATORY DUTIES

A. Cooperate with Engineer and Contractor; provide qualified personnel to perform work after due notice to proceed.

B. Perform specified inspections, secure samples, and test materials.
   1. Comply with specified standards.
   2. Ascertain compliance of materials with contract documents.

C. Promptly notify Engineer and Contractor of observed irregularities or deficiencies of work, equipment or material.

D. Promptly submit written report of each test and inspection; one copy each to Engineer, Owner, material supplier, and Contractor, and one copy to record documents file. Each report shall include:
   1. Date issued.
   2. Project title and number.
   3. Testing laboratory name, address, and telephone number.
   4. Name and signature of laboratory inspector.
   5. Date and time of sampling or inspection.
   6. Record of temperature and weather conditions if test performed in field.
   7. Date of test.
   8. Identification of product and specification section.
   9. Location of sample or test in project.
   10. Type of inspection or test.
   11. Results of tests and compliance with contract documents.
   12. Interpretation of test results, when requested by Engineer.

E. Perform additional tests as required by Engineer or Contractor.

1.04 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory not authorized to:
   1. Release, revoke, alter or enlarge on requirements of contract documents.
   2. Approve or accept any portion of work.
   3. Perform duties of Contractor.

1.05 CONTRACTOR RESPONSIBILITIES

A. Cooperate with laboratory personnel and provide access to work.

B. Provide to laboratory preliminary design mix proposed to be used for concrete and other material mixes which require control by testing laboratory.

C. Furnish copies of product test reports.

D. Furnish incidental labor and facilities.
   1. Provide access to work to be tested.
   2. Obtain and handle samples at project site or source of product to be tested.
   3. Facilitate inspections and tests.
   4. Store and cure test samples.

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

F. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's convenience.

G. Employ and pay for services of testing laboratory to perform additional inspections, sampling, and testing required when initial tests indicate work does not comply with contract documents.

END OF SECTION

SECTION 01500

TEMPORARY CONSTRUCTION FACILITIES AND UTILITIES

INDEX

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide and maintain temporary facilities and utilities required for construction; remove on completion of work.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

A. National Fire Protection Association (NFPA):
   1. National Electric Code (NEC), NFPA No. 70, and Iowa amendments.

B. Comply with federal, state, and local codes and regulations, and with utility company requirements.

PART 2 – PRODUCTS

2.01 TEMPORARY ELECTRICITY AND LIGHTING

A. General:
   1. Temporary lighting shall be sufficient to enable Contractor to complete work and enable Engineer to check work as it is being performed. Illumination shall meet or exceed state code requirements.

2. After substantial completion of permanent electrical system and building wiring, permanent receptacles may be used during finishing work.

B. Responsibilities:
1. Provide, maintain, and remove temporary electric service facilities.
2. Facilities exposed to weather shall be weatherproof type and electrical equipment enclosure locked to prevent access by unauthorized personnel.
3. Pay for installation of temporary services including poles, transformer charges, and metering.
4. Patch affected surfaces and structures after temporary services removed.
5. Arrange with local electric utility for temporary electric service subject to their requirements and approval.
6. Register meter in Contractor's name.
7. Provide lamps, wiring, switches, sockets, and similar equipment required for temporary lighting and small power tools.
8. Pay for electrical energy consumed for construction purposes including operation of ventilating equipment, heating of buildings, and testing and operating equipment after permanent wiring installed, until final acceptance by Engineer or until occupancy by Owner.
9. Provide and pay for service to temporary offices.

2.02 TEMPORARY HEAT

A. General:
1. Cold weather protection: Heating required before building is enclosed.
2. Temporary heat: heating required after enclosure of building or structure. Building or structure shall be considered as enclosed when it is roofed and has such protection at doorways, windows, and other openings as will provide reasonable heat retentions.
3. See requirements of specification for minimum temperature to be maintained for various trades and work. Except as otherwise called for, temperature in all parts of new buildings shall be kept above 50ºF. Maximum temperature in building shall be 75ºF. during heating season.
4. Heat shall be warm air heat from oil or gas-fired portable unit heaters suitably vented to outside as required for protection of health and property.
5. Open salamander type heaters not permitted.

B. Responsibilities:
1. Provide temporary heat. Make arrangements and pay fuel costs, supervise, and maintain heating units.
2. Provide adequate heat to all parts of building.
3. Pay for repairing or replacing any part of building or materials damaged because of lack of heat.

4. Provide temporary throwaway filters if, at any time, permanent system used for temporary ventilation.
5. Upon acceptance or occupancy of building(s) by Owner, Contractor's responsibility for temporary heating as specified shall be in accordance with OWNER'S USE article, this section.

2.03 TELEPHONE SERVICE

A. Provide telephone at which Contractor can be reached by Owner or Engineer at all times during the working day.
   1. Provide Owner and Engineer with at least 2 telephone numbers where Contractor's representative can be reached on weekends, evenings, and holidays in the event of an emergency.

2.04 WATER FOR CONSTRUCTION AND TESTING

A. Water is not available on project site. Make arrangements to obtain suitable water, if necessary.

2.05 SANITARY FACILITIES

A. Provide temporary sanitary toilet facilities conforming to state and local health and sanitation requirements, in sufficient number for use by Contractor's employees.

B. Maintain in sanitary condition and properly supply with toilet paper.

C. Use of existing sanitary facilities by the Contractor is not allowed.

2.06 TEMPORARY FIRE PROTECTION

A. Provide and maintain in working order, minimum of 1 fire extinguisher on each floor of each building, and such other fire protective equipment and devices as would be reasonably effective in extinguishing fires during early stages by personnel at project site.

B. Comply with NFPA, federal, state, local and other applicable requirements.

2.07 TEMPORARY SITE WORK

A. Provide and maintain temporary roadways necessary to carry out construction operations in clean, dust free, snow free, ice free, driveable condition.

B. Provide and maintain temporary site drainage and stormwater controls.

C. Exercise caution to minimize increase in suspended solids and turbidity in surface waters within and adjacent to construction area. Do not deposit spoils in surface waters. Control and minimize sediment runoff and excavation erosion to surface waters.

2.08 DAMAGE TO EXISTING PROPERTY

A. Be responsible for replacing or repairing damage to existing buildings, sidewalks, roads, parking lot surfacing, and other existing assets.

B. Contractor shall have option of having Owner contract for such work and have cost deducted from contract amount.

2.09 SECURITY

A. Security not provided by Owner.

B. Contractor shall be held responsible for loss or injury to persons or property where his work is involved, and shall provide security and take precautionary measures to protect Contractor's and Owner's interests.

2.10 TEMPORARY PARKING

A. Parking on construction site in designated areas may be provided as approved by Engineer and Owner.

B. Make arrangements for additional parking area for employee's vehicles if required.

C. Costs involved in obtaining this parking area shall be borne by Contractor.

2.11 TEMPORARY FENCING

A. Provide temporary fencing sufficient to prevent trespass by Contractor's employees and suppliers onto private property and by public onto construction site.
B. Materials shall be sufficiently durable to be effective for duration of construction period.

2.12 FIELD OFFICES AND BUILDINGS

A. If required by Contractor, erect where designated by Engineer and maintain in good condition, temporary field office and tool storage building(s) for Contractor's use.
   1. Tool storage building(s) shall be of ample size to provide space for tools and equipment. Building(s) shall be neat and well constructed, surfaced with plywood, drop siding, masonite or other similar material, well painted and void of advertisements.

2.13 OWNER'S USE

A. Upon acceptance of work, or portion of work defined and certified as substantially completed by Engineer, and Owner commences full-time successful operation of facility or portion thereof, Owner will pay cost for utilities used for Owner's operation. Contractor shall continue to pay for utilities used until final acceptance of work, except as provided herein. However, heat for heating building as required for construction purposes shall still be paid by Contractor unless, due to occupancy by Owner, more heat shall be required either due to increased temperature or lengthened duration, in which case Owner will bear difference in cost.

PART 3 – EXECUTION

3.01 GENERAL

A. Comply with applicable requirements specified herein.

B. Maintain and operate systems to ensure continuous service.

C. Modify and extend systems as work progress requires.

3.02 REMOVAL

A. Completely remove temporary materials, equipment, signs, and structures when no longer required.

B. In unfinished areas, clean and repair damage caused by temporary installations or use of temporary facilities, restore drainage, and evenly grade, seed or plant as necessary to provide appearance equal to or better than original.

C. In finished areas, restore existing or permanent facilities used for temporary services to specified, or to original, condition.

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

INDEX

PART 1 – GENERAL

1.01 DESCRIPTION

A. Material and equipment incorporated into work:
   1. Conform to applicable specifications and standards.
   2. Comply with size, make, type, and quality specified or as specifically approved by shop drawings, Engineer, or other submittal.

B. Manufactured and fabricated materials and equipment:
   1. Design, fabricate, and assemble in accordance with engineering and shop practices standard with industry.
   2. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
   3. Two or more items of same kind shall be identical, by same manufacturer.
   4. Material and equipment shall be suitable for service conditions.
   5. Equipment capabilities, sizes, and dimensions shown or specified shall be adhered to, unless variations are specifically approved, in writing, in accordance with General Conditions.
   6. Equipment shall be adapted to best economy in power consumption and maintenance. Parts and components shall be proportioned for stresses occurring during continuous or intermittent operation, and for additional stresses occurring during fabrication or installation.
   7. Design so working parts readily accessible for inspection and repair, easily duplicated, and replaced.

C. Do not use material or equipment for any purpose other than for which it is designed or specified.

1.02 SUBSTITUTIONS

A. Substitutions:
   1. Contractor's requests for changes in equipment and materials from those required by Contract Documents are considered "requests for substitutions" and subject to Contractor's representations and review provisions of Contract Documents when one of the following conditions are satisfied:
      a. Where request directly related to "or equal" clause or other language of same effect in specifications.
      b. Where required equipment or material cannot be provided within Contract Time, but not as result of Contractor's failure to pursue work promptly or coordinate various activities properly.
      c. Where required equipment or material cannot be provided in manner compatible with other materials of work, or cannot be properly coordinated therewith.
   2. Contractor's options:
      a. Compatibility of options: Where more than one choice available as options for Contractor's selection of equipment or material, select option compatible with other equipment and materials already selected.
      b. Standards, codes and regulations: Where compliance with imposed standard, code or regulation required, select from among products which comply with requirements of those standards, codes, and regulations.
      c. "Or Equal": For material or equipment specified by naming one or more equipment manufacturer and "or equal," Contractor shall submit request for substitution for any equipment or manufacturer not specifically named. Submit in accordance with GENERAL CONDITIONS, paragraph 1.15, and these General Requirements.
      d. Two or more manufacturers: For equipment of material specified by naming several manufacturers, select any one of manufacturers named. Do not provide or offer to provide unnamed manufacturer or equipment.
      e. Single manufacturer or material: For equipment or material specified by naming only one manufacturer or material, there is no option.

B. Conditions which are not substitutions:
   1. Requirements for substitutions do not apply to Contractor options on materials and equipment provided in specifications.
   2. Revisions to Contract Documents, where requested by Owner or Engineer, are "changes" not "substitutions."
   3. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute substitutions or basis for change orders, except as provided for in Contract Documents.

1.03 REUSE OF EXISTING MATERIAL

A. Except as specifically indicated or specified, do not use materials and equipment removed from existing structures in new work.

B. For material and equipment specifically indicated or specified to be reused in work:
   1. Use special care in removal, handling, storage, and reinstallation to ensure proper function in completed work.
   2. Arrange and pay for transportation, storage, and handling of products which require off-site storage, restoration or renovation.
   3. Off-site storage areas and buildings shall conform to requirements of this section.

1.04 MANUFACTURER'S INSTRUCTIONS

A. Installation of equipment and materials shall comply with manufacturer's instructions. Obtain and distribute printed copies of such instructions to parties involved in installation, including 2 copies to Engineer.
   1. Maintain 1 set of complete instructions at job site during installation and until completion of work.

B. Handle, install, connect, clean, condition, and adjust materials and equipment in accordance with manufacturer's written instructions and in conformity with specifications.
   1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult Engineer for further instructions.
   2. Do not proceed with work without written instructions.

1.05 TRANSPORTATION AND HANDLING

A. Arrange deliveries of materials and equipment in accordance with Construction Progress Schedule, coordinate to avoid conflict with work and conditions at site.
   1. Deliver materials and equipment in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
   2. Protect bright machined surfaces, such as shafts and valve faces, with heavy coat of grease prior to shipment.
   3. Immediately upon delivery, inspect shipments to ensure compliance with Contract Documents and approved submittals, and products have been protected and are undamaged.

B. Provide equipment and personnel to handle materials and equipment by methods recommended by manufacturer to prevent soiling or damage to materials or equipment, or packaging.

1.06 STORAGE, PROTECTION, AND MAINTENANCE

A. On-site storage areas and buildings shall conform to requirements of Section 01500 – Temporary Construction Facilities and Utilities.

B. Owner assumes no responsibility for materials and equipment stored in buildings or on site or at another location approved in writing. Contractor assumes full responsibility for damage due to storage of materials and equipment.

C. Interior storage:
   1. Store materials and equipment in accordance with manufacturer's instructions, with seals and labels intact and legible.
   2. Store materials and equipment subject to damage by elements in weathertight enclosures.
   3. Maintain temperature and humidity within ranges required by manufacturer's instructions.

D. Exterior storage:
   1. Store fabricated materials and equipment above ground, on blocking or skids, to prevent soiling or staining. Cover materials and equipment subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
   2. Store loose granular materials in well-drained area on solid surfaces to prevent mixing with foreign matter.
   3. Materials such as pipe, reinforcing and structural steel, and equipment shall be stored on pallets or racks, off ground.

E. Inspection and maintenance:
   1. Arrange storage in manner providing easy access for inspection, maintenance, and inventory.
   2. Make periodic inspections of stored materials and equipment to ensure materials and equipment maintained under specified conditions and free from damage or deterioration, and coverings in place and in condition to provide required protection.
   3. Perform maintenance on stored materials and equipment in accordance with manufacturer's written instructions and in presence of Owner or Engineer.
      a. Notify Engineer 24 hours before performance of maintenance.
      b. Submit report of completed maintenance and condition of coverings to Engineer with each Application for Payment.
      c. Failure to perform maintenance, to notify Engineer of intent to perform maintenance or to submit maintenance report may result in rejection of material or equipment.

F. Contractor shall assume responsibility for protection of completed construction and repair and restore damage to completed work equal to original condition.

G. Wheeling of loads over floors, with or without plank protection, not permitted in anything except rubber tired wheelbarrows, buggies, trucks or dollies. This applies to finished floors and exposed concrete floors, as well as those covered with composition tile or other applied surfacing.

H. Where structural concrete is also finished surface, avoid marking or damaging surface.

1.07 INSTALLATION, INSTRUCTIONAL, AND POST STARTUP SERVICES

A. General:
   1. This article covers on-site services of supplier's or manufacturer's representatives provided by Contractor during construction, equipment startup, and training of Owner's personnel for equipment or plant operation as specifically required in specification section for equipment or system.
   2. Include and pay costs for supplier's or manufacturer's services, including, but not limited to, those specified.

B. Installation services:
   1. Where installation services called for in specifications, provide competent and experienced technical representatives of manufacturers of equipment and systems to resolve assembly or installation procedures attributable to, or associated with, equipment furnished.
   2. After equipment installed, representatives shall perform initial equipment and system adjustment and calibration to conform to specifications and manufacturer's requirements and instructions.

C. Instructional services:
   1. Where training called for in specifications, provide competent and experienced technical representative of supplier to provide detailed instructions to Owner's personnel for operation of equipment. Training services shall include pre-startup and equipment startup, classroom, and on-site equipment instruction, as stated in specifications.
   2. Coordinate pre-startup training periods with Engineer and supplier's representative.
      a. Notify Engineer at least 48 hours before training sessions are to begin so Engineer can make arrangements with Owner's operating personnel.
      b. Reschedule canceled training sessions 48 hours in advance.
   3. Similar types of equipment differing in model, size or manufacturer shall require equal service time as stated in Part 1 of specific specification section.
   4. Complete pre-startup training 14 days prior to actual plant startup.

5. Operation and maintenance data shall constitute basis of instruction.
    a. Review data contents with personnel in full detail to explain aspects of operations and maintenance.

D. Post startup services:
1. After equipment/system in operation for at least 6 months, but no longer than 11 months, each equipment manufacturer or authorized equipment representative shall make final inspection where so required in specifications. Final inspection will provide assistance to Owner's operating personnel in making adjustments or calibrations required to ensure equipment or system operating in conformance with design, manufacturer, and specifications.

1.08 SPECIAL TOOLS AND LUBRICATING EQUIPMENT

A. Furnish, in accordance with manufacturer's recommendations, special tools required for checking, testing, parts replacement, and maintenance. Special tools are those specially designed or adapted for use on parts of equipment, and not customarily and routinely carried by maintenance mechanics.

B. Deliver to Owner when unit placed into operation and after operating personnel have been properly instructed in operation, repair, and maintenance of equipment.

C. Tools and lubricating equipment shall be of quality compatible to equipment manufacturer has furnished.

D. Refer also to requirements in Section 11000.

1.09 LUBRICATION

A. Where lubrication required for proper operation of equipment, incorporate necessary and proper provisions in equipment in accordance with manufacturer's requirements. Where possible, lubrication shall be automated and positive.

B. Where oil used, reservoir shall be of sufficient capacity to supply unit for 24 hour period.

1.10 GUARDS

A. Provide necessary guards to meet federal, state, and local requirements. Construct guards of expanded metal where possible.

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

Not Applicable.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

INDEX

PART 1 – GENERAL

1.01 DESCRIPTION

A. Maintain at site one record copy of:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change orders and other modifications to Contract.
   5. Engineer field orders, written instructions, or clarifications.
   6. Approved submittals.
   7. Field test records.
   8. Construction photographs.
   9. All associated permits.
   10. Certificates of inspection and approvals.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Store documents and samples in Contractor's field office apart from documents for construction.
   1. Provide files and racks for storage of documents.
   2. Provide secure storage space for storage of samples.

B. Maintain documents in clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

C. Make documents and samples available at all times for inspection by Engineer.

D. Failure to properly maintain record documents may be reason to delay a portion (up to 5%) of progress payments until records comply with Contract Documents.

1.03 RECORD DOCUMENTS

A. Maintain record set of Drawings and Specifications legibly changed to transfer approved modifications in completed work that differ from Contract Documents.

B. Label each document "PROJECT RECORD" in neat, large printed letters.

C. Record information concurrently with construction progress.
   1. Do not conceal any work until required information recorded.
   2. Record changes made by Written Agreement, Field Order, Change Order or Work Directive Change.

D. Drawings:
   1. General:
      a. Depths of various elements of foundation in relation to finish first floor datum.
      b. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
      c. Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
      d. Field changes.
      e. Details not on original drawings.
      f. Location and identification of exposed interior piping.
   2. Electrical:
      a. Horizontal and vertical locations and size of underground cable, conduit, and duct runs dimensioned from established building lines.
      b. Plan locations and size of interior concealed and exposed feeders.
      c. Size and location of access panels.
      d. Departures from original drawings and electrical work revisions.

1.04 SUBMITTALS

A. At Substantial Completion:
   1. Deliver one marked up set of drawings to Engineer for use in preparation of record drawings.

B. Accompany submittals with transmittal letter in duplicate, containing:
   1. Date.
   2. Project title and number.
   3. Contractor's name and address.
   4. Title of record document.
   5. Signature of Contractor or authorized representative.

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

Not Applicable.

END OF SECTION

SECTION 02050

DEMOLITION OF STRUCTURES

INDEX

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section includes, but is not limited to:
   1. Removal and salvage of electrical, and mechanical equipment.
   2. Rerouting utilities to remain.
   3. Shutting off, capping, and abandonment of utilities and underground piping.
   4. Demolition and removal of structures.
   5. Disposal of debris.

1.02 DEFINITIONS

A. Demolition: remove existing structure down to point below finish grade as specified or noted.

B. Removal: remove portions of existing structure or utility above and below grade as noted.

C. Abandonment: remove existing utility from service. Fully disconnect from portions of utility remaining in service. Remove all portions of utility being abandoned from influence zones of structures or buried piping. Plug ends of buried piping being abandoned with concrete.

D. Influence Zone: area bound by 1.5 horizontal to 2 vertical slope extending outward from one foot beyond outer edges of foundation, pavement, or piping.

1.03 JOB CONDITIONS

A. Prior to demolition of structures, accomplish following:
   1. Owner release of such structure.
   2. Electrical and mechanical services rerouted or shut off outside area of demolition.
   3. Salvage equipment scheduled for reuse in new work or scheduled to be delivered to Owner's storage facility.
   4. Survey and record condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again and restore facilities to pre-demolition condition at no additional cost to Owner. Conduct surveys in presence of Engineer.

B. Protection:
   1. Do not close or obstruct streets, walks, and other facilities occupied and used by Owner and public without prior written permission from Owner and other authorities having jurisdiction.
   2. Maintain structural stability of structures adjacent to or affected by work of this contract.
   3. Maintain in service and protect from damage existing facilities, utilities, and equipment indicated to remain or adjacent work areas.

C. Utilities:
   1. Notify utilities prior to razing operations to permit them to disconnect, remove, and/or relocate any equipment serving existing facilities.

D. Salvageable materials:
   1. Owner shall maintain all salvage rights on all existing equipment, material, and related appurtenances that may be removed or altered during construction.
   2. Salvaged material and equipment to be retained by Owner shall be delivered to Owner's storage facility.
   3. Equipment and materials not scheduled to be salvaged or reused in new work shall become property of Contractor and legally disposed of off-site.
   4. Materials to be reused:
      a. None.
   5. Material to be salvaged: None.
   6. Equipment and materials not scheduled to be salvaged or reused in new work shall become property of Contractor and legally disposed of off-site.

E. Schedule:
   1. Perform demolition and removal work so as not to interfere with Owner's operations.
   2. Coordinate demolition and removal work so new construction work installed before, during, and after work of this section may commence without undue delay.

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

3.01 GENERAL

A. Following is list of demolition work:
   1. Facilities to be demolished:
      a. Buried steel chamber pump station.
   2. Facilities to be removed:
      a. Removal all pumps, piping, electrical and other appurtenances inside the pump station.
   3. Utility and underground piping to be abandoned:
      a. As shown on drawings.
   4. Do not demolish, remove, or abandon existing pump station or associated piping until the new pump station is constructed and operational except as noted in Section 01040 - Special Construction.

3.02 DEMOLITION OPERATIONS

A. Remove existing structures 4' below finished grade including: superstructure, foundation, footings, utility drains, and other piping, as shown on drawings, or as required to permit new construction.

B. Provide drainage of structure demolished, cutting openings in floors of structure remaining in place. Holes shall be 6" dia. minimum spaced at 20' centers maximum (minimum of 2 each structure). Notify Engineer prior to backfilling structure remaining. Fill with well graded sand compacted to 95% maximum density.

C. Plug or cap utility drains and other piping in accordance with specified abandonment procedures.

3.03 REMOVAL OPERATIONS

A. Remove existing concrete, steel and masonry to extent indicated on drawings. Provide smooth, straight joint or cut line. Make cuts parallel with walls and/or floors. Patch walls, floors, and ceilings with non-shrink grout. Cut in masonry units to provide finished appearance.

B. Remove utilities and equipment to elevations and locations shown on drawings and plug and seal permanently with steel cap, concrete plug or other approved method in accordance with specified abandonment procedures.

C. Provide temporary shoring and bracing to transfer loads of existing construction to remain from construction being removed.

3.04 ABANDONMENT OPERATIONS

A. Abandon utilities and underground piping within limits noted.

B. Abandon disconnected utilities and underground piping within influence zone of proposed underground piping and proposed structures.

C. Provide compatible cap for pressurized type piping. Provide thrust blocks for caps unless piping has fully restrained joints.

D. Provide concrete plugs for gravity type piping. Plug shall be Class B concrete in accordance with Section 03300 - Cast-in-Place Concrete. Plug shall be at least 2' thick.

E. Where noted on plans, fill piping or manholes with flowable mortar.

3.05 DISPOSAL

A. Legally dispose of sludge, debris, and other undesirable and unsalvageable material resulting from demolition operations off-site.

B. Dispose of removed and broken concrete and other debris legally off-site.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

INDEX

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes formwork for concrete specified under Section 03300 – Cast-in-Place Concrete.

B. Where 'ACI 347' is referred to herein, reference is to 'ACI Standard Recommended Practice for Concrete Formwork' adopted by the American Concrete Institute.

C. Related work specified elsewhere:
   1. Section 03200 - Concrete Reinforcement.
   2. Section 03300 - Cast-in-Place Concrete.

D. Anchors and inserts are specified elsewhere.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:
   1. Contact surfaces of forms for concrete exposed: wood, plywood, hardboard, metal, form liner or other material which will produce surface finishes specified under Section 03300 - Cast-in-Place Concrete without adverse effect on concrete.
   2. Plywood: comply with PS 1-74; use maximum sheet sizes to keep joints to minimum.
   3. Hardboard: comply with FS LLL-H-35, Type 1, Class 2, hard pressed fiberboard treated for formwork use.
   4. Metal forms: smooth surfaces free from irregularities, dents and sags.
   5. Where used, form release agent must not stain or cause imperfections on concrete surface.

B. Chamfer strips: Polyvinylchloride, steel, good quality lumber carefully milled, free from protruding slivers and well sealed, or other nonabsorbent material.

C. Form Ties
   1. Form ties encased in concrete other than those specified in the following paragraphs shall be designed so that, after removal of the projecting part, no metal shall remain within 1-1/2" of the face of the concrete. The part of the tie to be removed shall be provided with a removable cone at least 1" diameter and 1-1/2" deep. Form ties in concrete exposed to view shall be the cone-washer type.
   2. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1-1/2" and sufficient dimensions to permit proper patching of the tie hole.
   3. Ties for liquid containment structures shall have an integral waterstop that is tightly welded to the tie.
   4. Common wire shall not be used for form ties.
   5. Alternate form ties consisting of tapered through-bolts at least 1" in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used at the Contractor's option. Obtain Engineer's acceptance of system and spacing of ties prior to ordering or purchase of forming. Clean, fill and seal form tie hole with non-shrink cement grout. The Contractor shall be responsible for watertightness of the form ties and any repairs needed.

2.02 DESIGN AND FABRICATION

A. Design, engineer and construct formwork to satisfy specified requirements and conditions shown on plans.

B. For concrete exposed to chemical attack, comply with recommendations contained in Chapter 4 of Environmental Engineering Concrete Structures - ACI 350.

C. Strength of forms, supports, and braces adequate to resist vertical and lateral loads; follow recommendations contained in Chapter 2 of ACI 347.

D. Provide positive means for adjusting shores and struts (wedges and jacks) so settlement can be taken up during concrete placement operations.

E. Allowable deflection of facing materials reflected in exposed concrete surfaces: not greater than 1/240 of span between structural members.

F. On exposed surfaces, pattern of joints between facing panels and marks left by form ties must be rhythmic and symmetrical.

G. Provide temporary openings near bottom of deep forms and other locations where necessary to facilitate observation and cleaning immediately prior to deposit of concrete.

H. Form design must include provisions for easy removal.

I. Provide 3/4" x 3/4" chamfers on external corners of columns, beams, slabs and walls which have two adjacent faces exposed.

J. Do not use earth cuts as forms for vertical surfaces without specific approval from Engineer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Solidly back joints between facing panels and perimeter edges of facing panels to maintain proper alignment.

B. Forms must be sufficiently tight to prevent leakage of mortar; gasket, tape, caulk or seal otherwise.

C. Cooperate with subcontractors in placement of anchors, bolts, inserts and other items embedded in concrete.

D. Leave section of forms adjacent to construction joint in place until concrete is deposited on other side of joint; retighten forms on completed section before next section is placed and carefully seal joint to prevent grout or paste leakage.

E. Securely brace shores and struts against lateral displacement.

F. Preparation of form surfaces:
   1. Remove loose concrete dust and other fine material from contact surface.
   2. Prior to placement of concrete, saturate board forms with joints opened by shrinkage of wood with water until wood swells and closes joints.
   3. Seal plywood and other wood surfaces not subject to shrinkage against absorption of moisture from concrete (field or factory applied).
   4. Apply coating for preventing of bond with concrete prior to placement of reinforcing steel; do not allow excess coating material to stand in puddles in forms or come in contact with concrete surfaces against which fresh concrete will be placed.
   5. Where painting of finished concrete is required, coatings applied to contact surface of forms must be compatible with type of paint to be used.

6. Where as-cast finishes are required, do not use form coatings which will impart stain to concrete.

G. Prior to placement of reinforcing steel, request Engineer to inspect form surfaces; obtain permission from Engineer to start placement of reinforcing steel.

3.02 WORKMANSHIP

A. Form surfaces adjacent to concrete must conform to shape, line, and dimension shown with corners uniform, true and sharp, unless otherwise shown on plans.

B. Transition between curved and straight surfaces must be smooth, even and tangent; when such forms are in place request Engineer to inspect them before concrete is placed.

C. When forms are removed, concrete surfaces shall conform to size, shape and line shown on plans within tolerances listed under Chapter 3 of ACI 347.

3.03 OBSERVATION AND MAINTENANCE

A. Observe formwork continuously while concrete is being placed to insure that there are no changes of elevation, plumbness or camber from as-designed conditions.

B. Stop placement if settlement is noted and adjust shores and struts to eliminate settlement.

C. If weakness in falsework is observed which will produce distortion or variation on concrete surfaces in excess of allowable tolerances, stop work and strengthen falsework; remove permanently damaged construction before proceeding with work.

3.04 REMOVAL OF FORMS

A. Remove in manner that will not mar, spall or otherwise damage the concrete or other work.

B. Formwork not supporting weight of concrete: Formwork at locations such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing concrete at not less than 50ºF. for 24 hours after its placement, provided all of the following criteria are met:
   1. Concrete has obtained strength required to not be damaged by form removal operations.
   2. Concrete curing and protection operations will be maintained in accordance with the requirements for those materials.

3. Shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

C. Do not remove supporting forms and shoring for slabs, beams, channels, troughs, corbels, brackets, haunches, cantilevered or Y-shape elements, or other flexural members until concrete complies with all of the following criteria:
   1. No sooner than 14 days following concrete placement.
   2. Obtained a minimum compressive strength of 80% of the 28-day strength.
   3. Of sufficient strength required to support its own weight and superimposed loads.

D. Remove the removable portion of form ties in a manner and at the period required to prevent damage to concrete.

E. Accomplish removal without prying against face of concrete or jarring structure; use wooden wedges only.

F. Remove supports in manner permitting concrete to assume load gradually and uniformly.

G. Perform reshoring for purpose of early form removal in manner that will not require large areas of new construction to support own weight.

H. When forms are removed before end of curing period, exposed concrete must be cured as specified under Section 03300 - Cast-in-Place Concrete.

I. Do not drop forms on floor.

J. Do not subject unsupported portions of structure to heavy construction or material loading.

3.05 REUSE OF FORMS

A. Reuse forms for exposed concrete only when in near new condition.

B. Do not reuse metal pans with bent flanges or dents until they have been straightened to near new condition.

C. Thoroughly clean and recoat forms before reuse; recondition if necessary.

D. Do not reuse forms if condition does not meet requirements set forth herein.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

INDEX

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section describes reinforcing steel for concrete specified under Section 03300 - Cast-in-Place Concrete.

B. Related work specified elsewhere:
   1. Section 03100 – Concrete Formwork.
   2. Section 03300 – Cast-in-Place Concrete.
   3. Section 03421 – Precast Concrete.
   4. Section 04200 – Unit Masonry.

1.02 SUBMITTALS

A. Submit complete shop drawings showing all dimensions necessary for fabrication and placement of reinforcing steel and accessories, without reference to contract drawings; include elevations of wall reinforcing and location of construction joints.

B. Do not start fabrication until receipt of reviewed drawings from Engineer.

C. See Section 01300 - Submittals for additional requirements.

1.03 MINIMUM REINFORCEMENT REQUIREMENTS

A. Bars:
   1. Reinforce footings as shown on drawings; where reinforcing is not shown include:
      a. #4 at 8" each way bars for spread wall footings.
      b. #5 at 8" each way bars top and bottom in trench footings up to 8" thick.
      c. #6 at 10" each way bars top and bottom in trench footings 10" thick and over.

2. Reinforce top of wall footing under door and other openings with two #4 bars, minimum; 4'-0" longer than opening.
3. Reinforce curbs as shown on drawings; where reinforcing is not shown, place one #4 bar top and bottom.
4. Reinforce walls as shown on drawings; where reinforcing is not shown, include:

Wall Thickness	Horizontal Bars	Vertical Bars	Location
6"	#4 @ 12"	#4 @ 12"	Center on Wall
8"	#4 @ 12"	#4 @ 12"	Center on Wall
10"	#4 @ 12"	#4 @ 12"	Each Face
12"	#5 @ 12"	#5 @ 12"	Each Face
16"	#5 @ 12"	#5 @ 12"	Each Face

5. At wall or floor openings, if reinforcing is not shown, include two #5 bars, each face, on all sides, 4'-0" longer than opening dimension.
6. Reinforce masonry load bearing and exterior concrete block walls as shown on drawings; where reinforcing is not shown, include #5 @ 24" vertical.

B. Mesh:
1. Reinforce slabs as shown on drawings; where reinforcing is not shown, include:
   a. 6" x 6" W2.1.x W2.1 mesh for following:
      1) 4" slabs on grade.
      2) Toppings.
   b. 6" x 6" W2.9 x W2.9 mesh for following:
      1) 6" or thicker slabs.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Bars:
1. ASTM A615, Grade 40 billet-steel with 40,000 psi minimum yield strength for #3 and smaller bars.
2. ASTM A615, Grade 60 billet-steel with 60,000 psi minimum yield strength for #4 and larger bars.

B. Prefabricated steel bar mats which meet specified bar requirements and spacings may be used in lieu of job placed individual bars.

C. Welded Wire Reinforcement, Mesh or Welded Wire Fabric: welded wire reinforcement; ASTM A1064.

D. Shear connectors: welded wire truss; ASTM A1064.

E. Spacers and chairs:
   1. Type: as shown on plans.
   2. Comply with ACI 315.
   3. Chairs: corrosion resistant.

F. Tie wire: black annealed wire; 16 gauge, minimum.

G. Mechanical splices: threaded splice; Dayton Superior D-101, or equal.

2.02 FABRICATION

A. Carefully form bars to shapes and dimensions shown on plans; where not shown, comply with requirements of ACI 315.

B. Tolerances: comply with ACI 117, ACI 301 and ACI 315 unless otherwise shown on plans.

C. Bend all bars cold.

D. Make bends for stirrups and ties around pin having diameter not less than two times thickness of bar.

E. Bend bars around pin having diameter not less than six times minimum thickness of bar; eight times minimum thickness for bars larger than 1".

F. Hooks: conform to requirements of ACI 318.

G. Where column bars are offset or dowels used for column splices, provide 1/2" clearance between bars or dowels and vertical bars of next lift.

H. Tag bars with metal, linen or rope fiber tags filled in by machine or waterproof ink; do not use paper tags.

PART 3 – EXECUTION

3.01 PLACEMENT

A. Design must comply with ACI 318 and details must conform to ACI 315, unless otherwise shown on plans.

B. Reinforcement: free from dirt, loose, flaky rust and scale, oil, grease, ice, or other coating which could reduce or destroy bond.

C. Bars:
   1. Accurately place and securely wire-tie bars in position before concrete is deposited; point wire-tie ends away from form.
   2. Support bars rigidly on spacers and chairs:
      a. Number, location and size: comply with Chapter 5 of ACI 315 and CRSI RB4.1 unless otherwise shown; other methods of support will be permitted subject to Engineer's approval.
      b. List number of supports for each span on schedule or mark on placing plan.
      c. Chairs required for top layer of reinforcing in footings.
      d. Use U or Z 1/4" reinforcing bar spacers between layers in walls at 5' oc each way.
   3. Lap splices and butt-welded splices in accordance with Chapter 7 ACI 350-06, Chapter 12 ACI 318-11 or (Chapter 25 of ACI 318-14). If a conflict exists between ACI codes, ACI 350-06 takes precedence.
   4. At walls without footing pads, rest bottom of reinforcing on concrete brick.
   5. Reinforcement spacing shown on plans is in inches.

D. Minimum protection between face of steel and outer face of concrete must comply with following, unless otherwise shown on plans:
   1. 3" for footings and other principal structural members where concrete is cast against ground.
   2. 2" for wall or other formed surfaces exposed to sewage, effluent, chemical attack, weather or in contact with ground; 1-1/2" if bars are #5 or smaller.
   3. 1-1/2" or 1-1/2 times maximum size of coarse aggregate for beams, girders and columns; dimension is to ties where used.
   4. 1" for floor joists where clear distance between joists is not over 30".
   5. 3/4" for slabs and walls not exposed to weather or directly to ground.
   6. Protection of reinforcement must at least equal to diameter of bars being covered, except 3/4" protection is sufficient for bars in slabs, regardless of bar size.

E. Tolerances:
   1. Reinforcement shall be placed per the clear cover requirements and dimensions shown in the plans and specifications with a positional tolerance of +/- 3/8” for concrete thickness less than or equal to 10 inches and +/- ½” for concrete thickness greater than 10 inches. If placement requirements specified in the current editions of ACI 117, ACI 301, ACI 350 or ACI 318 are more restrictive, the more restrictive requirements shall be followed.
   2. Height of bottom bars above bottom of form: 1/4" plus or minus from established dimension.
   3. Lengthwise:
      a. Top or bottom bars: 2"± from plan dimension (extend same amount into each support).
      b. Truss bars: 2"± from plan dimension (applies to ends of bars and bend points).

4. Bar spacing in walls and solid slabs: do not exceed two times thickness of slab or all unless otherwise shown on plans.
5. Lateral spacing in joists or beams where spacing is established: plus or minus 1/4".
6. Clearance between face of steel and face of concrete: plus or minus 1/4".
7. Height of top bars (top of bar to top of beam or slab): plus or minus 1/4" (if necessary to lower bars over 1/4", check with Engineer for increase in size or number of bars).
8. Stirrup or tie spacing: 2"± for any one unit (end unit not more than 1" either way from position shown).

F. Welded Wire Reinforcement (WWR):
   1. End lap by one of following methods:
      a. Overlap one full WWR (tip to tip of wires) and tie with wire and 1'-6" oc.
      b. Overlap with end cross wire of one piece in contact with next-to-end wire of other piece; tie to keep fabric in place or prevent edge from curling up.
   2. Side lap by one of following methods:
      a. Place selvage wire in middle of first WWR and wire tie at 5'-0" oc (stagger ties).
      b. Place selvage wire in contact with next-to-edge longitudinal wire; tie to keep fabric in place or prevent edge from curling up.
   3. Place WWR 2-1/2" below top of slab on grade, unless otherwise shown on plans or specified.
   4. Accurately place and rigidly support WWR on metallic supports, built-in concrete blocks or other suitable means; prevent displacement by foot traffic runways and compaction tools.
   5. Positioning WWR in slab by lifting with hook from bottom of form through concrete not permitted.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

INDEX

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section describes all cast-in-place concrete work shown on plans, including but not limited to:
   1. Foundations (footings and grade beams).
   2. Below grade walls.
   3. Tanks and similar structures.
   4. Columns.
   5. Interior walls at basement level.
   6. Interior slabs on grade.
   7. Bases for mechanical and electrical equipment.
   8. Concrete encasement.
   9. Grout for equipment leveling and where shown.
   10. Fill or fillet concrete for tanks and where shown.

B. Related work specified elsewhere:
   1. Section 01010 - General Provisions.
   2. Section 02200 - Sitework.
   3. Section 03100 - Concrete Formwork.
   4. Section 03200 - Concrete Reinforcement.
   5. Section 07900 – Joint Sealers.

1.02 QUALITY CRITERIA

A. Contractor must follow recommendations set forth in Chapter 4 of Environmental Engineering Concrete Structures - ACI 350 for concrete in contact with sewage or effluent or exposed to chemical attack.

B. Contractor shall construct a mock-up for each type of wall finish specified for review and acceptance by Engineer and shall construct additional mock-ups as required until acceptable. Accepted mock-ups shall constitute the minimum standard of quality for construction. Accepted mock-ups shall be maintained by the contractor during construction. All mock-ups shall be removed by the contractor when directed by the engineer. Minimum size of mock-up shall be 4'x4' and the mock-up shall include a sample of a patched tie hole.

1.03 STORAGE OF CEMENT AND AGGREGATES

A. Store cement in weathertight structure with floor raised not less than 1' from ground.

B. Do not use cement which has hardened or partially set; remove from site.

C. Store fine and coarse aggregate separately in manner to prevent segregation of sizes and avoid inclusion of dirt and other foreign materials.

D. Stockpile natural sand at least 24 hours before using.

1.04 DEPOSITING DURING COLD WEATHER

A. Do not place concrete without protection if temperature of surrounding air is below 40ºF. and falling or if it may be subjected to freezing temperature during curing period.

B. From November 1st to May 1st, do not place concrete without protective materials readily available, on job site, in quantities sufficient to protect all concrete that has not cured for specified period. U.S. Weather Bureau predictions will be used as basis for requiring that protective measures be taken.

C. Do not use frozen materials or materials containing ice in concrete.

D. Do not place concrete over or in contact with frozen earth; forms, reinforcement and fillers must be free from frost.

E. Protection of concrete required:
   1. If temperature is expected to drop into 32ºF. to 35ºF. range during period:
      a. After curing membrane specified herein under PROTECTING AND CURING is installed, cover following with minimum 1" blanket insulation:
         1) Exposed surfaces of slabs on earth.
         2) Framed components (including beams and walls) formed with 1" thick wood.
         3) All metal formed items.
      b. Protect insulation with polyethylene sheets, Sisalkraft, tarpaulins, or equal.
   2. If temperature is below 35ºF. when concrete is placed:
      a. Placement temperature of concrete must be 60ºF. plus or minus 10ºF.; methods and equipment for heating mixing water and aggregates must be agreeable to Engineer.
      b. Temperature of surrounding air must be maintained at minimum 50ºF. during placement and for not less than 5 day thereafter; minimum 40ºF. for next 2 days (3 days and 1 day respectively if high early strength cement is used).
      c. When heating is discontinued, lower temperatures gradually; maximum 1ºF. per hour for first 24 hours; 2ºF. per hour thereafter until outside temperature is reached.
   3. Any method of protection included in recommendations in Title 75-18 by ACI Committee 306 may be substituted for protection specified herein if temperature and moisture conditions recommended for type and service category of concrete being placed are maintained for recommended period of time; obtain permission of Engineer for substitute method before using.

F. Use of salts or chemicals for protection from freezing not permitted.

G. Remove and replace concrete damaged by freezing.

1.05 DEPOSITING DURING HOT WEATHER

A. Contractor must follow recommendations set forth in ACI 305R, Hot Weather Concreting to minimize detrimental effects of hot weather on concrete placed on project; whenever air temperature is expected to exceed 75ºF. during placement operations, Contractor must submit procedures for hot weather concreting to the engineer for review prior to placement of concrete. A minimum of seven days must be allowed for the engineer’s review.

B. Temperature of concrete at time of deposit must be below 90ºF.

1.06 SUBMITTALS

A. Contractor must submit concrete mix design showing type and quantities of all items used in the mix for each type of mix intended for use. As a minimum the submittal shall include documents to show type and quantity of cement, fly-ash, coarse aggregate, fine aggregate, water and admixtures that will be used in the mix. Certifications shall be provided to demonstrate all components of the mix meet the specified ASTM and or Mil standards. Coarse and fine aggregate gradations shall be provided.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Portland cement: ASTM C150, Type I, Type II or Type III and ASTM C595, Type IL. C_3A (Tricalcium aluminate) content must be less than 8% for concrete in direct contact with sewage or effluent or exposed to chemical attack.

B. Portland pozzolan cement: ASTM C595, Type IP or IP-A; pozzolan content must not exceed 25% by weight.

C. Fine aggregate:
   1. Meet requirements of ASTM C33, except where more rigid requirements are included herein.
   2. Gradation within requirements of ASTM C33, Par. 3; sieve analysis of aggregate must accompany mix design when submitted to Engineer for review.
   3. Natural sand:
      a. Clean, hard, strong, durable, uncoated grains.
      b. Coal and Lignite: 1.0% maximum.
      c. Prove acceptability of aggregate by laboratory test conducted and certified by laboratory acceptable to Engineer on samples taken in accordance with ASTM C75.

D. Coarse aggregate:
   1. Meet requirements of ASTM C33, except where more rigid requirements are included herein.
   2. Clean, hard, strong, durable uncoated pieces.
   3. Gradation within requirements of ASTM C33, Table II:
      a. #467 or #57, 1-1/2" or 1" to No. 4, for footings and plain concrete.
      b. #57, 1" to No. 4, for slabs on grade and reinforced walls.
      c. #57 or #67, 1" or 3/4" to No. 4, for slabs, beams, girders, columns, fillet and fill concrete.
      d. #7, 1/2" to No. 4, for fill over steel stair treads and landings.

4. Limitation of deleterious substances:
    a. Clay lumps and friable particles: maximum 1.0%.
    b. Soft particles: maximum 2.0%.
    c. Coal and Lignite: maximum 0.25%.
5. Crushed limestone: meet IDOT specifications 4115.03 for abrasion and 4115.04 for Class 2 or 3 durability; not more than 1.0% of clay lumps and friable particles, 2.0% of soft particles and 0.25% of coal and lignite allowed; prove acceptability by submission of certified laboratory test report.

E. Admixtures:
1. Air-entraining agents: ASTM C260.
2. Water reducing agents: ASTM C494, Type A.
3. Retarding agents: ASTM C494, Type B.
4. Accelerating agents: ASTM C494, Type C.
5. Water reducing and retarding agents: ASTM C494, Type D.
6. Water reducing and accelerating agents: ASTM C494, Type E.
7. High range water reducing agents: ASTM C494, Type F.
8. High range water reducing and retarding agents: ASTM C494, Type G.
9. Fly ash and GGBFS: IDOT Section 4108. Fly ash to be Class C.
10. Shrinkage reducing admixture: ASTM C157; W.R. Grace, or equal.
11. Synthetic fibers: high volume monofilament polypropylene/polyethylene blend; 1-1/2" to 2" length; 78 ksi fiber tensile strength; minimum 1,300 ksi modules of elasticity; ASTM C1116; dosage rate 3.5 lbs./CY of concrete.

F. Water: clean and free from injurious amounts of oil, alkalies, acids, or organic matter.

H. Dowels:
1. ASTM A15; 1'-6" long, smooth round steel rods: diameter as shown on drawings.
2. Where preformed filler is required, completely coat one end with heavy grease and cover with expansion cap.

I. Preformed expansion or isolation joint filler:
1. Self-expanding cork, ASTM D1752, Type III.
2. 1/2" thick, unless otherwise shown on drawings.

J. Joint sealer:
1. Thickol sealer: FS TT-S-00227E (two part) or FS TT-S-00230C (one part), Type I (self-leveling), Class B (resistant to 25% total movement), based on liquid polysulfide polymers.
2. Pour-type urethane sealant: Sonneborn Sonolastic Paving Joint Sealant (two parts), or Sonomeric CT (one part), or equal.

K. Backing rod: round polyethylene rod; Dow Chemical Co., Ethafoam rod, or equal.

L. Waterstops:
   1. Polyvinylchloride with following characteristics when tested in accordance with ASTM test method listed:

Specific Gravity	1.38 maximum	ASTM D792
Hardness	79 plus or minus 3	ASTM D2240
Tensile Strength	2000 psi (minimum)	ASTM D638
Elongation	350% (minimum)	ASTM D638
Cold Brittleness	-35ºF. or lower	ASTM D476

   2. Design: 6", ribbed with corrugations and center bulb, except where shown otherwise; Greenstreak Type 705, or equal.
   3. Expansive waterstop may be used for vertical construction joints and where shown on drawings; Greenstreak Hydrotite, or equal.

M. Liquid applied curing and sealing compounds:
   1. For interior surfaces, except where floor hardness is specified: West Concrete Floor Sealer (West Chemical Products, Inc.), Kure-N-Seal (Sonneborn-Contech), L & M Cure (L & M Construction Chemicals, Inc.), or equal; do not use Kure-N-Seal on floors that will be subjected to petroleum drips and spills, such as motor vehicle traffic or parking.

N. Liquid applied floor hardener; fluosilicate based material; Sonneborn Lapidolith, A.C. Horn Hornolith, L & M Fluohard, or equal.

O. Abrasive aggregate:
   1. Silicon carbide or aluminum oxide.
   2. Any manufacturer's gradation which falls in range of 12 to 36 grit is acceptable.

P. Grout: ASTM C1107 Class B or C; mix according to recommendations of manufacturer; strength: not less than that of adjacent concrete; L&M Crystex, Master Builders Masterflow 928, or equal.

Q. Use Dur-O-Wall heavy duty trusses, or equal, for vertical trusses; use single truss full height and width according to wall thickness.

R. Bond Breaker
   1. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint unless otherwise noted.
   2. Except where tape is specifically called for on the drawings, bond breaker for concrete shall be either bond breaker tape or a non-staining type bond prevention coating such as Williams Tilt-up Compound by Williams Distributors Inc.; Silcoseal 2000F, by SCA Construction Supply Division, Superior Concrete Accessories or equal.

S. Bonding Agent
   1. Epoxy bonding agent shall be a two-component, solvent-free, moisture insensitive, epoxy resin material conforming to ASTM C881 (1999), Type V. The bonding agent shall be Sikadur 32 Hi-Mod by Sika Corporation of Lyndhurst, NJ; Concresive Liquid (LPL) by Master Builders of Cleveland, OH or equal.
   2. Latex bonding agent shall be a non-reemulsifiable acrylic-polymer latex conforming to ASTM C1059, Type II.

2.02 QUALITY AND DESIGN OF MIXES

A. Design compressive strength:
   1. Pipe encasement, fill and fillet (Class B) concrete: 2,500 psi.
   2. All other (Class A) concrete: 4,000 psi.
   3. Maximum water to cement ratio 0.40 for concrete containing shrinkage reducing admixture. Maximum water to cement ratio 0.45 for all other (Class A) 4,000 psi concrete.

B. Design of mix:
   1. Overdesign mixes in accordance with plant coefficient of variation. Overdesign must assure less than 1 chance in 10 that test will fall below design compressive strength and that 99 chances out of 100 no test will fall below 90% of design compressive strength.
   2. Complete design in advance of first placement; any existing mix design may be used if made or checked within previous six months by approved testing laboratory using aggregates from same source and same gradation as those used on this project.
   3. Comply with ACI 211.1 Recommended Practice for Selecting Proportions for Normal Weight Concrete and recommendations set forth in Chapter 3 of Environmental Engineering Concrete Structures - ACI 350R for concrete in contact with sewage or effluent or exposed to chemical attack.
   4. Slump:
      a. Footings and substructure walls: 3" plus or minus 1".
      b. Beams, columns, slabs and reinforced walls: 3" plus or minus 1".
      c. Heavy mass construction: 2" plus or minus 1".

   5. Submit mix design to Engineer for agreement before any concrete is placed; include design which contains fly ash or Pozzolan based admix and design which contains retarding type water reducing admix, with appropriate slump adjustments, if need is indicated.
   6. Assign number to each mix design for future reference.

C. Admixtures:
   1. Air entraining agent:
      a. Add at mixer for all concrete.
      b. Concrete must contain 5.0% plus or minus 1.0% air by volume if maximum aggregate size is 1-1/2"; 6.0% plus or minus 1.0% if maximum aggregate size is 3/4" or 1", 7.0% plus or minus 1% if concrete contains shrinkage reducing admixture.
   2. Do not use calcium chloride or other salts as antifreeze or to accelerate set.
   3. Cement dispersing agent or concrete densifiers (water reducing and high range water reducing agents):
      a. Recommended to improve workability and control rate of hardening for controlling uniformity under varying temperature and weather conditions.
      b. Add water reducing and retarding type to mix if air temperature is above 80ºF. and freshly placed concrete will be exposed to sun and/or hot drying wind.
      c. Fly ash or Pozzolan based admixture recommended for exposed interior finish concrete, including slabs on grade and floor fill.
      d. Fly ash or pozzolan based admixture required when using high range water reducing agents.
      e. Do no use melamine-based high range water reducing agents if concrete is exposed to freeze-thaw cycles.
      f. Do not use high range water reducing agents in beams, joists or elevated slabs.
      g. Use in accordance with manufacturer's recommendations.
   4. Shrinkage reducing admixtures may be used at Contractor's option.

2.03 BATCHING AND MIXING

A. Operations, equipment and location of facilities subject to approval of Engineer.

B. Measuring of materials:
   1. By weight such that proportions can be accurately controlled and easily checked.
   2. Weigh ingredients separately.
   3. Weigh cement for each batch if fractional sacks or bulk cement is used.
   4. Water measurement to 1 pint plus or minus for total per batch.

C. Mix one cubic yard batch for at least 1-1/2 minutes after all materials are in mixer; increase time by 15 seconds for each additional cubic yard or fraction thereof.

D. Ready-mixed concrete: comply with ASTM C94.

2.04 QUALITY CONTROL

A. Slump tests:
   1. Make test in accordance with ASTM C143 on sample taken in accordance with ASTM C172.
   2. Tests required:
      a. First load each day.
      b. Whenever other tests are being made.
      c. After any change in mix.
      d. When directed by Engineer.

B. Temperature tests:
   1. Required whenever outside temperature is within 10ºF. of limiting temperatures specified herein under DEPOSITING DURING HOT (or COLD) WEATHER.
   2. Make tests at same time slump tests are taken.
   3. Use armored thermometer accurate to plus or minus 2ºF.
   4. Place thermometer in freshly discharged concrete and leave it in place until reading becomes stable.

C. Air content tests:
   1. By pressure method (ASTM C231) or volumetric method (ASTM C173) on samples taken in accordance with ASTM (C172).
   2. Test first load of air entrained concrete and spot check by additional test on each day that air entrained concrete in placed.

D. Compression tests:
   1. Prepare cylinders in accordance with ASTM C31.
   2. Set of 3 cylinders required for every run of 50 CY or fraction thereof.
   3. Cure cylinders under laboratory conditions and test by procedure in ASTM C39.
   4. Prepare additional cylinders and cure under job conditions if air temperature is likely to fall below 40ºF.
   5. Break cylinders at 7 and 28 days.
   6. If over 1 in 10 tests of laboratory specimens fall below design compressive strength specified, check design of mix and make necessary corrections before additional concrete is placed.
   7. When test specimens break below strength specified, Contractor may be required to test concrete affected by procedure in ASTM C42 (core tests) or load test portion of structure affected.
   8. Remove concrete not in accordance with specifications and replace without cost to Owner.

E. Record results of all test immediately in Log of Tests which must be maintained at job site; log must contain following information:
   1. Date and time test are made.

2. Test results, if immediately available.
3. Exact location where tested concrete was placed in structure.
4. Weather conditions, including air temperature at time tests were made.
5. Plant and number of mixer truck that delivered concrete.
6. Name of person who made test.
7. Mix design number.

PART 3 – EXECUTION

3.01 PREPARATIONS FOR PLACEMENT

A. Verify with Engineer that reinforcing steel placement has been checked, and with subcontractors that wall pipes, anchor bolts, wall thimbles, pipe sleeves, drains, conduit and outlets have been placed in forms.

B. Remove foreign materials (chips, blocks, sawdust, ice and water) from forms.

C. Where placing against hardened concrete, clean contact surface thoroughly and remove all laitance, wet vertical surfaces and slush with neat cement grout just prior to placement of new concrete.

3.02 WATERSTOPS

A. PVC Waterstops
   1. Install PVC waterstops for all joints where waterstops are indicated on the drawings, unless specifically noted otherwise. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Splices shall be made by welding.
   2. PVC splices shall be made by welding in accordance with the manufacturer's recommendations, subject to acceptance of the Engineer. Only manufacturer's special approved tools shall be used for welding. The finished splices shall provide a cross-section that is dense and free of porosity.
   3. Each piece of the waterstop shall be of maximum practicable length to provide a minimum number of splices.
   4. To properly secure PVC waterstops in wall joints before concrete is placed, drill holes in waterstops approximately 1" from each edge or between the outermost ribs at each edge and center the waterstop in the joint. Tie both edges of the waterstop and fasten to reinforcing steel with black annealed steel tie wire as specified for tying reinforcing steel and secure in place so that the waterstop will be perpendicular to the joint and remain in the required position during concrete placement. The spacing of the waterstop ties shall match the spacing of the adjacent reinforcing, but need not be spaced closer than 12" on center.
   5. Horizontal waterstops in slabs shall be clamped in position by the bulkhead (unless previously set in concrete).

6. Horizontal PVC waterstops in slabs shall have the edge of the waterstop lifted while placing concrete below the waterstop. Then the waterstop shall be manually forced against and into the placed concrete and covered with fresh concrete, to ensure adequate encasement of the waterstop in concrete.
7. Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Care shall be exercised to ensure that the waterstop is completely embedded in void-free concrete.
8. Waterstops shall be terminated 3" below the exposed top of walls. Expansion joint waterstop center bulbs shall be plugged with foam rubber, 1" deep, at point of termination.

B. Expansive Waterstops
1. Install waterstops at joints where specifically noted on the drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided.
2. Each piece of the waterstop shall be of maximum practicable length to provide a minimum number of connections or splices. Connections and splices shall conform to the manufacturer's recommendations and as specified herein.
3. Waterstops shall be terminated 3" below the exposed top of walls.
4. Prepare the joint surfaces, install primers or adhesives, and install expansive waterstops in accordance with the manufacturer' instructions.

3.03 PLACING CONCRETE

A. Notify Engineer 1 day before each placement.

B. Do not add water to concrete between mixing and placing operations without specific agreement of Engineer and continuous inspection acceptable to Engineer; under no circumstances may added water cause concrete to slump greater than that established in design mix; verify with slump tests; maintain uniform consistency.

C. Conveying:
1. Method must ensure uniform concrete at forms with minimum slump loss.
2. Chutes must be steep enough to permit concrete of design consistency to flow to point of deposit or other means of conveying must be used.

D. Fill forms completely in one operation.

E. During placement operations, work concrete around reinforcement, embedded fixtures, and into corners of forms; thoroughly compact and exercise particular care to prevent surface voids and honeycomb on exposed surfaces.

F. Placement in deep narrow forms other than column forms:
   1. Discharge into hopper feeding into drop chute if free fall will be more than 3'.
   2. Drop vertical; do not push or pull bottom of chute from vertical position to distribute concrete; move chute.
   3. For concrete exposed, the following applies:
      a. Place in maximum 20" deep layers and consolidate each layer with preceding layer before starting placement of next layer.
      b. Do not allow concrete to flow laterally for more than 3'; move chute or place sufficient number of chutes in forms to assure top of concrete is kept level.
      c. If placement rate is faster than 2' per hour, reduce slump proportionally as each 1/4 of form depth is filled so slump of top 1/4 will not exceed 3".
      d. If plasticized concrete is used, the maximum lift thickness may be increased to 7' and the maximum free fall of concrete shall not exceed 15'; subparagraphs "b." and "c." above do not apply.

G. Place beams, girders, brackets, column caps and haunches integrally with floor system.

H. Allow minimum 2 hours after deposit of columns or walls before depositing beams, girders or slabs supported thereon.

I. Vibration of concrete:
   1. Use internal type vibrator; insert and withdraw slowly.
   2. Insert vibrator vertically to full depth of layer being placed, at regular intervals (18" to 30").
   3. Do not use vibrator to cause concrete to flow from one location to another.
   4. Avoid segregation in concrete due to over vibration.
   5. Do not allow vibrator to come in contact with formwork surfaces for exposed concrete.

J. Stop placement only where directed, at point of no shear, and erect tight, plumb dams through forms.

3.04 JOINTS

A. Key construction joints; where reinforcing is interrupted, dowel joints; size and number of dowels as shown on drawings.

B. Place construction joints through framed slabs on center of span unless otherwise shown on drawings or approved by Engineer.

C. Wall construction joints must form symmetrical pattern on exposed surfaces, unless otherwise shown on drawings

D. Horizontal and Vertical construction joints are required where shown on the plans. Provide additional joints to meet maximum spacing requirements shown in Section 03300, 3.04, K and L of the specifications. Additional vertical joints are allowed at quarter points in walls. Reinforcement shall be continuous through the joints and keyways shall be provided unless shown otherwise on the drawings or noted otherwise in the specifications. Lap reinforcing steel as specified; install keyway and waterstop; submit location of proposed vertical construction joints prior to construction for Engineer's review.

E. Hold top of expansion or isolation joint filler maximum 1/2" below surface for joint sealer at exposed joints.

F. Control joints in slabs on grade:
   1. Saw cut joints to depth of 1/4 of slab thickness, unless otherwise specified; make cut not less than 8 hours or more than 24 hours after slab is placed unless shown or otherwise on the plans or indicated otherwise in the specifications.
   2. In lieu of saw cutting joint, Contractor may place metal crack control joint.
   3. Stop every other bar at joint.

G. Dowels:
   1. For expansion joints.
   2. Install in center of slab or at third points as shown on drawings, parallel to surface and perpendicular to joint.
   3. Completely coat one end with heavy grease at joints where preformed filler is required; expansion cap required over greased end of dowel.

H. Where applied floor coverings are scheduled, fill saw cut joints in interior slabs with dry mix of 1:9 cement and sand.

I. Fill all other interior saw cut joints, expansion and isolation joints with Thickol joint sealer in accordance with manufacturer's directions; prime edges of joint if recommended by manufacturer.

J. Waterstops:
   1. Required where shown on drawings and at joints subject to hydrostatic pressure.
   2. Heat splice joints in accordance with manufacturer's specifications.
   3. Install as detailed on drawings; wire to reinforcing.

K. Maximum Joint Spacing for Structures Not Intended to Contain Liquid:
   1. Wall Vertical Construction Joints:
      60 FT maximum centers.
      At wall intersections, 30 FT maximum from corner.

2. Base Slab, Floor and Roof Construction Joints:
   Placement to be approximately square and not to exceed 3500 SF.
   Maximum side dimension of pour to be less than twice the length of the short side and 80 FT.

L. Maximum Joint Spacing for Structures Intended to Contain Liquid:
   1. Wall Vertical Construction Joints:
      30 FT maximum centers.
      At wall intersections, 15 FT maximum from corner.

   2. Base Slab, Floor and Roof Construction Joints:
      Placement to be approximately square and not to exceed 2000 SF.
      Maximum side dimension of pour to be less than twice the length of the short side and 60 FT.

3.05 FINISH ON FORMED SURFACES

A. Uniform finish required on exposed concrete surfaces.

B. Texture on formed surfaces must be indicative of form material used, except for following limitations and requirements:
   1. Small isolated air bubbles will be allowed.
   2. Width and projection of form marks on exposed concrete must not be greater than 1/16", except no projections allowed on inside channel or conduit walls and slabs; grind off projections as required.

C. Finish exposed top surface of formed members as closely as possible to finish on formed surfaces.

D. Repair defective concrete and damaged areas as follows:
   1. Defects requiring repairs include but are not limited to:
      a. Voids in the concrete deeper than 1/8” including, but not limited to tie holes, air pockets (bug holes), honeycomb, rock holes, foreign material embedded in the concrete, and scabbing.
      b. Scabbing is a defect in which part of the form face, including release agent, adhere to the concrete.
   2. Cut back to solid concrete all weak concrete around holes and at honeycomb.
   3. Thoroughly wet area to be repaired and brush coat with neat cement grout.
   4. Fill large voids with cement mortar composed of 1 part cement, 2 parts fine aggregate and water; place in compacted layers to finish flush with adjacent surfaces.

5. On exposed concrete:
    a. Remove excess grout, after it is partially set, by working with float and rubbing with burlap; leave no visible filler or grout.
    b. Patched areas must match adjacent surface.

E. Where form ties are used, fill cutback holes as specified above for repairing defective concrete.

F. Smooth form finish all exposed concrete surfaces, completely remove fins.

G. Rough-Form Finish
    1. No additional finishing is required.

H. Rubbed Finish
    1. While the wall is still damp apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within all pits, air holes or blemishes in the parent concrete. Avoid coating large areas with the slurry at one time.
    2. Before the slurry has dried or changed color, apply a dry (almost crumbly) grout proportioned by volume and consisting of 1 part cement to 1-1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33 for such a material. Grout shall be uniformly applied by means of damp pads of coarse burlap approximately 6" square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in all imperfections.
    3. Allow the mortar to partially harden for 1 or 2 hours depending upon the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.)
    4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cutoff with the trowel so it can be wiped off clean with the burlap.
    5. On the day following the repair of pits, air holes and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.

6. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.

3.06 PROTECTING AND CURING

A. Protect exposed surfaces from premature drying.

B. Protect freshly placed concrete against wash by rain.

C. Keep concrete continuously cured for 7 consecutive days after placement, including weekends and holidays (3 days if Type III Portland cement is used.

D. Approved methods of curing:
   1. Wet cure using continuous sprinklers or submerging concrete; alternate cycles of wetting and drying not permitted; exercise special care when surrounding air is heated during cold weather operations.
   2. Cover with fabric mats and keep wet during curing period.
   3. Cover with waterproof paper which meets requirements of ASTM C171. Waterproof paper shall remain in place for duration of curing period.
   4. Cover with clear or white polyethylene sheets, 0.004" thick; lap edges minimum 4" and seal with tape. Polyethylene sheets shall remain in place for duration of curing period.
   5. Seal with liquid applied curing and sealing compound applied in accordance with manufacturer's directions; do not apply compound on construction joints.
   6. Do not use Methods 1, 2, and 5 in unheated areas during cold weather operations if exposed concrete is protected with blanket insulation.

E. Vertical surfaces:
   1. Wood forms, kept wet, and metal forms provide satisfactory curing; cure exposed top surfaces as specified above.
   2. When forms are removed before end of curing period, exposed concrete must be cured by one of first four approved methods included under Item D.

3.07 INTERIOR SLABS ON GRADE

A. Thickness as shown on drawings.

B. Place over vapor barrier as specified in Section 07110; 6" minimum well graded and compacted granular leveling course under membrane.

C. Isolation joint where shown on drawings and as specified herein under JOINTS.

D. Unless otherwise shown, place exposed slab either:
   1. In strips, maximum 15' wide with control joints centered on columns and saw across strips, as specified herein, under JOINTS, at maximum 15' spacings on column centers.
   2. Place alternate panels checkerboard with control joints on column centers in each direction and maximum 15' oc.

E. Finish as specified herein under FLATWORK FINISHING.

F. Note requirements for drains and process equipment.

3.08 SURFACE COURSES

A. Remove all debris and sweep cured slab base with heavy wire broom; dry brush to remove dust; wash and keep slab wet for 12 hours prior to placement of fill.

B. Remove any excess water 15 to 30 min. prior to placement of surface course.

C. Finish as specified herein under FLATWORK FINISHING.

3.09 FLATWORK FINISHING

A. Screed and float.

B. After floating, check surface with straight edge and eliminate high and low spots; interior slab must be level or flat within 1/4" in 10'; 3/8" in 20'; 3/4" in 40', and drain to floor drains; remove and replace any concrete slabs not meeting these requirements; replacement limits determined by extent of deficiencies and by structural considerations.

C. Do not use dust coat and add no water.

D. Trowel interior slabs, surface courses and concrete fillets not otherwise specified to smooth, polished surface:
   1. Delay troweling until concrete has hardened sufficiently to prevent excess fines form working to surface; avoid excessive troweling.
   2. After topping has set to ring trowel, trowel second time to produce burnished finish.

E. Fine float finish structural slabs over which waterproofing will be placed; floors in rooms, with vehicular access, steps and platforms.

F. Non-slip floor surfaces:
   1. Required for concrete fill of steel stairs and where shown on drawings.
   2. After concrete floor surfaces have been floated and troweled, but while still plastic, sprinkle abrasive aggregate evenly onto the surface and work it into the surface during finishing so that the grains are securely imbedded in the concrete at the surface. Application rate 25 to 40 lbs./100 SF as recommended by the manufacturer.

G. Liquid floor hardener:
   1. Required for interior floors not scheduled to receive floor coverings and for concrete fill of steel stairs.
   2. Do not use curing compounds for curing these slabs.
   3. Apply in 3 coats to thoroughly cured floor over clean dry surface in accordance with manufacturer's directions.
   4. Dilute with water, as recommended by manufacturer, for heavy duty dense floors.
   5. Unless otherwise recommended on directions furnished with material, dilute fluosilicate based liquid applied hardener (parts by volume) as follows:

Coat	Water	Hardener
First	3	1
Second	2	1
Third	1	1

3.10 EQUIPMENT BASES

A. Furnish bases for all mechanical and electrical equipment where shown on drawings or specified.

B. Where required, anchor bolts and template to ensure proper location must be furnished by subcontractor concerned.

C. Finish as specified herein under FLATWORK FINISHING.

D. Grout under base of equipment; pack grout to completely fill voids.

3.11 SEALING EXTERIOR SLABS

A. Required for exterior slabs placed between September 15 and May 1 which may be subjected to deicing agents.

B. After specified curing, seal slabs as follows:
   1. First coat 1/2 boiled linseed oil and 1/2 mineral spirits applied at rate of approximately 450 SF per gallon.
   2. After first coat has dried, apply second coat of uncut boiled linseed oil at rate of approximately 540 SF per gallon.

3.12 SCHEDULE OF FINISHES

A. Concrete shall be finished as specified either to remain as natural concrete to receive an additional applied finish or material under another section.

B. Concrete for the following conditions shall be finished as noted on the drawings and as further specified herein:
   1. Concrete to receive dampproofing or waterproofing: Rough-form finish.
   2. Concrete not exposed to view and not scheduled to receive an additional applied finish or material: Rough-form finish.
   3. Exterior vertical concrete above grade exposed to view: Rubbed finish.
   4. Interior vertical concrete exposed to view except in water containment areas: Rubbed finish.
   5. Vertical concrete in water containment areas. Rubbed finish on exposed surfaces and extending to 2' below normal operating water level: Rough-form finish on remainder of submerged areas.
   6. Interior and exterior underside of concrete exposed to view: Rubbed finish.
   7. Interior or exterior horizontal concrete not requiring floor hardener or sealer: Floated finish.
   8. Concrete for exterior walks, interior and exterior stairs: Broomed finish perpendicular to direction of traffic.
   9. Concrete slabs on which process liquids flow or in contact with sludge: Steel trowel finish.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

INDEX

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section describes fabricated metal items as specified hereinafter and miscellaneous metal shapes and plates not specified elsewhere, but shown on plans.

B. Installation of anchorage accessories specified under following sections:
   1. Section 03100 - Concrete Formwork.
   2. Section 04200 - Unit Masonry.

C. Related work specified elsewhere:
   1. Section 03300 - Cast-in-Place Concrete.
   2. Section 05120 - Structural Steel.
   3. Section 09900 - Painting.

1.02 SUBMITTALS

A. Submit complete shop and erection drawings:
   1. Clearly show fabrication and installation tolerances.
   2. Prepare field connection details along lines indicated and/or specified.
   3. Design basis, if any.
   4. Clearly show all materials (including ASTM numbers), dimensions, details, anchorage inserts, fasteners, weights, painting or coatings and similar details.

B. See Section 01300 - Submittals for additional requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

Listed materials apply unless shown otherwise on the drawings or other sections in the specifications.

A. Mild steel: 0.15 - 0.25% carbon content, free from scale and accurate to size or gauge.

B. Structural steel shapes, plates and bars: ASTM A36.

C. Reinforcing steel rods: ASTM A615, Grade 40 or 60.

D. Galvanizing: hot-dip, ASTM A385, ASTM A384, ASTM A153, ASTM A386, ASTM E376 and ASTM A123, minimum 4 mil thickness unless noted otherwise.

E. Aluminum-alloy extruded bars, rods, shapes and tubes: ASTM B221, alloy 6061-T6 or 6063-T6.

F. Aluminum-alloy shapes: ASTM B308, alloy 6061-T6 or 6063-T6.

G. Aluminum-alloy sheet and plate: ASTM B209, alloy 6061-T6 or 6063-T6.

H. Aluminum-alloy structural pipe and tube: ASTM B429, alloy 6061-T6 or 6063-T6.

I. Aluminum-alloy seamless extruded tubing: ASTM B241, alloy 6061-T6 or 6063-T6.

J. Cast aluminum fittings: ASTM B26, alloy 214.

K. Forged aluminum fittings: ASTM B247, alloy 6061-T6 or 6063-T6.

L. Cast aluminum treads with abrasive surface: Wooster Alumogrit Type 150, American Abrasive Alumalun Style CB-1, Stubbs CB15, or equal.

M. Aluminum grating treads and landings: Borden Type IB with 1-1/4" abrasive nosings, or equal.

N. Aluminum tread plate: ASTM B209; alloy 6061-T6 or 6063-T6.

O. Stainless steel: ASTM A167, Type 302/304 or 316 with No. 4 satin finish; castings: ASTM A296; chain: ASTM A473; bolts: ASTM F593, 300 Series; nuts: ASTM F594, 300 Series.

P. Coil inserts: Superior, or equal; electro-galvanized.

Q. Threaded rod: Series 300 stainless steel, unless noted otherwise.

2.02 FABRICATION

A. General:
   1. Weld joints and connections unless shown otherwise on drawings.
   2. Welds must conform to requirements of AWS D1.0-69, Code for Welding in Building Construction.
   3. Exposed welds neat and uniform; finishing or grinding of welds not required unless specified or necessary for proper clearance or fit with other items.

B. Frames for mechanical roof openings:
   1. Aluminum or stainless steel.
   2. All welded construction.

C. Mounting brackets and reinforcing angles:
   1. Aluminum or stainless steel.
   2. Anchorage as shown on drawings.

D. Aluminum platforms and walkways:
   1. Conform to details shown on drawings and OSHA requirements.
   2. Structural aluminum stringers, beams, columns, tubing, landing members, clips and support plates; stainless steel anchorage.
   3. Assemble components with neat, tight joints; conceal field connection fastenings where possible.
   4. Shop welded connections, unless otherwise shown.
   5. Close exposed ends of stringers with closure welded in place.
   6. Exposed mechanically secured joints: tight and neat in appearance; welded joints: completely closed and neat.
   7. Aluminum gratings: joints and connections neat and uniform; mechanically fasten grating to supporting members: see paragraph F. Grating, for further requirements.
   8. Aluminum tube handrails and railings: stainless steel or aluminum wall rail brackets with stainless steel anchorage at maximum 5' oc; return ends of wall rails to wall and terminate 1/4" free of wall; see paragraph E. Handrails, for further requirements.

E. Handrails:
   1. Prefabricated aluminum rails, posts, fittings, connectors, fascia brackets, wall brackets, toeboards, reinforcing bars, cover flanges; stainless steel concrete anchors, safety chains and miscellaneous items.
   2. Reynorail II, Reynolds Metals Co.; Connectorail, Julius Blum and Co., Inc., or equal.
   3. Finish: clear satin anodized finish on all exposed surfaces; 0.4 mil anodized for cast components, 0.7 mil anodized for extruded components; protect all pipe and fittings for shipping by packaging each piece in plastic film.

4. Construct two-pipe horizontal rails with upper pipe centered 42" and lower pipe 21" above floor, except as noted otherwise on drawings.
5. Handrail system designed to meet OSHA requirements.
6. Pipe rail and post outside diameter: 1.90"; minimum thickness Schedule 40.
7. Maximum post spacing: 5'-0", but not less than required for OSHA design.
8. Set posts as shown on drawings where indicated to provide maximum walking clearance.
9. Protect metals from electrolysis caused by contact between dissimilar metals.
10. Provide 1/4" x 4" aluminum plate toe plate required by OSHA; secure to handrail posts with aluminum or stainless steel fasteners.
11. Provide stainless steel safety chains where shown on drawings.
12. Provide removable rails at all pump locations where hoist access is required or where shown on drawings.

F. Grating:
1. Prefabricated skid resistant walking surface (per OSHA), aluminum grating with aluminum edge support angles and other support angles to limit deflection; details shown on drawings.
2. Klemp, I-Bar; Reliance Steel Products Co., I-Lok or Double Lok; Dravo, Tru-Lok; United States Gypsum Co., Grit Strut; United McGill Corp.; United Interlock Grating; Wheeling Corrugating Co., Metal Plank Grating, or equal.
3. Provide supports required to limit deflection to 0.25" with 100 psf live load; subject to field testing and rejection by Engineer.
4. Provide aluminum edge support angles for embedment in concrete required to set grating flush with top of concrete walls.
5. Edge banding or end plates at all edges and as required to stiffen irregular sections.
6. Provide openings shown; provide joints at center of openings where possible to permit removal of grating around items passing through.
7. Provide positive grating fasteners over each support using bolts, clips, plates and self-tapping screws as required; friction type fasteners not acceptable.

G. Pipe hangers: aluminum or stainless steel unless noted otherwise; Elcen, or equal.

H. Stop and weir plates: aluminum or stainless steel with stainless steel fasteners.

I. Stop plate grooves: extruded aluminum; groove width 1/8" wider than stop plate thickness; Neenah R-7501, or equal.

J. Tread plate: as detailed on drawings.

K. Ladders:
1. Aluminum; all welded construction.
2. Conform to details shown on drawings and OSHA requirements.
3. Side rail outside diameter: 1.90"; minimum thickness, Schedule 80.
4. Rungs: 1" dia. with abrasive top finish.

L. Hand Rake for Bar Screen:
   1. Aluminum alloy handle 7’-0” length and 1” diameter.
   2. Aluminum rake head with teeth sized to fit spacing for clear opening and depth for clearing the bar rack.
   3. Rake head to be 18” wide by 6” of 1/4” aluminum.

2.03 ANCHORS, BOLTS AND FASTENING DEVICES

A. Anchor bolt material shall be ASTM A307 unless otherwise noted.

B. Unless otherwise noted, bolts for the connection of carbon steel or iron shall be steel machine bolts; bolts for the connection of galvanized steel or iron shall be galvanized steel or stainless steel machine bolts; and bolts for the connection of aluminum or stainless steel shall be stainless steel machine bolts.

C. Unless otherwise noted, expansion anchors shall be zinc plated carbon steel wedge type anchors complete with nuts and washers. Type 316 stainless steel wedge type anchors shall be used where they will be submerged or exposed to the weather or where stainless steel wedge type anchors are required. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion cone portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Hilti, Kwik-Bolt II; Simpson Strong-Tie Wedge-All; Powers Power-Stud or equal. Holes for wedge anchors exposed to weather shall also be epoxied to prevent spalling concrete due to water entering the hole and freezing.

D. Compound masonry expansion anchors shall be lead expansion sleeve type anchors complete with nuts and washers. Anchors shall be precision die-cast zinc alloy with a minimum of two lead alloy expansion sleeves. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion sleeve portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Star Expansion Industries, Star Slugin or equal. Holes for expansion anchors exposed to weather shall also be caulked to prevent spalling concrete due to water entering the hole and freezing.

E. Adhesive anchors shall be a two-part dual cylinder chemical resin anchoring system. Cylinders shall contain premeasured amounts of resin, cement and a hardener. Adhesive epoxy anchors for bonding dowels and anchors in drilled holes shall be SIKADUR Anchor FIX-4 or approved equal. Approved equivalents shall meet the requirements of ASTM C-881.

F. Adhesive anchors, for fastening to hollow concrete block or brick, shall be a three-part stud, screen and chemical dispenser anchoring system. Adhesive cartridges shall contain premeasured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser. Stud assemblies shall consist of an all-thread anchor rod with nut and washer. Anchors shall be Hilti, HIT C-20 System or equal.

G. Automatic end welded headed anchor studs shall be flux ended studs made from cold drawn steel, ASTM A108 Grades C-1010 through C-1020. Headed anchor studs shall be Nelson, H4L Headed Concrete Anchors or equal.

H. Machine bolts and nuts shall conform to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.

I. Toggle bolts shall be Hilti, Toggler Bolt or equal.

2.04 SHOP PAINTING

A. Clean surface of steel items free of scale, rust or foreign matter and apply one shop prime coat to all steel items per Section 09900 - Painting.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Assemble components, securely join together and attach assembly to structure; where not specifically shown, each stair attachment must adequately transfer its dead load and 100 psf live load to structure.

B. Level stair treads and landings in both directions with tolerance of 1/8" in 10'.

C. Set balusters of each stair run in same vertical plane; plumb within 1/8" of vertical.

D. Set handrails parallel with top of strings, base or other rails within 1/8" in 10 running feet.

E. Install anchorage inserts in concrete formwork as shown on drawings.

F. Securely anchor all items plumb, square and level and in correct alignment with other work.

G. Coat aluminum surfaces in contact with concrete with bituminous paint.

H. Weirs:
   1. Set weir plates level and to elevations shown on plans with carpenters 3' level and torpedo level; check and adjust as necessary before plant startup.
   2. Check for warp and all dimensions of weirs after installation; adjust or reinstall if required by Engineer.

END OF SECTION

SECTION 09900

PAINTING

INDEX

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes painting and protective coatings of exterior and interior surfaces, equipment and piping.

B. Painting, as used herein, includes application of paints, enamels, fillers, stains, varnishes, sealers, or other coatings required for use as prime, intermediate or finish coats, as specified herein under painting schedule.

C. Unless specifically specified elsewhere, following surfaces are not to be painted.
1. Pipe, conduit and ducts in concealed spaces or buried.
2. Stainless steel and aluminum surfaces except as noted otherwise hereinafter.
3. Glass, vitreous enamel and chrome plated items.
4. Brass, bronze and copper.
5. Rubber, plastic and fiberglass.
6. Conduit and ducts on unpainted surfaces.
7. Concrete floors.
8. Interior concrete channels.

D. Shop prime coat is specified under following sections for corresponding materials:
1. Section 05120 - Structural Steel.
2. Section 05500 - Metal Fabrications.

E. Factory paint or pre-finish all equipment as specified herein unless specifically stated otherwise under equipment item specification.

F. Factory pre-finish certain miscellaneous items as specified elsewhere or per approved manufacturer's standard; colors selected by Engineer.

G. Removal and replacement of new door hardware to facilitate painting is specified under Section 08710 - Door Hardware.

H. Related work specified elsewhere: Section 13570 - Inside Process Piping.

1.02 QUALITY ASSURANCE REQUIREMENTS

A. Include following on label of containers:
1. Name of manufacturer.
2. Manufacturer's stock name, type and number.
3. Color.

B. Include following on label of containers or furnish information with materials list in form that will readily relate it to material in container:
1. Instructions for reducing, where applicable.
2. Detailed pigment/vehicle ratios.
3. Any special storage or application instructions.

1.03 SUBMITTALS

A. Materials List:
1. Submit complete list of materials and painting schedule for all coats required for each type of surface; deliver no material to job site until list is reviewed by Engineer.
2. List in form permitting identification by container labels.
3. Note recommended dry film thickness, type system, finish and surface preparation for each coat and each system on list.
4. Submit complete catalog describing all painting systems and types available and proposed.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to job site in original unopened containers with labels intact.

B. Store only acceptable materials at job site.

C. When stored in structure under contract, protect floor and walls of storage area from spatter or discoloration.

D. Store in well ventilated area, away from excessive heat, sparks, flame or direct sunshine; provide safeguards to prevent fire.

1.05 ENVIRONMENTAL CONDITIONS

A. Comply with manufacturer's recommendations as to temperature, humidity and surface conditions under which coating or coating system can be applied.

B. Do not apply finish in areas where dust is being or likely to be generated.

C. Do not apply paint on exterior surface exposed to hot sun or when surface temperature exceeds 105EF.

D. Apply all finishes under adequate illumination.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:
1. Finish materials: product of manufacturer who maintains laboratory under direction of qualified chemist and who maintains strict quality control.
2. Except where quality is established by definite criteria, finish materials must be best of their respective types produced by manufacturer.
3. Coating system for each surface type: product of single manufacturer.
4. Primer used to touch-up shop-applied prime coat: same type as shop coat.
5. Coatings used to touch-up factory prefinished items: same type as factory's finish coating.
6. Thinning and tinting materials: as recommended by manufacturer of material to be thinned or tinted.

B. Gloss (paint and enamel): measured on Gardner-Hunter Reflectometer using 60E Calibrated Gloss Standard, the following apply:
1. Flat finish: 10E or less.
2. Eggshell finish: 10E to 35E.
3. Semi-gloss finish: 35E to 70E.
4. Gloss finish: 65E and up.

2.02 COLORS

A. Color all coats as directed by Engineer.

B. Color prime coats to contrast at least two shades on scale of ten with substrate being primed, except for enamels.

C. Tint undercoats to approximate final color to assure uniform finish color, but with sufficient variation to distinguish between coats.

2.03 MIXING AND TINTING

A. Deliver paints and enamels ready-mixed to job site except where manufacturer recommends otherwise.

B. Job tint and mix only when acceptable to Engineer.

C. Use adequate means and take all precautions necessary to protect floor and adjacent wall surfaces during tinting and mixing operation.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine surfaces scheduled to be painted for conditions that will adversely affect execution, performance or quality of work and which cannot be corrected by normal cleaning, sanding and filling of cracks and nail holes.

B. Do not proceed with surface preparation or coating application until conditions are suitable; application of paint or other coating to surface constitute acceptance of that surface.

3.02 PREPARATION OF SURFACES

A. General:
   1. Remove foreign material and stains which will adversely affect adhesion or appearance of applied coating and make sure that surface is sufficiently dry; follow recommendations of paint manufacturer.
   2. Roughen gloss on existing painted surfaces by sanding or etching to provide proper tooth for adhesion of paint.
   3. Remove mold or mildew completely, wash surface with neutralizing solution, rinse and allow it to dry before painting.
   4. Test to determine moisture content of surface to be painted.

B. Metals:
   1. Completely remove oil and grease with solvent recommended by manufacturer and wipe dry with clean cloths.
   2. Remove mill scale, rust and defective paint down to sound surface or bare metal as recommended by paint manufacturer.
      a. SSPC-SP-6 Commercial Blast Cleaning.

b. SSPC-SP-7 Brush Off Blast Cleaning (NACE No. 4).
c. SSPC-SP-10 Near-White Blast Cleaning.
d. SSPC-SP-11 Bare Metal Power Tool Cleaning.

3. Pretreat galvanized surfaces with zinc phosphate solution; Galvaprep No. 5, or equal.
4. Wash exterior mill finish aluminum with mineral spirits or turpentine and allow to weather for month before painting; in lieu of weathering, roughen surface with steel wool.

C. Concrete:
1. Remove dirt, loose particles, excess mortar and any film left from form oil or curing compound.
2. Fill cracks and irregularities with portland cement grout to provide uniform surface.
3. Test for dryness.

D. Masonry: remove foreign matter, loose particles and efflorescence.

3.03 APPLICATION

A. Do not apply initial coat until moisture content of surface is within limitations recommended by paint manufacturer.

B. Apply materials without thinning, adulteration or change unless otherwise specified, recommended by manufacturer or approved by Engineer.

C. Apply by brush, roller or spraying equipment; spray application not permitted unless adequate precautions are taken to protect all items and surfaces not intended to be coated.
1. Spread or flow each coat smooth and even to film thickness recommended by manufacturer, without runs, sags, skips, excessive brush marks, or other defects.
2. Keep materials free from skins or lumps and well stirred during use.
3. Keep equipment clean, free from contaminants and suitable for finish required.

D. Comply with manufacturer's recommendations for drying time between coats; if not stated, dry for minimum 48 hours for exterior paint and minimum 24 hours for interior paint.

E. Sand and dust between coats to remove defects visible from distance of 5'; for enamel, use fine sandpaper or steel wool and clean between coats to produce an even, smooth finish unless otherwise specified.

F. Joints must present uniform appearance after painting, either completely open or completely closed.

G. Leave all parts of mouldings clean and true to detail with no undue build-up of paint in corners.

H. Make edges adjoining other materials or other colors clean and sharp with no overlapping.

I. Where colors differ between adjoining rooms or spaces and where door frames are to match wall colors, change color at doors.

J. Touch up suction or hot spots in first coat on concrete before applying second coat.

K. Final coat must have solid hiding and/or uniform appearance.

L. Where 100% polyurethane is specified, strictly follow manufacturer's specifications for surface preparation and application.

3.04 FIELD QUALITY CONTROL

A. Notify Engineer when surface preparation is complete and when each coat has been applied for inspection of work before succeeding specified coat is applied; if succeeding coat is applied without Engineer's approval, no credit will be given for applied coat and Contractor must recoat work in question.

3.05 PROTECTION AND CLEANING

A. Carefully protect adjacent work and materials.

B. Remove paint from floors, glass, or other surfaces not specified to receive paint.

C. When painting is complete, remove from premises all debris that are result of painting operations.

3.06 PAINTING SCHEDULE

A. Following general surface painting requirements and General Painting Schedule are not necessarily complete and do not limit scope of work.

B. Once proposed materials list with complete painting schedule is received, Engineer will specify specific painting systems with number of coats, dry film thicknesses and colors.

C. Exterior metals:
   1. Even if prefinished, Engineer will specify painting system and color for items specified under Section 05120 - Structural Steel, Section 05500 - Metal Fabrications that are exposed and equipment specified under Divisions 8, 11, 15 and 16.
   2. Prime coating:
      a. Touch-up weld burns or abrasions in shop applied prime coat.
      b. Unless specified otherwise, prime unprimed surfaces with primer recommended by manufacturer as best suited for finish type specified.
      c. Prime galvanized metal with coat of zinc dust primer (allow minimum 72 hours drying time under good drying conditions, before applying finish coats) or portland-cement-in-oil type paint (Tnemec Series 22, or equal).
      d. Prime non-anodized aluminum with coat of zinc chromate primer (minimum 23% zinc chromate).

D. Interior metals:
   1. Paint steel doors and frames, exposed items specified under Section 05120 - Structural Steel and Section 05500 - Metal Fabrications, diffusers, grilles, panel boxes, pipes and pipe supports.
   2. Painting not required for factory finished diffusers and grilles at acoustical ceilings and corrosion resistant metals (aluminum and stainless steel) except items specifically noted to be painted.
   3. Prime coating:
      a. Touch-up weld burns and abrasions in shop applied prime coat.
      b. Prime items which have not been shop primed, including pipe and conduit installed by Mechanical and Electrical Subcontractors where required, with primer recommended by manufacturer as best suited for surface being primed and finish coat(s) specified.
      c. Where required for proper adhesion or to assure complete hiding by finish coat(s) specified, prime prefinished or prime coated diffusers, grilles, electric panels, switch boxes, conduit and ducts installed on or adjacent to ceilings and walls which are to be painted.
      d. Use only primers recommended by finish coat manufacturer.
   4. On diffusers, grilles, panels, boxes, pipe supports, conduit and ducts apply same finish coat(s) as required for adjacent wall or ceiling surface.

E. Duct and equipment insulation covers:
   1. Painting of items installed and covered by Mechanical Subcontractor.
   2. One coat vinyl type primer-sealer.
   3. Finish coat(s) same as adjacent wall or ceiling surface.

F. Paint pipe lines as specified in Section 13570 - Inside Process Piping under Pipe Coding Schedule.

G. Paint materials as manufactured by Tnemec or Sherwin-Williams per General Painting Schedule.

GENERAL PAINTING SCHEDULE

Surface	Use	Tnemec	Sherwin-Williams
Exterior Metal			
All outside metal not immersed in water, e.g. castings, exposed piping, doors, etc.	General [(1)]	Prime Coat: Series 27WB Typoxy @ 4.0-6.0 mils D.F.T.	Prime Coat: Macropoxy 646 @ 4.0-6.0 mils D.F.T.
		Finish Coat: Series 1075U-(color) Endura-Shield II @ 2.5-4.0 mils D.F.T.	Finish Coat: Hi-Solids Polyurethane B65 @ 2.5-4.0 mils D.F.T.
Interior Metal			
All inside metal in highly corrosive environments e.g. pumps, exposed piping; beams, power and control panels, boxes, ventilators.	General	Prime Coat: Series N69-(color) Hi-Build Epoxoline II Primer @ 4.0-6.0 mils D.F.T.	Prime Coat: Macropoxy 646 @ 4.0-6.0 mils D.F.T.
		Finish Coat: Series N69-(color) Hi-Build Epoxoline II @ 4.0-6.0 mils D.F.T.	Finish Coat: Macropoxy 646 @ 4.0-6.0 mils D.F.T.
Interior Metal in contact with drinking water e.g. exposed piping	General	Prime Coat: Series N91-H2O (color) Hi-Build Epoxoline II Primer @ 2.5-3.5 mils D.F.T.	
		Finish Coat: Series N22-(color) Hi-Build Epoxoline II @ 16-24 mils D.F.T.	
Inside metal in areas other than highly corrosive environments: e.g. pumps, motors, shaft and guards, exposed piping; beams, panels, boxes, joists, ventilators, unit heaters, mechanical equipment, electric panels, miscellaneous equipment.	General[(1)]	Prime Coat: Series 27WB-Typoxy @ 4.0-6.0 mils D.F.T.	Prime Coat: Macropoxy 646 @ 4.0-6.0 mils D.F.T.
		Finish Coat: Series N69-(color) Hi-Build Epoxoline II @ 4.0-6.0 mils D.F.T.	Finish Coat: Macropoxy 646 @ 4.0-6.0 mils D.F.T.
	Machinery and Piping	Prime Coat: Series 27WB-Typoxy @ 4.0-6.0 mils D.F.T.	Prime Coat: Macropoxy 646 @ 4.0-6.0 mils D.F.T.
		Finish Coat: Series N69-(color) Hi-Build Epoxoline II @ 4.0-6.0 mils D.F.T.	Finish Coat: Macropoxy 646 @ 4.0-6.0 mils D.F.T.

GENERAL PAINTING SCHEDULE

Surface	Use	Tnemec	Sherwin-Williams
Inside metal: Doors, frames, windows, etc.	General	Prime Coat: Series 27WB Typoxy @ 4.0-6.0 mils D.F.T.	Prime Coat: Macropoxy 646 @ 4.0-6.0 mils D.F.T.
		2 Finish Coats: Series 1028-(color) Enduratone @ 2.5-4.0 mils D.F.T. per coat.	2 Finish Coats: Hi-Solids Polyurethane B65 @ 2.5-4.0 mils D.F.T. per coat.
All Others	General	Prime Coat: Series N69-(color) Hi-Build Epoxoline II @ 4.0-6.0 mils D.F.T.	Prime Coat: Macropoxy 646 @ 4.0-6.0 mils D.F.T.
		Finish Coat: Series N69-(color) Hi-Build Epoxoline II @ 4.0-6.0 mils D.F.T.	Finish Coat: Macropoxy 646 @ 4.0-6.0 mils D.F.T.
Masonry			
Apply paint to all exposed interior walls except where specifically excluded.	General	Prime Coat: Series 27WB-(color) Typoxy @ 80 SF/gallon.	Prime Coat: Macropoxy 646 @ 115 SF/gallon.
If porous surface primer is required use 1254 Epoxoblock or equivalent.		2 Finish Coats: Series N69-(color) Hi-Build Epoxoline II @ 225 SF/gallon, per coat.	2 Finish Coats: Macropoxy 646 @ 135 SF/gallon, per coat.
Gypsum Board			
Apply to all locations.	General	Prime Coat: Series 151-1051 Elasto-Grip FC @ 1.0-2.0 mils D.F.T.	Prime Coat: ProGreen 200 Latex Primer @ 1.0-2.0 mils D.F.T.
		Finish Coat: Series 113 or 114 H.B. Tneme-Tufcoat @ 4.0-6.0 mils D.F.T.	Finish Coat: Pro Industrial Hi-Bild WB Catalyzed Epoxy @ 4-6 mils D.F.T.
PVC Pipe			
Downspouts	Exterior	2 Coats: Series 1028-(color) Enduratone @2.5-4.0 mils D.F.T. per coat	
Interior Concrete/Concrete Masonry			
Dry Areas.	Acrylic Epoxy	Dense Surface Primer	Series 113 Tuffcoat @ 4-6 mils D.F.T.
If porous surface primer is required use 1254 Epoxoblock WB.		Finish Coat	Series 113 Tuffcoat @ 4-6 mils D.F.T.

GENERAL PAINTING SCHEDULE

Surface	Use	Tnemec	Sherwin-Williams
Exterior Masonry/Precast Concrete/Concrete			
	Acrylic Emulson	Surface Primer	Tneme-crete Series 180 @ 100 sf/gal. Back roll as needed.
		Finish Coat	Tneme-crete Series 180 @ 150 - 200 sf/gal. Back roll as needed.

(1) Except as listed below for specified applications.

(2) An acceptable approach is to remove the factory primer following installation and field apply the prime and finish coats as specified.

END OF SECTION

SECTION 10522

FIRE EXTINGUISHERS

INDEX

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes fire extinguishers where specified.

B. Related work specified elsewhere:
   1. Section 04200 - Unit Masonry.

1.02 SUBMITTALS

A. Submit complete product data, including roughing-in dimensions, installation instructions and anchorage details.

B. See Section 01300 - Submittals for additional requirements.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS

A. 10 lbs. multipurpose dry chemical type conforming to UL Standard 299, UL rating 4A-80BC.

B. Visual pressure gauge required.

C. Red finish to conform to OSHA.

D. Wall mounting bracket required for mounting extinguishers without cabinets.

E. Sign: Fiberglass; white lettering on red background; “FIRE EXTINGUISHER” with arrow pointing down; Brady Model 69074, or equal. Provide one sign per each extinguisher.

F. Provide a total of one (1) fire extinguishers in designated rooms and at locations determined by Owner.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Securely anchor brackets to wall where extinguishers are wall hung.

B. Comply with OSHA requirements.

C. Check all extinguishers to assure proper operating status.

D. Install sign over fire extinguisher.

END OF SECTION

SECTION 11000

PROCESS EQUIPMENT REQUIREMENTS

INDEX

PART 1 – GENERAL

1.01 SCOPE

A. General Requirements for all process equipment specified in Division 11. The Contractor is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to individual equipment specification sections.

1.02 RELATED SECTIONS

A. Conditions of the Contract.

B. Division 1 – General Requirements.

C. Division 9 – Section 09900 – Painting.

D. Division 13 – Special Construction.

E. Division 15 – Mechanical.

F. Division 16 – Electrical.

G. Division 17 – Instrumentation and Controls.

1.03 SUBMITTALS

A. Shop Drawings shall be provided in accordance with Section 01300 – Submittals.

B. Operation and Maintenance Manuals shall be provided in accordance with Section 01600 – Material and Equipment.

C. Equipment shall be furnished by manufacturers regularly engaged in the business or through authorized factory representatives. Verification of factory authorization to sell, service and start-up the equipment shall be furnished at shop drawing time.

1.04 PUMP DESIGN CONDITIONS

A. Design conditions for pumps are based on the piping arrangements and discharge sizes shown on the plans. Other piping configurations or different discharge sizes would change the conditions and shall be approved by the Engineer.

1.05 EQUIPMENT LAYOUT

A. Equipment layouts shown on the drawings are based on one or more of the approved manufacturers. Piping, equipment locations, conduit, or other modifications required because of use of different equipment than that shown on the plans shall be the responsibility of the Contractor at no cost to the Owner. All changes must be approved by the engineer. Redesign costs of the Engineer to accommodate different equipment shall be the responsibility of the Contractor.

PART 2 – PRODUCTS

2.01 EQUIPMENT GENERAL PRODUCTS

A. Equipment shall receive surface preparation and shop coatings in accordance with Section 09900 – Painting

B. Connecting piping and installation thereof shall be in accordance with Section 13570 – Inside Process Piping.

C. Valves installed with process equipment shall be in accordance with Section 13570 – Inside Process Piping.

D. Equipment motors for all process equipment shall meet the requirements of individual sections and exceed EPAC standards for efficiency.

E. All other equipment details shall meet the requirements of specific sections of Division 11.

2.02 COUPLINGS FOR DRIVER CONNECTION

A. Unless otherwise specified in the particular equipment sections, equipment with a driver greater than ½ HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible coupling shall be computer (laser) aligned vertically and horizontally. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taperlock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

B. Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas-Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

2.03 PIPE COUPLING TO PUMP

A. Flanged rigid half couplings or dismantling joints shall be used as connections. Refer also to Section 13570 – Inside Process Piping for specific requirements.

2.04 GUARDS

A. Exposed moving parts shall be provided with guards which meet the requirements of OSHA. Guards shall be fabricated of 14-gage steel, ½-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

2.05 CAUTION SIGNS

A. Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading 'CAUTION – AUTOMATIC EQUIPMENT MAY START AT ANY TIME." Signs shall be constructed of fiberglass material, minimum 1/8" thick, rigid, suitable for post mounting. Letters shall be white on a red background. The sign size and pattern shall be as directed by the Engineer. Signs shall be installed near guarded moving parts.
   1. Refer to Section 10400 – Identifying Devices.

2.06 GAGE TAPS, TEST PLUGS, AND GAGES

A. Gage taps shall be provided on the suction and discharge sides of pumps, blowers and compressors. Pressure and vacuum gages shall be provided where specified. Gage taps, test plugs, and gages shall be as specified in Divisions 15 and 16, respectively. Refer also to Section 13570.

PART 3 – EXECUTION

3.01 RECEIVING, UNLOADING, STORING

A. Contractor shall perform the work items listed below as they apply to process equipment specified in Division 11:
   1. Receive and unload shipments to plant site from suppliers.
   2. Pay all truck costs which may be billed to Owner due to failure to unload cars or trucks within time required by freight companies.
   3. Provide physical protection for stored equipment by supporting equipment 9" to 18" above ground, covering equipment with canvas or other heavy-duty sheeting and securely fastening coverings and replacing torn or damaged coverings, and storing all motors in dry, warm place and in accordance with manufacturer's recommendations.

3.02 FLOOR SHORING

A. Shore any parts of structure for which design loading would be exceeded during construction or equipment installation

B. Protect flooring and other finished surfaces by means of heavy planking,

C. Remove shoring and repair any damage to floors or other parts of structures after equipment has been moved in.

D. Allowable uniform loads which can be placed on floors and grating areas shall not exceed design loadings indicated on drawings.

E. Method of shoring shall be subject to review by the Engineer.

3.03 EQUIPMENT CLEANING

A. Thoroughly clean equipment of all temporary protective coatings and foreign materials prior to assembly or erection.

B. Blow out with compressed air all piping or tubing to be erected as required to remove all foreign material.

C. Clean external surfaces of erected equipment of oil, grease, dirt, or other foreign material.

D. Touch up shop paint, primer, and filler as required and leave surfaces smooth and ready for finish painting.

3.04 PUMP MOTOR AND ALIGNMENT

A. All rotating equipment shall be aligned before start-up by a qualified service engineer. Angular or paralleled misalignment between the motor shaft and drive must not exceed the manufacturer's standard with a maximum allowable of 0.010". Provide confirmation with the recommended type of coupling used if applicable.

B. Alignment of all rotating equipment shall be checked after installation of equipment and associated piping, but prior to grouting to determine that the equipment base is not distorted and pipe strain is not present. Prior to and during grouting, the piping shall be loosened from the unit receiving grout. After grouting, the alignment shall be checked again to determine that no pipe or equipment strain is present. All readings shall be recorded and furnished to the Owner.

C. The Contractor shall pour a concrete base and grout the pump base as directed. Generally, the procedure is: 1) level with metal blocks and shims at anchor bolt locations and check alignment; 2) install grout forms as required; 3) grout base.

3.05 START-UP

A. All equipment shall be placed into operation in accordance with a schedule properly coordinated with the Owner by the Contractor. Scheduling and acceptance of the equipment start-up shall be approved by the Project Engineer.

B. After completion of installation of all rotating equipment and all that is related, the equipment and installation shall be inspected and approved by a representative of the manufacturer as being in compliance with the manufacturer's recommendations and requirements. After such inspection, the equipment shall be field aligned and given any required adjustment and, when complete, the various items of equipment shall be ready to be placed into operation under the supervision of the manufacturer's representative.

3.06 MANUFACTURER'S FIELD SERVICE

A. Manufacturer's Representative shall check out the equipment installation, certify to the Engineer that the equipment is installed and operates correctly.

B. The Manufacturer's Representative shall provide the following minimum total working days (a working day is 8 hours at the plant site and does not include travel time to and from site) for start-up training to instruct the Owner in operation and maintenance procedures:

Each reference to field services applies to a separate site visit. Thus, a start-up visit requiring (1) day and an operator training visit requiring (1) day may require two separate site visits each (1) day in length, and not one visit (2) days in length. Refer to the individual equipment sections for length of requirement.

3.07 PIPE EXTENSIONS

A. Provide and install extensions with valve if required to grease connections and oil drain lines on motors, reducers, drives or other mechanical equipment where grease and drain lines are not accessible without difficulty as directed by the Engineer.

3.08 SPECIAL TOOLS

A. All equipment furnished under this Contract shall be furnished with all special tools and devices (not normally available) necessary for the proper adjustment, maintenance and repair of the particular equipment item or system. All such special tools shall be delivered to the Owner at the time of equipment start-up and operator training. Complete instructions for the use of such special tools shall be included in the O & M Manuals provided for the equipment.

3.09 SPARE PARTS

A. All spare parts shall be individually packed for long-term storage. Boxes shall be clearly labeled with description, part number and equipment for which it is for. All spare parts shall be delivered to the Owner and signed for by the Plant Superintendent or responsible operator in charge.

END OF SECTION

SECTION 11330

HORIZONTAL CENTRIFUGAL PUMPS

INDEX

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes two horizontal centrifugal pumps which includes but is not limited to pumps, motors, and related accessories as shown on the drawings and specified hereinafter.

B. Related work specified elsewhere:
   1. Section 01600 - Material and Equipment.
   2. Section 11000 - Equipment Installation.

C. Manufacturers: Fairbanks Morse, or Flowserve.

D. Pumps used in potable water service shall be certified to NSF 61 Drinking Water System Components – Health Effects, and certified to be Lead-Free in accordance with NSF/ANSI 372.

1.02 BASIC REQUIREMENTS

A. Furnish materials, labor, equipment and appurtenances necessary to insure a complete installation as specified in this section.

B. Manufacturer to furnish services of factory/field engineer for one period totaling one 8-hr. working day at site to inspect installation, witness initial system startup and instruct Owner's personnel concerning maintenance and operation requirements of pumps.

C. Submittals
   1. Shop drawings: complete performance curves, fabrication and installation drawings and schematics, including layout, dimensions, component weights, details, anchorage inserts and installation information necessary to show compliance with specifications and recommended installation procedures.

2. See Section 01300 - Submittals for additional requirements.
3. Certified performance data and curves at rated speed from factory tests; indicate discharge head, total pump efficiency, brake horsepower, and NPSH required. Testing standard is to be HI Level 2B.
4. Submit certification from manufacturer that materials and equipment supplied are NSF 61 lister. Supply pump with secondary nameplate stating the entire pump assembly is NSF 61 certified.

D. Provide stainless steel nameplates on pump and motor; include manufacturer, model number, capacity, total dynamic head, rpm and motor information required by NEMA.

PART 2 - PRODUCTS

2.01 PUMPS

A. Provide two (2) horizontal, centrifugal, single stage, double suction, split case pumps with motor mounted on a common steel base.

B. Operating conditions:

	High Service Pumps
Quantity	2
Rotative Speed, rpm	3,600
Capacity, gpm (min.)	700
Total Dynamic Head, ft.	345
Efficiency (Min.)	71.9%
Minimum Shutoff Head, ft.	365
Suction (In.)	5” or 6”
Discharge (In.)	4"

C. Pump shall be non-overloading throughout curve.

D. Casing: Class 35 cast iron minimum; tested at 150% of maximum working pressure; horizontally split with pump suction and discharge cast integrally with lower half; upper half of casing removable without disturbing piping connections; ANSI 125 lb. flat face flanges for suction and discharge; provide 1/2" NPT air release connection and 1/2" ball valve in upper part of casing; provide 1/2" NPT casing drain connection and plug; 1/4" gauge connections in suction and discharge.

E. Impellers: nickel aluminum bronze, keyed and fixed in axial position by threaded shaft sleeves; impeller skirts grooved and fit with close tolerances to casing ring; enclosed with smooth water passages; dynamically balanced for operating conditions.

F. Wearing rings: fit casing with removable bronze wearing ring or stainless steel (AISI 416), secure with locking device.

G. Shaft: high strength carbon steel, machined ground and polished; provide rubber slingers on shaft and lip seals in bearing housings; bronze shaft sleeves; maximum run-out of shaft at face: not to exceed 0.002"; provide and install shaft guards at motor coupling.

H. Mechanical seal: mount on bronze shaft sleeve or stainless steel (316); locate so that seal liquid is directed directly over seal; provide seal with Ni-Resist stationary faces, carbon rotating faces, stainless steel springs and synthetic rubber bellows or ceramic; design seal so that leakage cannot enter bearings; provide necessary equipment for seal lubrication; rated for 150 psig.

I. Pump bearings: separate from pump casing; machined for exact shaft alignment; anti-friction ball bearings designed to carry radial and axial thrust load of impeller and pump shaft; size for not less than 100,000 hours bearing life; provide zerk fittings for grease lubrication.

J. Pump base: support each pump and motor on fabricated steel, common base plate designed to support weight of pump and motor plus all stresses imposed by vibration, shock and direct and eccentric loads; drill base for anchor bolts and supply template; grout base to eliminate vibration.

K. Coupling: provide flexible coupling and coupling guard between pump and motor.

L. Rotation from driven end: Counter clockwise.

2.02 MOTORS

A. Provide horizontal, energy efficient, constant speed, inverter duty, squirrel cage induction motors; General Electric Energy $aver, US Electrical Type RE or Reliance Electric XE.

B. Horsepower: as required to drive pumps:
   1. High service pumps – 125 HP.

C. RPM: match pump rpm.

D. Rotation: match pump rotation.

E. Voltage: 460 volt.

F. Phase: 3.

G. Frequency: 60 Hz.

H. Guaranteed minimum full load efficiency: meet or exceed minimum efficiency value listed in Efficiency Table in NEMA MG 1-12-10; perform efficiency testing in accordance with IEEE Standard 112, Test Method B, using accuracy improvement by segregated loss determination including stray load loss improvement as specified in NEMA MG.

I. Motor designed and manufactured to meet NEMA MG 1, Section IV – "Performance Standards Applying to All Machines," Part 31 – "Definite-Purpose Inverter-Fed Polyphase Motors".

J. Maximum ambient temperature: 40E C.

K. Insulation: Class F.

L. Temperature rise: Class B.

M. Service factor: 1.15.

N. Torque: as required to start and drive pump; allow for 10% voltage dip during starting.

O. Bearings: two; anti-friction, oil or grease lubricated ball bearings.

P. Conduit box: gasketed with threaded conduit holes; include ground plug; locate at easily accessible location.

Q. Enclosure: open dripproof; prime and finish paint with standard color.

R. Hardware: Stainless steel.

S. Supply with shaft grounding ring to inhibit stray currents common with VFD applications and thermostats for high motor temperature. Thermostats (normally closed) should be used for motor shutdown upon actuation (open) during a high motor temperature condition.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations and as shown on drawings and approved submittals.

B. Manufacturer's representative to inspect installation and assist in initial system start-up as specified hereinbefore.

C. See Section 01600 – Material and Equipment for additional requirements.

END OF SECTION

SECTION 13570

INSIDE PROCESS PIPING

INDEX

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes inside process piping and appurtenances required for complete piping systems as shown on the plans.

B. "Inside" refers to all piping and appurtenances not buried or directly covered with earth.

C. "Process piping" refers to all piping and appurtenances specified and required for treatment unit equipment and controls shown on drawings.

D. All pipe and appurtenance material in contact with potable water shall meet requirements of NSF/ANSI 61.

E. This section also includes certain piping and appurtenances not shown on drawings but associated with inside piping and appurtenances.
   1. Equipment vents and drains.
   2. Piping required for proper operation of piping system equipment including drain valves at low points in piping; no additional compensation allowed for drain piping and small valves.
   3. Connections to instruments and control apparatus; include pressure gauges and other appurtenances required for satisfactory operation of piping system and proper function of instruments and controls.

4. All flanges, unions, expansion joints, bolts, gaskets, reducing fittings, bushings, adapters, hangers and supports.

F. Certain piping, valves, controls and accessories are specified with equipment.

G. Refer to schematic diagrams for some piping and valves not detailed on drawings.

1.02 SUBMITTALS

A. Provide detailed drawings of all shop fabricated piping; include following information:
   1. Identify pipe service and material to be used for each.
   2. Show overall dimensions.
   3. Show location of all nozzles, taps, supporting lugs and other pipe attachments.
   4. Pipe material, wall thickness and/or schedule number, joint types and fitting types.
   5. Identification mark for each pipe section.
   6. Drawings showing details of pipe hangers and supports for each pipe service including locations, materials, strength capacity, spacing, inserts and other similar information.
   7. Valve types, sizes, weights, dimensions, materials, locations and pressure ratings.
   8. Valve operator types, sizes, weights, dimensions, materials, electrical and/or pneumatic characteristics and special requirements.
   9. Submit certification from manufacturer that materials and equipment supplied are NSF 61 listed.

PART 2 - PRODUCTS

2.01 PIPE MATERIALS

A. Pipe material, thickness, joints and fittings to conform with Inside Process Pipe Specification Table included hereinafter. Use of bolt on flanges will not be permitted on this project.

B. Pipe material and valves permissible for each type service to conform with Inside Process Piping Schedule shown hereinafter; where more than one pipe material is listed for particular service, Contractor must select and furnish only one pipe material for that service unless Engineer approves otherwise (galvanic action may occur if certain pipe materials are intermixed).

C. Label intended use for every pipe length and fitting supplied for construction to eliminate misuse in field.

INSIDE PROCESS PIPE SPECIFICATION TABLE

Pipe	Material	Thickness	Joints	Fittings
Ductile Iron (DI)	AWWA C151; ANSI A21.51 or A21.10; coating and lining as specified hereinafter; ASTM D1330 red rubber gaskets; ASTM A307 Grade B nuts and bolts.	Class 53	Threaded flanges per AWWA C110 and C115; ANSI B16.1 with full face 1/8" gaskets, chamfered or rounded end bolts projecting 0 to 1/4" beyond other face of nut.	Flanged per AWWA C110 and C115; ANSI B16.1; 250 psi pressure rating.
Polyvinylchloride (pvc)	ASTM C1785, Type 1, Grade I	Schedule 80	Solvent cement ASTM D2647	ASTM D1785

INSIDE PROCESS PIPING SCHEDULE

Pipe Flow Description	Installed Condition	Pipe Material
Raw Water	Interior	DI
Drain (D)	Interior	pvc

2.02 PIPE COATINGS AND LININGS

A. Interior or submerged ductile iron pipe shall receive shop surface preparation, shop priming, and field painting in accordance with Section 09900 - Painting.

B. Cement mortar line all ductile iron pipe and fittings. Thickness not less than 1/16" for sizes 3" through 12", and 3/32" for sizes 14" through 24". Permitted thickness tolerance of + 1/8" on pipe and + 1/4" on fittings. Apply bituminous seal coat over cement lining. Coating shall be smooth, tough, and tenacious, and impervious to water without any tendency to scale off.

2.03 PIPE THROUGH WALLS AND SLABS

A. Provide embedded wall flange on steel and iron pipe passing through concrete walls and slabs; fabricate wall pipes to dimensions required; place embedded wall flange in center of wall or slab; Clow Corp.; U.S. Pipe, or equal.

B. Provide wall sleeves where shown on drawings with intermediate flange and bell on one end for mechanical joint gaskets, glands and studs; Clow Corp.; U.S. Pipe, or equal.

C. Provide floor and wall sleeves as shown on drawings between inside floor levels and rooms; fill space between sleeve and pipe with silicone foam.

D. Provide special concrete wall and floor slab sleeve for pvc pipe as detailed on drawings; continuous, synthetic rubber link seal to fill void between pipe and sleeve (or core drilled hole) as manufactured by Thunderline Corp., or equal; install per manufacturer's recommendations; use double seal where shown on drawings.

2.04 PIPE HANGERS AND SUPPORTS

A. Install hangers and supports as required to support piping shown on drawings; conform to American Standard Code for Pressure Piping, ANSI B31.1 and Federal Specification WW-H-171.

B. Provide galvanized steel or stainless auxiliary structural steel members, other than building structural steel, required for supporting or anchoring piping and accessories, except where specifically noted otherwise on drawings.

C. Drill holes, provide bolting material and inserts as required to fasten auxiliary structural members to building work; welding not allowed.

D. Provide corrosion resistant anchors, rollers and special supports as required to securely anchor and guide piping; prevent transmission of excessive forces to building structure or to any piece of equipment or piping.

E. Arrange and locate anchors, rollers and guides, not detailed; subject to acceptance of Engineer.

F. Provide compatible materials to prevent galvanic and corrosive action between pipe and hanger or support.

G. Brace piping system to withstand all loads caused by surge, water hammer or shock.

H. Hang and support all pipe in strict accordance with pipe and pipe hanger and support manufacturer's recommendations and as acceptable to Engineer; submit complete details of proposed hanger and support systems before fabrication; provide continuous support of horizontal pvc pipe using galvanized steel angles or channels or individual hangers at spacing approved by Engineer.

I. Prefabricated pipe hangers and supports: Unistrut Corp.; Elcen Metal Products Co.; Grinnell Co., Inc., or equal; corrosion resistant materials.

J. General location and type shown on drawings, only for major pipe hangers and supports.

K. Refer to Section 05500 - Metal Fabrications for general material specifications.

2.05 RESTRAINED DISMANTLING JOINT

A. Smith-Blair Model 975, or equal.

B. Flange to flange connection with longitudinal adjustment typically 2”.

C. 150 psi working pressure, full restraint for flanged pipe and fittings.

D. Alloy steel bolts, nuts and tie rods.

2.06 FLANGED ADAPTERS

A. Smith Blair or Rockwell Model 912, or equal.

B. Provide tie rods of sufficient number and strength to restrain coupling at test pressure 150 psi specified. Use minimum of two 5/8" dia. tie rods.

2.07 MECHANICAL SLEEVE COUPLINGS

A. Dresser, Style 38, or equal.

B. Use where shown on drawings and where permitted by Engineer.

2.08 UNIONS

A. Provide unions as required for installation and removal of equipment, where shown on drawings and as directed by Engineer.

B. Use 150 lb., malleable iron, ground joint with brass to iron seats and screwed ends for all metallic piping smaller than 2", except stainless steel.
   1. Use threaded unions with socket pipe connections for plastic piping.
   2. Use threaded stainless steel unions with welded pipe connections for stainless steel piping smaller than 2".

C. Use flanges or flexible couplings in lieu of unions for all piping 2" and larger.

2.09 VALVES IN GENERAL

A. Valve types: conform to diagrams shown on drawings.
B. Use valves of single manufacturer for each pipe service insofar as possible.

C. Provide all special tools required for packing and disassembling valves.

D. Laying dimensions of flanged valves in accordance with ANSI B16.10.

E. Flanges: ANSI B16.1, 125 lbs. template.

F. Valves designed specifically for service intended.

G. Test valves as specified hereinafter.

H. Provide valve tags as specified hereinafter.

I. Valves used in potable water service shall be certified to ANSI/NSF 61 Drinking Water System Components – Health Effects, and certified to be Lead Free in accordance with NSF/ANSI 372.

2.10 BUTTERFLY VALVES

A. Conform to latest revision of AWWA C504 for Class 150B and Underwriters Laboratories Classification in accordance with ANSI/NSF Standard 61 for Butterfly Valves. Provide flanged or lug style valves where shown on drawings.

B. Valve bodies: cast iron, ASTM A126, Class B or ductile iron, ASTM A536. Short body design with 125 lb. flanged ends faced and drilled per ANSI B16.1 standard for cast iron flanges.

C. Discs: cast iron, ASTM A48, Class 40C or ductile iron, ASTM A536. Disc seating edge shall be solid 316 stainless steel; disc shaft attachment shall be 304 stainless steel disc pins or torque screws.

D. Valve shaft: 304 stainless steel. Valve shaft seals shall be self-compensating V-type packing with multiple seal rings; single molded shaft seal is not acceptable. Valve shaft bearings shall be non-metallic and permanently lubricated.

E. Seat: EPDM for hot air or as required for other services and shall be vulcanized to body for sizes 3" through 20". For 24" valves, seat shall be mechanically retained by epoxy wedge in valve body and shall be adjustable and replaceable without disassembly of disc and shaft or operator. Rubber seat cartridge or seats retained on valve disc is not acceptable.

F. Shop paint interior and exterior valve surfaces per latest revision of AWWA C504. Interior lining shall meet the requirements of NSF 61. Each valve and valve operator shall be installed, adjusted and tested by valve manufacturer per latest revision of AWWA C504, at manufacturing plant.

G. For manually operated valves, provide 10-position lever operators through 6" size. For valves 8" and larger, provide traveling nut handwheel actuators in complete conformance with AWWA C504. Housings will be cast iron and shall be weatherproof or buriable construction if required. Provide chainwheel with galvanized chain if located 7' or higher above floor. All units shall have adjustable open and closed position stops.

I. Butterfly valves shall be DeZurik, Pratt, Golden Anderson, or equal for flanged valves or lug valves.

2.11 BALL VALVES

A. Polyvinylchloride (pvc) ball valves; 4" and smaller only.
1. Use pvc valves and pipe of same manufacturer to insure system compatibility.
2. Type 1, Grade 1 pvc per ASTM D1784.
3. Viton O-ring seals; Teflon seats; 150 psig design cold water working pressure.
4. Double true union type with double block design.
5. R. & G. Sloane, or equal.

B. Metal ball valves; for metal piping only.
1. Type 316 stainless steel ball and stem.
2. Bronze glands and silicone bronze body bolts.
3. Bronze or weldex handle with plastic covered grip.
4. Glass-filled TFE seat, body seal and stem packing.
5. Precompressed ball design with body bolt adjustment for normal wear.
6. Full port design; 300 psig working pressure rating.
7. Flanged, threaded, welded or soldered end connections as required.
8. Pittsburgh Brass Manufacturing Co., or equal.
9. Metal ball valves shall be manufactured and certified in accordance with NSF 61 requirements.

2.12 SLANTING DISC CHECK VALVES

A. Body shall be ASTM A126 Gr. B cast iron with two piece design. Body halves shall be O ring sealed and bolted together to capture seat ring on 55º angle. Area through seat section shall be 40% larger than inlet and outlet of valve. Each body half shall have access cover for internal inspection. Machine each body half to accept top mounted oil dashpot. Cast disc stabilizers into valve body.

B. Disc shall have hydrofoil design to create lift and provide low head loss. Discs shall be solid 316 stainless steel per ASTM A296 for sizes 6” through 10” and ASTM A536 ductile iron with 316 stainless steel disc ring for sizes 12” and larger. Body seat and disc ring shall be 316 stainless steel per ASTM A296 and manufactured to be field replaceable without any special tools. Pivot pins shall be 303 stainless steel per ASTM A582. Pivot pin bushings shall be aluminum bronze per ASTM B150 Alloy 2 for sizes 6” through 10” and 304 stainless steel per ASTM A269 for sizes 12” and larger. Provide stainless steel indicator to show disc position.

C. Provide top mounted dashpot for controlled opening and non slam closing to minimize surge and water hammer. Dashpot shall be self contained oil system, separate and independent from the pipeline media. Opening and closing speeds shall be independently adjustable by color coded micrometer type control valves. Provide internal adjustable cushion chamber in head of cylinder for slower speed during last few degrees of disc closing. Oil reservoirs shall be 316 stainless steel per ASTM A240 and hydraulic hoses S.A.E. certified.

D. Check valves shall be APCO Model CSD-TMD, Series 800T, or equal.

2.13 AIR RELEASE VALVES

A. Provide simple lever type air release valves and ball isolation valves which automatically release accumulated air from system while it is pressurized and operating. Valves shall be 3/4" size, with cast iron body and cover, stainless steel trim and float, and renewable Buna-N seat.

B. Air release valves shall be manufactured and certified in accordance with NSF 61 requirements.

C. Air release valves shall be G.A. Industries Fig. 910, or equal.

D. Provide with saddle connection, stainless steel nipples and ball valve to isolate.

2.14 TRANSITION COUPLINGS

A. Rockwell Model 413 or equal.

2.15 PRESSURE SENSORS

A. Provide pressure gauges on pump discharges as shown on drawings and Pressure Sensor Schedule; position for easy reading; certain pressure gauges may be specified elsewhere with equipment.

B. "Quality" type pressure gauges.
   1. 3-1/2" dial, open front, stem mounted, bronze Bourdon tube, silicone oil filled; stainless steel case.
   2. + 1.0% accuracy (full span); acrylic plastic windows.
   3. Ashcroft 1009, or equal.
   4. Provide intermediate diaphragms to isolate water from gauge; 316 stainless steel construction; Ashcroft 101 series, or equal; fill gauge and upper half of diaphragm with silicone oil.
   5. Provide brass tubing for gauge as required; include gauge cock between housing and gauge assembly with brass body and Teflon seats; fill tubing with silicone oil.
   6. Refer also to the detail on the plans.

PRESSURE SENSOR SCHEDULE

Service	Sensor Type	Number Required	Gauge Range
Pumps Nos. 1, 2	Pressure	2	200 psig
Pumps Nos. 1, 2	Compound	2	-10 to 30 psig

2.16 SURGE RELIEF VALVE

A. Surge relief valve shall function to open quickly when system pressure exceeds pilot setting, and will close slowly at adjustable speed once system pressure subsides. Valve body: ASTM A126 cast iron with integral flanges per ANSI B16.1, Class 125.

B. Main valve: differential piston type with no diaphragms. Valve piston shall be guided over full length of its stroke by long stationary vee-ports downstream of seating surface. Throttling shall be by vee-ports and not by seat itself. All internal guiding and sealing surfaces shall be bronze, ASTM B62.

C. Surge relief valve shall include bronze, spring loaded, resilient seated pilot valve, y-strainer, visual position indicator, stop valves, and adjustable closing speed control, all factory mounted and piped. All service shall be accomplished through flanged cover without removing valve from line.

D. Surge relief valve shall be G.A. Industries Fig. 6600-D, or equal.

2.16 SAMPLE TAPS

A. Furnish and install 1/2", smooth nose sample taps as shown on plans. Locate with Owner. Assume 10 will be required.

B. Conbraco 26-305-01 or equal.

2.17 PIPE COLOR CODING AND LABELING SCHEDULE

A. Colors listed are general. Actual colors will be selected at later date based on approved manufacturer and listed on color coordinating schedule.

B. Equipment labels and tags:
   1. Name designation of process equipment having electrical connections or valves shall be as shown on drawings.
   2. Name and number designation of valves shall be as established during construction.
   3. Stencil name and number designations on piece of equipment or valve with minimum 1" high to maximum of 4" high block letters and numerals depending on size of piece of equipment and as determined by Engineer.
   4. Identify other equipment and valves too small for stenciling with 1-1/2" dia. 19 gauge polished brass metal tags fastened with No. 16 brass jack chains. Metal tags and chains shall have identifying numbering or lettering stamped in. Identifying code will be provided by Engineer. Where tags are used, pipe shall be color coded as specified.

C. Labels and Directional Arrows:
   1. Apply labels with directional arrows at connections to equipment, valves, branch fittings, at least one wall, floor or ceiling boundary within room, and at intervals not greater than 36'-0". Two labels minimum each room, crawl space or compartment.

   2. At each label, arrows indicating direction of flow shall point away from label. If flow may be in both directions, use double headed arrows.
   3. Lettering shall bear full pipe system name as scheduled.
   4. Lettering height shall be as follows:

Outside Pipe Diameter (in.)	Minimum Letter Height (in.)
3/4 - 1-1/4	1/2
1-1/2 – 2	3/4
2-1/2 – 6	1-1/4
8 and over	2-1/2

D. Schedule:

Pipe System	Pipe Color
Raw Water	Tan

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
1. Make necessary field measurements to determine pipe laying lengths; work pipe into place without forcing or springing.
2. Restrain all water piping greater than 10" diameter.
3. Use fittings as shown on drawings.
4. Provide sufficient unions and flanged connections to permit easy dismantling of equipment and piping for maintenance; minimize field welding required.
5. All small piping not shown: arrange workable layout with convenient locations for valves and accessories.
6. Follow customary practices of industry for first class work; use competent and skilled workmen.
7. No additional compensation allowed for modifications of piping required to suit equipment furnished.
8. Piping not detailed: arrange workable layout with convenient access to all valves and specialty items; arrangement subject to approval of Engineer.
9. Slope drain piping 1/4" per foot minimum.
10. Provide drains at low points for drain piping.
11. Paint per Section 09900 - Painting.

B. Joints:
1. Iron pipe: all flanged joints; flange or pipe face true to line; clean before assembly; gasket faces free of burrs and abrasions; draw up bolts and nuts uniformly and snug.
a. Mechanical joint wall pipe with mechanical joint face set flush with wall may be used with bolt holes tapped for studs to retain follower gland.
b. Prepare lined pipe for installation per manufacturer's recommendations.

C. Field cleaning:
1. Rap and blow out piping and valves before and after installation with compressed air.
2. Completely remove temporary preservative coatings from valves and other piping accessories.
3. Contractor responsible for malfunctioning of pumps, valves, controls or other equipment due to presence of foreign material left in piping during installation; clean, repair or replace all malfunctioning or damaged equipment at no expense to Owner.

3.02 TESTS

A. Pressure lines:
1. Test liquid piping systems with water after installation, in accordance with ANSI/AWWA C600 for Pressure Piping; inspect all joints for leakage after piping has been under pressure 24 hours.

2. Test air piping systems with air; paint all joints and valves with soap solution, observe any bubbles; maintain test pressure on piping for not less than 4 hours; test pressure: twice average system working pressure.
3. Valve off, or otherwise isolate instruments, controls or other piping accessories which may be damaged by test pressure.
4. Provide test pumps, test plugs, blind flanges, pipe and gauges and make required piping connections.

B. Gravity lines: test all gravity lines per ASTM C828.

C. Test valves as specified hereinbefore.

D. Retest piping showing leakage; replace or repair defective pipe, fittings and valves disclosed during tests to satisfaction of Engineer.

E. Disinfect all potable water lines and tanks per ANSI/AWWA C653.

3.03 VALVE SCHEDULE

A. See drawings for valve schedule.

Lake Icaria Pump Station Valve Schedule				
Valve Label	**Valve Type**	**Location**	**Usage**	**DWG No.**
02-1 (By Owner)	16" Gate Valve	Existing 16" TEE	Isolate	02-C-3
02-2 (By Owner)	12" Gate Valve	Buried 12" RW	Isolate	02-C-3
10-1	8" Butterfly	Pump No. 1	Suction	10-P-1
10-2	8" Butterfly	Pump No. 2	Suction	10-P-1
10-3	8" Check Valve	Pump No. 1	Discharge	10-P-1
10-4	8" Check Valve	Pump No. 2	Discharge	10-P-1
10-5	8" Butterfly	Pump No. 1	Isolate	10-P-1
10-6	8" Butterfly	Pump No. 2	Isolate	10-P-1
10-7	8" Butterfly	Flow Meter	Isolate	10-P-1
10-8	8" Butterfly	Flow Meter	Isolate	10-P-1
10-9	8" Butterfly		Isolate	10-P-1
10-10	8" Butterfly		Isolate	10-P-1

Contractor Note:

1. Valve schedule generally lists valves 4" and larger with a couple exceptions that manufacturer requires.
2. Valves listed include interior and exterior (Section 02610) valves.
3. The schedule is intended to be complete, but the Contractor must confirm and provide final tally of types and sizes.

END OF SECTION

SECTION 16050

ELECTRICAL REQUIREMENTS

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide electrical work, complete and operable, in accordance with the Contract Documents.

B. The provisions of this section apply to all sections in Division 16, except as indicated otherwise.

C. The work of this section is required for operation of electrically-driven equipment provided under specifications in other divisions. The Contractor's attention is directed to the requirement for proper coordination of the work of this section with the work of equipment specifications and the work of instrumentation sections.

D. Concrete, excavation, backfill, and steel reinforcement required for encasement, installation, or construction of the work of the various sections of Division 16 is included as a part of the work under the respective sections, including duct banks, manholes, handholes, equipment housekeeping pads, and light pole bases.

1.02 REFERENCE STANDARDS

A. The work of this section and all sections in Division 16 shall comply with the following as applicable:
   1. NEC (NFPA 70) National Electrical Code
   2. NETA International Electrical Testing Association
   3. NEMA 250 Enclosure for Electrical Equipment (1000 Volts Maximum)

B. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.

C. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 CFR 1926, as applicable), state building standards, and applicable local codes and regulations.

D. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.03 SIGNAGE AND MARKINGS

A. Identification: Provide danger, caution, and warning signs and equipment identification markings in accordance with applicable federal and state OSHA and NEC requirements.

B. Local Disconnect Switches:
   1. Each local disconnect switch for motors and equipment shall be legibly marked to indicate its purpose unless the purpose is indicated by the location and arrangement.

C. Warning Signs:
   1. 600 volts nominal, or less: Entrances to rooms and other guarded locations that contain live parts shall be marked with conspicuous signs prohibiting unqualified persons to enter.

D. Isolating Switches: Isolating switches not interlocked with an approved circuit interrupting device shall be provided with a sign warning against opening them under load.

1.04 PUBLIC UTILITIES REQUIREMENTS

A. Electric Utility: Southwest Iowa Rural Electric Cooperative.
   1. Contact: (888) 220-4869.

B. The Contractor shall contact the serving utility and verify compliance with requirements before construction.

C. Electrical service shall be as indicated and be as required by the serving utility.

D. The Contractor shall verify and provide service conduits, fittings, grounding devices, and service wires not provided by the serving utility and/or Owner.

1.05 PERMITS AND INSPECTION

A. Permits shall be obtained and inspection fees shall be paid according to the General Conditions.

1.06 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Division 01.

B. Shop Drawings: Include the following:
   1. Complete material lists stating manufacturer and brand name of each item or class of material.
   2. Shop drawings for all grounding work not specifically indicated.
   3. Front, side, rear elevations, and top views with dimensional data.
   4. Location of conduit entrances and access plates.
   5. Component data.
   6. Connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers.
   7. Method of anchoring, weight.
   8. Types of materials and finish.
   9. Nameplates.
   10. Temperature limitations, as applicable.
   11. Voltage requirement, phase, and current, as applicable.
   12. Front and rear access requirements.
   13. Test reports.
   14. Grounding requirements.
   15. Catalog cuts or photocopies of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material. Catalog data sheets shall be stamped to indicate the project name, applicable Section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the Engineer's stamp.

C. Shop drawings shall be custom prepared. Drawings or data indicating "optional" or "as required" equipment are not acceptable. Options not proposed shall be crossed out or deleted from shop drawings.

D. Owner's Manuals: Complete information in accordance with Division 01.

E. Record Drawings: The Contractor shall show invert and top elevations and routing of all duct banks and concealed below-grade electrical installations. Record drawings shall be prepared, be available to the Engineer, and be submitted according to Division 01.

1.07 AREA DESIGNATIONS

A. General
   1. Raceway system enclosures shall comply with Section 16110 - Electrical Raceway Systems.

      Electric work specifically indicated in sections within any of the Specifications shall comply with those requirements.

AREA	NEMA ENCLOSURE CLASSIFICATION						
	1	3R	4X	7	9	12	Notes
Booster Station Bldg.						X	
Building Exterior		X	X				Wet Location

B. Material Requirements
   1. NEMA 1, 3R, and 12 enclosures shall be steel coated with ANSI 61 grey paint unless noted otherwise on plans.
   2. NEMA 4X: stainless steel unless specified otherwise.

1.08 TESTS

A. The Contractor shall be responsible for factory and field tests required by specifications in Division 16 and by the Engineer or other authorities having jurisdiction. The Contractor shall furnish necessary testing equipment and pay costs of tests, including replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

B. Where test reports are indicated, proof of design test reports for mass-produced equipment shall be submitted with the shop drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be approved prior to shipment. Field test reports shall be submitted for review prior to Substantial Completion.

C. Equipment or material that fails a test shall be removed and replaced.

1.09 CONSTRUCTION SEQUENCING

A. Continuance of existing booster station operation during construction is critical. Work shall be scheduled, subject to Owner's approval, to minimize any required shutdown time. The Contractor shall submit a written request, including sequence and duration of activities to be performed during any shutdown.

B. Switching, safety tagging, etc., required for equipment shutdown and power outages shall be performed by the Contractor. In no case shall the Contractor begin any work without written authorization by the Engineer.

C. The Contractor shall visit the Site before submitting a Bid to better acquaint itself with the work of this Contract. Lack of knowledge will not be accepted as a reason for granting extra compensation to perform the work.

PART 2 - PRODUCTS

2.01 GENERAL

A. Equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. Equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the work shall be products of the same manufacturer. Equipment and materials shall be of industrial grade standard of construction.

B. Where a NEMA enclosure type is indicated in a non-hazardous location, the Contractor shall utilize that type of enclosure, despite the fact that certain modifications such as cutouts for control devices may negate the NEMA rating.

C. On devices indicated to display dates, the year shall be displayed as 4 digits.

2.02 MOUNTING HARDWARE

A. Miscellaneous Hardware:
   1. Nuts, bolts, and washers shall be stainless steel.
   2. Threaded rods for trapeze supports shall be continuous threaded, stainless steel, 3/8" dia. minimum.
   3. Strut for mounting of conduits and equipment shall be stainless steel. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion. Aluminum strut shall not be utilized for free standing support frames. Strut shall be as manufactured by Unistrut, B- Line, or equal.

4. Anchors for attaching equipment to concrete walls, floors and ceilings shall be stainless steel expansion anchors, such as "Rawl-Bolt," "Rawl-Stud" or "Lok-Bolt" as manufactured by Rawl; similar by Star, or equal. Wood plugs shall not be permitted.
5. Refer to Section 16070 – Hangers and Supports for additional details.

2.03 ELECTRICAL IDENTIFICATION

A. Nameplates: Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock, Formica type ES-1, or equal. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes as required. Engraved characters shall be block style with no characters smaller than 1/8" top to bottom.

B. Conductor and Equipment Identification: Conductor identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Incidentals: The Contractor shall provide all materials and incidentals required for a complete and operable system, even if not required explicitly by the Specifications or the drawings. Typical incidentals are terminal lugs not furnished with vendor supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor furnished equipment to connect with other equipment indicated in the Contract Documents.

B. Field Control of Location and Arrangement: The drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined by the Contractor in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations on the drawings, however, shall be followed as closely as possible.
1. Where "home runs" are shown, the Contractor shall route the conduits in accordance with the indicated installation requirements. Routings shall be exposed or encased as indicated, except that conduit in finished areas shall be concealed unless specifically indicated otherwise. Conduits encased in a slab shall be sized for conduit OD to not exceed one-third of the slab thickness and be laid out and spaced to not impede concrete flow.

2. Conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms as indicated. Where the drawings do not indicate exact locations, such locations shall be determined by the Engineer. If equipment is installed without instruction and must be moved, it shall be moved without additional cost to the Owner. Lighting fixture locations shall be adjusted slightly to avoid obstructions and to minimize shadows.
3. Wherever conduits and wiring for power circuits, lighting and receptacles are not indicated, it shall be the Contractor's responsibility to provide required conduits and wiring, based on the actual installed fixture layout and the circuit designations as indicated. Wiring shall be #12 AWG minimum, conduits shall be 3/4" minimum (exposed) and 1" minimum (encased). When circuits are combined in the same raceway, the Contractor shall derate conductor ampacities in accordance with NEC requirements.

C. Workmanship: Materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the work. Installation shall be coordinated in the field with other trades to avoid interferences.

Protection of Equipment and Materials: The Contractor shall fully protect materials and equipment against damage from any cause. Materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry. The Contractor shall replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections as part of the work.

3.02 CORE DRILLING

A. The Contractor shall perform core drilling required for installation of raceways through concrete walls and floors. Locations of floor penetrations, as may be required, shall be based on field conditions. Verify all exact core drilling locations based on equipment actually furnished as well as exact field placement. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the Owner prior to any core drilling activities. Damage to any encased conduits, wiring, and piping shall be repaired as part of the work.

3.03 CONCRETE HOUSEKEEPING PADS

A. Concrete housekeeping pads shall be provided for indoor floor standing electrical equipment. Housekeeping pads for equipment, including future units, shall be 4" above surrounding finished floor or grade and 2" larger in both dimensions than the equipment, unless otherwise indicated.

B. Concrete housekeeping curbs shall be provided for conduit stub-ups in indoor locations that are not concealed by equipment enclosures. Such curbing shall be 3" above finished floor or grade.

3.04 EQUIPMENT ANCHORING

A. Floor supported, wall, or ceiling hung equipment and conductors shall be anchored in place by methods that will meet seismic requirements in the area where the project is located. Wall-mounted panels that weigh more than 500 lbs. or that are within 18" of the floor shall be provided with fabricated steel support pedestals. If the supported equipment is a panel or cabinet enclosed within removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung from 4" stud walls and weighing more than 300 lbs. shall have auxiliary floor supports.

B. Leveling channels anchored to the concrete pad shall be provided for switchgear and pad-mounted transformer installations.

C. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the work of this Contract. Such recommendations shall be submitted as shop drawings under Section 01300 - Submittals.

3.05 EQUIPMENT IDENTIFICATION

A. Equipment and devices shall be identified as follows:
   1. Nameplates shall be provided for panel boards, control and instrumentation panels, starters, switches, and pushbutton stations. In addition to nameplates, control devices shall be equipped with standard collar-type legend plates.
   2. Control devices within enclosures shall be identified as indicated. Identification shall be similar to the subparagraph above.
   3. Toggle switches which control loads out of sight of switch and multi-switch locations of more than 2 switches shall have suitable inscribed finish plates.
   4. Equipment names and tag numbers, where indicated on the drawings, shall be utilized on nameplates.
   5. The Contractor shall furnish typewritten circuit directories for panel boards; circuit directory shall accurately reflect the outlets connected to each circuit.

3.06 CLEANING

A. Before final acceptance, the electrical work shall be thoroughly cleaned. Exposed parts shall be thoroughly cleaned of cement, plaster, and other materials. Oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and cracks and corners scraped out. Touch-up paint shall be applied to scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum-cleaned.

END OF SECTION

SECTION 16070

HANGERS AND SUPPORTS

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Conduit and equipment supports.

B. Anchors and fasteners.

1.02 REFERENCES

A. NECA - National Electrical Contractors Association.

B. ANSI/NFPA 70 - National Electrical Code.

1.03 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.04 CONTRACTOR SUBMITTALS

A. The Contractor shall submit shop drawings in accordance with Section 01300 - Submittals and Section 16050 - Electrical Requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials and Finishes: Provide stainless steel hangers, supports and anchors to provide complete corrosion resistance.

B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit.

C. Anchors and Fasteners:
   1. Concrete Structural Elements:
      a. Use steel or malleable iron concrete inserts set in place prior to placing new concrete.
      b. Use expansion anchors not less than 1/4” bolt size and not less than 1-1/8” embedment in existing concrete.
         1) Use power set fasteners not less than 1/4 inch diameter with depth of penetration not less than 3 inches in existing concrete.
         2) Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
            a) Steel Structural Elements: Use beam clamps or spring steel clips.
            b) Concrete Surfaces: Use self-drilling anchors or expansion anchors.
            c) Hollow Masonry, Plaster and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
            d) Solid Masonry Walls: Use expansion anchors.
            e) Sheet Metal: Use sheet metal screws.
            f) Wood Elements: Use wood screws.

2.02 MANUFACTURERS

A. Superstrut, Unistrut, B-line, or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify all channels, fasteners, anchors and miscellaneous equipment are suitable for the application.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Do not fasten supports to pipes, ducts, mechanical equipment and conduit.

D. Obtain permission from Engineer before using powder-actuated anchors.

E. Obtain permission from Engineer before drilling or cutting structural members.

END OF SECTION

SECTION 16110

ELECTRICAL RACEWAY SYSTEMS

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide electrical raceway systems, complete and in place, in accordance with the Contract Documents.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Submittals, and Section 16050 - Electrical Requirements.

B. Shop Drawings
   1. Complete catalog cuts of raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.
   2. Dimensioned layout drawings of cable tray routings, including elevations.

PART 2 - PRODUCTS

2.01 GENERAL

A. Pull and junction boxes, fittings, and other indicated enclosures that are dedicated to the raceway system shall comply with this section.

B. Electrical raceways and associated fittings shall be UL listed and approved for the intended installation.

2.02 CONDUIT

A. Rigid Galvanized Steel (RGS) Conduit:
   1. Rigid steel conduit shall be mild steel, hot-dip galvanized inside and out.
   2. Rigid steel conduit shall be manufactured in accordance with ANSI C80.1 - Rigid Steel Conduit, Zinc Coated, and UL-6.
   3. Suitable for use as exposed conduit in indoor and outdoor applications.
   4. Manufacturers, or equal.
      a. LTV Steel
      b. Triangle
      c. Wheatland Tube

B. Rigid Non-Metallic Conduit:
   1. Rigid non-metallic conduit shall be Schedule 40 pvc, sunlight resistant.
   2. Rigid non-metallic conduit shall be manufactured in accordance with NEMA TC-2 - Electrical Plastic Tubing and Conduit, and UL-651 - Standard for Rigid Non-Metallic Conduit.
   3. Suitable for use as underground direct bury conduit.
   4. Manufacturers, or equal.
      a. Carlon
      b. Condux

C. Liquidtight Flexible Conduit:
   1. Liquidtight flexible conduit shall be constructed of a flexible aluminum or galvanized metal core with a sunlight resistant thermoplastic outer jacket.
   2. Liquidtight flexible conduit shall be manufactured in accordance with UL-360 - Steel Conduits, Liquid-Tight Flexible.
   3. Suitable for use at equipment connections and applications where vibration is expected.
   4. Aluminum inner core shall be utilized when used when terminated to rigid aluminum raceways.
   5. Manufacturers, or equal.
      a. Anaconda, Sealtite
      b. Electriflex, Liquatite Type LA

D. Electrical Metallic Tubing (EMT) or Intermediate conduit (IMC) will not be accepted except where concealed.

2.03 FITTINGS AND BOXES

A. General:
   1. Cast and malleable iron fittings for use with metallic conduit shall be the threaded type with 5 full threads.

2. Fittings and boxes shall have neoprene gaskets and non-magnetic stainless steel screws. Covers shall be attached by means of holes tapped into the body of the fitting. Covers for fittings attached by means of clips or clamps will not be acceptable.
3. Boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.
4. In outdoor areas, conduit shall be terminated in raintight hubs as manufactured by Myers, O.Z. Gedney, Appleton, or equal. In other than outdoor areas, sealed locknuts and bushings shall be used.
5. Conduit, fittings, and boxes in hazardous locations shall be suitable for the Class and Division indicated.

B. Malleable Iron Fittings and Boxes:
1. Fittings and boxes for use with galvanized steel conduit shall be of malleable iron or gray-iron alloy with zinc plating.
2. Manufacturers, or equal.
a. O.Z. Gedney
b. Crouse-Hinds
c. Appleton

C. PVC Fittings and Boxes:
1. Fittings for use with rigid non-metallic conduit shall be pvc, solvent welded type.
2. Boxes shall be pvc or fiberglass reinforced polyester (FRP).
3. Manufacturers, or equal.
a. Carlon
b. Crouse-Hinds
c. Hoffman
4. Provide welding solvent as required for installation of non-metallic conduit and fittings.

D. Stainless Steel Boxes:
1. Stainless steel boxes shall be used with pvc coated RGS conduit and where indicated.
2. Stainless steel boxes shall be NEMA 4X, Type 304.
3. Stainless steel shall be minimum 14-gauge thickness, with a brushed finish.
4. Doors shall have full length stainless steel piano hinges. Non-hinged boxes are not acceptable.
5. Manufacturers, or equal.
a. Hoffman
b. Rohn
c. Hammond

E. Sheet Steel Boxes:
1. Sheet steel boxes shall be galvanized steel outlet and switch boxes.

2. Manufacturers, or equal.
    a. Raco
    b. Steel City
    c. Appleton Electric

2.04 CONDUIT SCHEDULE

A. Refer to Section 16050 for conduit system environmental ratings.

PART 3 - EXECUTION

3.01 GENERAL

A. Wiring shall be run in raceway unless indicated otherwise.

B. Raceways shall be installed between equipment as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for this purpose. Factory elbows shall be utilized wherever possible.

C. Where raceway routings are indicated on plan views, follow those routings to the extent possible; Conduits shall be concealed in walls unless indicated otherwise; do not conceal conduits inside concrete floors unless shown specifically on drawings or authorized by the Engineer.

D. Where raceways are indicated but routing is not indicated, such as home runs, raceway routings shall be the Contractor's choice and in strict accordance with the NEC and customary installation practice. Raceway shall be encased, exposed, concealed, or under floor as indicated; conduits in finished areas (offices, hallways etc.) shall be concealed unless specifically indicated otherwise.

E. Routings shall be adjusted to avoid obstructions. Coordinate between trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation, and removal and re-installation to resolve conflicts shall be by the Contractor as part of the work.

F. Exposed raceways shall be installed parallel or perpendicular to structural beams.

G. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.

H. Exposed raceways shall be installed at least 1/2" from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, exposed raceways shall be installed 1/4" minimum from the face of walls or ceilings by the use of clamp backs or struts.

I. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, suitable insulating means shall be provided to prevent such corrosion.

3.02 CONDUIT

A. Exposed conduit shall be rigid galvanized steel.
   1. Where galvanized conduit has to be cut, the galvanized coating shall be repaired per manufacturer's instructions.

B. Conduit concealed or encased in concrete shall be rigid Schedule 40 PVC; exterior buried conduit can be rigid Schedule 40 PVC. Where conduit emerges from concrete encasement, a pvc coated RGS elbow shall be utilized for transition from the concrete. Conduit shall emerge from the concrete perpendicular to the surface whenever possible.

C. Exposed conduit shall be 3/4" minimum trade size. Encased conduit shall be 1" minimum trade size. Supports shall be installed at distances required by the NEC.

D. Conduit shall not be encased in the bottom floor slab below grade.

E. Concrete cover for conduit and fittings shall not be less than 1-1/2" for concrete exposed to earth or weather, or less than 3/4" for concrete not exposed to weather or in contact with the ground.

F. Conduits passing through a slab, wall, or beam shall not impair significantly the strength of the construction.

G. Conduits embedded within a slab, wall, or beam (other than those merely passing through) shall satisfy the following in accordance with NEC and ACI standards:
   1. Conduits with their fittings embedded within a column shall not displace more than 4% of the gross area of cross section.
   2. Conduits shall not be larger in outside dimension than one third the overall thickness of slab, wall, or beam in which embedded.
   3. Conduits shall not be spaced closer than 3 outside diameters on centers.
   4. Install embedded conduits in middle 1/3 of concrete slab.

H. Conduit shall be placed so that cutting, bending, or displacing reinforcement from its proper location will not be required.

I. Threads shall be coated with a conductive lubricant before assembly.

J. Joints shall be tight, thoroughly grounded, secure, and free of obstructions in the pipe. Conduit shall be adequately reamed to prevent damage to the wires and cables inside. Strap wrenches and vises shall be used to install conduit to prevent wrench marks on conduit. Conduit with wrench marks shall be replaced.

K. Wherever possible, conduit runs shall slope to drain at one or both ends of run. Wherever conduit enters substructures below grade, the conduit shall be sloped to drain water away from the structure. Extreme care shall be taken to avoid pockets or depressions in conduit.

L. Installation of rigid steel conduit though a core-drilled hole in an exterior wall below grade shall utilize a sealing device as manufactured by Link Seal or equal.

M. Connections to lay-in type grid lighting fixtures shall be made using flexible metal conduit not exceeding 4' in length. Connections to motors and other equipment subject to vibration shall be made with liquid-tight flexible conduit not exceeding 3' in length. Equipment subject to vibration that is normally provided with wiring leads shall be provided with a cast junction box for the make-up of connections.

N. Conduit passing through walls or floors shall have plastic sleeves.

O. Conduit, fittings, and boxes required in hazardous classified areas shall be suitably rated for the area and shall be provided in strict accordance with NEC requirements.

P. Empty conduits shall be tagged at both ends to indicate the final destination. Where it is not possible to tag the conduit, destination shall be identified by a durable marking on an adjacent surface. A pull-cord shall also be installed in each empty conduit. This shall apply to conduits in floors, panels, manholes, equipment, etc.

Q. Where conduit emerges from direct burial, a rigid conduit elbow shall be utilized below grade for transition to rigid conduit. Conduit shall emerge from the ground perpendicular to the surface whenever possible.

END OF SECTION

SECTION 16120

WIRES AND CABLES

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide wires and cable, complete and operable, in accordance with the Contract Documents.

1.02 CONTRACTOR SUBMITTALS

A. The Contractor shall submit shop drawings in accordance with Section 01300 - Submittals and Section 16050 - Electrical Requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. Conductors, include grounding conductors, shall be copper. Aluminum conductor wire and cable will not be permitted. Insulation shall bear UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. All conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article

310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.

2.02 POWER AND LIGHTING WIRE

A. Wire rated for 600 volts in duct or conduit for all power and lighting circuits shall be Class B Type XHHW cross-linked polyethylene conforming to UL-44 - UL Standard for Thermoset-Insulated Wires and Cables. THHN/THWN for all wires smaller than or equal to No. 4 AWG; XHHW insulation for all wires larger than
No. 4 AWG.

B. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3% at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5%.

C. Conductors for branch circuits as defined in Article 100 of the NEC, shall be sized to prevent voltage drop exceeding 3% at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5%.

D. Wiring for 600 volt class power and lighting shall be as manufactured by General Cable, Okonite, or Rome Cable.

2.03 CONTROL WIRE

A. Control wire in duct or conduit shall be the same type as power and lighting wire indicated above.

B. Control wiring shall be No.14 AWG.

C. Control wires at panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 C. at dry locations, and be as manufactured by American, Carol Cable, or equal.

2.04 INSTRUMENTATION CABLE

A. Instrumentation cable shall be rated at 300 volts.

B. Instrumentation cables shall be composed of two 18 gauge stranded tinned copper conductors, 0.19” thick polyethylene insulation, an aluminum polyester foil outer shield, a No. 20 AWG stranded tinned copper drain wire, and a pvc outer jacket with a thickness of 0.028".

C. Manufacturer and model number: Belden 8760, or equal.

2.05 COAXIAL CABLE

A. Complying with RG-8/9913; suitable for outdoor application; solid inner conductor, foam polyethylene dielectric, aluminum tape outer conductor and black polyethylene outer jacket.

B. Cable shall be Times Microwave Systems LMR-400, or equal.

2.06 ETHERNET DATA CABLE

A. Communication Cable
   1. Category 6 cable conforming to ANSI TIA/EIA-568-B.2-2001.
   2. Shielded with stranded conductors.
   3. 4 pair, 23 AWG; capable of transmitting data up to 1000 MBPS.
   4. Heavy duty oil and sunlight resistant PVC jacket with sequential markings at 2’ interval; NEC rated and UL listed.
   5. Belden or equal.

2.07 CABLE TERMINATIONS

A. Compression connectors shall be Burndy "Hi Lug", Thomas & Betts "Sta-Kon,", or equal. Threaded connectors shall be split bolt type of high strength copper alloy. Pressure type, twist-on connectors will not be acceptable.

B. Pre-insulated fork tongue lugs shall be Thomas & Betts, Burndy, or equal.

C. General purpose insulating tape shall be Scotch No. 33, Plymouth "Slip-knot", or equal. High temperature tape shall be polyvinyl as manufactured by Plymouth, 3M, or equal.

D. Labels for coding 600 volt wiring shall be computer printable or pre-printed, self-laminating, self-sticking, as manufactured by W.H. Brady, 3M, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall provide and terminate all conductors except where indicated.

3.02 INSTALLATION

A. Conductors shall not be pulled into raceway until raceway has been cleared of moisture and debris.

B. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

C. Instrumentation and coaxial cables shall not be run in the same raceway with power and control wiring except where specifically indicated.

D. Wire in panels, cabinets, and wire ways shall be neatly grouped using nylon tie straps, and shall be fanned out to terminals.

3.03 SPLICES AND TERMINATIONS

A. General:
   1. Wire taps and splices shall be properly taped and insulated according to their respective classes.
   2. In general, there shall be no cable splices in underground manholes or pull boxes. If splices are necessary, the cables shall be brought aboveground and terminated in a NEMA 4X, stainless steel terminal or splice cabinet on a concrete pad. Splices in underground manholes and pull boxes may be made only with the approval of the Engineer.
   3. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.
   4. Excess control and instrumentation wire shall be properly taped and terminated as spares.

B. Control Wire and Cable:
   1. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.
   2. In junction boxes, motor control centers, and control panels, control wire and spare wire shall be terminated to terminal strips.

C. Instrumentation Wire and Cable:
   1. Shielded instrumentation cables shall be grounded at one end only, preferably the receiving end on a 4-20 mA system.
   2. Two- and three-conductor shielded cables installed in conduit runs which exceed available standard cable lengths may be spliced in pull boxes. Such cable runs shall have only one splice per conductor.

D. Power Wire and Cable:
   1. All 120/208-volt, 120/240-volt, and 480/277-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the Contractor.
   2. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of 2 layers of varnished cambric tape overtaped with a minimum of 2 layers of high temperature tape.

3.04 CABLE IDENTIFICATION

A. General: Wires and cables shall be identified for proper control of circuits and equipment and to reduce maintenance effort. Identification shall appear within 3" of conductor terminals and at each pull or junction box.

B. Identification Numbers: The Contractor shall assign to each control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to all conductors having common terminals and shall be shown on "as built" drawings. "Control Conductor" shall be defined as any conductor used for alarm, annunciator, or signal purposes.
   1. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. Individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers assigned in the Contract Documents.
   2. All 120/208-volt conductors shall be color coded as follows: Phase A - black, Phase B - red, Phase C - blue, and Neutral - white.
   3. All 120/240-volt system conductors shall be color coded as follows: Line 1 - Black, Line 2 - Red, and Neutral - White.
   4. All 480/277- volt system conductors shall be color coded as follows: Phase A - Brown, Phase B - Orange, Phase C - Yellow, and Neutral - Gray.
   5. Color coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the Site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.
   6. General purpose AC control cables shall be red. General purpose DC control cables shall be blue.
   7. Spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
   8. Terminal strips shall be identified by computer printable, cloth, self-sticking marker strips attached under the terminal strip.

3.05 TESTING

A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-68-516 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. Factory test results shall be submitted with the shop drawings. The following field tests shall be the minimum requirements:
   1. Power cable rated at 600 volts shall be tested for insulation resistance between phases and from each phase to a ground using a megohmeter.
   2. Field testing shall be done after cables are installed in the raceways.
   3. Field tests shall be performed by a certified test organization acceptable to the cable manufacturer. Test results shall be submitted to the Engineer for review and acceptance.
   4. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

B. Continuity Test: Control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing cables in service.

END OF SECTION

SECTION 16140

WIRING DEVICES

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide wiring devices, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 16050 – Electrical Requirements apply to this section.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Submittals.

B. Shop Drawings:
   1. Complete catalog cuts of switches, receptacles, enclosures, covers, and appurtenances, marked to clearly identify proposed materials.
   2. Documentation showing that proposed materials comply with the requirements of NEC and U.L.
   3. Documentation of the manufacturer's qualifications.

PART 2 - PRODUCTS

2.01 GENERAL

A. All devices shall carry the U.L. label.

B. General purpose duplex receptacles and toggle switch handles shall be brown everywhere. Receptacles shall be specification grade and conform to NEMA WD-1, Federal Specifications W-C-596E and W-S-896E, respectively.

2.02 LIGHTING SWITCHES

A. Local branch switches shall be toggle type, rated at 20 amperes, 120-277 VAC, and shall be General Electric Cat. No. GE-5951-1 for single pole, GE-5953-1 for 3-way and GE-5954-1 for 4-way, or similar types as manufactured by Hubbell, Leviton, or equal.

2.03 GENERAL PURPOSE RECEPTACLES

A. Duplex receptacles rated 125 V, 20 amp. shall be polarized 3 wire type for use with 3 wire cord with grounded lead and 1 designated stud shall be permanently grounded to the conduit system (NEMA 5-20R). Duplex 120 V receptacles shall be G.E. 5362, Hubbell 5362, or equal. Single receptacles shall be G.E. 4102, Hubbell 4102, or equal.

B. Ground-fault circuit interrupting receptacles (GFCI's) shall be installed at outdoor locations as required by the NEC. GFCI's shall be duplex, specification grade, tripping at 5 mA. Ratings shall be 125 V, 20 amperes, NEMA WD-1, Configuration 5-20R, capable of interrupting 5,000 amperes without damage. Feed-through type GFCI's serving standard receptacles will not be permitted. GFCI's shall be as manufactured by Hubbell, Bryant, Leviton, or equal.

2.04 ENCLOSURES AND COVERS

A. Surface mounted switches and receptacles shall be in FS or FD type weatherproof conduit fittings.

B. Switch and receptacle covers on surface mounted boxes shall be die cast copper-free aluminum.

C. In areas where cast boxes are used, switch and receptacle covers shall be Crouse-Hinds Catalogue No. DS185 and WLRD-1, or Adalet No. WSL and WRD, or equal.

D. Receptacles in wet locations shall be with a hinged metallic cover/enclosure marked "Suitable for Wet Locations when in use" and "UL Listed." There shall be a gasket between the enclosure and the mounting surface and between the hinged cover and mounting plate/base. The cover shall be TayMac Specification Grade, or equal.

2.05 NAMEPLATES

A. Provide nameplates or equivalent markings on switch enclosures to indicate ON and OFF positions of each switch. ON and OFF for 3-way or 4-way switches is not acceptable. Provide receptacles for special purposes with nameplates indicating their use. Conform to requirements of Section 16050.

PART 3 - EXECUTION

3.01 GENERAL

A. Perform work in accordance with the National Electrical Code.

3.02 CONNECTION

A. Rigidly attach wiring devices in accordance with National Electrical Code, and as indicated, avoiding interference with other equipment.

B. Securely fasten nameplates using screws, bolts, or rivets centered under or on the device, unless otherwise indicated.

3.03 GROUNDING

A. Ground all devices, including switches and receptacles, in accordance with NEC, ART 250, and Section 16450 - Grounding.

B. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.

C. Ground flush receptacles and their metal plates through positive ground connections to outlet box and grounding system. Maintain ground to each receptacle by spring-loaded grounding contact to mounting screw or by grounding jumper, each making positive connection to outlet box and grounding system at all times.

3.04 FIELD TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 16050.

B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.

END OF SECTION

SECTION 16450

GROUNDING

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide the electrical grounding system, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 16050 - Electrical Requirements apply to this section.

C. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts and manufacturer's services.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Submittals and Section 16050 - Electrical Requirements.

B. Shop Drawings: Manufacturer's product information for connections, clamps, and grounding system components, showing compliance with the requirements of this section.

PART 2 - PRODUCTS

2.01 GENERAL

A. Components of the grounding electrode system shall be manufactured in accordance with ANSI/UL 467 - Standard for Safety Grounding and Bonding Equipment, and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

2.02 GROUNDING SYSTEM

A. Grounding loop conductors shall be bare annealed copper conductors suitable for direct burial. Conductors shall be No. 4/0 unless indicated otherwise.

B. Ground Rods:
   1. Unless indicated otherwise, the ground rod shall be a minimum of 3/4" in diameter, 10' long, and have a uniform covering of electrolytic copper metallically bonded to a rigid steel core. The copper to steel bond shall be corrosion resistant.
   2. Conform to ANSI/UL 467.
   3. Sectional type joined by threaded copper alloy couplings.

C. Buried cable-to-cable and cable-to-ground rod connections shall be made using exothermic welds by Cadweld, Enrico Products, or equal.

D. Exposed grounding connectors shall be of the compression type (connector to cable), made of high copper alloy, and be manufactured specifically for the particular grounding application. The connectors shall be Burndy, O.Z. Gedney, or equal.

E. Grounding clamps shall be used to bond each separately derived system to the grounding electrode conductors.

F. Equipment Grounding Circuit Conductors:
   1. These conductors shall be the same type and insulation as the load circuit conductors. The minimum size shall be as outlined in Table 250.122 of the National Electrical Code, unless indicated otherwise.
   2. Metallic conduit systems shall have equipment grounding wires as well as being equipment grounding conductors themselves.

G. Manufacturers of grounding materials shall be Copperweld, Blackburn, Burndy, or equal.

PART 3 - EXECUTION

3.01 GROUNDING

A. Provide a separate grounding conductor, securely grounded in each raceway independent of raceway material.

B. Provide a separate grounding conductor for each motor and connect at motor box. Do not use bolts securing motor box to frame or cover for grounding connectors.

C. Size as given on the conduit schedule and in accordance with the NEC-Article 250.

D. Route conductors inside raceway.

E. Provide a grounding type bushing for secondary feeder conduits which originate from the secondary section of each MCC section, switchboard, or panelboard.

F. Individually bond these raceways to the ground bus in the secondary section.

G. Provide a green insulated wire as grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

H. Provide a separate grounding conductor in each individual raceway for parallel feeders.

I. Interconnect the secondary switchgear neutral bus to the ground bus in the secondary switchgear compartment only at service entrance point or after a transformer.

J. Bond cold water pipe system and building structure to separate grounding electrode per NEC.

K. Provide the duct bank ground system indicated, including, trenching, splices, ground rods, and connections to equipment and structures.

L. Measure ground impedance in accordance with IEEE STD 81 after installation but before connecting the electrode to the remaining grounding system.

M. Low Voltage Grounded System (600V or less): A low voltage grounded system is a system where the local power supply is a transformer with the transformer secondary grounded.
   1. Grounding system connections for a premises wired system supplied by a grounded AC service shall have a grounding electrode connector connected to the grounded service conductor at each service, in accordance with the NEC.
   2. The grounded circuit conductor shall not be used for grounding non-current carrying parts of equipment, raceways, and other enclosures except where specifically listed and permitted by the NEC.

N. Embedded Ground Connections:
   1. Underground and grounding connections embedded in concrete shall be UL listed compression type ground grid connectors.
   2. The connection shall be made in accordance with the manufacturer's instructions.
   3. The Contractor shall not conceal or cover any ground connections until the Engineer or authorized representative has established that every grounding connection conforms to the Contract Documents and has given the Contractor written confirmation.

O. Ground Ring:
   1. Furnish trenching and materials necessary to install the ground ring as indicated.
   2. Bonding conductor shall be in direct contact with the earth and be of the size indicated.
   3. Minimum burial depth 36" or as indicated on the drawings, whichever is greater.
   4. Re-compact disturbed soils to original density in 6" layers.

P. Ground Rods:
   1. Locations shall be as indicated.
   2. Rods forming an individual ground array shall be equal in length.

Q. Shield Grounding:
   1. Shielded instrumentation cable shall have its shield grounded at one end only unless shop drawings indicate the shield will be grounded at both ends.
   2. The grounding point shall be at the control panel or otherwise at the receiving end of the signal carried by the cable.
   3. Termination of shield drain wire shall be on its own terminal screw.
   4. Terminal screws shall be jumpered together using manufactured terminal block jumpers.
   5. Connection to the ground bus shall be via a green No. 12 conductor to the main ground bus for the panel.

END OF SECTION

SECTION 16455

VARIABLE FREQUENCY DRIVE UNITS

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. General: The Contractor shall provide variable frequency drive (VFD) units, complete and operable, in accordance with the contract documents. It is the intent of this section to require complete, reliable, fully tested variable frequency drive systems suitable for attended or unattended operation.

B. The requirements of Section 16050 - Electrical Work, General, apply to the work of this section.

C. Single Manufacturer: Like products shall be the end product of one manufacturer in order to standardize appearance, operation, maintenance, spare parts, and manufacturer's services. This requirement, however, does not relieve the Contractor of overall responsibility for the work.

D. Coordination: The equipment provided under this section shall operate the electric motor driver with the driven equipment as indicated under other equipment specifications. The Contractor's attention is specifically directed to the need for proper coordination of the work under this section and the work under the specific equipment sections.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Submittals, except that shop drawing information for the drives shall be submitted as part of the information for the driven equipment.

B. Shop Drawings: Shop drawings shall include the following information:
   1. Equipment information.
      a. Name of drive manufacturer.
      b. Type and model.
      c. Assembly drawing and nomenclature.
      d. Maximum heat dissipation capacity in KW.
   2. Conduit entrance provisions.
   3. Circuit breaker type, frames, and settings.
   4. Information related to relays, timers, pilot devices, control transformer VA, and fuse sizes. Include catalog cuts.
   5. System schematic ladder diagram and interconnection diagrams. The schematic ladder diagram shall include all remote devices. The ladder diagram shall incorporate the control logic on the corresponding elementary schematic on the contract drawings. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned to the Contractor stamped "REVISE-RESUBMIT".
   6. Factory test data certifying compliance of similar equipment from the same manufacturer with requirements of this section.

C. The Technical Manual shall contain the following documentation:
   1. Manufacturer's 2 year warranty.
   2. Field test report.
   3. Programming procedure and program settings.

PART 2 - PRODUCTS

2.01 GENERAL

A. Variable frequency drives shall be furnished complying with these specifications. Equipment to be operated through variable frequency drives include the following:

Qty	Designation	Service Equipment	HP	Constant or Variable Torque (C/V)	RPM	Enclosure Type
2	VFD-1,2	Booster Pumps	125	Constant	1800	Wall-mount

2.02 EQUIPMENT

A. The power supply shall be an adjustable frequency inverter designed to convert incoming 3 phase, 480 volt, 60 Hertz power to a DC voltage and then to adjustable frequency AC by use of a 3 phase inverter. The inverter shall be a voltage source design producing a pulse-width-modulated type output. The inverter shall be a 6-pulse PWM. The inverters shall be designed to operate 460 volt, 3 phase, 60 Hertz, NEMA-B, open drip-proof (1.15 SF) or TEFC (1.15 SF), squirrel-cage high efficiency inverter duty induction motors over the range of 50-100% of base speed without derating or requiring any motor modifications, inverters shall be capable of delivering nameplate horsepower exclusive of service factor without the need for mandatory thermostats or feedback tachometers. The VFD shall vary both the AC voltage and frequency simultaneously to operate the motor at required speeds. Current source inverters will not be acceptable. Inverters shall be sized to match the KVA and inrush characteristics of the motors actually furnished. The Contractor shall be responsible for matching the controller to the load (variable torque or constant torque) as well as the speed and current of the actual motor being controlled.

B. The minimum VFD inverter efficiency shall be 95% at 100% speed and load, and 85% at 50% speed and load.

C. The VFD shall shut down in an orderly manner when a power outage occurs on one or more phases. Upon restoration of power and a "start" signal, the motor shall restart and run at the speed corresponding to the current process input signal.

D. The VFD shall be provided with additional features described below:
   1. Inrush current adjustment between 50 and 110% of motor full load current (factory set at 100%).
   2. Overload capability at 110% for 60 seconds for variable torque loads and 150% for constant torque loads.
   3. Adjustable acceleration and deceleration.
   4. Input signal of 4 - 20 mA from process.
   5. Output speed signal of 4 - 20 mA. Signals other than 4 - 20 mA are not acceptable.
   6. On loss of input signal, the VFD shall operate at a preset speed.
   7. A minimum of two selectable frequency jump points to avoid critical resonance frequency of the driven system.
   8. Provide ethernet control interface.
   9. Additional devices and functions as indicated.

E. Protection: The VFD shall have, as a minimum, the following protection features:
   1. Input line protection shall be provided with metal oxide varistor (MOV) and RC network.
   2. Protection against single phasing.

3. Instantaneous over current protection.
4. Electronic over current protection.
5. Ground fault protection.
6. Over temperature protection for electronics.
7. Protection against internal faults.
8. Ability to start into rotating motor (forward or reverse rotation).
9. Additional protection and control as indicated and as required by the motor and driven equipment.

F. Service Conditions: The VFD shall be designed and constructed to satisfactorily operate within the following service conditions.
1. Elevation to 1500'.
2. Ambient temperature - 0ºC. to 40ºC.
3. Humidity: 0 to 95%, non-condensing.
4. AC line voltage variation: plus 10% to minus 10%.
5. AC line frequency variation: plus and minus 2 hertz.

G. Electrical equipment provided in addition to the adjustable frequency inverter for each drive shall include:
1. 3% (minimum) Line Reactor integral to the drive enclosure.
2. Fused 480-120 volt control transformer to provide system control power for the logic and pilot lamps.
3. Main disconnect switch.

H. The inverter signal circuits shall be isolated from the power circuits. The inverter shall follow the setting of a remote potentiometer. Refer to the Electrical Elementary Schematic drawings for speed control and start/stop methods. The following operator devices for the inverter shall be mounted and wired at locations indicated:
1. Speed meter calibrated in percent speed.
2. Inverter fault trip output alarm contacts.
3. Other controls and readouts normally furnished as standard equipment, or as otherwise indicated on the Electrical Contract Drawing Elementary Schematics.

I. Screw type terminal boards, properly identified, shall be provided for interconnection to remote controls and instrumentation.

J. Enclosure: VFD's shall be designed to not exceed the space requirements as indicated on the Contract Drawings. VFD's shall be subject to rejection for exceeding the space indicated.

2.03 SPARE PARTS

A. The Contractor shall furnish the spare parts listed below, suitably packaged and labeled with the corresponding equipment number.

B. During the term of this contract, the Contractor shall notify the Engineer in writing about any manufacturer's modification of spare part numbers, interchangeabilities, or model changes. If the Engineer determines that the modified parts no longer apply to the equipment provided, the Contractor shall furnish other applicable parts at no increase in cost to the Owner.

C. The following spare parts shall be furnished:
   1. One set of spare fuses of each size.
   2. One of each type of circuit board.
      a. Control board.
      b. Power board.
      c. Diode bridge.
      d. Transistor module.
   3. One of each size and type power diode and transistor.
   4. One set of tools for maintenance of VFD units.

2.04 MANUFACTURERS

A. The variable frequency drive units shall be Allen-Bradley, Cutler-Hammer, Schneider Electric or approved equal.

PART 3 - EXECUTION

3.01 SERVICES OF MANUFACTURER

A. General: An authorized service representative of the manufacturer shall be present at the site for1 work day to furnish the services listed below. For the purpose of this paragraph, a work day is defined as an 8-hour period excluding travel time.

B. Inspection, Startup, Field Adjustment: The authorized service representative shall supervise the following and certify the equipment and controls have been properly installed, aligned, and readied for operation.
   1. Installation of the equipment.
   2. Inspection, checking, and adjusting the equipment.
   3. Startup and field testing for proper operation.
   4. Performing field adjustments to insure that the equipment installation and operation comply with requirement.

C. Instruction of Owner's Personnel: The authorized representative shall instruct the Owner's personnel in the operation and maintenance of the equipment, including step by step troubleshooting with test equipment. Instruction shall be specific to the VFD models provided. Training shall be scheduled a minimum of 3 weeks in advance of the first session. Training shall include individual sessions for 1 shift of plant personnel.

Proposed training materials shall be submitted for review, and comments shall be incorporated. Training materials shall remain with the trainees. The Owner may videotape the training for later use with the Owner's personnel.

3.02 INSTALLATION

A. The Contractor shall perform all programming of drive parameters required for proper operation of the VFD's included in this project. Submit records of programming data in the equipment Technical Manual.

3.03 FIELD TESTING

A. Testing, checkout, and startup of the VFD equipment in the field shall be performed under the technical direction of the manufacturer's service engineer. Under no circumstances shall any portion of the drive system be energized without authorization from the manufacturer's representative.

END OF SECTION

SECTION 16470

PANELBOARDS AND TRANSFORMERS

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide panelboards, general purpose dry-type energy efficient transformers as shown, complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.02 CONTRACTOR SUBMITTALS

A. General: Submittals shall be in accordance with Section 01300 - Submittals and Section 16050 - Electrical Work, General.

B. Shop Drawings
   1. Transformers.
      a. Dimension drawings.
      b. Technical certification sheets.
      c. Drawing of conduit entry/exit locations.
      d. Transformer ratings, including:
         1) Voltage.
         2) Continuous current.
         3) Basic impulse level for equipment over 600 volts.

4) Kva.
e. Descriptive bulletins.
f. Product sheets.

2. Panelboards.
a. Breaker layout drawings with dimensions and nameplate designations.
b. Component list.
c. Drawings of conduit entry/exit locations.
d. Assembly ratings including:
1) Short circuit rating.
2) Voltage.
3) Continuous current.
e. Cable terminal sizes.
f. Descriptive bulletins.
g. Product sheets.
h. Installation information.
i. Seismic certification and equipment anchorage details.

PART 2 - PRODUCTS

2.01 GENERAL

A. Transformers
1. The transformers shall be dry-type, designed, manufactured, and tested in accordance with the latest applicable standards of ANSI and NEMA.
2. Transformers shall be UL-listed and bear the UL label.

B. Panelboards
1. Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1-Panelboards, as well as the provisions of UL 50 - Safety Enclosures for Electrical Equipment and UL 67 - Safety Panelboards. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-volt, 3-phase operation or 120/240-volt for single phase operation as indicated. Power panelboards shall be rated for 480 volts, 3-phase, 3-wire operation.
2. The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers.

2.02 TRANSFORMERS

A. Energy Efficiency: Standard dry-type transformers, 15 KVA and larger, must meet the energy efficiency requirements of NEMA TP-1. The product requirements are in the appliance regulations, Title 20, and the usage requirements are in Title 24. K-factor transformers are exempt from these requirements.

B. Ratings
   1. KVA and voltage ratings shall be as indicated.
   2. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96 - Guide for Loading Dry Type Distribution and Power Transformers.
   3. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:
      a. Up to 9 kva: 40 db
      b. 10 to 50 kva: 45 db
      c. 51 to 150 kva: 50 db

C. Construction
   1. Insulation Systems.
      a. Transformers shall be insulated as follows:
         1) 2 kva and below: 150°C. insulation system based upon 80°C. rise.
         2) 3 to 15 kva: 185°C. insulation system based upon 115°C. rise.
         3) 15 kva and above: 220°C. insulation system based upon 150°C. rise.
      b. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C. maximum ambient.
      c. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM D 635 - Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
   2. Transformer windings shall be copper, unless shown otherwise.
   3. Transformers shall have four 2-1/2% taps, two above and two below 480 volts.

D. Refer to drawings for standalone transformer location.

2.03 PANELBOARDS

A. Ratings
   1. Panelboards rated 240 VAC or less shall have short circuit ratings not less than 10,000 amp. RMS symmetrical.
   2. Panelboards rated 480 VAC shall have short circuit ratings not less than 25,000 amp. RMS symmetrical.
   3. Panelboards shall be labeled with a UL short circuit rating. Series ratings are not acceptable.

B. Construction
   1. All lighting and power distribution panels shall have copper busbars.
   2. Breakers shall be 1, 2, or 3 pole as indicated, with ampere trip ratings as required by the equipment. Breakers shall be quick-make and quick-break, inverse time trip characteristics, to trip free on overload or short circuit, and to indicate trip condition by the handle position.

3. The panels shall have hinged doors with combination catch and latch. The front panels shall be so arranged that when the plates are removed, the gutters, terminals and wiring will be exposed and accessible. The doors shall have inner doors within the plates to have only the breaker operating mechanism exposed when they are opened. Live conductors and terminals shall be concealed behind the plates.
4. All panelboards shall be rated for the intended voltage.
5. All circuit breakers shall be interchangeable and capable of being operated in any position as well as being removable from the front of the panelboard without disturbing adjacent units. No plug-in circuit breakers will be acceptable.
6. Lighting and power distribution panels which are not part of a motor control center shall be constructed in accordance with Section 16050. Panels shall have the necessary barriers, supports, and liberal wiring gutters. Trim screws shall be stainless steel. All panelboard parts of metal other than copper, aluminum, or stainless steel shall be cadmium plated.
7. Panelboards shall be UL listed except for special enclosures which are not available with UL listing.
8. Panelboards shall be suitable for use as service entrance as indicated or as otherwise required by the N.E.C.

C. Manufacturers:
   1. Cutler Hammer
   2. Square D
   3. Allen Bradley

2.04 CIRCUIT BREAKERS

A. Circuit breakers having a frame size of 150 amp. or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units.

B. Circuit breaker disconnect operators shall be capable of accommodating 3 padlocks for locking in the "open" position.

2.05 SURGE PROTECTIVE DEVICE

A. Surge suppression system shall be furnished in accordance with NEMA LA 1, IEEE C62.41.1, and IEEE C62.41.2. Surge suppressor shall be rated for line voltage and shall provide a minimum of 80 kA per phase surge current protection.

B. Provide protective device within panelboard as disconnecting means and short circuit protection per manufacturer’s recommendation. Factory mount within panelboard utilizing UL-recognized mounting device.

PART 3 - EXECUTION

3.01 GENERAL

A. All work of this section shall be installed as indicated in Section 16050.

END OF SECTION

SECTION 16485

MISCELLANEOUS ELECTRICAL DEVICES

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide miscellaneous electrical equipment as indicated herein or in other sections of the Specifications.

B. All the equipment listed herein may not have been used on this project; refer to plans for type of equipment, locations and other details.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Miscellaneous electrical devices shall comply with the requirements of NEC, NEMA, and UL.

1.03 CONTRACTOR SUBMITTALS

A. Furnish shop drawings in accordance with Section 01300 - Submittals and Section 16050 - Electrical Requirements.
   1. Ladder diagrams and written descriptions explaining ladder diagram operation and system operation for local control stations.
   2. Include catalog cuts of all equipment including enclosures, overcurrent devices, relays, pilot devices, terminations, and wire troughs, etc.

PART 2 - PRODUCTS

2.01 CONTROL ENCLOSURES AND JUNCTION BOXES

A. Control Enclosures:
   1. In finished rooms, enclosures shall be NEMA 12 steel enclosures painted with ANSI 61 exterior and white interior.
   2. In all other non-hazardous areas and exterior mounted, enclosures shall be NEMA 4X stainless steel (prior to modifications) with brushed finish. Where possible, penetrations shall be made in such a manner to maintain the NEMA 4X rating. If this is not possible, the penetrations shall be made in such a manner to minimize entry of foreign materials into the enclosure.
   3. Enclosures shall be freestanding, pedestal-mounted, or equipment skid-mounted, as indicated. Internal control components shall be mounted on a removable mounting pan. Mounting pan shall be finished white.
   4. When required to maintain controlled temperature inside enclosure, outdoor mounted enclosures shall be provided with thermostatically-controlled heaters; insulate control panels when heaters are provided.
   5. Provide screened weep holes for draining condensation.

2.02 DISCONNECT SWITCHES

A. Low Voltage Disconnect Switches (less than 600V)
   1. Heavy duty, non-fusible, single throw; fused where shown.
   2. Horsepower rated.
   3. UL listed.
   4. Padlockable in "Off" position and door interlock.
   5. Enclosure per area classification in Section 16050.
   6. Voltage/phase requirements as shown on drawings.
   7. Auxiliary control contact as applicable and as indicated.
   8. As manufactured by G.E., Cutler-Hammer, or Square D.
   9. Refer to plans for sizes.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install miscellaneous electrical devices specified herein in accordance with Section 16050 and in accordance with the manufacturer's recommendations. All equipment specified herein may not have been used on the project. Refer to drawings for equipment used on this project.

B. Conduit, conductors, and terminations shall be installed in accordance with Section 16050.

END OF SECTION

SECTION 16500

LIGHTING

INDEX

PART 1 – GENERAL

1.01 REFERENCES

A. All LED lighting products must be approved and listed on the Energy Star Qualified Commercial LED Lighting List For Lamps – (http://www.energystar.gov/productfinder/product/certified-light-bulbs/results). For Fixtures – (http://www.energystar.gov/productfinder/product/certified-light-fixtures/results).

B. ANSI/NFPA 70 - National Electrical Code.

C. ANSI/NFPA 101 - Life Safety Code.

1.02 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Provide dimensions, ratings, and performance data.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.03 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Conform to requirements of NFPA 101.

C. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01600.

B. Accept products on site. Inspect for damage.

C. Protect luminaires and accessories from finish damage by handling carefully.

PART 2 - PRODUCTS

2.01 LUMINAIRES

A. Furnish products and associated support hardware as scheduled in the plans.

2.02 EXIT SIGNS

A. Directional Arrows: Universal type for field adjustment.

B. Mounting: Universal, for field selection.

2.03 OCCUPANCY SENSORS

A. Digital dual technology with passive infrared (PIR) and ultrasonic (US) sensors with one (1) relay with occupancy (auto-on) and vacancy (manual-on) operating modes.

B. 1000 square foot, 180 degrees coverage area.

C. 120/277VAC operation.

D. Manufacturer and Model No: Hubbell Building Automation lightHAWK2 # LHMTS 1-G-WH, or approved equal.

E. Warranty: 5 year limited.

F. Suitable for wall and/or ceiling mounting. Refer to plans for locations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

C. Install wall mounted luminaires at height indicated on Drawings.

D. Bond products and metal accessories to branch circuit equipment grounding conductor.

3.02 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.03 ADJUSTING

A. Aim and adjust luminaires.

B. Adjust exit sign directional arrows as indicated.

C. Replace failed fixtures with new prior to Substantial Completion.

3.04 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosure.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

3.05 LIGHT FIXTURE SCHEDULE

A. As scheduled on the Drawings.

END OF SECTION

SECTION 17100

PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. This section describes process control and instrumentation systems.

B. The Contractor shall provide all Process Control and Instrumentation Systems (PCIS) complete and operable, in accordance with the Contract Documents.

C. The requirements of this section apply to all components of the PCIS unless indicated otherwise.

D. Related work specified elsewhere:
   1. Division 16 - Electrical.
   2. Section 17200 - Instrumentation and Control Equipment.
   3. Section 17300 - Control Panels.

1.02 REFERENCES

A. National Fire Protection Association (NFPA):
   1. NFPA 70 - National Electrical Code (NEC), latest edition.

B. National Electrical Manufacturers Association (NEMA):
   1. NEMA ICS-2 - Industrial Control Devices, Controllers, and Assemblies.
   2. NEMA 250 - Enclosures for Electrical Equipment.

C. Underwriters Laboratories (UL):
   1. UL 508 - Industrial Control Equipment.

1.03 GENERAL

A. The Contractor shall use a Controls Integrator (CI) and qualified electrical installers to furnish, install, and place into service process instrumentation, controls and appurtenant work as specified and shown.

B. Contractor shall assign to the CI full responsibility for the functional operation of instrumentation and integrated controls systems. The Controls Integrator shall:
   1. Perform engineering required to select, to furnish, to supervise installation and connection, to calibrate, and to place into operation additional sensors, instruments, controls, accessories, and other equipment as specified.
   2. Be responsible for the integration of related systems and shall ensure compatibility of components through the coordination of all hardware, signal converters, communications software and accessories.
   3. Be under direct, written agreement with the Contractor and comply with specified requirements of these Documents.
   4. Not be the employee of nor be affiliated with manufacturers or manufacturers' representatives of major equipment such that a conflict of interest could adversely affect progress of the Work.

C. Work specified in Division 17 includes furnishing, installing, start-up, testing and adjusting of all required equipment, including instruments, equipment, hardware, software, wiring, accessory equipment, and training to provide a completely operational process control and instrumentation system.

D. It shall be the responsibility of the Contractor through the use of the CI to furnish a complete and fully operating system; The Contractor shall be responsible for all details which may be necessary to properly install, adjust and place in operation the complete installation; The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the Contract Documents.

E. It shall be the responsibility of the CI to examine all new and existing equipment that is transmitting signals to, or receiving signals from, equipment specified in Division 17; The CI shall be responsible for providing signal converters, buffer amplifiers, and isolation devices to make signal levels, reference to ground, etc. compatible between devices specified in Division 17 and existing equipment.

1.04 CONTROLS INTEGRATOR EXPERIENCE AND CAPABILITIES

A. The CI shall be normally engaged in assembly, installation, repair, and maintenance of process control and instrumentation systems and must have been supplying similar types/quantities of control systems in municipal water and wastewater treatment industry for a minimum of 5 years.

B. The CI shall have qualified, trained service personnel on staff who are capable of programming, maintaining and adjusting the system; The CI shall be capable of offering an extended service contract after completion of the warranty period, including 24 hour, 7 day a week emergency services; service personnel must be available within 8 hours of verbal notice on all days of week.

C. The CI shall have service and parts office within 200 miles of project site and shall be able to provide service within time period acceptable to the Owner or shall have the capability to provide service to project site remotely by modem; the local office shall have full-time service personnel and answer telephone calls in person; provide home telephone numbers of management personnel for use in case of emergencies.

D. The Controls Integrator shall be one of following companies in full conformance with Specifications:
   1. Automatic Systems Company; Contact: Jake McFarland (515) 232-4770, jmcfarland@automaticsystemsco.com
   2. Jetco; Contact: John Whitacre (515) 967-5874, jwhitacre@jetcoelectric.com
   3. Electric Pump; Contact: Bob White (515) 421-6050, rwhite@electricpump.com

1.05 SUBMITTALS

A. Submit informational literature/data for following materials and equipment in accordance with general procedures set forth in Specifications:
   1. All equipment and components indicated on Drawings and specified in this section.
   2. Software packages including complete description of features and capabilities.

B. Submit shop drawings for following materials and equipment in accordance with general procedures set forth in Specifications:
   1. Panel drawings including system schematic drawings, terminal numbering, component schematic drawings, dimension drawings, layout drawing and nameplate schedule.
   2. Overall system diagram showing all components, converters, cables, and connectors.
   3. Programmable Logic Controller (PLC) programs in ladder format including verbal description of each rung's function; assign point numbers to all inputs and outputs, and show point numbering in PLC program.
   4. Proposed graphic displays; submit actual hardcopy of programmed graphic screens.

5. The submittal shall address all hardware and software to be supplied. In addition, include:
    a. Identification of the respective responsibilities of each party to the project. Including what is provided by the system manufacturer, what is to be subcontracted etc.
    b. Description of the major user related features and operating characteristics of the proposed system.
    c. Description of all master site hardware and software updates including examples of HMI and PC SCADA displays, control loops, reports, and how the operator will interface with the system to achieve each specified function.
    d. Description and operation of all required configuration features of the I/O and local and remote control loop characteristics.
    e. Description containing startup implementation plan, participant's responsibilities and a schedule of events.
    f. All significant equipment to be supplied shall be listed followed by descriptive data sheets. The equipment list shall include each component name, manufacturer, model number, a description of the operation, quantity supplied, and any special setup and operation and maintenance characteristics.
    g. Drawings of equipment to be supplied shall include as a minimum, overall dimension details for each unit including installation arrangements, door mounted operator devices and instruments. Wiring diagrams of all system components including field device connections shall be included and specific installation wiring responsibilities identified.

C. Operations and Maintenance (O&M) Manuals: submit minimum of two (2) sets of operation and maintenance manuals containing:
    1. A detailed written description of system hardware, software, and system operation shall be provided. The description of hardware and software shall identify pertinent references to sections of standard hardware and software manuals where operational procedures are detailed. Control loops shall be fully described in the O&M manual.
    2. Panel equipment, field devices and instruments, including "as-built" system schematics.
    3. Final copy of PLC program on 8-1/2" x 11" sheets in ladder format including verbal description of each rung's function.
    4. PLC program burned on DVD.
    5. Point lists for all PLC inputs/outputs; identify point number (tag), point description, point type, range in engineering units (if analog point), PLC number, rack and slot number, and point address.

D. Final as-built drawings.

E. All submittals bound in 3-ring binders with labeled tabs separating sections.

1.06 GUARANTEE

A. Contractor shall guarantee operation of system and that materials and workmanship of equipment be free from defects for period as defined in General Conditions of project manual providing equipment has been operated and maintained in accordance with manufacturer's recommendations.

1.07 WARRANTY

A. Controls Integrator shall provide a comprehensive two (2) year parts and labor warranty for complete control system.

1.08 TESTING

A. The controller and peripherals shall be tested as best possible at the factory as an integrated unit prior to shipment. The engineer shall be notified at least 2 weeks in advance of the system test. Include test results as an attachment to the equipment.

B. Panel furnished under this section constructed in accordance with UL 508.

C. Panel shop-inspected by UL or constructed in UL-recognized facility; completed panel shall bear serialized UL label indicating acceptance under Standard 508.

PART 2 - PRODUCTS

2.01 GENERAL

A. Code and Regulatory Compliance: PCIS work shall conform to or exceed the applicable requirements of the National Electrical Code. Conflicts between the requirements of the Contract Documents and any codes or referenced standards or specifications shall be resolved accordingly.

B. Current Technology: Meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the Shop Drawings unless otherwise required to match existing equipment.

C. Hardware Commonality: Instruments which utilize a common measurement principle (for example, d/p cells, pressure transmitters, level transmitters that monitor hydrostatic head) shall be furnished by a single manufacturer. Panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single manufacturer.

D. Loop Isolators and Converters: Signal isolators shall be provided as required to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wirewound resistors shall be installed at all field side terminations in the control panels to ensure loop integrity. Signal conditioners and converters shall be provided where required to resolve any signal level incompatibilities or provide required functions.

E. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20% within the minimums and maximums of their rated environmental operating ranges. The Contractor shall provide power wiring for these devices. Enclosures suitable for the environment shall be furnished. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

F. Signal Levels: Analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable. Electrical signals outside control panels shall be 4 to 20 ma. dc except as indicated. Signals within enclosures may be 1 to 5 volts dc. Electric signals shall be electrically or optically isolated from other signals. Pneumatic signals shall be 3 to 15 psig with 3 psig equal to 0% and 15 psig equal to 100%.

G. Control Panel Power Supplies: Control panels shall be provided with redundant power supplies which are configured in a fault-tolerant manner to prevent interruption of service upon failure and interruption of service necessitated by the replacement of a power supply. Power supplies shall have an excess rated capacity of 40%. The failure of a power supply shall be annunciated at the control panel and repeated to the PLC.

H. Alternative Equipment and Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the Engineer through the "or equal" process of Section 01600 - Material and Equipment. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage, and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available.

2.02 OPERATING CONDITIONS

A. The PCIS shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:
   1. Environment: a water treatment plant facility.
   2. Temperature Range: 32 through 104°F.
   3. Thermal Shock: 1°F. per minute, max.
   4. Relative Humidity: 20 through 95%, non-condensing.

2.03 SPECIAL TOOLS

A. The CI shall furnish a priced list of any and all special tools required to calibrate and maintain the instrumentation provided under the Contract Documents. After approval the CI shall furnish the requested tools on that list.

B. Special tools shall be submitted before startup commences, suitably wrapped and identified.

PART 3 - EXECUTION

3.01 PROJECT MANAGEMENT

A. Supplier shall provide engineering and administrative services necessary to fulfill requirements of Specifications.

B. Supplier shall provide services of experienced project manager as overall coordinator during course of project.

3.02 INSTALLATION

A. General:
   1. Instrumentation, including instrumentation furnished under other divisions, shall be installed under Division 17 and the manufacturers' instructions.
   2. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the Owner exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the Contractor shall make such changes without additional cost to the Owner.

B. Conduit, Cables, and Field Wiring:
   1. Conduit shall be provided under Division 16 without delay to the work of Division 17.
   2. Process equipment control wiring, 4-20 mA signal circuits, signal wiring to field instruments, PLC input and output wiring and other field wiring and cables shall be provided under Division 16.
   3. Terminations and wire identification at PCIS equipment furnished under this or any other division shall be provided under Division 17.

C. Ancillary Devices: The Contract Documents show all necessary conduit and instruments required to make a complete instrumentation system. The Contractor shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements. Such changes shall not be a basis of claims for extra work or delay.

D. Installation Criteria and Validation: Field-mounted components and assemblies shall be installed and connected according to the requirements below:
   1. Installation personnel have been instructed on installation requirements of the Contract Documents.
   2. Technical assistance is available to installation personnel at least by telephone.
   3. Installation personnel have at least 1 copy of the approved Shop Drawings and data.
   4. Instrument process sensing lines shall be installed in conduit under Section 16050 - Electrical General Provisions. Individual tubes shall be run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3' of rigid tubing.
   5. Bends shall be formed to uniform radii with the proper tool without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at panels requiring pipe or tubing entries.
   6. Differential pressure elements shall have 3 valve manifolds.
   7. Flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.
   8. Power and signal wires shall be terminated with crimped type lugs.
   9. Connectors shall be, as a minimum, water tight.
   10. Wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.
   11. Wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically approved by the Engineer. Wiring shall be protected from sharp edges and corners.
   12. Mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.
   13. Verify the correctness of each installation, including polarity of electric power and signal connections, and make sure process connections are free of leaks. The Contractor shall certify in writing that discrepancies have been corrected for each system checked out.
   14. The Owner will not be responsible for any additional cost of rework attributable to actions of the Contractor or the Controls Integrator.

3.03 CALIBRATION

A. General: Devices provided under Division 17 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Calibration Points: Each instrument shall be calibrated at 20, 40, 60, 80 and 100% of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Standards and Testing.

C. Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the Engineer.

D. Field Calibration: Instruments which were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument data sheets.

E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers.

F. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:
   1. Project name.
   2. Tag number.
   3. Manufacturer.
   4. Model number.
   5. Serial number.
   6. Calibration range.
   7. Calibration data: Input, output, and error at 10%, 50%, and 90% of span.
   8. Switch setting, contact action, and deadband for discrete elements.
   9. Space for comments.
   10. Space for sign-off by Controls Integrator and date.
   11. Test equipment used and associated serial numbers.

G. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the Engineer. The Contractor shall have the Instrumentation Supplier sign the tag when calibration is complete. The Engineer will sign the tag when the calibration and testing has been accepted.

3.04 START-UP

A. The Controls Integrator shall provide skilled programmer/instrumentation engineer or technician who shall complete troubleshooting and start-up to place entire system into satisfactory operation; engineer or technician shall make necessary inspection of completed installation, make necessary final field adjustments and make program revisions as required for start-up.

B. Demonstrate proper operation of all system features and functions to Owner and Engineer.

C. Coordinate start-up scheduling with Owner and Engineer.

3.05 ON-SITE SERVICES

A. In addition to other services specified including start up, provide competent technician or programmer/instrumentation engineer to perform following services at times approved by Owner:
   1. Software revisions and training: One 8 hour days on-site to train Owner's personnel on:
      a. Operation and maintenance of all equipment furnished.
      b. SCADA system operations.
      c. PLC programming.

B. Call-back trip to occur at time determined by Owner.

END OF SECTION

SECTION 17200

INSTRUMENTATION EQUIPMENT

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. General: The Contractor shall provide instrument systems and switches, complete and operable in accordance with the Contract Documents.

B. "Smart" transmitters shall be furnished when or where ever possible.

C. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to this section.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 17100.

PART 2 - PRODUCTS

2.01 MAGNETIC FLOW METERS

A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.

B. Each meter shall be furnished with a stainless steel metering tube and carbon steel flanges with a polyurethane liner. Liner shall have a minimum thickness of 0.125”. The inside diameter of the liner shall be within 0.125” of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.

C. The flow tube shall be provided with flush mounted electrodes. Ultrasonic electrode cleaning shall not be acceptable.

D. Grounding rings shall be provided for all meters.

E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum, 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.

F. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65°C. Meter and transmitter housings shall meet NEMA 4X requirements as a minimum and shall be suitable for continued submergence in water. When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas. Non-metallic transmitter housings shall not be acceptable.

G. Flow tubes shall be provided with an isolated replaceable terminal block for ease of replacement in the event that condensation or moisture enters the terminal housing preventing the need to replace the entire flow tube.

H. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages. Transmitter display shall be located at meter assembly.

I. The transmitter's preamplifier input impedance shall be a minimum of 109-1011 ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.

J. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external contact operation.

K. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.

L. The transmitter shall be capable of communicating digitally with a remote configuration device via a frequency-shift-keyed, high frequency signal superimposed on the 4-20 mA output signal. The remote configuration device shall be capable of being placed anywhere in the 4-20 mA output loop. A security lockout feature shall be provided to prevent unauthorized modification of configuration parameters.

M. Accuracy shall be 0.50% of rate over the flow velocity range of 1 to 30ft/sec. Repeatability shall be 0.1% of rate; minimum turndown shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50°C. Power supply shall be 115 VAC, 60 Hz.

N. The transmitter shall be furnished with licensed option for continuous flow meter and system verification and shall be activated as required by the specification or instruments list. The meter verification function shall be internal to the transmitter continuously comparing the transmitters current signature values with those set to establish a baseline and will provide an alert should meter determine it is operating outside configurable limits.

O. Flow tubes shall be 150-lb carbon steel flange mounted unless otherwise noted. AWWA C207 Table 3 Class D for 30” and larger diameter meters. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Transmitter shall be mounted remotely on wall.

P. Magnetic flow meter systems shall be manufactured by Rosemount, Endress+Hauser, Krohn or approved equal.

Q. The following magnetic flow meters shall be provided:

Tag No.	Description	Size	Range, gpm	NEMA Rating
FIT 1-1	Booster Sta. Discharge Meter	8”	0-2000	NEMA 4X

2.02 PRESSURE TRANSMITTER

A. High performance gauge or differential pressure transmitter with HART based digital communication capabilities. Two-wire, capacitance, piezo-resistive, or silicon strain gauge type. 4-20mA analog output.

B. Transmitter shall have dual-compartment housing with moisture barrier completely isolating the electronic circuitry from the field wiring and calibration terminals.

C. Transmitter shall have integral LED display for local pressure indication.

D. Suitable for liquid, gas and vapor service. Process measurement ranges: -100”WC to 150 psig.

E. Manufacturer:
   1. Rosemount 3051 Series
   2. Endress+Hauser Cerabar/Deltabar Series
   3. Foxboro I/A Series

F. The following pressure instrumentation shall be provided:

Tag No.	Description	Range	NEMA Rating
PIT 1-1	Booster Pump Suction Pres.	-100-100”WC	NEMA 4X
PIT 2-1	Booster Pump Discharge Pres.	0-150 psig	NEMA 4X

2.03 FLOODING SWITCH

A. Gems LS-270, or equal.

B. 316 stainless steel body, Buna-N float.

C. SPST switch.

D. The following flood switch shall be provided:

Tag No.	Description	NEMA Rating
LSH 1-1	Booster Station Flood	NEMA 4X

2.04 ROOM TEMPERATURE THERMOSTAT

A. Corrosion resistant wall mountable room thermostat.

B. Manufacturer and model number: Chromalox WCRT-100, or equal.

C. 40ºF. to 100ºF. temperature range; 25ºF. differential.

D. SPDT contact switch; 25 amps. at 120-240 VAC.

E. The following temperature switch shall be provided:

Tag No.	Description	NEMA Rating
TSL 1-1	Booster Station Low Temp.	NEMA 4X

2.05 MAGNETIC DOOR SWITCH

A. Corrosion resistant door frame mountable magnetic switch. Secure to door frame and door in accordance with manufacturer's guidelines.

B. Manufacturer and model number: Edwards Signal 61, or equal.

D. SPDT contact switch; 250 mA at 30V. Furnish with interposing relay to be mounted within Control Panel.

E. The following door switch shall be provided:

Tag No.	Description	NEMA Rating
ZS 1-1	Booster Station Occupancy Switch	NEMA 1

PART 3 - EXECUTION

3.01 GENERAL

A. Instruments shall be installed in accordance with manufacturer’s installation instructions and in accordance with Section 17100.

3.02 CALIBRATION, ADJUSTMENT AND TESTING

A. Devices requiring field calibration shall be calibrated in presence of Owner's representative and documented.

END OF SECTION

SECTION 17300

CONTROL PANELS

INDEX

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. General: The Contractor shall provide a control panel, complete and operable, in accordance with the Contract Documents.

B. Contractor shall provide for modification to existing Water Treatment Plant SCADA software to include process data and alarms from new Booster Station.

C. The requirements of Section 17100 - Process Control and Instrumentation Systems apply to this Section.

1.02 CONTRACTOR SUBMITTALS

A. General: Submittals shall be furnished in accordance with Section 01300 - Submittals.

B. Control Panel Engineering Submittal: The Contractor shall submit a control panel engineering submittal (CPES) for the control panel. The CPES shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding

circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation, face plate mounted instrumentation components, internal panel arrangements, and external panel arrangements. All panel drawings shall, as a minimum, be "B" size with all data sheets and manufacturer specification sheets being "A" size. The submittal shall be in conformance with ISA-S20 - Standard Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, shall be submitted as a singular complete bound volume or multi-volume package within 120 calendar days after Notice to Proceed, and shall have the following contents:

1. A complete index shall appear in the front of the bound volume. Panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.
2. Scaled physical arrangement drawings drawn to scale which define and quantify the physical groupings comprising control panel sections, auxiliary panels, subpanels, and racks. Cutout locations with nameplate identifications shall be shown.
3. Front of panel layout for the control panel.
4. Schematic/elementary diagrams shall depict all control devices and circuits and their functions.
5. Wiring/connection diagrams shall locate and identify electrical devices, terminals, and interconnecting wiring. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
6. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.
7. A bill of material which enumerates all devices associated with the control panel.
8. Submit informational literature/data for all components including but not limited to Control Panel internal devices, PLC hardware and software, etc.
9. Programmable Logic Controller (PLC) programs in ladder format including notated description of each rung's function; assign point numbers to all inputs and outputs, and show point numbering in PLC program.
10. Proposed graphic displays; submit actual hard copy of programmed graphic screens.

C. Operations Manual: Provide operations and maintenance information for the following:
   1. Panel equipment, field devices and instruments, including "as-built" system schematics.
   2. Final copy of PLC program on 8-1/2" x 11" sheets in ladder format including verbal description of each rung's function.
   3. USB flash drive containing final PLC program and final distributed control software program.
   4. Complete software documentation including programming information and operator's guides.

5. Point lists for all PLC inputs/outputs; identify point number (tag), point description, point type, range in engineering units (if analog point), PLC number, rack and slot number, and point address.

D. All submittals shall be bound in 3-ring binders with labeled tabs separating each section.

1.03 QUALITY ASSURANCE

A. All materials, equipment and parts shall be new and unused of current manufacturer.

B. Control panel supplier shall be responsible for providing all necessary accessories required for a complete and operable system.

C. All control panels shall be constructed in accordance with UL 508A standards and shall bear the UL listing.

1.04 WARRANTY

A. See Division 01 for additional requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. Environmental Suitability: The control panel shall be suitable for operation in the ambient conditions associated with the location designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided as necessary in order to maintain all instrumentation devices 20% within the minimums and maximums of their rated environmental operating ranges. The Contractor shall provide all power wiring for these devices. Enclosures suitable for the environment shall be provided.

B. The control panel controls shall be 120 VAC. Control conductors shall be provided in accordance with the indicated requirements.

C. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. The Contractor shall provide sufficient terminal blocks to connect 25% additional conductors for future use.

D. Control panel mounted devices shall be mounted a minimum of 3' above finished floor elevation.

2.02 CONTROL PANELS

A. Booster Station Control Panel (CP-1)
   1. Furnished by Controls Integrator.
   2. The control panel shall be a freestanding, single door NEMA Type 12 enclosure.
   3. Constructed of 12-gauge steel with continuously welded seams, ground smooth.
   4. Provide lifting eyes on top of enclosure.
   5. Provide panel with high-impact thermoplastic data pocket.
   6. Panel shall have seamless foam-in-place, on-piece gasket to provide oil-tight and dust-tight seal against contaminants.
   7. Three-point door latching system with pad lockable handle.
   8. Finish shall be ANSI 61 gray, no other colors will be accepted.
   9. Control panel enclosure shall be Hoffman, Saginaw or equal; sizes as required.
   10. Provide interior LED lighting package with door activated switch.
   11. Provide a 15 amp, 120 volt, service outlet circuit within the back-of-panel area. The circuit shall be provided with a 3 wire, 120 volt, 15 amp., duplex receptacle.
   12. Furnish control panel with CompactLogix PLC, graphical display screen and other specified control panel components to facilitate control interface with existing radio telemetry system. Provide adequate backplane space for relocation of existing radio transceiver and installation of new coaxial surge protector.
   13. Furnish control panel with necessary fuses, circuit breakers, surge arrestors, relays, terminals and other ancillary components required for a complete and operable control system.

B. Mounting of Instruments
   1. The panel vendor shall provide cutouts, and shall mount all instrument items indicated to be panel mounted.
   2. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality as indicated.
   3. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.
   4. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

C. Panel Wiring
   1. Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire, UL listed Type MTW, and shall be rated 600 volts. Wires for power circuits within panel shall be No. 14 minimum and sized for the load. Wires for instrument signal circuits and alarm input circuits within panel shall be No. 16 AWG. All shielded cables, shall be No. 18 AWG minimum.
   2. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, Brady Type B 500 or equal, or shall be heat shrink plastic.

3. For case grounding, panels shall be provided with a 1/4" x 1" copper ground bus complete with solderless connector for one No. 4 AWG bare stranded copper cable. The copper cable shall be provided by the Contractor and be connected to a system ground loop.
4. Power Supply Wiring
    a. Unless otherwise indicated, instruments, and alarm systems shall operate on 120 volt, 60 Hz circuits.
    b. Each potentiometer type instrument, electronic transducer, controller, or analyzer shall have an individual disconnect switch. Disconnect switches shall have metal or plastic tags indicating instrument tag numbers. Individual plug and cord set power supply connections may be used without switches when indicated in the material specification.
5. Alarm Wiring: The panel vendor shall install and wire alarms including light cabinets, audible signal units, test and acknowledge switches, and remote logic units as indicated. Interconnecting wiring to panel mounted initiating devices shall also be wired by the panel vendor. The wiring from external initiating devices shall be provided by the Contractor. Where plug and cord sets are provided for component interconnection, the panel vendor shall harness and support the cables in neat and orderly fashion. Where separate wire is required, panel vendor shall install No. 16 AWG with THWN or THHN insulation between all components.
6. Signal Wiring
    a. Signal wire shall be twisted pair or triads. Cable shall be constructed of No. 16 AWG copper signal wires with THWN or THHN insulation.
    b. Color code for instrument signal wiring shall be as follows:
    Positive (+) – Black
    Negative (-) – White

D. Labor and Workmanship: Panels shall be fabricated and wired by fully qualified workmen who are properly trained, experienced, and supervised.

2.03 PROGRAMMABLE LOGIC CONTROLLER

A. General:
1. Furnish and install programmable logic controller (PLC) including but not limited to power supply, microprocessor, input modules, output modules and other associated equipment as specified herein and as shown on drawings.
2. PLC and all components shall be designed, manufactured and tested in accordance with latest applicable UL standards.
3. The PLC, I/O modules, power supply modules, communication interface devices, and peripheral equipment shall be mounted inside the control panel. Incoming I/O wiring from the field to the control panel shall be terminated on terminal blocks in the lower portion of the enclosure. A nameplate shall be mounted on the outside of the door of the enclosure and be engraved with "CP/PLC".

4. PLC to have following features:
    a. Modular construction, allowing I/O modules to be individually added or removed.
    b. Mounting equipment, racks, connecting cables, and other equipment included to provide functioning control system.
5. Input/output modules to have following features:
    a. Inputs and outputs modular, with 4, 8 or 16 circuits per module; status LEDs for each point, powered from field voltage, installed in each module.
    b. Field wiring to screw connectors attached to I/O mounting rack; removal and replacement of any I/O module without disturbing field wiring or any other I/O modules.

B. Qualifications:
1. Manufacturer: ISO 9000, 9001 or 9002 certified for equipment herein specified; produced similar electrical equipment for minimum period of 5 years.
2. When requested by Engineer, provide acceptable list of installations of similar equipment to demonstrate compliance with qualifications.

C. PLC
1. Minimum of 12K words (16-bit) of internal RAM memory provided for storage of control program plus additional data storage for up to 4K words; full memory of CPU usable for program or data storage.
2. Program functions include contacts, coils, timers, counters, math functions, proportional-integral-derivative (PID) control, shift registers, bit and word operations.
3. Entire programmable controller system capable of operating in ambient temperatures of +32ºF. to +140ºF.; relative humidities of 5% to 95% non-condensing.
4. CPU capable of being networked to other programmable controllers or host computer.
5. Manufacturer, or equal: Allen-Bradley Compact Logix 5069-L320ER with Studio 5000 programming software unless shown otherwise on drawings.
6. All software is to be licensed to the Owner.

D. Input/output Units
1. Analog Input/Output Characteristics: 4-20 milliamperes DC.
2. Digital Input/Output Characteristics: 120 volts AC, LED isolated from main processor. Individual I/O shall be electrically isolated, 2-wire discrete, dry contact relay equivalent.
3. Required Hardware:
    a. Input/Output Rack, Processor, Communications Interface Module (programmer port), rack and module power supplies.
    b. Each type of module shall have 20% spare capacity.
4. Manufacturer, or equal: Allen-Bradley.
5. Analog input module: Allen Bradley 5069-IF8, or equal.
6. Analog output module: Allen Bradley 5069-OF8, or equal.

7. Digital input modules: Allen Bradley 5069-IA16, or equal.
8. Digital output modules: Allen Bradley 5069-OW16, or equal.

E. Power Supply
1. Input Voltage: 120 volts, 60 Hz, 1.0 KVA UPS.
2. Memory Backup: E^2 PROM memory chip set programmed with final operational software.
3. Manufacturer, or equal: Allen-Bradley.

F. Operator Interface:
1. Operator interface to allow online data monitoring and modification.
2. Mount operator interface terminal on door of Control Panel; operator interface to be accessible without opening door.
3. Operator interface terminal:
   a. Panel mount color display monitor with keypad operator input.
   b. Interface to PLC.
   c. 256K minimum application memory.
   d. NEMA 12 case.
   e. 120 VAC power supply.
   f. Allen-Bradley PanelView Plus 7, 10” size.
   g. As a minimum the following graphical screens shall be provided:
      1) Pump Station overview.
      2) Alarms; alarm screen to pop-up automatically when alarm condition occurs.
      3) Pumps
      4) Flow meter and pressure instrumentation
      5) Historical Daily flow Data.
      6) Historical Instantaneous Flow Data.
      7) Other graphics screens as defined by Owner and/or Engineer.
      8) A hard copy of the proposed graphics screens shall be included in the shop drawing submittal.

2.04 CONTROL PANEL DEVICES

A. Pushbuttons, selector switches, and LED pilot lights shall be the heavy-duty, oil-tight type, sized to 30 mm. Miniature style devices are not acceptable. Devices shall be as manufactured by G.E., Cutler-Hammer, or equal.
1. Lens colors shall be green for "run," "open," or "on"; red for "stopped," "closed," or "off"; and amber for alarm.
2. Pilot lights shall be low voltage, transformer, push-to-test type.
3. Provide hazardous location type pilot devices in classified locations.

B. Transient voltage suppressor: Edco HSP121BT1RU, Joslyn Model 1250-32, or equal. AC Power Isolator: provide power line noise suppressors to protect the electronic equipment. The units shall provide for common mode noise attenuation at a ration of up to 20 million to 1 and normal-mode noise attenuation typically 1,000 to 1 (60db).

C. LED control panel light with door-activated switch. Hoffman or equal.

D. Control power circuit breaker: 15 amp., 120 VAC, single pole Cutler Hammer QC1015 or equal.

E. Service receptacle: duplex; 15 amp., 125 volts; GFCI with indicator light/ Leviton Catalog No. 6598-I, or equal; install in Raco No. 670, or equal utility box.

F. Condensation heaters: thermostatically controlled; one heater in each compartment of outdoor control panels; 120 volts, single phase; wattage as required to maintain set temperature; provide properly sized fuse on line side. Hoffman or equal.

G. DC power supplies: 12 volts (1.7A), 15 volts (4.5A) and 24 volts (1.2A); Sola Silver Line Model SLS or equal; provide properly sized fuse on line side. Power supplies shall be sized to accommodate control panel loads plus 25% capacity reserved for future use.

H. Reset push button: heavy duty, watertight/oil tight flush head, red button; Allen Bradley 800T-A2D2 (normally closed) or equal.

I. Provide properly sized time-delay fuses for wiring leaving enclosure to receive contact closure/open signals; Littlefuse FLM series, or equal.

J. Terminals: barrier type, 9/16-inch spacing, nominal 2.5kV RMS rating.

K. Indicating lights: nominal l-inch diameter LED type with opaque colored lens; press-to-test feature; heavy duty oil tight as required.

L. Control switches:
   1. Electronic circuits: Gold flashed contacts; initial resistance, 0.01 ohms; 0.5 amp. at 120 VAC, resistive; heavy duty, oil tight as required.
   2. Control circuits: Contact rating conforming to NEMA A-600 designation; heavy duty, oil tight as required.
   3. Control/timer relays:
      a. All general-purpose control relays and time delays shall have dust covers and plug-in configuration, with screw terminal socket allowing exchange without disturbing the wiring.

4. Coil: continuous operation at 120 VAC ±10% unless shown otherwise.
   a. Contacts; 3 pole, double throw, minimum; 10 amp. (unless shown otherwise), 120VAC, resistive.
5. 4 position selector switches: Allen Bradley 800T-N2KF4, or equal; provide supplemental contact block for emulating the switch on SCADA; refer to 16485 – Miscellaneous Electrical Devices for additional requirements on switches, relays and lights, etc.

M. Ethernet Network Switch: Managed industrial 10/100 Base Ethernet network switches. Din-rail mountable with provisions for number of network connections as shown in the Plans. Network switch shall be capable of operating in true ring configuration; Red Lion, N-TRON or equal.

N. Uninterruptible Power Supply: True online, double-conversion style. Input fuse or circuit breaker protection. Internal sealed, lead-acid battery; Eaton/Powerware, Liebert or equal.

2.05 DISTRIBUTED CONTROL SOFTWARE

A. Controls Integrator shall provide for modification to existing Water Treatment Plant (WTP) SCADA software to incorporate new process data and alarms from Booster Station Control Panel. New display screen graphics shall replace those for existing booster.

B. Fully configured by Contractor to satisfy requirements of functional descriptions in Section 17400 - Control Descriptions.

C. Existing WTP Distributive Control Software: Wonderware InTouch Runtime 60k, v7.1 to 10.1.

D. Software Tags
   1. The software package shall handle all external data, internal data, and functions in "tag" format. Tags shall be a group of standardized software routines that can be set up by an operator to manipulate data.
   2. The program shall use the software tags throughout all software routines. It shall be possible for different routines to access the same tag.
   3. Allow operator to call any tag to the computer screen. The tag display shall indicate type of tag, point name, value or state, alarm conditions and other information depending on the tag type.
   4. Allow operator to write new tags, combine tags, and manipulate tags to develop new closed-loop functions, graphics and data-bases.

5. As a minimum, the following tag types shall be provided:
    a. Analog Tag - include operator entries for high alarm point, low alarm point, rate-of-change alarm point, conversion to engineering units, scan frequency, filtering, and trending sample frequency.
    b. Digital Tag - include operator entries for scan frequency, inverting digital value, and overriding digital value to 0 or 1 state.
    c. Alarm Tag - include operator entries for editing alarm message on screen, enable/disable alarm, report return to normal status.
    d. Calculation Tag - include operator entries to perform logical and mathematical functions on any analog or digital values input to the tag. Allow up to eight input variables. Perform addition, subtraction, multiplication, division, sine, cosine, square root, natural logarithm, logarithm, Boolean functions, scan frequency, and trending sample frequency.
6. Allow operator to call tag summaries to a computer screen and/or printer. Standard summaries shall include:
    a. Tags in alarm
    b. Tags in standby
    c. Tags with disabled alarms
    d. Tags off
    e. All tags
7. Contractor shall program the system and configure a tag for each PLC input and output point. Contractor shall enter tag values, alarm points, ranges, scan frequency, etc. so that all tags are available for use at the computers by the Owner when additional graphics and trends are built in the future.

E. Computer Graphics
1. Computers shall have color video graphic displays showing the plant process. Provide a menu for selection of the various graphics. Graphics shall have at least 64 colors.
2. Graphics shall show current analog values (in engineering units), digital values and equipment status. Graphics showing process equipment (e.g., pumps, blowers, valves, etc.) shall be interfaced with all related input/output points so that current status of the equipment is shown:
    a. White - motor off or valve closed.
    b. Green - motor on or valve open.
    c. Red - alarm condition.
    d. Flashing - valve in intermediate position.
    e. Yellow - motor required.

3. Software shall contain "graphics builder" routine to allow the operator to create additional graphics. Graphics builder shall contain a menu of standard symbols, lines and shapes, and commands to facilitate building or modifying graphics. The graphics builder feature shall include a menu of common symbols (such as pumps, tanks, piping fittings, etc.) and shapes that can be selected using a mouse. Graphic builder shall include edit functions such as "copy", "move", "cut" and "paste" to facilitate making new screens and modifying existing screens.
4. Graphics shall be dynamic, capable of being linked with a software tag so that the graphic changes as analog or digital values change (e.g., a tank changes color as it is filled up).
5. Contractor shall build the initial graphics for the project. Screen layout, menus, directories, graphic designs and color selections shall be submitted for review and shall be confirmed with the Engineer and Owner during construction.
6. System Overview Graphic - Contractor shall build a graphic screen that is representative of the overall wastewater treatment facilities. The screen shall allow the operator to access other graphic screens by "clicking" the mouse on the appropriate building/structure. When an alarm occurs, the associated building/structure shall flash in red on the overview graphic.
7. Individual Building / Process Graphics - Contractor shall build approximately 50 graphics showing all processes. The graphics shall be linked to all related PLC inputs/outputs to display equipment running status, alarm conditions, water levels (dynamic display), flow rates, etc.
8. Control Graphics - Contractor shall build approximately 25 graphics for operator control of pumps, valves and equipment as specified. Each graphic shall allow operator to place equipment in "AUTO" mode and adjust setpoints and timing values as specified in the functional descriptions for each equipment item.
9. Provide graphical links between process graphics and control graphics so operator may transition between related screens with a single mouse operation.
10. In addition to the graphics specified previously and elsewhere in this Specification, Contractor shall build 6 graphics as determined by Owner/Engineer during construction.

F. Alarms
1. Computer shall have an alarm screen that shows new alarms, acknowledged alarms and daily alarm log.
2. Each alarm point shall identify the alarm location, a 20-character minimum alarm description, and time of occurrence.
3. Computer shall allow operator to acknowledge alarms and to print alarm summary on demand.

4. Print all alarm occurrences on the alarm printer, including date and time of occurrence and time of acknowledgment.
5. Alarms shall sound through the computer internal speakers and alarm horn in each Building.
6. Allow the operator to disable any alarm points via the computer (for equipment maintenance, etc.). This feature shall require a password to enable/disable alarms.
7. New alarm conditions shall display as a single line at the bottom of the computer screens when the alarm summary is not displayed.
8. Computer shall have a list of all alarms on a screen. Allow operator to enable or disable alarms.
9. Analog Value Alarms:
    a. Allow operator to assign "high" and "low" software setpoints to all analog inputs and outputs. If measured value exceeds the high setpoint or falls below the low setpoint, energize an associated alarm at the computer. All displays and software setpoints shall be in engineering units.
    b. Analog value alarms shall function as described above for plant alarms.
10. Equipment "Fail" Alarms
    a. Where a PLC calls for an equipment item to operate, the PLC shall monitor the associated equipment "RUNNING" contacts.
    b. If a RUNNING signal is not returned after five seconds (adjustable), then generate a descriptive alarm point.
11. Communication Failure Alarms
    a. Provide alarms to indicate loss of communication with each device on the network.

G. Faceplate Displays
1. Computers shall have menu screens that allow operators to call any analog value or PID loop to the screen. The screen shall show the analog value or PID loop as a faceplate display with analog scale, numerical value, alarm limits, and other related information.
2. Through mouse commands, allow operator to modify scale, alarm limits, setpoint (if PID), and to call related tags.

H. Historical Data Collection
1. Scan all analog inputs and outputs each minute, and store data in a file. At the end of each hour, calculate maximum, minimum and average value for each point, and store the three values in a new file.
2. Each day prompt the operator to select either to store the previous day's one-minute values on a memory stick, on the hard drive, or to delete the data from the computer.

3. Retain the hourly minimums, maximums, totals, and averages for use in trending and reports. At the end of each month, allow the operator up to 15 days to select to either store the data on a memory stick, on the hard drive, or to delete the data from the computer.
4. The software shall allow the operator to establish different scan rates for each point, with up to six (6) selectable rates.
5. Supplier shall meet with Owner during software development to confirm the desired initial configuration, and to establish historical data protocol.

I. Trending
   1. Provide historical trend screens to recall data that has been collected by the historical data base. Allow the operator to select from 1 to 8 points on each trend display. The data shall have the appearance of a vertical-scale strip chart recorder with resolution of 2% of span. Display values in engineering units.
   2. Allow operator to access any time window within the last month (for hourly data) and within the last 24 hours (for one-minute data).
   3. Allow operator to build real-time trend screens with up to 8 points per screen. Continuously update the screens as real-time data is collected.

J. Reports
   1. Software shall be fully DDE-compliant to allow report generation using Microsoft Excel, latest revision (no substitutions).
   2. Supplier shall build the following reports:
      a. General Requirements for Reports - Report formats will be furnished to the Supplier during construction. Each report listed below shall have columnar format with the number of columns and rows as indicated. Provide footer rows with column total, average, minimum and maximum for each parameter as is applicable. Develop the report to automatically obtain and calculate each parameter where data is available via the process control system. Prompt the operator where manually-entered data is needed. Each parameter may consist of one of the following types of data:
         (1) Manual - A value entered by the operator.
         (2) Automatic - A value obtained from the process control system.
         (3) Calculated - A formula is applied to the entered or monitored data.
         (4) Combination - The parameter is determined through some combination of manual data, automatic data and/or calculations.
      b. Provide the following individual reports:
         (1) Monthly State Operating Reports
         (2) Daily Operating Reports - 130 values by 24 hours (130 columns by 24 rows).

(3) Monthly Operating Report - 130 values by 31 days.
(4) Runtime / Flow Summary - Daily report showing accumulated daily runtime for each process equipment item, and totalized flow for each flowmeter input. Provide monthly report summary with monthly runtimes, monthly totalized flows, and average daily flow computation. Perform totalization in the plant PLCs so data is not lost during computer failure.

K. Passwords
1. Software package shall have not less than 3 levels of password protection. Permit the operator to establish passwords and assign password level to all program features.
2. Initially set up passwords as follows:
a. No password - allow operator to "view" the plant process only.
b. Level 1 - allow operator to change setpoints, override outputs, disable alarms, and enter data on reports.
c. Level 2 - allow operator to change blocks, modify block arrangements and related functions.
d. Level 3 - allow operator to reconfigure system architecture.
3. Configure the system such that each user has a separate password assigned by the plant superintendent. A user shall be required to "log on" before making process changes. Record time of "log on", "log off", and operators name for each user.
4. Supplier shall meet with Owner during software development to confirm the desired initial configuration of passwords.

2.06 SPARE PARTS

A. Provide 1 spare power supply for the Control Panel.

B. Provide 1 spare memory cartridge containing control program.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Preparation for Shipment and Shipping
1. Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment.
2. Control panel testing and inspection shall be performed prior to shipping.
3. Control panels shall be installed in accordance with Section 17100.

B. Modify existing SCADA control program and display screen graphics to reflect project control descriptions.

3.02 SIGNAL AND CONTROL WIRING

A. Wiring Installation: Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing out panel to components on a part of the fixed structure, and (4) wiring to panel mounted components. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

B. Wiring run to control devices on the panel front shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

D. Shop Drawings shall show conformance to the above wiring installation requirements.

E. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on Shop Drawings. These numbers shall be marked on conductors at every terminal.

3.03 PROGRAMMING SERVICES

A. Program programmable logic controllers (PLCs) and operator interface terminal as required by functional descriptions.

B. Provide additional programming during start-up, training, and call-back periods as specified.

C. Control Integrator shall coordinate with process equipment manufacturer’s supplied PLCs and their field service representative to set up network and coordinate all aspects of acquiring and transmitting various control functions from vendor furnished PLCs.

3.04 INSPECTION AND APPROVAL

A. Panel fabricator shall conduct the following tests prior to shipment.
   1. Alarm circuits rung out to determine their operability.
   2. Electrical circuits checked for continuity and where applicable, operability.
   3. Any other test required to place the panel in an operating condition.

B. It shall be the responsibility of the Contractor to furnish all necessary testing devices and sufficient manpower to perform the tests required by the Engineer.

C. Field Testing: The control panel shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

3.05 EXHIBITS

A. I/O Point List

END OF SECTION

Section 17300
Exhibit A - I/O List

Item	Description	Function	I/O Type				Notes
			DI	DO	AI	AO	
Booster Station Control Panel - CP-1							
Flow Meter (FIT 1-1)	Booster Station Discharge Flow	Value	1		1		
Inlet Pressure (PIT 1-1)	Booster Station Inlet Pressure	Value			1		
Discharge Pressure (PIT 2-1)	Booster Station Discharge Pressure	Value			1		
Booster Pump 1	Start/Stop	Command		1			
Booster Pump 1	In Auto	Status	1				
Booster Pump 1	Running	Status	1				
Booster Pump 1	Pump Fault	Alarm	1				
Booster Pump 1 VFD	Ethernet Interface						Network Connection
Booster Pump 1 VFD	VFD Fail	Alarm	1				
Booster Pump 1 VFD	VFD Speed	Command/Return			1	1	
Booster Pump 2	Start/Stop	Command		1			
Booster Pump 2	In Auto	Status	1				
Booster Pump 2	Running	Status	1				
Booster Pump 2	Pump Fault	Alarm	1				
Booster Pump 2 VFD	Ethernet Interface						Network Connection
Booster Pump 2 VFD	VFD Fail	Alarm	1				
Booster Pump 2 VFD	VFD Speed	Command/Return			1	1	
Building Monitoring	Flood Switch	Alarm	1				
Building Monitoring	Low Temperature	Alarm	1				
Building Monitoring	Door Switch	Status	1				
SCADA Communication	Radio. Comm. Watchdog	Status	1	1			
Control Panel Monitoring	UPS Fail	Alarm	1				
Control Panel Monitoring	Control Power Active	Status	1				
Minimum Spare (10%)			8	8	2	2	
		Total	**DI**	**DO**	**AI**	**AO**	
			23	**11**	**7**	**4**	

SECTION 17400

CONTROL DESCRIPTIONS

INDEX

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes how each portion of control system operates.

B. The functional descriptions, in conjunction with the drawings and technical requirements for products as described in Section 17200 - Instrumentation Equipment and Section 17300 - Control Panels, define the minimum requirements for installation.

C. All products used to meet the functional descriptions shall be those specified in Sections 17200 and 17300.

D. Related work specified elsewhere:
   1. Division 16 - Electrical.
   2. Section 17100 - Process Control and Instrumentation System.
   3. Section 17200 - Instrumentation Equipment.
   4. Section 17300 - Control Panels.

1.02 GENERAL REQUIREMENTS

A. Alarm/Event Logging Colors. The following is the color scheme for alarms and events that are displayed on the Panelview.
   1. Cyan: Operator entered event.
   2. Red: Active unacknowledged alarm.
   3. Yellow: Active acknowledged alarm.
   4. Blue: Unacknowledged alarm - returned to normal.
   5. White: Acknowledged alarm - returned to normal.

B. Equipment Status and Data Information for MMI Displays. The following is the color scheme for dynamic changing status:
   1. Gray: equipment which is not controlled and/or does not supply status information to the control system i.e. manual valves.
   2. Yellow: Equipment Off-line (lockout/tagout system).
   3. Blue: Equipment in the off state, valves closed i.e. process non-active state.
   4. Cyan: Equipment or subsystems in standby mode.
   5. Magenta: Equipment in the on state, valves open i.e. process active state.
   6. Green: analog process values, bar graphs, etc. which indicate operating within acceptable limits (not an alarm state).
   7. Red Flashing: Indication of an alarm that is not acknowledged.
   8. Red: Indication of an acknowledged alarm.
   9. Bordered Box: Indication of an analog process variable.
   10. Double Border Box: Indication of an analog process operator entered setpoint.

C. Alarm/Event Logging. All alarms and events shall be logged to a tabular display on the display screen with date, time, tag name, description, status, value, and priority of alarms/events. The tabular display screen shall allow the Operator to acknowledge all alarms. Events shall include start/stop of equipment, open/close or position change of valves, operator initiated changes, setpoint changes, etc. Up to an Operator adjustable setpoint number of current events and alarms shall be displayed on the tabular screen with the older events and alarms beyond that setpoint number being stored in the historical database log.

D. General Monitoring and Displaying of Discrete Input Signals. Discrete input signals which represent equipment status shall be displayed on the display screens.

E. General Monitoring, Displaying, and Recording of Analog Input Signals. Process variable signals shall be displayed on the display screens. They shall be scaled in engineering units. All alarm limits are assigned to the associated process variable. Values shall be historically logged and trended as required.

F. Process Status. All process alarms, equipment status, and process variable values shall be available at any of the computer software display screens. Failures of any PLC on the digital communications network shall also be alarmed.

G. Equipment Run Times. The running time for all motorized equipment located in the plant and at all remote sites shall be totalized and displayed.

H. Automatic Rollover. Provide automatic rollover back to zero for all run times, meter totalizations, etc. Provide reports with automatic calculation to account for the automatic rollover to zero.

I. All computer display screens that allow an Operator to enter setpoints and to change software switches shall be password protected. An Operator must successfully log in with his password before any changeable setpoints are allowed.

J. Provide an Operator adjustable time delay setpoint with all setpoints throughout the control system.

K. Provide de-bounce timers or other programming logic throughout the system to prevent all alarms, setpoints, or controls repeat; and nuisance or otherwise unneeded alarms, starts, stops, etc.

L. Provide scan rate time delays or other programming logic throughout the system to prevent all alarms, setpoints, or controls repeat; and nuisance or otherwise unneeded alarms, starts, stops, etc.

M. Provide testing and logic to positively ensure that no lockout conditions can develop in anyway or in any form of operation, be it standard, non-standard, or emergency.

N. Monitor communications status of all remote facilities and plant panels.

O. Where alarms are called for provide High and High-High, Low and Low-Low, and others if specifically required.

P. Provide software Hand/Off/Auto switches, Duty/Standby switches, Local/Off/Remote switches, On-line/Off-line switches, Open/Close switches, Open/Stop/Close switches, Open/Stop/Close/Auto switches, Manual/Auto switches, On/Off pushbuttons, etc. for each equipment item.

Q. In the Off or Off-line position, provide a software pop-up "tag-out" box with descriptor lines for Operator entry of wording describing the reason for the device being out of service, for each item of equipment, instrumentation, etc. Provide a

yellow tag on the equipment device on the applicable screens to visually indicate that it is off-line and tagged out, and cannot be operated through the control system as long as tagged out. The Off-Line switch and Tag-Out shall be used to isolate the particular device, but shall not affect the operation of the particular treatment process or plant as a whole.

R. Change piping/valves/equipment/building color to indicate flowing or not, working or not, operational or not, running or not, opened or closed, etc.

S. Screens shall be fully dynamic.

1.03 OIT SCREENS

A. The Controls Integrator shall develop graphical screens to dynamically depict the operation and status of the Treatment Plant functions, and tabular screen(s) to present system setpoints and summarize process values/quantities. The screens shall include but not be limited to:
   1. Operator authentication/authorization.
   2. Overview screen.
   3. Pumps, Instrumentation, etc.
   4. Process setpoints.
   5. Process values/quantities.
   6. Alarm status/history.

B. The Controls Integrator shall develop a preliminary set of screens for submission to the Owner/Engineer for review and comment prior to finalizing the screens.

PART 2 - FUNCTIONAL DESCRIPTIONS

2.01 INSTRUMENTATION SCHEDULE

A. Refer to Section 17200 - Instrumentation and Control Equipment.

B. Control descriptions included herein are generic in nature, but reflect design intent. Descriptions may not include all functions, status and alarms; these descriptions will be modified during submittal stage; Controls Integrator shall develop algorithms based on the input/output point schedule and control descriptions.

2.02 SYSTEM PRESSURE

A. The Booster Station Control Panel shall continuously monitor Pump suction and discharge water pressure with pressure indicating transmitters (PIT 1-1/2-1), where indicated in the plans.
   1. Transmit the 4-20 mA signal to the Control Panel PLC and display on the Control Panel display screen.
   2. Allow the operator to establish software alarm setpoints for high pump discharge pressure (150 psig) and low pump inlet pressure (0 – 15 psig).

2.03 BOOSTER PUMPS

A. Provide for automatic control and monitoring of the pumps from the Booster Station Control Panel and VFD's.
   1. Provide a three position (HAND-OFF-AUTO) selector switch for each pump to be located at Control Panel.
      a. When in HAND mode, the booster pump shall operate continuously at a set pumping rate as selected via the pump VFD keypad. The pump shall run until an alarm condition is experienced.
      b. When in OFF mode, the booster pump shall be interlocked from operating.
      c. When in AUTO mode, the pumps shall operate at variable speed to maintain operator selected control mode. Applicable control modes are as follows:
         1) Time of Day Control Mode: Booster pump shall be called to operate based on Operator adjustable START time, and cease operation when adjustable STOP time is achieved.
         2) Total Flow Mode: Pump shall operate at variable speed to maintain operator adjustable total flow rate measured at FIT 1-1. Initial peak flow setpoint shall be 1.0 mgd (700 gpm). Increase pump speed if flow is dropping below operator setpoint. Decrease pump speed if flow is raising above operator setpoint.
   2. Provide high temperature and leak seal sensing at each Pump.
   3. Provide elapsed time meter on VFD to log Pump run time.
   4. Provide alarm indicators on Booster Station Control Panel (CP-1) to alert of system alarms, including but not limited to: MOTOR TEMP, MOTOR OVERLOAD, VFD FAULT, FAIL TO RUN.

B. The Booster Pumps shall operate in Lead/Lag configuration. If the Lead pump cannot satisfy the process setpoint at full pumping capacity, the Lag pump shall start. The Lead pump shall drop to minimum speed upon the startup of the second pump, and both pumps shall ramp up and down together to maintain the process setpoint. Both pumps shall ramp up and down to maintain the operator adjustable setpoint dependent on which operating mode is selected.

C. The control system shall balance pump run times by cycling the Lead pump at each start, or at a user selected timeframe (0-14 days). Under this scenario the Lead pump would become the Lag, and the Lag would become the Lead.

D. Provide adjustable software time delays on all control setpoints to avoid excessive cycling of equipment.

E. Monitor the pump "running" inputs. If the pump is called to operate, and a run signal is not received after a programmable time delay, initiate the associated pump "failure to run" output and alarm point.

2.04 BOOSTER STATION FLOW RATE

A. Continuously monitor Booster Station discharge flow with flow meter (FIT 1-1) as shown and specified.
   1. Indicate total flow rate (gallons per minute) on control panel display screen on the door of the Control Panel, CP-1.
   2. Indicate total plant flow(x 1000 gallons) on control panel display screen on the door of the Control Panel, CP-1.
   3. Transmit 4-20 mA total flow rate signal and totalized flow pulse signal to PLC.

2.05 BOOSTER STATION BUILDING MONITORING

A. Controls Integrator to furnish flooding, occupancy and temperature switches where shown in the plans and listed in Section 17200.

B. Annunciate when flooding switch detects water on the floor in the associated structures. Flood alarms shall be displayed on Booster Station control panel and relayed to Water Treatment Plant SCADA interface.

C. Annunciate when temperature switch detects a low temperature occurrence in the associated structures. Low temperature alarms shall be displayed on Booster Station control panel and relayed to Water Treatment Plant SCADA interface.

D. Annunciate when building door switch detects occupancy in the associated structures. Building occupancy alarms shall be displayed on Booster Station control panel and relayed to Water Treatment Plant SCADA interface.

2.06 HISTORICAL FLOW DATA

A. Provide for recording flows in two spreadsheet formats.

B. Provide Historical Instantaneous Flow column headings as follows: Date, Time, Booster Station Flow Rate.
   1. Show all flow rates in gallons per minute (gpm) recorded at 15 minute intervals.
   2. Display spreadsheet on display screen of CP-1.
   3. Provide for downloading of information to external storage device.

C. Provide Historical Daily Flow headings as follows: Date, Booster Station Flow Rate.
   1. Show all flow rates in million gallons per day (MGD).
   2. Record flows at midnight of previous day.
   3. Display spreadsheet on display screen of CP-1.
   4. Provide for downloading of information to external storage device.

2.07 SCADA INTEGRATION

A. Provide for integration with existing Water Treatment Plant SCADA system. Controls provider shall modify existing display screen graphics to include process data and alarms from new Booster Station.

B. Controls provider shall coordinate installation and setup of Ethernet radio equipment relocated from existing Booster Station control panel.

PART 3 - EXECUTION

Not Applicable.

END OF SECTION