

**UTILITIES COMMISSION
City of New Smyrna Beach, Florida**

**INVITATION TO BID
EQUIPMENT AND MATERIALS
ITB 04-09**

YOU ARE HEREBY INVITED TO SUBMIT A SEALED BID FOR EQUIPMENT AND MATERIALS NECESSARY FOR THE SMITH STREET PUMP STATION AND 20" LOW PRESSURE TRANSMISSION MAIN FOR THE ENGINEERING DEPARTMENT OF THE UTILITIES COMMISSION, CITY OF NEW SMYRNA BEACH, FLORIDA CONFORMING TO THE ATTACHED SPECIFICATIONS.

SUBMIT BIDS IN DUPLICATE TO: John O'Brien
Materials Manager
Utilities Commission
City of New Smyrna Beach
(386) 424.3045 Voice
(386) 424.2748 Fax
jobrien@ucnsb.org

MAILING ADDRESS:	WALK-IN DELIVERY ADDRESS:
Post Office Box 100	200 Canal Street
New Smyrna Beach, Florida 32170-0100	New Smyrna Beach, Florida 32168

BIDS DUE BY: **January 27, 2009, 2:00 PM.** They then will be publicly opened and read aloud at **2:30 PM.** A pre-bid conference shall be held on January 12, 2009, at 10:00 AM in the main conference room at the Utilities Commission, City of New Smyrna Beach, 200 Canal Street, New Smyrna Beach, Florida 32168.

Bidders must indicate on the sealed envelope the following:

- A. Invitation to Bid Number**
- B. Hour and Date of Opening**
- C. Name of Bidder**

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SCHEDULE

ITB 04-09

DISTRIBUTION OF THE INVITATION TO BID	DECEMBER 23, 2008
NON- MANDATORY PRE-BID CONFERENCE TO BE HELD AT 200 CANAL STREET NEW SMYRNA BEACH, FL AT 10:00 AM	JANUARY 12, 2009
DEADLINE FOR FINAL QUESTIONS BY 2:00 PM E-MAIL TO JOBRIEN@UCNSB.ORG	JANUARY 16, 2009
ADDENDUM PUBLISHED BY 5:00PM	JANUARY 20, 2009
BID RETURN DEADLINE BY 2:00PM LOCATION: UCNSB 200 CANAL ST. NEW SMYRNA BEACH, FL	JANUARY 27, 2009
BIDS THEN WILL BE OPENED AND READ ALOUD AT 2:30 PM	

**UTILITIES COMMISSION
City of New Smyrna Beach, Florida
GENERAL INSTRUCTIONS AND CONDITIONS**

SECTION 2 – GENERAL TERMS AND CONDITIONS

1. The term **COMMISSION** used herein refers to the Utilities Commission, City of New Smyrna Beach, Florida, or its duly authorized representative.
2. The term **BIDDER** used herein refers to the dealer/manufacturer or business organization submitting a bid to the **COMMISSION** in response to this solicitation.
3. **BIDDERS** are expected to examine, when applicable, the drawings, specifications, delivery requirements, performance sites and all instructions to satisfy themselves of conditions affecting cost of performing this contract.
4. No material, labor or facilities will be furnished by the **COMMISSION** unless specifically stated.
5. The **BIDDER** hereby attests that the prices in this offer have been arrived at independently without consultation, communication or agreement with any competitor for the purpose of restricting competition.
6. The **BIDDER** warrants that the prices of the items set forth herein do not exceed the prices charged by the **BIDDER** under a contract with the State of Florida.
7. The **BIDDER** agrees that the supplies and services furnished under this award shall be covered by the most favorable commercial warranties the **BIDDER** gives any customers for comparable quantities of such supplies or services and that the rights and remedies provided herein are in addition to and do not limit any rights afforded to the **COMMISSION** by any other provision of this award.
8. A duly authorized representative of the **COMMISSION** will accomplish inspection and acceptance of the supplies/services purchased herein at the designated delivery point.
9. All invoices resulting from the award of this bid will be paid within 30 days of receipt of invoice or receipt of goods or acceptance of work performed.
10. A Bid Form is provided and a completed original and one duplicate copy shall be returned in a **sealed envelope properly marked with Bid number and acknowledgment of receipt of addenda where applicable**. It is incumbent upon each bidder to ensure that they have received all addenda before submitting their bid.
11. Bids will be publicly opened, read aloud and recorded, on the date and time indicated, at the location specified in the request for bid. It is the Bidders sole responsibility to assure his/her bid is delivered at the proper time and place of the bid. The Commission will not be responsible for late deliveries or delayed mail. Bids delivered after the time specified shall not be considered, such bids shall remain **unopened**.
12. Carelessness in quoting prices or in preparation of bid otherwise, will not relieve the bidder. Bidders are expected to examine specifications, delivery schedule, extensions, and all terms and conditions in the bid documents. Bids having erasures or corrections must be initialed in ink by the Bidder. In the event of an extension error(s), the unit price will prevail. Written amounts shall take precedence over numerical amounts.
13. Bids may be amended or withdrawn only by written notice prior to the bid opening. Amendments must be sealed. Amendments or withdrawals received after the bid opening will not be effective, and the original bid submitted will be considered.

14. **Public Entity Crimes:** UNDER SECTION 287.133(2)(a), FLORIDA STATUTES, A person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not submit a bid on a contract to provide any goods or services to a public entity, may not submit a bid on a contract with a public entity for the construction or repair of a public building or public work, may not submit bids on leases of real property to a public entity, may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity, and may not transact business with any public entity in excess of the the threshold amount provided in Section 287.017, for Category two for a period of 36 months from the date of being placed on the convicted vendor list. See attachment "A".
15. In the event of a tie bid, a preference is given to vendors submitting certification with the bid of a drug free work place in accordance with Section 287.087 Florida Statutes. This requirement affects all public entities in the State of Florida, and became effective January 1, 1991.
16. Bids shall be **addressed and mailed or delivered as specified on page 1 to 200 Canal St. New Smyrna Beach, Florida 32168.**
17. In the event an Invitation to Bid is returned as a no bid, "**NO BID**" shall be properly marked on the outside of the envelope with the bid number.
18. The **Commission** reserves the right to reject bids containing any additional terms or conditions not specifically requested in the original conditions and specifications.
19. Failure of the contractor to deliver within the time specified, or within a reasonable time as interpreted by the Utilities Commission or failure to make replacements of rejected articles as directed, shall permit the Utilities Commission to purchase on the open market articles of comparable grade to take the place of those rejected or not delivered. On all such purchases, the contractor shall reimburse the **Utilities Commission**, within a reasonable time specified by the Purchasing Authority, for any expenses incurred in excess of the defaulted price. Payments due the contractor by the **Utilities Commission** may be withheld until reimbursement is received.
20. When brand or trade names are used in the bid invitation, it is for the purpose of item identification and to establish standards for quality; style and features. Bids on equivalent items will be considered unless items are noted as no substitutes. Equivalent bids must be accompanied by descriptive literature and/or specifications to receive consideration. Demonstrations and/or samples may be required and shall be at not charge to the Utilities Commission. The **UTILITIES COMMISSION** reserves the right to determine if bid goods are equivalent to specified goods.
21. Awards shall be made as required for the best interest of the **Commission**. The right is reserved to make award(s) by individual items, group of items, all or none, or any combination thereof, with one or more suppliers.

22. **INSURANCE:** The Vendors, where applicable, shall, at its sole expense, maintain in effect at all times during the performance of the services insurance coverage with limits not less than those set forth below and with insurers and under forms of policies satisfactory to Commission.

<u>Coverage</u>	<u>Minimum Amounts and Limits</u>
(a) Worker's Compensation	Statutory requirements at location of work
Employer's Liability	\$ 100,000 Each occurrence \$ 300,000 Disease, aggregate \$ 100,000 Disease, each employee
(b) General Liability	\$1,000,000 General Aggregate \$1,000,000 Products – Comp Ops Agg \$ 500,000 Each Occurrence \$ 50,000 Fire Damage \$ 5,000 Medical Expense
(c) Automobile Liability (owned, hired and non-owned)	\$1,000,000 Combined Single Limit
Option of Split Limits:	
(1.) Bodily Injury	\$ 500,000 Per Person \$1,000,000 Per Accident
(2.) Property Damage	\$ 500,000

Coverage shall apply to the indemnity agreement and shall include the UTILITIES COMMISSION their officers and employees, each as additional insureds but only as regards to their liability arising out of Contractor's performance of the work or out of operations performed by others on behalf of Contractor under this Contract. The insurance as afforded to such additional insureds shall state that it is primary insurance and shall provide for a severability of interest or cross-liability clause. Prior to commencing performance of any work or site mobilization, Contractor shall furnish Commission with Certificates of Insurance (identifying on the face thereof the Project name and Contract number) as evidence of the above required insurance and such Certificates shall provide for thirty (30) days written notice to Commission prior to cancellation thereof.

Commission is not maintaining any insurance on behalf of Contractor covering loss or damage to the work or to any other property of Contractor unless otherwise specifically set forth herein.

None of the requirements contained herein as to types, limits and approval of insurance coverage to be maintained by Contractor are intended to and shall not in any manner limit or qualify the liabilities and obligations assumed by Contractor under this contract.

Contractor shall deliver the original Certificate of Insurance and one copy to the agent of the Commission.

Notices, in original and one copy, of cancellation, termination and alternation of such policies shall also be provided to the agent of the Commission.

23. **Conflict of Interest of Officers or Employees of the Contracting Entity/Local Jurisdiction, Members of the Local Governing Body, or Other Elected Officials**

No member or employee of the contracting entity/local jurisdiction or its designees or agents; no member of the governing body; and no other public official of the Utilities Commission who exercises any function or responsibility with respect to this contract, during his/her tenure or for one year thereafter, shall have any interest, direct or indirect, in any contract or subcontract, or the proceeds thereof, for work to be performed. Further, the Contractor shall cause to be incorporated in all subcontracts, the language set forth in this paragraph prohibiting conflict of interest.

24. **Employee Conflict of Interest**- It shall be unethical for any Utilities Commission employee to participate directly or indirectly in a procurement contract when the Utilities Commission employee knows that:

(1) The Utilities Commission employee or any member of the Utilities Commission employee's immediate family has a financial interest in the procurement contract; or

(2) any other person, business, or organization with whom the Utilities Commission employee or any member of a Utilities Commission employee's immediate family is negotiating or has an arrangement concerning prospective employment is involved in the procurement contract.

A Utilities Commission employee or any member of a Utilities Commission employee's immediate family who holds a financial interest in a disclosed blind trust shall not be deemed to have a conflict of interest with regard to matters pertaining to that financial interest.

25. **Gratuities and Kickbacks**.

(1) **Gratuities.** It shall be unethical for any person to offer, give, or agree to give any Utilities Commission employee or former Utilities Commission employee, or for any Utilities Commission employee or former Utilities Commission employee to solicit, demand, accept, or agree to accept from another person, a gratuity or an offer of employment in connection with any decision, approval, disapproval, recommendation, or preparation of any part of a program requirement or a purchase request, influencing the content of any specification or procurement standard, rendering of advice, investigation, auditing, or in any other advisory capacity Utilities Commission in any proceeding or application, request for ruling, determination, claim or controversy, or other particular matter, pertaining to any program requirement or a contract or subcontract, or to any solicitation or proposal therefore.

(2) **Kickbacks.** It shall be unethical for any payment, gratuity, or offer of employment to be made by or on behalf of a subcontractor under a contract to the prime contractor or higher tier sub-contractor or any person associated therewith, as an inducement for the award of a subcontract or order.

(3) **Contract Clause.** The prohibition against gratuities and kickbacks prescribed in this Section shall be conspicuously set forth in every contract and solicitation therefore.

THE UTILITIES COMMISSION RESERVES THE RIGHT TO WAIVE INFORMALITIES IN ANY BID, TO REJECT ANY AND ALL BIDS IN WHOLE OR IN PART, WITH OR WITHOUT CAUSE, AND/OR ACCEPT THE BIDS OR PORTIONS THEREOF THAT IN ITS JUDGMENT WILL BE FOR THE BEST INTEREST OF THE UTILITIES COMMISSION.

SECTION 3 – REQUIRED CERTIFICATIONS AND REPRESENTATIONS

SECTION 3.1
CERTIFICATION OF DRUG-FREE WORKPLACE

IDENTICAL TIE BIDS - Preference shall be given to businesses with drug-free workplace programs. Whenever two or more bids which are equal with respect to price, quality, and service are received by the State or by any political subdivision for the procurement of commodities or contractual services, a bid received from a business that certifies that it has implemented a drug-free workplace program shall be given preference in the award process. Established procedures for processing tie bids will be followed if none of the tied vendors have a drug-free workplace program. In order to have a drug-free workplace program, a business shall:

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

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

VENDOR SIGNATURE

**SWORN STATEMENT UNDER SECTION 287.133(3) (1)
FLORIDA STATUTES, ON PUBLIC ENTITY CRIMES**

THIS FORM MUST BE SIGNED IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICER AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted Bid, Bid or Contract for_____.

2. This sworn statement is submitted by_____

[name of entity submitting sworn statement] whose business address is: _____

_____and (if applicable) its Federal Employer Identification Number (FEIN) is _____.

(If entity has no FEIN, include the Social Security Number of the individual signing this sworn statement: _____.

3. My name is _____and my relationship to the entity named above is _____.

4. I understand that a "public entity crime" as defined in Paragraph 287.133 (1) (g), Florida Statutes, means a violation of any state or federal law be a person with respect to and directly related to the transaction of business with any public entity or with an agency or political subdivision of any other state or with the United States, including, but not limited to, any bid or contract for goods or services to be provided to any public entity or an agency or political subdivision of any other state, or of the United States and involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy, or material misrepresentation.

5. I understand that "convicted" or "conviction" as defined in Paragraph 287.133 (91) (b), Florida Statutes means a finding of guilt or a conviction of a public entity crime, with or without adjudication of guilt, in any federal or state trial court or recording, relating to charges brought by federal or state trial court or recording, relating to charges brought by federal or state trial court or recording, relating to charged brought by indictment or information after July 1, 1989, as a result of just verdict, non-jury trial, or entity of a plea of guilty or nolo contendere.

6. I understand the "affiliate" as defined in Paragraph 287.133(1)(a), Florida Statutes, means: (1) A Predecessor or Successor of a person convicted of public crime: or (2) An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholder, employees, members, and agents who are active in the management of an affiliate. The ownership by one person of shares constituting a controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value under an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of public crime in Florida during the preceding 36 months shall be considered an affiliate.

7. I understand that a "person" as defined in Paragraph 287.133(1) (e), Florida Statutes, means any natural person or entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts for the provisions of goods or services let by a public entity, or which otherwise transacts or applies to transact business with a public entity. The term "person" includes those officers, directors, executives, partners, shareholders, employees, members and agents who are active in management of an entity.

8. Based on information and belief, that statement which I have marked below is true in relation to the entity submitting this sworn statement. [Please indicate which statement applies]

Public Entity Crimes Statement

Page 2 of 2

_____ Neither the entity submitting this sworn statement, or one more of the officers, directors, executives, partners, shareholders, employees, members or agents who are active in the management of the entity, nor any affiliate or the entity, has been charged with and convicted of public entity subsequent to July 1, 1989, AND [Please indicate which additional statement applies.]

_____ There has been a proceeding concerning the conviction before a hearing officer of the State of Florida, Division of Administrative Hearings. The final order entered by the hearing officer did not place the person or affiliate on the convicted vendor list. [Please attach a copy of the final order.]

_____ The person or affiliate was placed on the convicted vendor list. There has been a subsequent proceeding before a hearing officer of the State of Florida, Division of Administrative Hearings. The final order entered by the hearing officer determined that it was in the public interest to remove the person or affiliate from the convicted vendor list. [Please attach a copy of the final order.]

_____ The person or affiliate has not been placed on the convicted vendor list. [Please describe any action taken by or pending with the Department of General Services.]

Date

Signature

STATE OF: _____

COUNTY OF: _____

PERSONALLY APPEARED BEFORE ME, the undersigned authority,

[name of individual signing] who after first sworn by me affixed his/her signature in the space provided above on this _____ day of _____, 20_____.

My commission expires:

Notary Public

Print, Type, or Stamp of Notary Public

Personally known to me, or
Produced Identification:

Type of I.D.

NON-COLLUSION AFFIDAVIT OF PRIME BIDDER

State of _____

County of _____

_____, being first duly sworn, deposes and says that:

He/she is _____ of _____, Bidder that has submitted the attached Bid;

He/she is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;

Neither the said Bidder nor any of its officers, partners, owners, agent representatives, employees, or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm or person, to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit or cost element of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against the UCNSB.

The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

Signed

Title

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

Title

My Commission Expires: _____

SECTION 3.4 - AUTHORIZED SIGNATURES/NEGOTIATORS

The bidder or proposer represents that the following persons are authorized to sign and/or negotiate contracts and related documents to which the bidder or proposer will be duly bound:

Name	_____	Title	_____	Phone #	_____
	_____		_____		_____
	_____		_____		_____
	_____		_____		_____

(Signature)

(Title)

(Name of Business)

The bidder/offeror shall complete and submit the following information with the bid or proposal:

Type of Organization

_____ Sole Proprietorship _____ Partnership

_____ Joint Venture _____ Corporation

State of Incorporation: _____

Federal I.D. or Social Security number is: _____

SECTION 3.5

VENDOR INFORMATION

In addition to General conditions, your BID may be disqualified if the following vendor information is not returned with your BID.

Vendor is:

- () Corporation
- () Partnership
- () Sole Proprietorship
- () Other _____(Explain)

Federal Employer Identification

Number or Social Security Number: _____

Do you collect Florida State Sales Tax? () Yes () No

Firm Name: _____

Mailing Address: _____

Telephone No. _____ Fax No. _____

Email Address: _____ Web Address: _____

Commodity or Service Supply: _____

If vendor is quoting, as a manufacturer's representative and the purchase order should be addressed to the manufacturer in care of the vendor, so indicate.

If remittance address is different from the mailing address so indicate below.

Firm Name: _____

Mailing Address: _____

Submitted by: _____

Name & Title Printed: _____

SECTION 3.6

QUESTIONNAIRE ITB # 04-09

Additional space may be required. Please answer questions in the order presented. All questions must be answered or contractor may be disqualified.

1. Has your company ever been denied insurance or had insurance canceled?
2. Is your company bondable? Has your company ever been denied bond? If yes, explain.
3. Can your insurance company produce a certificate of insurance stating your limits and naming UCNSB as an Additional Insured?
4. Since January 1, 2001, has your company been a defendant in any lawsuits?
5. Is your company a subsidiary or otherwise legally affiliated with any other company?
6. Is your company rated by Dunn & Bradstreet or any other rating agency? If yes, what is the name of the agency and rating?
7. Is your company in any stage of bankruptcy, including initial filing?
8. Can you supply us with three (3) business references similar to UCNSB? If yes, attach a list including contact and phone number.
9. Has your company been disbarred by the Federal Government or any State Government?
10. How many employees does your company have?

Staff Employees: Full Time _____ Part Time _____

Contract Employees: Full Time _____ PartTime _____

REQUEST FOR TAXPAYER IDENTIFICATION NUMBER

Step 1. Provide your complete name and Taxpayer Identification Number *(Check ONE box only)*

U.S. Resident – Individual/Sole Proprietor (Form 1099 reportable)
 Name _____
 If you are a sole proprietor, name the owner of the business: _____
 Social Security Number _____ Employer Identification Number _____

U.S. Partnership, Limited Liability Company ("LLC"), or Trust (Form 1099 reportable)
 Name (as shown on your tax return) _____ Employer Identification Number _____

U.S. Corporation (exempt from Form 1099 reporting except for medical or legal services)
 if an LLC electing corporate status for U.S. tax purposes, please attach a copy of your U.S. tax election on IRS Form 8832, *Entity Classification Election*
 Name (as shown on your tax return) _____ Employer Identification Number _____

U.S. Tax-Exempt Organization or Federal, State, or Local Government Agency (exempt from Form 1099 reporting)
 Name (as shown on your tax return) _____ Employer Identification Number _____

Step 2. Certification/Signature *(Complete the following)* Under penalties of perjury my signature certifies that:

- The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me).
- I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding.
- I am a U.S. person* (including a U.S. resident alien).

Certification Instructions - You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, number 2 above does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the Certification, but you must provide your correct TIN.

Signature: _____ Phone: (____) _____

Print Name: _____ Title: _____ Date: _____

Address: _____ City: _____ State: _____ ZIP: _____

Instructions for U.S. Tax Persons

As a business, federal income tax law requires us to report certain payments we make to you if you are not exempted from this reporting responsibility. In order for us to properly meet the federal tax law requirements, we need certain information from you. Please complete the information requested above and return this form to the address shown above. If you do not provide us with your correct taxpayer identification number, you may be subject to a \$50 penalty imposed by the Internal Revenue Service. In addition, you may be subject to 28% backup withholding on reportable payments we make to you.

If you have any questions, please call us at _____ (provide requester's telephone number).

*Are you a U.S. person? The IRS defines a U.S. person as:

- a U.S. citizen;
- an entity (company, corporation, trust, partnership, estate, etc.) created or organized in, or under the laws of, the United States; a state; or the District of Columbia;
- a U.S. resident alien (someone who has a "green card" or has passed the IRS "substantial-presence test."

For an explanation of the substantial-presence test, please see IRS Pub. 515 or 519, available at www.irs.gov.

If your answer is NO, please do not complete this form and contact us at (insert requester's phone number here) _____.

If your answer is YES, please complete the form.

See page 2 for additional information.

FOR OFFICE USE ONLY

<i>Please complete and return as: (requester's return address)</i>	<i>(Requester's name, address, and account as they appear in requester's records.)</i>
_____	Name _____
_____	Locator ID _____
_____	_____

SECTION 3.8

REQUIRED DISCLOSURE

At its sole discretion, the Owner may reject any bidder the Owner finds to lack, or whose present or former executive employees, officers, directors, stockholders, partners or owners are found by the Owner to lack honesty, integrity, or moral responsibility. The discretion of the Owner may be exercised based on the Owner's own investigation, public records, or any other reliable sources of information. By submitting a bid, bidder recognizes and accepts that the Owner may reject the bid based upon the exercise of its sole discretion and bidder waives any claim it might have for damages or other relief resulting from the rejection of its bid based on these grounds.

THE UTILITIES COMMISSION RESERVES THE RIGHT TO WAIVE INFORMALITIES IN ANY BID, TO REJECT ANY AND ALL BIDS IN WHOLE OR IN PART, WITH OR WITHOUT CAUSE, AND/OR ACCEPT THE BIDS OR PORTIONS THEREOF THAT IN IT'S JUDGMENT WILL BE FOR THE BEST INTEREST OF THE UTILITIES COMMISSION.

Section 3.9

BID SUBMITTAL REQUIREMENTS – ONE (1) ORIGINAL AND TWO (2) COPIES

Bids shall include all of the information solicited in this ITB, and any additional information that the Bidder deems pertinent to the understanding and evaluating of the bid. **Bids shall be organized and sections tabbed in the following order.** The Bidder should not withhold any information from the written response in anticipation of presenting the information orally or in a demonstration, since oral presentations or demonstrations may not be solicited. All bids shall include, at a minimum, the following information. Failure to supply all of the information requested may result in the bid being excluded from consideration.

Factor #1 **Experience:**

Provide a profile showing company history, business structure, list of principals. A minimum of five (5) years in business is required.

Factor #2 **References:**

Submit a detailed list of clients receiving similar services within the last two years. Please include a brief description of the scope of work performed and the name, phone number and email address of the contact person.

Factor #3 **Pricing:**

Submit Bid Reply Form here

Factor #4 **License and Insurance:**

Include a copy of your current Occupational License from an authorizing government agency. Submit a copy of your Certificate of Insurance here. UCNSB does not need to be named as an Additional Insured at this time but that is a requirement when work commences.

Factor #5 **Public Entity Crimes and Non-collusion Affidavit**

All Bidders shall properly complete, notarize and submit Public Entity Crimes Non Collusion Form included in this document.

Factor #6 **Addenda Acknowledgement**

Please submit all addenda (if any) related to this bid here.

Factor #7 **Questionnaire**

The Questionnaire responses requested in the next section should be submitted here

Factor #8 **Vendor Application**

Submit completed vendor application here

Factor#9 **Alternate Manufacturers/Suppliers**

Submit completed alternate manufacturers/suppliers form here

Factor #10 **Other Information**

Provide any information that will provide insight to the evaluators about qualifications, fitness and abilities of the Bidder. This information should be succinct.

SECTION 00300

BID FORM

SCHEDULE OF PRICES FOR
 UTILITIES COMMISSION
 City of New Smyrna Beach
 SMITH STREET PUMP STATION AND 20" LOW PRESSURE TRANSMISSION MAIN
 MATERIALS AND EQUIPMENT
 U.C. PROJECT NO. 06612-63

<u>Item</u>	<u>Description</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Amount</u>	<u>Calendar Days Delivery ARO</u>
I. BUTTERFLY VALVES						
1	12" Diameter Manually Operated	4	Each	\$ _____	\$ _____	_____
2	12" Diameter Mechanically Operated	3	Each	\$ _____	\$ _____	_____
3	14" Diameter Manually Operated	3	Each	\$ _____	\$ _____	_____
4	18" Diameter Manually Operated	3	Each	\$ _____	\$ _____	_____
5	24" Diameter Manually Operated	1	Each	\$ _____	\$ _____	_____
II. GATE VALVES						
6	16" Diameter	3	Each	\$ _____	\$ _____	_____
7	20" Diameter (Horizontal)	13	Each	\$ _____	\$ _____	_____
III. CHECK VALVES						
8	12" Diameter	3	Each	\$ _____	\$ _____	_____
IV. PRESSURE REDUCING VALVES						
9	6" Diameter	1	Each	\$ _____	\$ _____	_____
10	14" Diameter	1	Each	\$ _____	\$ _____	_____
11	16" Diameter	5	Each	\$ _____	\$ _____	_____
V. PIPE						
12	20" Lengths PVC	780	Each	\$ _____	\$ _____	_____
13	Alternate – Ductile Iron with Polyethylene Sleeves (Increase) (Decrease)	780	Each	\$ _____	\$ _____	_____

SECTION 00300

BID FORM

MATERIALS AND EQUIPMENT

U.C. PROJECT NO. 06612-63

<u>Item</u>	<u>Description</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Amount</u>	<u>Calendar Days Delivery ARO</u>
VI. PUMPS						
14	High Service Pump #1, #2 and #3 – Pump and Motor and Adjustable Frequency Control (Per Attached Specs.)	3	Each	\$_____	\$_____	_____
15	Transfer Pump #1 and #2 – Pump and Motor (Per Attached Specs.)	2	Each	\$_____	\$_____	_____
16	Transfer Pump #3 – Pump and Motor (Per Attached Specs.)	1	Each	\$_____	\$_____	_____
17	Transfer Pump #4 and #5 – Pump and Motor (Per Attached Specs.)	2	Each	\$_____	\$_____	_____

VII. GENERATOR

18	Diesel Engine Generator 600 KW Package	1	Each	\$_____	\$_____	_____
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BASE BID TOTAL - SUM OF ITEMS 1 THROUGH 18 (Price in Figures) \$_____

NOTE: You may bid on any or all items

CONDITIONS OF SALE

- Deliveries shall be scheduled a minimum of 24 hours in advance with the Owner. Delivery shall be accompanied by a Bill of Lading listing quantity of each item delivered. The vendor shall be responsible for unloading all materials—pipe outdoors, equipment indoors in storage building. Vendor shall furnish and operate any equipment needed to unload materials and equipment.
- Price Declines. If any item should between the time of bid and manufacture and delivery experience a cost decrease to the vendor, the vendor shall so immediately notify the purchaser (Owner) and pass through any price declines to the purchaser (Owner).
- A non-mandatory pre-bid conference is scheduled on January 12, 2009.

Section 01300

SUBMITTALS

1. SHOP DRAWINGS AND ENGINEERING DATA.

1.01. **General.** Shop Drawings and engineering data (submittals) covering all equipment and all fabricated components and building materials which will become a permanent part of the Work under this Contract shall be submitted to Engineer for review, as required. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. Contractor shall submit a complete initial submittal including all components. When an item consists of components from several sources, Contractor's initial submittal shall be complete including all components.

All submittals, regardless of origin, shall be approved by Contractor and clearly identified with the name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each copy of all submittals, regardless of origin, shall be stamped or affixed with an approval statement of Contractor. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

Contractor shall be solely responsible for the completeness of each submittal. Contractor's stamp or affixed approval statement of a submittal, per Figure 01300-1, is a representation to Owner and Engineer that Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that Contractor has reviewed and coordinated each submittal with the requirements of the Work and the Contract Documents.

All deviations from the Contract Documents shall be identified as deviations on each submittal and shall be tabulated in Contractor's letter of transmittal using Figure 01300-2. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

The Contractor shall submit shop drawings in either hard copy or electronically. All submittals shall be made with the selected method, and the Contractor shall inform the Engineer by letter one week after award of the Contract, which method has been selected. Submittals made by any method other than that selected by the Contractor, will be returned without review.

For electronic submittals, drawings and the necessary data shall be submitted electronically to Engineer as specified below. Submittal documents shall be in black and white unless color is required for the review of the submittal. All electronic files shall be in Portable Document Format (PDF) as generated by Adobe Acrobat Professional Version 7.0 or higher. The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated. PDF images must be at a readable resolution. For most documents, they should be scanned or generated at 300 dots per inch (dpi). Optical Character Recognition (OCR) capture must be performed on these images so that text can be searched, selected and copied from the generated PDF file. The PDF documents shall have a bookmark created in the navigation frame for each major entry ("Section" or "Chapter") in the Table of Contents. Thumbnails shall be generated for each page or graphic in the PDF file.

The opening view for each PDF document shall be as follows:

Initial View: Bookmarks and Page

Magnification: Fit In Window

The file shall open to the Contractor's transmittal letter, with bookmarks to the left. The first bookmark shall be linked to the Table of Contents.

PDF document properties shall include the submittal number for the document title and the Contractor's name for the author.

Electronic submittal file sizes shall be limited to 10 MB. When multiple files are required for a submittal the least number of files possible shall be created.

The contractor shall post submittals and retrieve the Engineer's submittal review comments through the Engineer's project website accessible through the Internet. Instruction on procedures for posting and retrieving submittals will be provided after award of the Contract.

Facsimiles (fax) will not be acceptable. Engineer will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

1.02. Engineer's Review of Submittals. Engineer's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered. Engineer's review shall not relieve Contractor of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Contractor's sole responsibility for compliance with the Contract Documents.

Engineer's submittal review period shall be 21 consecutive calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal in Engineer's office. The time required to mail the submittal or resubmittal back to Contractor shall not be considered a part of the submittal review period.

When the drawings and data are returned with review status "NOT ACCEPTABLE" or "RETURNED FOR CORRECTION", the corrections shall be made as instructed by Engineer.

If submittals are made in hard copy, five corrected copies shall be resubmitted. If submittals are made electronically, the corrected drawings and data shall be resubmitted through the project website. Resubmittals by facsimile or e-mail will not be accepted. When the drawings and data are returned with review status "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", or "RECORD COPY", no additional copies need be furnished unless specifically requested by Engineer.

1.03. Resubmittal of Drawings and Data. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify that all corrected data and additional information previously requested by Engineer are provided on the resubmittal.

When corrected copies are resubmitted, Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) or a unique identification that indicates the initial submittal and correct sequence of each resubmittal.

If more than one resubmittal is required because of failure of Contractor to provide all previously requested corrected data or additional information, Contractor shall reimburse Owner for the charges of Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

Resubmittals shall be made within 30 days of the date of the letter returning the material to be modified or corrected, unless within 14 days Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.

The need for more than one resubmittal, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of Engineer to review and return any submittal to Contractor within the specified review period.

1.04. Color Selection. Contractor shall submit samples of colors and finishes for all accepted products before Engineer will coordinate the selection of colors and finishes with Owner. Engineer will prepare a schedule of finishes that include the colors and finishes selected for both manufactured products and for surfaces to be field painted or finished and will furnish this schedule to Contractor within 60 days after the date of acceptance of the last color or finish sample.

2. OPERATION AND MAINTENANCE DATA AND MANUALS. Adequate operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment Supplier shall prepare a project specific operation and maintenance manual for each type of equipment indicated in the individual equipment sections or the equipment schedule.

Parts lists and operating and maintenance instructions shall be furnished for other equipment not listed in the individual equipment sections or the equipment schedule.

Operation and maintenance manuals shall include the following:

- a. Equipment function, normal operating characteristics, and limiting conditions.
- b. Assembly, installation, alignment, adjustment, and checking instructions.
- c. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
- d. Lubrication and maintenance instructions.
- e. Guide to troubleshooting.
- f. Parts lists and predicted life of parts subject to wear.
- g. Outline, cross section, and assembly drawings; engineering data; and wiring diagrams.
- h. Test data and performance curves, where applicable.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by Contractor.

Three hard copies of each manual shall be submitted to Engineer prior to the date of shipment of the equipment. When the O&M manuals are returned with the review status "RETURNED FOR CORRECTION", the corrections shall be made as instructed by the Engineer, and two copies of the corrected portion(s) and one complete corrected copy of the O&M manual returned to the Engineer. After review by Engineer, is complete three hard copies and one electronic copy of each operation and maintenance manual shall be prepared and delivered to Engineer not later than 30 days prior to placing the equipment in operation.

Manuals shall be submitted in electronic format to the Engineer prior to the date of shipment of the equipment. The manuals shall be submitted and the Engineer's review comments retrieved, through the project website accessible through the Internet. Instruction on procedures for posting and retrieving O&M submittals and review comments will be provided after award of the Contract. When the O&M manuals are reviewed "RETURNED FOR CORRECTION", the corrections shall be made as instructed by the Engineer, and corrected manuals resubmitted to the Engineer. When review by the Engineer is complete, three copies of each electronic O&M manual shall be delivered on CD-ROM to the Engineer. Each CD shall contain only one copy of one manual. Delivery of the final O&M shall be made 30 days prior to placing the equipment in operation.

All material shall be marked with project identification, and inapplicable information shall be marked out or deleted.

Shipment of equipment will not be considered complete until all required manuals and data have been received.

2.01. Hard Copy Operation and Maintenance Manuals. Hard copies submitted for review shall be temporarily bound in heavy paper covers bearing suitable identification. All manuals and other data shall be printed on heavy, first quality 8-1/2 x 11 inch paper, with standard three-hole punching. Drawings and diagrams shall be reduced to 8-1/2 x 11 inches or 11 x 17 inches. Where reduction is not practicable, larger drawings shall be folded separately and placed in envelopes, which are bound into the manuals. Each envelope shall be suitably identified on the outside. Each volume containing data for three or more items of equipment shall include a table of contents and index tabs. The final hard copy of each manual shall be prepared and delivered in substantial, permanent, three-ring or three-post binders with a table of contents and suitable index tabs.

2.02. Electronic Operation and Maintenance Manuals. Electronic manuals shall be in Adobe Acrobat's Portable Document Format (PDF), and shall be prepared at a resolution between 300 and 600 dots per inch (dpi), depending on document type. Optical Character Recognition (OCR) capture shall be performed on these documents. OCR settings shall be performed with the "original image with hidden text" option in Adobe Acrobat Exchange.

File size shall be limited to 10 MB. When multiple files are required the least number of files possible shall be created. File names shall be in the format OMXXXXX-YYYZ-V.pdf, where XXXXX is the five digit number corresponding to the specification section, YYY is a three digit O&M manual number, e.g. 001, Z is the letter signifying a resubmittal, A, B, C, etc, and V is a number used only when more than one 10 MB file is required for an O&M manual.

Documents prepared in PDF format shall be processed as follows:

1. Pages shall be searchable (processed for optical character recognition) and indexed when multiple files are required.
2. Pages shall be rotated for viewing in proper orientation.
3. A bookmark shall be provided in the navigation frame for each entry in the Table of Contents.
4. Embedded thumbnails shall be generated for each completed PDF file.
5. The opening view for PDF files shall be as follows:
 - Initial View: Bookmarks and Page
 - Page Number: Title Page (usually Page 1)
 - Magnification: Set to Fit in Window
 - Page: Single Page
6. Where the bookmark structure is longer than one page the bookmarks shall be collapsed to show the chapter headings only.
7. When multiple files are required the first file of the series (the parent file) shall list every major topic in the Table of Contents. The parent file shall also include minor headings bookmarked based on the Table of Contents. Major headings, whose content is contained in subsequent files (children) shall be linked to be called from the parent to

the specific location in the child file. The child file shall contain bookmark entries for both major and minor headings contained in the child file. The first bookmark of any child file shall link back to the parent file and shall read as follows "Return to the *Equipment Name* Table of Contents", e.g. Return to the Polymer Feed System Table of Contents.

8. Drawings shall be bookmarked individually.
9. Files shall be delivered without security settings to permit editing, insertion and deletion of material to update the manual provided by the manufacturer.

2.03. Labeling. As a minimum, the following information shall be included on all final O&M manual materials, including CD-ROM disks, jewel cases, and hard copy manuals:

Equipment name and/or O&M title spelled out in complete words.

Project Name.

City Project/Contract Number.

Specification Section Number. Example: "Section 15500"

Manufacturer's name.

File Name and Date.

For example:

Backwash Pump Operation and Maintenance Manual

Somewhere Plant Expansion

Project/Contract No. _____

Specification Section 11110

Manufacturer

OM11110-001.pdf, 5/05/07

End of Section

Section 02630

POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

PART 1 - GENERAL

Pressure and leakage tests, cleaning, and disinfection, are covered in other sections. Pipe trenching, bedding, and backfill are covered in the Trenching and Backfilling section.

Ductile Iron Pipe
Steel Pipe
PCCP

Pipes of alternate materials are covered in other sections.

Pipe shall be furnished where indicated in the pipeline schedule or where indicated on the drawings.

1-1. GOVERNING STANDARDS. Except as modified or supplemented herein, all PVC pressure pipe shall conform to the applicable requirements of ANSI/AWWA C900 and C905.

The supplementary information required in the governing standards is as follows:

Affidavit of Compliance	Required.
Plant Inspection	Not required.
Special Markings	Not required.
Special Preparation for Shipment	Not required.
Certification	Required.

1-2. SUBMITTALS. Drawings and data shall be submitted in accordance with the Submittals section. Drawings and data shall include, but shall not be limited to, the following:

Gasket material.
Pipe length.
Affidavit of Compliance (ANSI/AWWA C900, Sec. 6.3).
Affidavit of Compliance (ANSI/AWWA C905, Sec. 6.3).
Certification (ANSI/AWWA C900, Sec. 4.2.3).
Certification (ANSI/AWWA C905, Sec. 4.2.3).

1-3. DELIVERY, STORAGE AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

Pipe, fittings, and accessories shall be handled in accordance with Chapter 6 of AWWA Manual M23, to ensure installation in sound, undamaged condition. Pipe shall not be stored uncovered in direct sunlight.

PART 2 - PRODUCTS

2-1. DIMENSIONS. The dimension ratios (DRs: outside diameter to wall thickness) of PVC pressure pipe shall be as indicated in the PVC Pressure Pipe Schedule 02630-S01.

2-2. MATERIALS.

Pipe	ANSI/AWWA C900 or C905; cast iron pipe OD, dimension ratio as specified herein.
Fittings	Cast iron; ANSI/AWWA C110/A21.10, 250 psi [1.7 MPa] pressure rating, except shorter laying lengths will be acceptable.
Joints	
PVC to PVC	ANSI/AWWA C900 or C905, stab type, with elastomeric synthetic rubber gaskets. Gaskets of natural rubber will not be acceptable.
PVC to Cast Iron	ANSI/AWWA C111/A21.11, except gaskets shall be synthetic rubber. Natural rubber will not be acceptable.
Tapping Saddles	Ductile iron, with galvanized steel straps and synthetic rubber sealing gasket, 250 psi [1.7 MPa] pressure rating.
Restrained Joints	ASTM F1674, EBAA Iron 2000 series (4 inch through 20 inch) [100 mm through 500 mm] or concrete thrust blocking.
Tapping Sleeves	Ductile iron, 250 psi [1.7 MPa] pressure rating.
Polyethylene Encasement	Tube or sheet, ANSI/AWWA C105/A21.5.
Joint Tape	Self-sticking, PVC or polyethylene, 10 mils [250 µm] thick; Chase "Chasekote 750", Kendall "Polyken 900", or 3M "Scotchrap 50".

Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Conductive Tracer	Detection tape, 3 inches [75 mm] wide; aluminum foil core, 0.5 mil [13 μm] thick, encased in a protective inert plastic jacket; 5,000 psi [35 MPa] min tensile strength; 2.5 lbs per inch per 1,000 feet [45 g/mm per 300 mm] min mass; color coded in accordance with APWA Uniform Color Code; Allen Systems "Detectatape", Lineguard "Type III", or Reef Industries "Terra Tape D".

Manufacturing quality control shall be maintained by frequent, regularly scheduled sampling and testing. Testing shall comply with the governing standards.

2-3. SHOP COATING AND LINING. The exterior surfaces of cast iron fittings shall be coated with a bituminous coating. The interior surfaces of cast iron fittings shall be lined with cement mortar.

PART 3 - EXECUTION

3-1. INSPECTION. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; spigot ends and bells shall be examined with particular care. All defective pipe and fittings shall be removed from the site of the work.

3-2. LAYING PIPE. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified in the Trenching and Backfilling section. Pipe shall not be laid in water or other unsuitable conditions.

Pipe shall be laid with bell ends facing the direction of laying, except when reverse laying is specifically permitted by Engineer.

Foreign matter shall be prevented from entering the pipe during installation.

Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug. All water shall be removed from the trench prior to removing the plug.

A conductive tracer shall be buried above PVC pipe, not more than 18 inches [450 mm] below the ground surface.

3-2.01. Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted.

3-2.02. Alignment. Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the maximum deflections specified by the manufacturer.

Unless otherwise specified or indicated on the drawings, and subject to acceptance by Engineer, either shorter pipe sections or fittings shall be installed as required to maintain the indicated alignment or grade.

3-3. CUTTING PIPE. Cutting shall comply with the pipe manufacturer's recommendations and with Chapter 7 of AWWA Manual M23. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed to remove all roughness and sharp corners and shall be beveled in accordance with the manufacturer's instructions.

3-4. JOINTS. Joints shall be stab-type unless otherwise indicated on the drawings.

3-4.01. Stab Type Joints. Jointing shall conform to the instructions and recommendations of the pipe manufacturer. All surfaces for gasketed joints shall be lubricated immediately before the joint is completed. Gaskets and lubricants shall be supplied by the pipe manufacturer, shall be suitable for use in potable water, shall be compatible with the pipe materials, shall be stored in closed containers, and shall be kept clean. Each spigot shall be suitably beveled to facilitate assembly.

3-4.02. Mechanical Joints. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Over-tightening of bolts to compensate for poor installation practice will not be permitted.

3-5. CONNECTIONS WITH EXISTING PIPING. Connections with existing pipes shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by Owner. Facilities shall be provided for proper dewatering and for disposal of water removed from the dewatered lines and excavations without damage to adjacent property.

Special care shall be taken to prevent contamination of potable water lines when dewatering, cutting into, and making connections with existing pipe. No trench water, mud, or other contaminating substances shall be permitted to enter the lines. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and then swabbed with, or dipped in, a 200 mg/L chlorine solution.

3-6. SERVICE CONNECTIONS. Tapping saddles or tapping sleeves shall be used for all service connections 2 inches [50 mm] and smaller. Direct tapping of PVC pipe will not be permitted. Fittings shall be used for service connections larger than 2 inches [50 mm].

3-7. CONCRETE ENCASEMENT. Concrete encasement shall be installed as indicated on the drawings. Concrete and reinforcing steel shall be as specified in the Cast-in-Place Concrete section. All pipe to be encased shall be suitably supported and blocked in proper position and shall be anchored against flotation.

3-8. RESTRAINED JOINTS. All bell-and-spigot or all-bell tees, Y-branches, bends deflecting 11-1/4 degrees [0.19 rad] or more, valves, and plugs which are installed in piping subjected to internal hydrostatic heads in excess of 30 feet [9 m] shall be provided with suitable restraint.

Concrete blocking shall extend from the fitting to solid, undisturbed earth and shall be installed so that all joints are accessible for repair. The dimensions of concrete reaction blocking shall be as indicated on the drawings or as directed by Engineer.

Reaction blocking, anchorages, or other supports for fittings installed in fills or other unstable ground shall be provided as indicated by the drawings or as directed by Engineer.

All steel clamps, rods, bolts, and other metal accessories used in tapping saddles or reaction anchorages subject to submergence or in contact with earth or other fill material, and not encased in concrete, shall be coated in accordance with the Protective Coatings section.

3-9. PRESSURE AND LEAKAGE TESTS. After installation, PVC piping shall be hydrostatically tested for defective workmanship and materials as specified in the Pipeline Pressure and Leakage Testing section.

3-10. LEAKAGE. All PVC piping shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor.

3-11. CLEANING AND DISINFECTION. After installation, PVC piping shall be cleaned and disinfected as specified in the Cleaning and Disinfection section.

End of Section

Section 11140

VERTICAL DIFFUSION VANE PUMPS – TRANSFER SERVICE

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of vertical diffusion vane pumping units as indicated herein:

Pump designation.	Transfer Pump (TP)
Number of pumps.	5
Pump tag numbers.	TP-1 through TP-5
Pump location.	Glencoe WTP

Each pumping unit shall be complete with a pump, electric motor, pedestal, sub-base, anchor bolts, and all other appurtenances specified or required for proper operation.

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standard. Except as modified or supplemented herein, all vertical diffusion vane pumps shall conform to the applicable requirements of ANSI/AWWA E101-88 and the Hydraulic Institute Standards.

1-2.03. Tagging. Each item of equipment and each part shipped separately shall be tagged and identified with indelible markings for the intended service. Tag number shall be clearly marked on all shipping labels and on the outside of all containers.

1-2.04. Power Supply. Unless otherwise indicated, power supply to the equipment shall be 480 volts, 60 Hz, 3 phase.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals section. The data and specifications for each pumping unit shall include, but shall not be limited to, the following:

Pumps

Name of manufacturer.
Type and model.
Design rotative speed.
Diameter of discharge outlet.
Diameter of line shafting.
Type of lineshaft bearings.
Diameter and wall thickness of pump column.
Number of stages.
Type of bowl bearings.
Complete performance curves showing capacity versus head, NPSH required, pump and wire-to-water efficiency, and bhp plotted to scales consistent with performance requirements.
OD of pump bowls.
Weight including bowls, column, and pedestal

Complete Pumping Unit

Max overall dimensions.
Total weight including motor and base plate.
Data on shop painting.

Motors

As specified in the General Purpose Induction Motors section 16220.

1-3.02. Operation and Maintenance Data and Manuals. Adequate operation and maintenance information shall be supplied as required in the Submittals section. Operation and maintenance manuals shall be submitted in accordance with the Submittals section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-4. QUALITY ASSURANCE.

1-4.01. Balance. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case, the unfiltered vibration velocity, as measured at any point on the machine including the motor, shall not exceed the maximum vibration limit of the governing standard unless otherwise required.

At any operating speed, the ratio of rotative speed to the critical speed of a unit or its components shall be less than 0.8 or more than 1.3.

1-4.02. Efficiency Evaluation. If the efficiency, as determined by the shop test, is below the specified minimum efficiency, Owner may, at his option, reject the unit.

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

1-6. SPARE PARTS AND ACCESSORIES. Spare parts shall be suitably packaged, with labels indicating the contents of each package. Spare parts shall be delivered to Owner as directed. The following spare parts shall be furnished with each pump.

<u>Spare Part</u>	<u>Quantity</u>
Mechanical seals	1

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. Transfer Service

The pumping units shall be suitable for the following service conditions:

Type of environmental exposure.	Indoor	
Ambient air temperature range.	20 to 110	°F
Liquid temperature range.	70 to 80	°F
Pumps start and stop against a closed valve.	Yes	
Site elevation.	32.5	ft
Units subject to freezing temperatures.	No	
Crane facilities available.	Yes	

Parts shall be interchangeable between units of similar size and capacity to extent practical.

All equipment furnished shall be designed to meet all specified conditions and to operate satisfactorily at this elevation.

Each pumping unit shall be designed to facilitate installation and removal using the facilities provided for that purpose as indicated on the drawings.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. Pumping units shall be designed for the following performance and design requirements, at maximum speed unless otherwise noted:

Pump tag numbers.	TP-1, TP-2	TP-3	TP-4, TP-5	
Rated head.	45	45	145	ft
Capacity at rated head.	4167	3125	3125	gpm
Operating head range for full speed continuous operation.	10 to 70	5 to 55	130 to 180	ft
Minimum shutoff head.	—	—	—	ft
Maximum shutoff head.	—	—	—	ft
Maximum nominal pump speed.	1800	1200	1200	rpm

Maximum power required at pump input shaft at any point in the operating range.	100	100	200	bhp
Maximum power at shutoff head.	—	—	—	bhp
Efficiency.	—	—	—	%
Type of efficiency indicated.	Wire to water	Wire to water	Wire to water	
Efficiency calculated at.	Rated head	Rated head	Rated head	
Pump designed for reverse rotation.	No	No	No	
Maximum “A” rated weighted noise at 3 ft.	87	87	87	dBa
Maximum unfiltered vibration velocity.	HIS	HIS	HIS	in/s
Minimum nominal size of pump column.	16	16	16	in
Minimum NSPHA at the suction flange at rated head.	37	37	37	ft
Minimum ratio of NSPHA to NPSHR.	1.1	1.1	1.1	
Nominal submergence range above wetwell floor.	4.5 to 17.5	4.5 to 17.5	4.5 to 17.5	ft
Vertical distance from wetwell floor to center line of above floor discharge.	24.5	24.5	24.5	ft
Maximum vertical distance from center line of above floor discharge to bottom of sub-base.	2	2	2	ft
Maximum length of any component or subassembly.	15	15	15	ft
Approximate clearance between crane hook and operating floor.	19	19	19	ft

Overall (wire-to-water) efficiency for constant speed pumps shall include losses in the pump and motor. Overall (wire-to-water) efficiency for variable speed pumps shall include losses in the pump, motor, adjustable frequency drive, and any transformers supplied as part of the adjustable frequency drive equipment.

Minimum shop test pressure on bowl assembly shall be 1.5 times the shutoff head plus maximum suction pressure where applicable.

The pump setting shall be as indicated on drawings.

For design and rating purposes, the water to be pumped shall be assumed to have a temperature of 85°F.

Pump performance shall be stable and free from damaging cavitation, vibration, and noise in the operating head range. The performance of pumps with an enclosed impeller shall be based on a radial running clearance between the bowl wearing ring and the impeller of not less than 6 mils, or 0.5 mil per inch of wearing ring diameter, whichever is greater.

2-3. MATERIALS.

Suction Strainer	Stainless steel
Pump Bowls	Cast iron, ASTM A48, Class 30.
Impellers	Silicon Bronze, ASTM B584 – 873.
Bowl Wearing Rings	Bronze, ASTM B505 – 927.
Bowl Assembly Shaft	Martensitic stainless steel, AISI Type 410 or 416.
Bowl Bearings	Bronze, ASTM B505-932, water lubricated, except suction case (bowl) bearing shall be permanently packed with water-resistant grease.
Lineshaft, stainless steel	Martensitic stainless steel shaft, AISI Type 410 or 416, with Martensitic stainless steel couplings of dissimilar alloy.
Open Lineshaft Bearings	Goodrich "Cutless Rubber", water lubricated.
Flanged Pump Column	AWWA C200 steel pipe at least 3/8 inch thick, with flanged couplings.
Stuffing Box Housing	Cast iron, ASTM A48, Class 30.
Stuffing Box Bearing	Bronze, ASTM B505-932, water, internal lubricated.
Mechanical Seal	Single one piece balanced cartridge type; John Crane, Durametallic, or equal.
Water Slinger	Rubber or bronze.
Pedestal and Subbase	Cast iron or fabricated steel.
Lineshaft Coupling Thread Lubricant	Jet-Lube "Nikal", John Crane "Thred Gard Nickel", Never-Seez "Pure Nickel Special", or Permatex "Nickel Anti-Seize".

Epoxy Coating

Ameron "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard 891", or Tnemec "Series N140 Pota-Pox Plus".

2-4. PUMP CONSTRUCTION. Each pump shall be the turbine type suitable for wetpit installation.

2-4.01. Suction Bowl Inlet. Wetpit pumps shall be equipped with a flared suction bowl inlet and a suction strainer. Net opening of the suction strainer shall be at least 2-1/2 times the inlet area of the pump.

2-4.02. Impellers and Bowls. Impellers shall be accurately machined, dynamically balanced, and securely locked on the pump shaft. Impellers shall be enclosed.

Balance rings which depend upon close running clearances to reduce the load on the drive unit thrust bearing will not be acceptable unless otherwise indicated.

Pump bowls shall be equipped with wearing rings designed to maintain pump efficiency. Wearing rings shall be securely locked in place so that they will not move or loosen during any condition of operation or handling, including reverse rotation of the pump.

2-4.03. Shafting. All pump shafting shall conform to the applicable sections of the governing standard. Shaft diameter shall be not less than the minimum permitted for the applicable driver nameplate power rating. Shafting shall be open.

2-4.04. Lineshaft Sleeves. Not used.

2-4.05. Shaft Couplings. Shaft couplings shall transmit the maximum combination of torque and thrust and shall maintain alignment between adjacent shaft sections. Couplings shall be threaded type.

During assembly, anti-seize thread lubricant shall be applied to male threads of all threaded connections.

2-4.06. Bearing Retainers. Not used.

2-4.07. Lineshaft Enclosing Tube. Not used.

2-4.08. Pump Column. Pump column sections shall be so designed and constructed that accurate alignment will be obtained when the column is assembled. The type of couplings shall be flanged.

The pump column shall be long enough to locate the suction inlet a distance of at least equal to 1/3 times the bell diameter, but not more than 3/4 times the bell diameter above the wetwell floor.

The diameter of the pump column shall be uniform from the pump pedestal to the bowl discharge.

Column sections shall be provided with lifting lugs or dogs to facilitate pump removal. Lifting lugs or dogs shall be a least 12 inches below the column flange and shall be designed to prevent deflection of the column flange.

2.4.09. Lineshaft Stuffing Box. A stuffing box shall be provided at the top of the pump pedestal for sealing the lineshaft entry point.

The stuffing box shall be provided with a single mechanical seal suitable for vertical turbine pump service.

2-4.10. Seal Water Station. Not used.

2-4.11. Pedestal. Each pump pedestal shall be designed to support the drive unit and the entire pump assembly. Suitable openings shall be provided for access to the stuffing box and other accessories. A registered connection or dowels shall be provided between the motor and the pedestal. The tolerance of the registered fit shall be less than the stuffing box bearing tolerance so that when installed the shaft will not touch the stuffing box bearing. A suitable stuffing box leakage collector with a 1/2 inch tapped drain opening shall be provided. Each pocket shall have a drain connection.

2-4.12. Pump Discharge Outlets. Pump discharge outlets may have flanged ends. The pump discharge outlet shall be integral with the pedestal. The pump discharge outlet shall be above the floor.

The diameter and drilling of the flange shall conform to ANSI/ASME B16.1, Class 125.

A 1/2 inch NPT tapped and plugged pressure gauge connection shall be provided on the horizontal center line of the pump discharge outlet. The size and configuration of the connection shall conform to Figures 2.6.17 and 2.6.18 of the Hydraulic Institute Standards.

2-4.13. Subbase. A rigid subbase with rounded corners shall be provided to support each pedestal. Abutting surfaces between the subbase and the pedestal shall be machined to provide uniform bearing.

Each subbase shall have a center opening large enough to permit withdrawal of the entire pump assembly.

2-4.14. Pump Barrel. Not used.

2-4.15. Shop Painting. All iron and steel parts which will be in contact with pumped liquid or submerged after installation, including the inside of the pump column and all exterior surfaces below the subbase plate or mounting flange, shall be shop cleaned by blasting in accordance with the coating manufacturer's recommendations and painted with an epoxy coating system. The coating shall have a dry film thickness of at least 10 mils and shall consist of a prime (first) coat and one or more finish coats. At least 1 quart of the finish material shall be furnished with each pump for field touchup.

All interior surfaces of pump barrel shall be shop cleaned by blasting in accordance with the coating manufacturer's recommendations and painted with an epoxy coating system. Exterior surfaces of pump barrels to be exposed shall be by blasting in accordance with the coating manufacturer's recommendations and painted with an epoxy coating system. The coating shall have a dry film thickness of at least 10 mils and shall consist of a prime (first) coat and one or more finish coats. Exterior surfaces of pump barrels to be encased in concrete are to be shop primed coated.

All other iron and steel surfaces, except stainless steel and machined surfaces, shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an oil-resistant enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.

2-5. ACCESSORIES.

2-5.01. Solenoid Oiler. Not used.

2-5.02. Anti-Reverse Device. Where the pumping unit is specified to be designed for reverse rotation due to reverse flow, a backstop or non-reverse device shall not be used. However, a self release coupling that prevents reverse rotation due to phase reversal may be used.

2-5.03. Drawdown Gauge. Not used.

2-5.04. Air Release Connection. An outlet connection shall be provided for mounting an air and vacuum valve as specified in the Air Release and Combination Air Valves section. The outlet connection shall be ___ in., threaded, and shall be located on the highest point of the pump.

2-6. DRIVE UNITS.

2-6.01. Electric Motors. Electric motors shall be designed as specified in the General Purpose Induction Motors section 16220.

Motor shaft shall be solid type.

For solid shaft motors, an adjustable coupling designed for vertical pump service shall be provided between each solid shaft motor and the shafting to permit removal of the motor without disturbing the pump. The coupling shall be flanged type, keyed to the shafts, and shall provide for vertical adjustment of the impeller with the motor in place.

Where mechanical seals are specified, the adjustable coupling shall be spacer type to permit removal of the mechanical seal without disturbing the motor.

2-6.02. Stabilizer. Not used.

2-6.03. Adjustable Frequency Drives. Not used.

2-7. SHOP TESTS. Each pump shall be tested at the factory for capacity, power requirements, and efficiency at specified rated head, evaluated head, shutoff head, operating head extremes, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall be made in conformity with the requirements and recommendations of the Hydraulic Institute Standards.

Each pumping unit shall be shop tested with the motor to be installed in the work.

For pumping units under 100 horsepower, a certified performance curve including head, pump input power, pump efficiency, and wire-to-water efficiency shall be prepared by the pump manufacturer. Five copies of the certified curve shall be delivered to Engineer not less than 10 days prior to the shipment of the equipment from the factory.

For pumping units 100 horsepower and larger, a certified test report shall be prepared. Five certified copies of a report covering each test shall be prepared by the pump manufacturer and delivered to Engineer not less than 10 days prior to the shipment of the equipment from the factory. The report shall include data and test information as stipulated in the Hydraulic Institute Standards, copies of the test log originals, test reading to curve conversion equations, and certified performance curves. The curves shall include head, pump input power, pump efficiency, and wire-to-water efficiency (when specified), rpm, and shop test NPSH available, plotted against capacity. The curves shall be easily read and plotted to scales consistent with performance requirements, with all test points clearly shown.

PART 3 - EXECUTION

3-1. INSTALLATION. Each pump will be installed in accordance with Equipment Installation section.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Startup Requirements section, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the contract price.

3-2.02. Installation Supervision. The equipment manufacturer shall furnish a qualified field installation supervisor during the equipment installation.

All costs for these services shall be included in the contract price.

Manufacturers' installation supervisor shall observe, instruct, guide, and direct the installing contractor's erection or installation procedures. The equipment manufacturer will be provided with written notification 10 days prior to the need for such services.

End of Section

Section 11141

VERTICAL DIFFUSION VANE PUMPS – HIGH SERVICE

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of vertical diffusion vane pumping units as indicated herein:

Pump designation.	High Service Pump (HSP)
Number of pumps.	3
Pump tag numbers.	HSP-1 through HSP-3
Pump location.	Smith Street PS

Each pumping unit shall be complete with a pump, electric motor, pedestal, sub-base, anchor bolts, and all other appurtenances specified or required for proper operation. HSP-1 and HSP-3 shall be furnished with an adjustable frequency drive.

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standard. Except as modified or supplemented herein, all vertical diffusion vane pumps shall conform to the applicable requirements of ANSI/AWWA E101-88 and the Hydraulic Institute Standards.

1-2.03. Tagging. Each item of equipment and each part shipped separately shall be tagged and identified with indelible markings for the intended service. Tag number shall be clearly marked on all shipping labels and on the outside of all containers.

1-2.04. Power Supply. Unless otherwise indicated, power supply to the equipment shall be 480 volts, 60 Hz, 3 phase.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals section. The data and specifications for each pumping unit shall include, but shall not be limited to, the following:

Pumps

Name of manufacturer.
Type and model.
Design rotative speed.
Diameter of discharge outlet.
Diameter of line shafting.
Type of lineshaft bearings.
Diameter and wall thickness of pump column.
Number of stages.
Type of bowl bearings.
Complete performance curves showing capacity versus head, NPSH required, pump and wire-to-water efficiency, and bhp plotted to scales consistent with performance requirements.
OD of pump bowls.
Weight including bowls, column, and pedestal
Diameter and wall thickness of pump barrel.
Diameter of suction flange.

Complete Pumping Unit

Max overall dimensions.
Total weight including motor and base plate.
Data on shop painting.

Motors

As specified in the General Purpose Induction Motors section.

Adjustable Frequency Drives

As specified in the Adjustable Frequency Drives section.

1-3.02. Operation and Maintenance Data and Manuals. Adequate operation and maintenance information shall be supplied as required in the Submittals section. Operation and maintenance manuals shall be submitted in accordance with the Submittals section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-4. QUALITY ASSURANCE.

1-4.01. Balance. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case, the unfiltered vibration velocity, as measured at any point on the machine including the motor, shall not exceed the maximum vibration limit of the governing standard unless otherwise required.

At any operating speed, the ratio of rotative speed to the critical speed of a unit or its components shall be less than 0.8 or more than 1.3.

1-4.02. Efficiency Evaluation. If the efficiency, as determined by the shop test, is below the specified minimum efficiency, Owner may, at his option, reject the unit.

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

1-6. SPARE PARTS AND ACCESSORIES. Spare parts shall be suitably packaged, with labels indicating the contents of each package. Spare parts shall be delivered to Owner as directed. The following spare parts shall be furnished for each pump.

<u>Spare Part</u>	<u>Quantity</u>
Mechanical seals	1

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. High Service

The pumping units shall be suitable for the following service conditions:

Type of environmental exposure.	Indoor	
Ambient air temperature range.	20 to 110	°F
Liquid temperature range.	70 to 80	°F
Pumps start and stop against a closed valve.	Yes	
Site elevation.	11.0	ft
Units subject to freezing temperatures.	No	
Crane facilities available.	Yes	

Parts shall be interchangeable between units of similar size and capacity to extent practical.

Each pumping unit shall be designed to facilitate installation and removal using the facilities provided for that purpose as indicated on the drawings.

All equipment furnished shall be designed to meet all specified conditions and to operate satisfactorily at the site elevation indicated.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. Pumping units shall be designed for the following performance and design requirements, at maximum speed unless otherwise noted:

Pump tag numbers.	HSP-1,3	HSP-2	
Rated head.	180	180	ft
Capacity at rated head.	3650	3650	gpm
Operating head range for full speed continuous operation.	170 to 185	170 to 185	ft
Minimum shutoff head.	—	—	ft

Maximum shutoff head.	—	—	ft
Maximum nominal pump speed.	1800	1800	rpm
Minimum head at reduced speed.	—	--	ft
Capacity at minimum head and reduced speed.	—	--	gpm
Approximate minimum pump speed.	1080	--	rpm
Maximum power required at pump input shaft at any point in the operating range.	250	250	bhp
Maximum power at shutoff head.	—	—	bhp
Efficiency.	80	80	%
Type of efficiency indicated.	Pump	Pump	
Efficiency calculated at.	Rated head	Rated head	
Pump designed for reverse rotation.	No	No	
Maximum “A” rated weighted noise at 3 ft.	87	87	dBa
Maximum unfiltered vibration velocity.	HIS	HIS	in/s
Minimum nominal size of pump column.	30	30	in
Minimum NSPHA at the suction flange at rated head.	40	40	ft
Minimum ratio of NSPHA to NPSHR.	1.1	1.1	
Nominal size of pump discharge.	16	16	in
Nominal diameter of pump barrel.	30	30	in
Maximum suction pressure.	—	—	psi
Nominal size of pump barrel inlet flange.	18	18	in
Vertical distance from center line of pump discharge to pump barrel inlet connection.	14	14	ft
Maximum length of any component or subassembly.	15	15	ft
Approximate clearance between crane hook and operating floor.	16	16	ft

Overall (wire-to-water) efficiency for constant speed pumps shall include losses in the pump and motor. Overall (wire-to-water) efficiency for variable speed pumps shall include losses in the pump, motor, adjustable frequency drive, and any transformers supplied as part of the adjustable frequency drive equipment.

Minimum shop test pressure on bowl assembly shall be 1.5 times the shutoff head plus maximum suction pressure where applicable.

The pump setting shall be as indicated on drawings.

For design and rating purposes, the water to be pumped shall be assumed to have a temperature of 85°F.

Pump performance shall be stable and free from damaging cavitation, vibration, and noise in the operating head range. The performance of pumps with an enclosed impeller shall be based on a radial running clearance between the bowl wearing ring and the impeller of not less than 6 mils, or 0.5 mil per inch of wearing ring diameter, whichever is greater.

2-3. MATERIALS.

Suction Strainer	Stainless steel
Pump Bowls	Cast iron, ASTM A48, Class 30.
Impellers	Silicon Bronze, ASTM B584 – 873.
Bowl Wearing Rings	Bronze, ASTM B505 – 927.
Bowl Assembly Shaft	Martensitic stainless steel, AISI Type 410 or 416.
Bowl Bearings	Bronze, ASTM B505-932, water lubricated, except suction case (bowl) bearing shall be permanently packed with water-resistant grease.
Lineshaft, stainless steel	Martensitic stainless steel shaft, AISI Type 410 or 416, with Martensitic stainless steel couplings of dissimilar alloy.
Open Lineshaft Bearings	Goodrich "Cutless Rubber", water lubricated.
Flanged Pump Column	AWWA C200 steel pipe at least 3/8 inch thick, with flanged couplings.
Stuffing Box Housing	Cast iron, ASTM A48, Class 30.
Stuffing Box Bearing	Bronze, ASTM B505-932, water, internal lubricated.
Stuffing Box Hardware	Corrosion-resistant metal.
Mechanical Seal	Single one piece balanced cartridge type; John Crane, Durametallc, or equal.
Water Slinger	Rubber or bronze.
Pedestal and Subbase	Cast iron or fabricated steel.

Pump Barrel	AWWA C200 steel pipe or ANSI/AWWA C151/A21.51 ductile iron pipe, at least 3/8 inch thick, with flanged couplings.
Pipe Thread Lubricant	Teflon paste type thread sealer suitable for potable water service where required.
Lineshaft Coupling Thread Lubricant	Jet-Lube "Nikal", John Crane "Thred Gard Nickel", Never-Seez "Pure Nickel Special", or Permatex "Nickel Anti-Seize".
Epoxy Coating	Ameron "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard 891", or Tnemec "Series N140 Pota-Pox Plus".

2-4. PUMP CONSTRUCTION. Each pump shall be the turbine type suitable for barrel installation.

2-4.01. Suction Bowl Inlet. Barrel pumps shall be equipped with a flared suction bowl inlet and a suction strainer.

2-4.02. Impellers and Bowls. Impellers shall be accurately machined, dynamically balanced, and securely locked on the pump shaft. Impellers shall be enclosed.

Balance rings which depend upon close running clearances to reduce the load on the drive unit thrust bearing will not be acceptable unless otherwise indicated.

Pump bowls shall be equipped with wearing rings designed to maintain pump efficiency. Wearing rings shall be securely locked in place so that they will not move or loosen during any condition of operation or handling, including reverse rotation of the pump.

Pump bowls shall be equipped with a re-placeable wear liner designed to maintain pump efficiency.

2-4.03. Shafting. All pump shafting shall conform to the applicable sections of the governing standard. Shaft diameter shall be not less than the minimum permitted for the applicable driver nameplate power rating. Shafting shall be open.

2-4.04. Lineshaft Sleeves. Not used.

2-4.05. Shaft Couplings. Shaft couplings shall transmit the maximum combination of torque and thrust and shall maintain alignment between adjacent shaft sections. Couplings shall be threaded type.

During assembly, anti-seize thread lubricant shall be applied to male threads of all threaded connections.

2-4.06. Bearing Retainers. Not used.

2-4.07. Lineshaft Enclosing Tube. Not used.

2-4.08. Pump Column. Pump column sections shall be so designed and constructed that accurate alignment will be obtained when the column is assembled. The type of couplings shall be flanged.

The pump column shall be long enough to locate the suction inlet a distance of at least equal to 1/3 times the bell diameter, but not more than 3/4 times the bell diameter above the wetwell floor.

The diameter of the pump column shall be uniform from the pump pedestal to the bowl discharge.

Column sections shall be provided with lifting lugs or dogs to facilitate pump removal. Lifting lugs or dogs shall be a least 12 inches below the column flange and shall be designed to prevent deflection of the column flange.

2.4.09. Lineshaft Stuffing Box. A high pressure stuffing box shall be provided at the top of the pump pedestal for sealing the lineshaft entry point.

The stuffing box shall be provided with a single mechanical seal suitable for vertical turbine pump service.

2-4.10. Seal Water Station. Not used.

2-4.11. Pedestal. Each pump pedestal shall be designed to support the drive unit and the entire pump assembly. Suitable openings shall be provided for access to the stuffing box and other accessories. A registered connection or dowels shall be provided between the motor and the pedestal. The tolerance of the registered fit shall be less than the stuffing box bearing tolerance so that when installed the shaft will not touch the stuffing box bearing. A suitable stuffing box leakage collector with a 1/2 inch tapped drain opening shall be provided. Each pocket shall have a drain connection.

2-4.12. Pump Discharge Outlets. Pump discharge outlets may have flanged ends. The pump discharge outlet shall be integral with the pedestal. The pump discharge outlet shall be above the floor.

The diameter and drilling of the flange shall conform to ANSI/ASME B16.1, Class 125.

A 1/2 inch NPT tapped and plugged pressure gauge connection shall be provided on the horizontal center line of the pump discharge outlet. The size and configuration of the connection shall conform to Figures 2.6.17 and 2.6.18 of the Hydraulic Institute Standards.

2-4.13. Mounting Flange. A mounting flange shall be provided as indicated on the drawings. The mounting flange shall be integral with a steel sleeve or barrel. Abutting surfaces of the mounting flange and pedestal shall be machined to provide uniform bearing. The flatness of the mounting surface shall be one mil per foot or better.

2-4.14. Pump Barrel. Barrel (can type) pumps, shall have barrels of the length and design recommended by the manufacturer, subject to review and acceptance by Engineer. Each pump

barrel shall be provided with suitable baffle and mounting flange. The mounting flange shall be designed for a gasket seal.

2-4.15. Shop Painting. All iron and steel parts which will be in contact with pumped liquid or submerged after installation, including the inside of the pump column and all exterior surfaces below the subbase plate or mounting flange, shall be shop cleaned by blasting in accordance with the coating manufacturer's recommendations and painted with an epoxy coating system. The coating shall have a dry film thickness of at least 10 mils and shall consist of a prime (first) coat and one or more finish coats. At least 1 quart of the finish material shall be furnished with each pump for field touchup.

All interior surfaces of pump barrel shall be shop cleaned by blasting in accordance with the coating manufacturer's recommendations and painted with an epoxy coating system. Exterior surfaces of pump barrels to be exposed shall be by blasting in accordance with the coating manufacturer's recommendations and painted with an epoxy coating system. The coating shall have a dry film thickness of at least 10 mils and shall consist of a prime (first) coat and one or more finish coats. Exterior surfaces of pump barrels to be encased in concrete are to be shop primed coated.

All other iron and steel surfaces, except stainless steel and machined surfaces, shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an oil-resistant enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.

2-5. ACCESSORIES.

2-5.01. Solenoid Oiler. Not used.

2-5.02. Anti-Reverse Device. Not used.

2-5.03. Drawdown Gauge. Not used.

2-5.04. Air Release Connection. An outlet connection shall be provided for mounting an air and vacuum valve as specified in the Air Release and Combination Air Valves section. The outlet connection shall be ___ in., threaded, and shall be located on the highest point of the pump.

2-6. DRIVE UNITS.

2-6.01. Electric Motors. Electric motors shall be designed as specified in the General Purpose Induction Motors section 16220.

Motor shaft shall be solid type.

For solid shaft motors, an adjustable coupling designed for vertical pump service shall be provided between each solid shaft motor and the shafting to permit removal of the motor without disturbing the pump. The coupling shall be flanged type, keyed to the shafts, and shall provide for vertical adjustment of the impeller with the motor in place.

Where mechanical seals are specified, the adjustable coupling shall be spacer type to permit removal of the mechanical seal without disturbing the motor.

If the motor is not shop tested with the pump, certified motor efficiency data shall be furnished to the pump supplier based on tests conducted on the motor or on an identical motor.

2-6.02. Stabilizer. Not used.

2-6.03. Adjustable Frequency Drives. HSP-1 and HSP-3 shall be furnished with an adjustable frequency drive. The design of each adjustable frequency drive shall be coordinated with the requirements of the pumping unit. The pump manufacturer shall be responsible for furnishing the adjustable frequency drive, for matching the motor and the drive, and for coordinating the collection of data and the design effort to limit harmonics to the levels specified.

Adjustable frequency drives shall be designed as specified in the Adjustable Frequency Drives section 16150.

2-7. SHOP TESTS. Each pump shall be tested at the factory for capacity, power requirements, and efficiency at specified rated head, evaluated head, shutoff head, operating head extremes, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall be made in conformity with the requirements and recommendations of the Hydraulic Institute Standards.

Each pumping unit shall be shop tested with the motor and adjustable frequency drive to be installed in the work. For pumping units with adjustable frequency drives, the wire-to-water efficiency test shall include the adjustable frequency drive (and isolation transformers if supplied with the adjustable frequency drive) to be installed in the work. Wire-to-water efficiency shall be based on certified efficiency data of the motor, adjustable frequency drive, and the isolation transformer if provided with the drive. Certified efficiency data shall be included in the report.

For pumping units 100 horsepower and larger, a certified test report shall be prepared. Five certified copies of a report covering each test shall be prepared by the pump manufacturer and delivered to Engineer not less than 10 days prior to the shipment of the equipment from the factory. The report shall include data and test information as stipulated in the Hydraulic Institute Standards, copies of the test log originals, test reading to curve conversion equations, and certified performance curves. The curves shall include head, pump input power, pump efficiency, and wire-to-water efficiency (when specified), rpm, and shop test NPSH available, plotted against capacity. The curves shall be easily read and plotted to scales consistent with performance requirements, with all test points clearly shown.

PART 3 - EXECUTION

3-1. INSTALLATION. Each pump will be installed in accordance with Equipment Installation section.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Startup Requirements section, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the contract price.

3-2.02. Installation Supervision. Installation supervision by the manufacturer is not required. The equipment manufacturer shall furnish a qualified field installation supervisor during the equipment installation.

All costs for these services shall be included in the contract price.

Manufacturers' installation supervisor shall observe, instruct, guide, and direct the installing contractor's erection or installation procedures. The equipment manufacturer will be provided with written notification 10 days prior to the need for such services.

End of Section

Section 11910

ENGINE-GENERATOR

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of one diesel fueled engine-driven electric generator unit. The engine-generator shall be located inside the pump station as indicated on the drawings.

Equipment designation.	Engine-Generator (EGEN)
Number of units.	1
Equipment tag numbers.	EGEN-971

The engine-generator shall be a skid-mounted package unit consisting of an engine, an alternator, auxiliary systems, controls, and accessories as specified, and as required for a complete operating system.

1-2. GENERAL. Equipment furnished under this section shall be assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Coordination. All equipment specified in this section shall be furnished through a single engine-generator manufacturer who shall be responsible for the design, manufacture, coordination, and proper installation and operation of the entire system.

The Contractor shall properly coordinate the work between the suppliers of equipment to be used with or connected to the engine-generator to ensure that all required provisions for mounting the accessories are included.

Equipment furnished under this section shall be assembled, erected, and placed in proper operating condition in full conformity with specifications of the equipment manufacturer unless exception are noted by the Engineer.

The engine-generator unit shall be a standard product of the manufacturer and shall be a packaged type unit, fully shop assembled, wired and tested, requiring no field assembly of critical moving parts.

Contractor shall verify that each component of the system is compatible with all other parts of the system; that all piping, materials, and motor sizes are appropriate; and that all devices necessary for properly functioning system have been provided.

Contractor shall, at his own expense, arrange for and obtain all necessary permits, inspections, and approval by the proper authorities in local jurisdiction of such work.

Requirements of the engine-generator specified herein shall be coordinated with the electrical section, plant control system section, miscellaneous steel piping section, the miscellaneous ball valves section, and the aboveground fuel storage tank section.

1-2.03. Governing Standards. Except where modified or supplemented by these specifications, all equipment and materials shall be designed and constructed in accordance with the latest applicable requirements of the standard specifications and codes of ANSI, ASTM, NEMA, IEEE, EEI, HEI, ISO, NFPA, SAE, and other such regularly published and accepted standards as well as state and local codes.

1-2.04. Power Supply. Site power supply provided will be 480 volts, 60 Hz, three phase for operation of the equipment and accessories. The engine-generator shall be provided with a power panel sized to power the required loads as specified herein. The engine (starting and controls) will operate from batteries specified herein. When needed, a control transformer shall be provided within the power panel for control supply.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete assembly and installation drawings, together with detailed specifications and data covering materials, drive unit, parts, devices and accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittals section. The data and specifications for each unit shall include, but shall not be limited to, the following:

Manufacturer, model, and type:

- Engine.
- Alternator.
- Battery charger and battery.
- Fuel oil cooler (if required by engine design).
- Silencer.
- Day Tank

Engine output horsepower and efficiency curves at rated capacity.

Fuel consumption at rated capacity.

Ratings at specified conditions:

- Engine (net horsepower).
- Engine (maximum performance horsepower bare engine).
- Generator kW at specified power factor.
- Volts.
- Amperes.

Overall dimensions and weight:

- Length.
- Width.
- Height.
- Net weight.

Wiring diagrams and schematics, including the engine control panel and generator line circuit breaker.

Alternator insulation class and temperature ratings.

- Alternator winding pitch.
- Calculations or test results showing compliance with specified motor starting and voltage dip requirements.
- Generator line circuit breaker rating.
- Control panel layout, identifying location of all instrumentation being supplied.
- Engine drawing to include location of all piping connections.
- Operation instructions.
- Letter from the engine-generator manufacturer confirming that the unit will provide the specified minimum kW rating at the specified design conditions and time duration.
- Battery sizing calculations.
- Battery charger sizing calculations.
- Maximum output short circuit kVA available.
- Exhaust gas emission data, maximum valves at loads of 1/2, 3/4, and full:
 - Carbon Monoxide (CO), lb/hr
 - Nitrogen Oxides (NO_x), lb/hr
 - Sulfur Dioxide (SO₂), in lb/hr
 - Particulate Matter (PM), in lb/hr
 - Temperature, F
 - Flow, acfm
- Equipment skid drawing including material list.
- Calculations indicating pressure loss at the specified power outage capacity of the unit and that the exhaust silencer provides sound attenuation equal to or greater at the specified frequencies.
- Certificate of compliance.
- Name, address and phone number of the manufacturer's repair facility.

1-3.02. Operation and Maintenance Manuals. Adequate operation and maintenance information shall be supplied as required in the Submittals section. Operation and maintenance manuals shall be submitted in accordance with the Submittals section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

1-5. SPARE PARTS. The following spare parts and accessories shall be furnished in substantial wooden boxes with identifying labels and delivered to the vicinity of the project site or the Owner as directed:

<u>Spare Parts</u>	<u>Quantity</u>
Air filters.	2 sets
Oil filters.	4 sets
Fuel filters.	12 sets
V-belts.	1 sets

All spare parts shall be provided in waterproof packages suitable for export service, labeled with its description and part numbers. Each item or set of parts expected to be installed at one time shall be in an individual package. All special tools required for routine maintenance of the equipment shall be provided with the spare parts. The spare parts shall be stored as directed by the Owner.

If any of the above spare parts are used during the installation process, they shall be replaced by the manufacturer at no cost to the Owner.

PART 2 - PRODUCTS

2-1. **SERVICE CONDITIONS.** The engine-generator unit shall be designed to operate under the following service conditions:

Ambient air temperature range.	15 to 110	°F
Site elevation.	50	ft

The engine-generator unit will be used as a power unit for selected electrical loads when utility-supplied power fails.

The engine-generator shall automatically start and connect to the electrical loads when initiated from the switchgear automatic transfer controls.

Fuel for the engine-generator will be furnished from a day tank, as specified herein, and an aboveground fuel storage tank as specified in the Aboveground Fuel Storage Tank section.

The engine-generator supplier shall provide the correct amount and grade of crankcase oil, coolant, and other fluids (except fuel) necessary for initial testing and operation.

2-2. **PERFORMANCE AND DESIGN REQUIREMENTS.** The engine-generator unit shall be designed for the operating conditions and requirements as follows:

Tag number	EGEN-971	
Generator		
Minimum power rating capacity with accessories, for generator voltage output and service conditions specified herein.	600	kW
Output frequency.	60	Hz
Output voltage.	480	VAC
Output power factor.	0.8	
Output phase and configuration.	Three phase, 4 wire, wye configuration	

Maximum voltage dip.	See performance table	
Engine		
Fuel supply.	No. 2 diesel	
Maximum speed.	1,800	Rpm
Minimum piston displacement.	1,100	in ³
Black start required.	Yes	
Guaranteed Emissions	Tier 2	

The engine-generator shall be designed to operate during a power outage for a minimum of 24 continuous hours and a maximum of 100 hours per year.

Engine-generators submitted with ratings in excess of current published data will not be acceptable.

The engine-generator shall at a minimum meet the Environmental Protection Agency New Source Performance standard emission regulations.

The engine-generator supplier shall coordinate with the local air quality management authority to ensure the equipment meets all current local air emissions requirements. Field testing of actual emissions will be required per section 3-3 to determine compliance with the emissions requirements.

The engine-generator unit furnished shall be of a design that can be accommodated in the space as indicated on the drawings.

Any special fittings or piping required for connection to fuel piping shall be furnished and installed.

The engine-generator shall satisfactorily start the following loads in the listed order, while meeting the specified voltage dip.

<u>Load Step</u>	<u>Load Description</u>	<u>Rating</u> (hp)	<u>Voltage</u> <u>Drop</u>	<u>Comments</u>
Step 1	Lighting Loads	35 kVA	20%	Across the line
Step 2	HVAC Loads	50kVA	20%	Across the line
Step 3	High Service Pump #1	250 hp	10%	AFD
Step 4	High Service Pump #2	250 hp	15%	RVSS

2-3. ACCEPTABLE MANUFACTURERS. The engine-generator shall be a current production model. The engine-generator shall be manufactured by the supplier Caterpillar, Cummins, or Kohler.

The manufacturer of the engine-generator unit shall have a full-time, fully factory trained technical staff and an equipped 24 hour service facility having all personnel and all equipment required to maintain, repair, or overhaul the engine-generator unit and associated equipment.

2-4. ENGINE-GENERATOR UNIT.

2-4.01. Engine. The engine shall be 4-stroke cycle type and shall be equipped with the following:

Electronic governor for isochronous regulation of engine speed from no load to full load alternator output.

Dry type air cleaner with replaceable elements.

2-4.02. Alternator. The engine-generator alternator shall be a 4 pole, revolving field design with temperature compensated solid state voltage regulator, brushless rotating rectifier exciter system, and drip-proof construction with amortisseur windings. The alternator shall be directly connected to the engine flywheel housing, and the rotor shall be driven through a semi-flexible driving flange to ensure permanent alignment.

Frequency regulation shall be isochronous ± 0.15 Hz from no load to rated load. Voltage regulation shall be within ± 2 percent of rated voltage, steady state, from no load to full load. The momentary voltage drop shall not exceed the specified percent without starter coils dropping out or stalling the engine at any time when applying or starting the specified loads. Recovery to stable operation shall occur within 2 seconds.

The alternator shall have Class F insulation as defined by NEMA MG1-1.65 and temperature rise shall be within NEMA MG1-22.40 definition at rated condition.

Three current transformers shall be furnished and installed in a box on the generator for generator differential current protection. This requires all the winding leads to be brought outside the generator before forming the neutral. After the neutral is formed, a current transformer shall be provided in the box for generator ground fault relaying. The ground fault current transformer may be installed in the neutral grounding resistor as an alternative. The characteristics of the current transformers used for differential protection shall be coordinated with those supplied in the generator switchgear. Current transformer ratios are indicated on the drawings and shall be confirmed by the coordination study.

The alternator conduit box shall be sized to accommodate the separate phase leads, neutral leads, current transformers, voltage surge arrestors and capacitors, and connections as indicated on the electrical one-lines.

The winding pitch shall be 2/3 pitch.

Harmonic filters shall be provided where determined by the supplier for proper operation when powering solid-state motor starters.

2-4.02.01. Surge Protection. The engine-generator shall be provided with a voltage surge protection system installed in the generator terminal box or in a separate enclosure near the generator terminal box.

2-4.03. Fuel System. The engine-generator unit shall be furnished with a complete fuel system including engine-driven fuel pump, packaged day tank, tank supply and return pumps, engine supply and return line, and with all accessories as required for proper operation. All items shall be suitable for the specified fuel and located inside the engine-generator room. The engine driven fuel pump shall transfer the fuel from the day tank to the engine-generator.

All stainless steel flexible connectors shall be provided for the fuel supply and return lines.

A combination fuel filter/separator shall be located upstream from the flexible connector. The combination fuel filter/separator shall be a manifold unit with shutoff valves and shall permit servicing the filter/separator without engine shutdown. This shall permit valving off one filter/separator and bypassing the fuel to the other filter/separator. Filter/separator shall be manufactured by Racor or equal.

Fuel oil coolers shall be provided if the engine fuel system absorbs heat from the unit injectors and surrounding jacket water. The fuel cooler shall be a radiator mounted, air cooled unit that uses the air flow from the radiator for the cooling airflow. To prevent overheating of the fuel in the day tank, the fuel oil cooler shall be adequately sized to cool the return fuel from the engine to the required fuel inlet temperature.

The day tank shall be a packaged day tank with rupture basin as manufactured by Simplex or equal. The day tank shall meet all EPA, state and local requirements, be UL listed, vented, and shall normally be used to store the specified petroleum product at atmospheric pressure.

The day tank shall have minimum usable capacity of 100 gallons. The day tank shall be of welded steel construction throughout.

The day tank package shall include the following items:

- Motor driven gear supply pump complete with starter and disconnect for supplying fuel to the day tank from the fuel storage tank. Minimum supply pump capacity of 7 gpm with 1/2 hp, 208 volt, 60 Hz, 3 phase motor.

- Motor driven gear overflow/return pump complete with starter and disconnect for supplying fuel to the fuel storage tank from the day tank. Minimum return pump capacity of 7 gpm with 1/2 hp, 208 volt, 60 Hz, 3 phase motor.

- 1 gpm hand pump.

- Rupture basin.

- Strainer on fuel inlet.

- Vent cap.

- Level gauge capable of measuring the fuel level without the engine running.

- Control panel.

- Priming tee assembly.

- Primary tank emergency vent.

- Tank siphon type drain with priming tee, firesafe shutoff valve and cap. Rupture basin drain with firesafe shutoff valve and cap.

The following connections shall be provided with the day tank:

- Engine Fuel supply.
- Engine Fuel return.
- Fuel Inlet
- Fuel Overflow/return.
- Inspection.
- Level gauge.
- Vent.
- Primary tank emergency vent.
- Float switch for control of fuel supply pump.
- Float switch for control of fuel overflow/return pump.
- Leak detection.
- Low level switch.
- Low Low level switch.
- High level switch.
- High High level switch.
- Rupture basin drain with cap.
- Tank pump out with cap.

Controls for the day tank shall include, but not be limited to the following:

“Hand-Off-Auto” selector switch to control operation of the fuel supply pump in the “Auto” mode based on the fuel level in the day tank.

Low level switch (LSL) with electrically isolated contacts for control of the fuel supply pump (ON) and to close AC powered solenoid valve for siphon-break.

Low-Low level switch (LSLL) with electrically isolated contacts for remote annunciation. The Low Fuel alarm shall be set to annunciate when the tank contents above the engine supply connection drop below 25 percent of the tank’s capacity.

High level switch (LSH) with electrically isolated contacts for control of the fuel supply pump (OFF) and to open AC powered solenoid valve for siphon-break. Tank levels corresponding to fuel supply pump ON/OFF setting shall be as recommended by the manufacturer.

High-High level switch (LSHH) with electrically isolated contact for remote high level annunciation and to control operation of overflow/return pump based on the fuel level in the day tank. Tank levels corresponding to the fuel supply pump ON/OFF setting shall be as recommended by the

manufacturer.

Level switch with electrically isolated dry contacts for remote leak detection on the engine control panel and to stop the supply pump.

Test push button for overflow/return pump.

The day tank control panel shall include, but not limited to, the following items.

- Continuous reading level gauge
- Lights for the following conditions:
 - High level alarm.
 - Power available.
 - Not in “Auto”.
 - Pump running indicator.
 - Rupture basin leak alarm.

The control panel shall be provided, at a minimum, with all of the items listed above and shall be prewired by the manufacturer to terminal strips with the unit, with the exception of the power supply, anti-siphon solenoid valve and remote alarms, which shall be provided with terminals for field wiring.

The rupture basin shall be open top, encircle the tank to prevent spilling of any leaked fuel from the primary tank from contaminating the engine-generator room, and be sized to contain minimum 110 percent of the tank’s capacity.

A suitably sized vent connection and vent cover shall be provided for the day tank. The vent cover shall be installed outside the building and shall have an aluminum body, a screen over the outlet, and shall be designed to prevent rainwater from entering the line.

Suitably sized emergency vent connections for the primary tank and secondary tank emergency vents shall be provided for the day tank. The emergency relief vent shall be installed outside the building and shall be designed to relieve excessive internal pressure caused by fire exposure.

The vent line and the emergency relief vent shall terminate just outside the building.

A siphon-break, normally open, solenoid valve shall be provided at the highest point of the fuel supply line. The anti-siphon valve shall be pope back to the above ground fuel storage tank vent line rise pipe to prevent moisture from entering the valve as indicated on the drawings. The valve shall be used to break siphon when open and to make siphon when closed. It shall be connected to the day tank level controller to energize (close) whenever fuel is required.

2-4.04. Exhaust System. The engine-generator unit shall be furnished with a complete exhaust system including an exhaust silencer, exhaust piping, stainless steel bellows expansion joints, and accessories required for a complete operating system.

The silencer shall be a 10 inch size for Caterpillar and Cummins units and 12 inch size for Kohler unit and shall be chamber type, all welded AISI Type 304L stainless steel construction, with 1 inch drain connection complete with stainless steel threaded plug. The exhaust silencer shall be furnished with suitable stainless steel bracket supports for vertical mounting as indicated

on the drawings. The brackets supports shall extend a minimum of 6 inches from the side of the silencer. The silencer shall be reinforced to withstand a horizontal force of 1,000 pounds at the inlet connection, and shall be provided with a maximum of 10 inch side inlet (12 inch for Kohler) and 10 inch top outlet flange (12 inch for Kohler) connections. The centerline of the inlet connection shall be located 48-inches above the bottom end of the silencer as indicated on the drawings. Silencers shall be Maxim “M51”, Nelson “400” or equal.

The silencer shall be provided with stainless steel support legs suitable for bolting to the bracket supports with the silencer. The combination of the length of the legs, the location of the inlet connection, and the location of the bracket supports shall be such that the bottom of the exhaust silencer is not less than 10 8 feet above ground level. Suitable stainless steel mounting plate shall be provided for attaching the legs to a concrete base, as indicated on the drawings. The support legs shall be designed to withstand a wind velocity of 120 mph.

Minimum silencer attenuation for the following mid band frequencies shall be as follows:

63 Hz	22	dB
125 Hz	30	dB
250 Hz	35	dB
500 Hz	33	dB
1,000 Hz	29	dB
2,000 Hz	28	dB
4,000 Hz	28	dB
8,000 Hz	29	dB

Expansion joints, anchors, hangers, and supports shall be provided for the exhaust piping so that no load is transmitted to the engine exhaust connections from engine flexing, exhaust pipe weight, or thermal expansion.

The expansion joint in the vertical rise immediately above the engine exhaust connection shall be provided with a suitable flange on one end for attaching the engine exhaust connection and a 10 inch (12 inch for Kohler) butt welded connection on the other end.

The expansion joint in the horizontal piping shall be provided with butt welded connections. Each expansion joint shall be three-ply, bellows type, fabricated of all stainless steel, and shall be designed for 4-1/2 inch axial compression. The expansion joints shall be Hyspan “Series 2500” or equal. Insulation shall not be applied over the expansion joints.

The exhaust shall discharge vertically at the silencer outlet. A rain cap shall be provided to prevent rain from entering the exhaust pipe. The rain cap shall open from exhaust pressure from the engine and shall close when exhaust flow stops. The cap shall be stainless steel counterbalancing with vertical discharge.

Exhaust emission test ports shall be provided in the exhaust piping after the silencer. Ports shall be threaded and shall be provided with stainless steel threaded caps.

2-4.05. Starting System and Control Power. The engine-generator unit shall be furnished with a complete electric motor start system including starting motors, battery pack with rack, cables, and battery charger.

The batteries shall be of the high rate, nickel-cadmium type and have a 24 volt output. The battery shall be electrically sized for the engine furnished to maintain minimum cell voltages of 0.65 volt per cell during initial starting, and 0.85 volt per cell throughout the cranking time for five consecutive starting attempts of 10 seconds each. Battery voltages shall be maintained under the conditions specified herein.

The battery charger shall be suitable for the nickel-cadmium battery pack. The charger shall have a DC output suitable to supply power for all continuous loads and to recharge the batteries from a fully discharged state to normal operating voltage within 8 hours. The battery charger shall be provided with a NEMA 2 corrosion resistant enclosure. The battery charger shall be provided with the following: on/off switch, DC ammeter, DC voltmeter, AC input and DC output circuit breakers or fuses, floating voltage equalization, equalizing timer, and relays with form c contacts for remote annunciation of loss of AC power, low battery voltage, and high battery voltage.

The batteries, battery rack, and battery charger shall be located inside a separate vented enclosure. The battery rack frame shall be constructed of corrosion resistant material.

The engine-generator shall automatically supply power to the remote bus that powers the battery charger when it is operating and when utility power is not available.

2-4.06. Cooling System. The engine-generator unit shall be cooled with unit-mounted radiator cooling system complete with radiator, radiator duct flange, expansion tank, water pump, belt-driven fan, fan guard, thermostatic temperature control, high-water temperature cutout, electric jacket water heater and all accessories required for proper operation. The radiator shall be sized with sufficient capacity for cooling of the engine and all other accessories required for proper operation. The fan shall draw air over the engine and discharge through the radiator.

The radiator shall be ducted as indicated on the drawings for discharge outside the building. Radiator ducting, intake and exhaust louvers, dampers and damper operators are specified in the louver and vent sections and the heating and ventilating, and air conditioning sections.

A fabric type flexible connection shall be installed on the radiator air outlet duct flange to the discharge duct. Fabric shall be of sufficient width to provide space of approximately 4 inches between connected items. The flexible connections shall be UL listed, minimum 30 ounce, glass-fiber fabric, and coated on both sides with neoprene. The connection material shall be furnished by Elgen Manufacturing Company, Ventfabrics, Inc., or equal.

The cooling system shall be filled with a permanent antifreeze mixture of the ethylene glycol type with rust inhibitor.

The electric jacket water heater shall be furnished to maintain jacket water at 90°F with a winter ambient temperature as specified herein. The jacket water heater shall be thermostatically controlled.

2-4.07. Control Panel. The engine-generator unit shall have a generator mounted control panel which shall be provided with vibration isolators to prevent damage to the instruments from engine-generator vibration.

Adequate clearance shall be provided between the panel and the engine to allow engine maintenance without moving the control panel.

The control panel shall be automatic and safety type and shall, at a minimum, include all items required by NFPA 110, Level 1 in addition to the following instruments and control devices:

Tachometer.

Non-resettable hour meter.

AC voltmeter, AC ammeter, voltmeter/ammeter selector switch with “off” position.

Two normally open dry contacts which close when the engine is running and open with it is stopped.

Dry contact that closes for remote common alarm.

Dry contact that closes when the control selector switch is in “auto” mode.

Indicating lights with common alarm for the following:

Day tank low fuel level.

Day tank leak detection.

Day tank high fuel level.

The control panel shall be provided with a three-position selector switch with the following positions: “RUN-OFF-AUTO”. In the “RUN” position, the engine starting sequence shall be initiated providing local control for maintenance. In the “AUTO” position, the engine-generator will be remotely started and stopped by a run contact from the automatic transfer switch. Isolation contacts for when the unit is in the “AUTO” position shall be provided for remote indication.

2-4.08. Crankcase Vent Blow-By Absorber. Suitable crankcase breather system shall be provided by engine-generator supplier to remove oil mist from the crankcase prior to induction in to the air intake system. The system shall meet the applicable Tier level emission requirements.

2-4.09. Power Panel. The engine-generator unit shall have a 12 minimum circuit load center including a 480 to 120 VAC transformer powered from a generator connected bus as indicated on the drawings, with two full capacity taps, main and feeder breakers, rated as needed. The load center shall be mounted inside the enclosure and isolated from generator vibration. The load center shall be pre-wired to all engine generator accessories as needed. The power panel shall supply power to the following:

Engine-generator starting system battery charger.

Fuel system.

Engine jacket water heater.

2-4.10. Generator Line and Generator Component Overcurrent Protection. A generator line circuit breaker rated for the generator output voltage, having the trip rating indicated on the drawings, shall be provided on the output terminals. The line circuit breaker shall be pre-wired to the generator output terminals, and shall be provided within the generator enclosure in outdoor applications or shall be furnished in a skid mounted NEMA 1 enclosure for indoor applications.

Overcurrent protection devices shall be provided as needed by the system design to protect generator rotor and excitation system components.

2-4.11. Limiting Dimensions. The engine-generator unit fabricated shall be of a design that can be accommodated in the space available as specified herein and as shown on the drawings. Any special fittings or piping required for connection to fuel piping or exhaust piping shall be furnished and installed.

2-5. SHOP PAINTING. All steel and iron surfaces shall be protected by suitable coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, engine, alternator, enclosure, piping, and valves shall be shop primed and finish painted prior to shipment to the site.

Stainless steel, nonferrous, and nonmetallic surfaces shall not be painted.

2-6. SHOP TESTS. The manufacturer shall shop test the engine-generator set with its control panel and unit mounted radiator to demonstrate that the equipment conforms to specified requirements for load capacity.

All items included on the control panel shall be assembled, wired, and tested in the manufacturer's shop.

The tests shall consist of repeated starts and stops, operation under a load bank at specified capacity frequency, voltage, phase, and power factor for a minimum of 1 continuous hour, and tests to demonstrate that each safety shutdown device is working properly. Contractor shall submit certified copies of the shop test results prior to shipping the unit.

2-7. AIR EMISSIONS PERMIT. Contractor shall be responsible for preparing and submitting air emissions permit application on behalf of the Owner to the local air quality authority for the unit being supplied based on the maximum number of operating hours specified herein and guaranteed emissions.

Permit to include provisions for the Owner to contact the local air quality authority for permission to operate the unit in the even the permit hours may be exceeded due to unforeseen conditions.

2-8. OPERATION INSTRUCTION. Step-by-step instructions shall be furnished by the engine manufacturer for the unit. The instructions shall include, but not be limited to, the following procedures or information:

Startup of the unit.

Normal shutdown of the unit.

Emergency shutdown of the unit.

Normal operation of the unit, typical temperatures, pressures, speed, etc., for gauges and instruments which are displayed on the panel.

The operation instructions shall be submitted for review in accordance with the submittals section. When the review is complete, the instruction sheets shall be printed on heavy paper or cardboard stock and laminated with clear plastic. Two copies of the laminated instructions shall be furnished with the unit. One copy shall be located or displayed at the control panel for the unit. The reserve copy shall be delivered to Owner. The instructions specified here are in addition to the operation and maintenance manuals required by the submittals section.

PART 3 - EXECUTION

3-1. INSTALLATION. The engine-generator will be installed in accordance with the Equipment Installation section.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. When required, an experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Startup Requirements section, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the contract price. Contractor shall include a minimum of ___ day(s) and ___ trip(s) to the site.

3-2.02. Installation Supervision. Manufacturers' installation supervisor shall observe, instruct, guide, and direct the installing contractor's erection or installation procedures. The equipment manufacturer will be provided with written notification 10 days prior to the need for such services.

3-3. FIELD TESTING. Manufacturer's field services shall be provided for field testing. All costs for these services shall be included in the contract price.

3-3.01. Performance Test. The unit shall be mechanically checked for proper operation. Each alarm and safety shutdown shall be checked by artificially simulating an alarm condition. Defective equipment and controls disclosed by the tests shall be replaced or corrected, and the packages placed in satisfactory operating condition.

The engine-generator set shall be tested to demonstrate that the equipment conforms to specified requirements for load capacity, and starting duty.

The complete system (engine, generator, fuel system, fuel storage tank, and control panel) shall be field tested together by the manufacturer as a complete system to assure compatibility.

The test shall consist of repeated starts and stops, operation under a load bank at the specified power rating and power factor for the duration listed below. Before each test, the engine shall be brought to steady state conditions as determined by the instrument reading.

- Four (4) continuous hours at specified power rating and power factor within normal operating conditions of the unit without any alarm conditions.
- Four (4) starts of the specified loads in the order listed followed by 30 minutes of continuous operation per start all within normal operating conditions of the unit without any alarm conditions.
- Demonstration of four (4) starts.

Contractor shall furnish the lubricants, load bank, and the fuel for the tests.

At the option of the Owner, an independent laboratory will be provided by the Owner for the exhaust gas sampling and analysis during the 4 hour load test of the engine. The laboratory analysis will be used for verification the units meets the guaranteed emissions.

Any retesting or modifications to the equipment to meet the above requirements and emission guarantees shall be approved by the Engineer. All costs of modifications and retesting, including the independent laboratory for air emission testing, shall be at no cost to the Owner.

The following items shall be measured, recorded at 15 minute intervals, and submitted in a field test report:

Outdoor ambient temperature.

Indoor ambient temperature.

Barometric pressure.

kW output.

Engine speed, rpm.

Engine jacket water temperature.

Engine oil pressure.

Start time.

Completion time.

Test reports shall verify that the specified tests have been performed and shall state results. Test results shall be submitted as required in the Submittals section.

3-4. TRAINING. The manufacturer shall conduct on-site training to instruct the Owner on operation and maintenance of the units. The training shall be arranged and coordinated with the Owner through the Contractor. All costs for these services shall be included in the contract price. The training program shall not be less than 2 hours in duration (and up to 4 hours if required by the Owner) and the class size shall be up to 5 persons selected by the Owner.

End of Section

DUCTILE IRON PIPE

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of ductile iron pipe. Ductile iron pipe shall be furnished complete with all fittings, jointing materials, pipe hangers and supports, anchors, blocking, encasement, and appurtenances. Piping shall be furnished by Owner.

Piping furnished hereunder shall be complete with all joint gaskets, bolts, and nuts required for installation of any valves and equipment furnished by others for installation under this contract.

Pipe hangers and supports, pressure and leakage testing, cleaning, disinfection, and cathodic protection are covered in other sections. Cast iron soil pipe is covered in the Miscellaneous Piping section. Pipe trenching, embedment, and backfill are covered in the Trenching and Backfilling section.

For other materials permitted as an alternative to ductile iron pipe, see Pipeline Schedule. and Polyvinyl Chloride (PVC) pipe will be permitted as an alternative to ductile iron pipe.

1-1.01. Main Pipe Supplier. All ductile iron pipe, fittings, and specials shall be fabricated, lined, coated, and furnished under the direction and management of one pipe supplier, (the Main Pipe Supplier). The Contractor shall designate the Main Pipe Supplier and notify them in writing of their responsibilities, which shall include, at a minimum; ensure and certify that all pipe, fittings, specials, and other materials specified herein, are being manufactured in full accordance with the contract documents; prepare and submit all submittal information and shop drawings; and make any corrections that may be required to submittal information and shop drawings.

1-1.02. Main Pipe Supplier's Experience and Field Services. The Main Pipe Supplier's minimum required experience qualifications shall include manufacture of a pipeline at least 1 mile [1.6 km] in length, of a diameter equal to or larger than the pipe to be provided, with joints, lining, and coating suitable for the same or a higher pressure rating, which has performed satisfactorily for the past 5 years.

All ductile iron pipe shall be installed in accordance with the Main Pipe Supplier recommendations.

1-2. SUBMITTALS. Drawings, details, specifications, and installation schedules covering all ductile iron pipe and accessories shall be submitted in accordance with the Submittals section. The drawings and data shall include, but shall not be limited to, the following:

Certification by manufacturer for each item furnished in accordance with the ANSI/AWWA Standards.

Restrained joints details.

Certification of pipe manufacturer's field services, including a copy of the initial services, and all subsequent inspection reports.

Certification of gaskets, certifying that gasket material is suitable for services intended.

Certification of joint lubricant.

Certification of proof-of-design tests for joints, including restrained joints.

Certification of pipe manufacturer or fabricator and certification of proof-of-design tests for welded-on outlets.

Laying schedule complete with an explanation of all abbreviations used in the schedule. For long, straight pipe runs, the laying schedule shall list the pipeline station and centerline elevation at least every 100 feet.

Two samples of the polyethylene encasement, each sample clearly identified as required by the Governing Standards and test results from an independent third party laboratory of the requirements specified in ANSI/AWWA C105/A21.5. The method that the Contractor proposes to use for measuring deflection of pipe joints.

Submittal data shall clearly indicate the country of origin of pipe, fittings, flanges, restraining devices, and accessories.

Contractor shall submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-2.01. Emergency Repair Manual. Not used.

1-3. SHIPPING, HANDLING, AND STORAGE. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section, and as specified herein.

Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Equipment, tools, and methods used in handling and installing pipe and fittings shall not damage the pipe and fittings. Hooks inserted in ends of pipe shall have broad, well-padded contact surfaces. Unpadded hooks, wire brushes or other abrasive tools shall not be permitted to come into contact with polyethylene lining if such lining is specified.

Contractor-furnished pipe and fittings in which the lining has been damaged shall be replaced by and at the expense of Contractor. With the concurrence of Engineer, small and readily accessible damaged areas may be repaired.

If the lining of Owner-furnished pipe or fittings is damaged by Contractor during unloading or handling, the damaged pipe or fittings shall be replaced by and at the expense of Contractor. Where the damaged areas are small and readily accessible, Contractor may be permitted to repair the lining.

Contractor shall repair any damage to pipe coatings before the pipe is installed.

PART 2 - PRODUCTS

2-1. PIPE CLASS. The class of ductile iron pipe shall be **Class 250**. The specified class includes service allowance and casting allowance.

Pipe wall thickness for grooved and threaded end pipe shall be increased if necessary to comply with the following minimum thickness:

<u>Pipe Size</u>		<u>Minimum Class</u>	
<u>inches</u>	<u>Mm</u>	<u>Threaded Ends (1)</u>	<u>Grooved Ends (2)</u>
4-16	100-400	53	53
18	450	53	54
20	500	53	55
24	600	53	56
30-54	750-1400	53	--
60 & 64	1500-1600	350	--

(1) Complies with ANSI/AWWA C115/A21.15 for minimum pipe wall thickness for threaded flanges.

(2) Complies with ANSI/AWWA C606 for grooved and shouldered joint ductile iron pipe.

2-2. MATERIALS

Pipe	Ductile iron, ANSI/AWWA C151/A21.51, Table 1 or Table 3.
Gaskets – All Joint Types	<p>Synthetic rubber; natural rubber will not be acceptable. Gaskets for potable water service shall be certified as suitable at the pipe pressure and for chlorinated and chloraminated potable water; a certificate of gasket suitability shall be submitted. Gaskets shall be furnished by the pipe manufacturer.</p> <p>Gas and oil-resistant gaskets shall be made of Nitrile (NBR [Acrylonitrile Butadiene]) rubber. The name of the material shall be permanently marked or molded on the gasket. Gaskets shall be certified as suitable where soils may be contaminated with gas and oil products. A certificate of gasket suitability shall be submitted.</p>
Joint Lubricant	Vegetable-based lubricant recommended by the pipe manufacturer. Petroleum or animal-based lubricants will not be acceptable. Lubricants that will be in contact with treated or potable water shall be certified as being in compliance with ANSI/NSF 61.

Fittings		ANSI/AWWA C110/A21.10 (except shorter laying lengths will be acceptable for U.S. Pipe), or ANSI/AWWA C153/A21.53, minimum working pressure rating as follows, unless indicated otherwise on the drawings.		
<u>Fitting Size</u> in. [mm]	<u>Material</u>	<u>Type</u>	<u>Min. Working Pressure Rating,</u> psi [kPa]	
4 to 24 [100 to 600]	DI	Mechanical and Push-on joints	350 [2,400]	
4 to 24 [100 to 600]	DI	Flanged joints	250 [1,700]	
30 to 48 [750 to 1,200]	DI	All joints	250 [1,700]	
54 to 64 [1,350 to 1,600]	DI	All joints	150 [1,000]	
All fittings shall be ductile iron and suitable for a factory test pressure of rated working pressure plus 100 psi or 1.5 times rated working pressure, whichever is less, without leakage or damage.				
Push-on Joints		ANSI/AWWA C111/A21.11.		
Restrained Push-on Joints, gaskets with stainless steel gripping segments, (4 inch through 12 inch) [100 mm through 300 mm]		American "Fast Grip" or "Field Lok 350 Gasket" manufactured by U.S. Pipe and furnished to licensed Tyton® joint manufacturer.		
Restrained Push-on Joints, locking wedge type, (4 inch through 24 inch) [100 mm through 600 mm]		EBAA Iron "Megalug" Series 1700; U.S. Pipe "TR Flex Gripper Ring"; Star Pipe Products "StarGrip 3100"; or American "Field Flex Ring", without exception.		
Restrained Push-on Joints, positive locking segments and/or rings, (4 inch through 64 inch) [100 mm through 1,600 mm]		American "Flex-Ring," or "Lok-Ring"; Clow "Super-Lock"; U.S. Pipe "TR Flex"; or Griffin "Snap-Lok."		

Mechanical Joints	ANSI/AWWA C111/A21.11.
Restrained Mechanical Joints (factory prepared spigot), (4 inch through 48 inch) [100 mm through 1,200 mm]	American "MJ coupled Joints", or Griffin "Mech-Lok".
Restrained Mechanical Joints, (field cut spigot), (4 inch through 24 inch) [100 mm through 600 mm]	EBA Iron "Megalug" Series 1100, or Star Pipe Products "StarGrip 3000" without exception.
Mechanical Joints with Tie Rods	As indicated on the drawings.
Tie Rods	ASTM A307.
Steel Pipe	ASTM A53, Schedule 40 or 80 as indicated on the drawings.
Washers	ANSI/ASME B18.22.1, plain steel.
Mechanical Couplings	
Couplings	Dresser "Style 38"; Smith-Blair "r 411 Steel Coupling"; or Romac "Style 400" or "Style 501"; without pipe stop.
Gaskets	Oil-resistant synthetic rubber. Gaskets shall be furnished by the pipe manufacturer. Gaskets for potable water service shall be certified as suitable for chlorinated potable water; a certificate of gasket suitability shall be submitted.

Shop Coating and Lining

Cement Mortar Lining with Seal Coat	ANSI/AWWA C104/A21.4.
Ceramic Epoxy Lining	Induron "Protecto 401 Ceramic Epoxy".
Glass Lining	Two-coat system applied over blast-cleaned surface; ground and finish coats separately fired; finished lining thickness at least 8 mils [200 μm], Mohs' Hardness 5 to 6 density [2,500 to 3,000 kg/m ³] as determined by ASTM D792; Fast Fabricators, Inc. "MEH 32" or "SG-14".

Universal Primer	Manufacturer's standard. If in contact with treated or potable water, certify as being in compliance with ANSI/NSF 61.
Asphaltic Coating	Manufacturer's standard.
Coal Tar Epoxy	Manufacturer's standard.
Liquid Epoxy	ANSI/AWWA C210, non-coal tar modified, or when in contact with treated or potable water, certify as being in compliance with ANSI/NSF 61.
Medium Consistency Coal Tar	Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol."
Polyethylene Encasement	Seamless, ANSI/AWWA C105/A21.5; LLDPE - 8 mil [200 µm] or HDCLPE - 4 mil [100 µm].

2-2. SHOP COATING AND LINING. The interior of all pipe and fittings, unless noted otherwise, shall be cement mortar lined and seal coated. The interior of all air piping shall be unlined and uncoated.

The exterior surfaces of all pipe and fittings which will be exposed in interior locations shall be shop primed. Flange faces shall be coated with a suitable rust-preventive compound. Exterior surfaces of all other pipe and fittings shall be coated with asphaltic coating.

PART 3 - EXECUTION

3-1. INSPECTION. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; pipe ends shall be examined with particular care. All defective pipe and fittings shall be removed from the site.

3-2. PREPARATION. The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter prior to installation. Before jointing, all joint contact surfaces shall be wire brushed if necessary, wiped clean, and kept clean until jointing is completed.

Precautions shall be taken to prevent foreign material from entering the pipe during installation. Debris, tools, clothing, or other objects shall not be placed in or allowed to enter the pipe.

3-3. CUTTING PIPE. Cutting shall be done in a neat manner, without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the ends of the pipe shall be dressed with a file or a power grinder to remove all roughness and sharp edges. The cut ends of push-on joint pipe shall be suitably beveled.

All field cutting of existing gray cast iron pipe shall be done with mechanical pipe cutters, except where the use of mechanical cutters would be difficult or impracticable.

Contractor shall use factory prepared pipe ends unless a field cut is required for connections.

Ends of ductile iron pipe shall be cut with a portable guillotine saw, abrasive wheel, saw, milling cutter, or oxyacetylene torch. The use of hydraulic squeeze type cutters will not be acceptable. Field-cut holes for saddles shall be cut with mechanical cutters; oxyacetylene cutting will not be acceptable.

3-4. ALIGNMENT. Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the values stipulated in Table 3 or Table 4 of AWWA C600, unless specially designed bells and spigots are provided.

Either shorter pipe sections or fittings shall be installed where needed to conform to the alignment or grade indicated on the drawings.

3-5. LAYING PIPE. Buried pipe shall be protected from lateral displacement by placing the specified pipe embedment material installed as specified in the Trenching and Backfilling section. Under no circumstances shall pipe be laid in water, and no pipe shall be laid under unsuitable weather or trench conditions.

Whenever pipe laying is stopped, the open end of the pipe shall be sealed with a watertight plug, which will prevent trench water from entering the pipe.

Pipe shall be laid with the bell ends facing the direction of laying, except where reverse laying is specifically acceptable by Engineer.

3-6. FIELD JOINTS. Joints in buried and tunnel locations shall be mechanical or push-on type unless otherwise indicated on the drawings or where required to connect to existing piping or to valves. Bells on wall castings and wall sleeves shall be mechanical joint type, with tapped holes for tie rods or stud bolts. All other joints shall be flanged unless otherwise indicated on the drawings.

Certification of joint design shall be provided in accordance with ANSI/AWWA C111/A21.11, Section 4.5, Performance Requirements, as modified herein. The joint test pressure shall be not less than 2 times the working pressure or 1-1/2 times the test pressure of the pipeline, whichever is higher. The same certification and testing shall also be provided for restrained joints. For restrained joints, the piping shall not be blocked to prevent separation and the joint shall not leak or show evidence of failure. It is not necessary that such tests be made on pipe manufactured specifically for this project. Certified reports covering tests made on other pipe of the same size and design as specified herein and manufactured from materials of equivalent type and quality may be accepted as adequate proof of design.

Restrained joints shall be extended after they are assembled to minimize further takeup.

Field closure pieces shall be located away from the bends beyond the length over which joints are to be restrained.

3-7. MECHANICAL JOINTS. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Bolts shall be uniformly tightened to the torque values listed in Appendix A of ANSI/AWWA C111/A21.11. Overtightening of bolts to compensate for poor installation practice will not be acceptable.

The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry.

3-8. PUSH-ON JOINTS. The pipe manufacturer's instructions and recommendations for proper jointing procedures shall be followed. All joint surfaces shall be lubricated with a soap solution provided by the pipe manufacturer immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

Pipe ends for restrained joint pipe shall be prepared in accordance with the pipe manufacturer's recommendations.

3-9. FLANGED JOINTS. Not used.

3-10. FLANGED COUPLING ADAPTERS. Not used.

3-11. DISMANTLING JOINTS. Dismantling joints shall be provided for restrained coupling 14 inch and larger and where indicated on the drawings and as specified herein. Dismantling joints shall comply with AWWA C219 and shall be restrained flange by flange couplings manufactured as a single unit. Dismantling joints shall be installed in accordance with the manufacturer's recommendations.

3-12. MECHANICAL COUPLINGS. Mechanical couplings shall be carefully installed in accordance with the manufacturer's recommendations. A space of at least 1/4 inch [6 mm], but not more than 1 inch [25 mm], shall be left between the pipe ends. Pipe and coupling surfaces in contact with gaskets shall be clean and free from dirt and other foreign matter during assembly. All assembly bolts shall be uniformly tightened so that the coupling is free from leaks, and all parts of the coupling are square and symmetrical with the pipe. Following installation of the coupling, damaged areas of shop coatings on the pipe and coupling shall be repaired to the satisfaction of Engineer.

The interior surfaces of the middle rings shall be prepared for coating in accordance with instructions of the coating manufacturer and shall then be coated with liquid epoxy in accordance with ANSI/AWWA C210. The remaining components shall be cleaned and shop primed with universal primer.

3-13. GROOVED-END JOINTS. Not used.

3-14. POLYETHYLENE ENCASEMENT. All buried ductile iron pipe, including all straight pipe, bends, tees, adapters, closure pieces, and other fittings or specials, and all valves, shall be provided with at least one wrap of polyethylene encasement. Locations where ductile iron pipe shall be double wrapped with polyethylene encasement are indicated on the drawings and/or as specified in the provisions for Corrosion Protection section.

Polyethylene tube protection shall be installed in accordance with ANSI/AWWA C105/A21.5, Method A. Preparation of the pipe shall include, but shall not be limited to, removal of lumps of clay, mud, cinders, etc., prior to installation.

Where ductile iron pipe is also embedded or encased in concrete, the polyethylene tube shall be installed over the pipe for 5 feet [1.5 m] either side of each end of the concrete encasement.

The terms "polyethylene tube protection" and "polyethylene encasement" are interchangeable and shall have the same meaning in these Contract Documents.

3-14.01. Inspection and Testing. Tests for preliminary acceptance of polyethylene encasement materials as required in the submittal paragraph shall be made at the expense of the Contractor.

The Owner may obtain samples from the material supplied in the field and have test conducted by an independent third-party laboratory, at the Owner's expense, of the requirements specified in ANSI/AWWA C105/A21.5.

3-15. OUTLETS. Not used..

3-16. WALL PIPES OR CASTINGS. Not used.

3-17. REDUCERS. Reducers shall be eccentric or concentric as indicated on the drawings. Reducers of eccentric pattern shall be installed with the straight side on top, so that no air traps are formed.

3-18. CONNECTIONS WITH EXISTING PIPING. Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by Owner. Facilities shall be provided for proper dewatering and for disposal of all water removed from dewatered lines and excavations without damage to adjacent property.

Special care shall be taken to prevent contamination when dewatering, cutting into, and making connections with existing potable water piping. Trench water, mud, or other contaminating substances shall not be permitted to enter the lines. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and then all potable water pipe, fittings, and valves shall be swabbed with, or dipped in, a 200 mg/L chlorine solution.

3-19. INSULATED FLANGED JOINTS. Not used.

3-20. CONCRETE ENCASEMENT. Not used.

3-21. REACTION ANCHORAGE AND BLOCKING. Not used.

3-22. PRESSURE AND LEAKAGE TESTS. Pipe and fittings shall be subjected to a pressure test and a leakage test in accordance with the Pipeline Pressure and Leakage Testing section.

Pipe and fittings shall be subjected to a pressure test and a leakage test. The Contractor shall provide all necessary pumping equipment; piping connections between the piping and the nearest available source of test water; pressure gauges; and other equipment, materials, and facilities necessary for the tests.

All pipe, fittings, valves, pipe joints, and other materials which are found to be defective shall be removed and replaced with new and acceptable materials, and the affected portion of the piping shall be retested by and at the expense of Contractor.

All joints shall be watertight and free from visible leaks. Any visible leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor.

3-23. CLEANING. The interior of all pipe and fittings shall be kept clean of any foreign matter until the work has been accepted.

End of Section

Section 15093

CHECK VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of check valves as specified herein and as indicated in the Check Valve Schedule.

Piping, pipe supports, insulation, and accessories that are not an integral part of the valves or are not specified herein are covered in other sections.

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the drawings, specified, otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Temporary Number Plates. Each check valve with an identifying number listed in the Check Valve Schedule, shall be tagged or marked in the factory with the identifying number.

1-2.03. Permanent Number Plates. All check valves, except buried or submerged valves, that have been assigned a number on the drawings or in the Check Valve Schedule, shall be provided with a permanent number plate. The location of number plates and the method of fastening shall be acceptable to Engineer. Numerals shall be at least 1 inch [25 mm] high and shall be black baked enamel on anodized aluminum plate.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with the Submittals section. Included in the submittal shall be drawings by the valve manufacturer to indicate the position of the valve actuator and valve shaft.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. CONSTRUCTION.

2-1.01. Valves VC-1. Not used.

2-1.02. Valves VC-2.

VC-2	Rating	Class 125
	Code	AWWA C508
Water, sludge, liquid service, or sump pump discharge	Type	Horizontal swing, threaded bonnet
	Body/Bonnet	
	Trim	ASTM B62 bronze
	Seat	Bronze, regrinding
	Disc	Bronze
Threaded ends	Hinge Pins	Manufacturer's standard
	End Connection	Threaded
	Temp. Limitations	-20 to 212°F [-29 to 100°C]
2 inch [25 mm] or smaller pipe	Manufacturers	Stockham "B-321", Walworth "Fig 3406"

2-1.03. Valves VC-3. Not used.

2-1.04. Valves VC-4. Not used.

2-1.05. Valves VC-5. Not used.

2-1.06. Valves VC-6. Not used.

2-1.07. Valves VC-7. Not used.

2-1.08. Valves VC-8. Not used.

2-1.09. Valves VC-9. Not used.

VC-9	Rating	Class 250
	Type	Dual disc wafer
High pressure clear water service	Body/Bonnet	ASTM A126, Class B, cast iron
	Trim	
	Seat	Buna-N
	Disc	ASTM B148 Alloy 952, aluminum bronze
3 through 12 inch [75 through 300 mm] pipe	Springs/Hinge Pins/Stops	AISI Type 316 stainless steel
	Bearings	Teflon
	End Connection	Plain, installed between ASME B16.1, Class 250, raised faced flanges
		-20 to 225°F [-29 to 107°C]

	Temp. Limitations	intermittent, 0 to 180°F [-18 to 82°C] continuous
	Manufacturers	Marlin “Wafer Check 250HZNSR”, Stockham “WG-970”, “Duo-Chek II Figure 30HMF”, Apco Valve and Primer “9200AR1R”

2-1.10. Valves VC-10. Not used.

2-1.11. Valves VC-11. Not used.

2-1.12. Valves VC-12. Not used.

VC-12 High pressure clear water service 14 inch [350 mm] and larger pipe lines	Rating	250 psig
	Type	Dual disc wafer
	Body	ASTM A126, Class B, cast iron
	Trim	
	Seat Ring	Buna-N
	Disc	ASTM B148 Alloy 952, aluminum bronze or ductile iron with bronze trim
	Springs/Hinge Pins/Stops	AISI Type 316 stainless steel
	Bearings	Teflon
	End Connection	Plain, installed between ASME B16.1, Class 250, raised faced flanges
	Temp. Limitations	-20 to 225°F [-29 to 107°C] intermittent, 0 to 180°F [-18 to 82°C] continuous
Manufacturers	Marlin “Wafer Check 250HZNSR”, “Duo-Chek II Figure 25HMF”, Apco Valve and Primer “9000AR1R”	

2-1.13. Valves VC-13. Not used.

2-1.14. Valves VC-14. Not used.

2-1.15. Valves VC-15. Not used.

2-1.16. Valves VC-16. Not used.

2-1.17. Valves VC-17. Not used.

2-1.18. Valves VC-18. Not used.

2-1.19. Valves VC-19. Not used.

2-1.20. Shop Coatings. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop coated for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating.

Coating Materials

Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Epoxy Enamel (for liquid service)	Ameron "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard°891", or Tnemec "Series N140 Pota-Pox Plus".
Rust-Preventive Compound	As recommended by the manufacturer.

Surfaces To Be Coated

Unfinished Surfaces

Interior Surfaces

Liquid Service	Epoxy enamel.
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Exterior Surfaces of Valves To Be Buried, Submerged, or Installed in Manholes or Valve Vaults	Asphalt varnish or coal tar epoxy.
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Exterior Surfaces of All Other Valves	Universal primer.
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Polished or Machined Surfaces	Rust-preventive compound.
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Actuators and Accessories	Universal primer.
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PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with Valve Installation section.

End of Section

PRESSURE REDUCING VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of pressure reducing valves as specified herein.

Piping, pipe supports, insulation, and accessories which are not an integral part of the valves or are not specified herein are covered in other sections.

1-2. GENERAL.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials provided under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Permanent Number Plates. All valves covered by this section, except buried or submerged valves, that have been assigned a number on the drawings or in the Pressure Reducing Valves Schedule, shall be provided with a permanent number plate. The location of number plates and the method of fastening shall be acceptable to Engineer. Numerals shall be at least 1 inch [25 mm] high and shall be black baked enamel on anodized aluminium plate.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals section. The data and specifications for each unit shall include, but shall not be limited to, the following:

Name of manufacturer.

Type and model.

Construction materials and finishes.

Unit dimensions.

Performance curves indicating flow capacity versus pressure drop.

1-3.02. Operation and Maintenance Data and Manuals. Adequate operation and maintenance information shall be supplied as required in the Submittals section. Operation and maintenance manuals shall be submitted in accordance with the Submittals section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and Storage shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN REQUIREMENTS. Pressure reducing valves shall be designed to meet the service requirements as indicated herein.

Each pressure reducing valve shall be designed to provide tight shutoff under conditions of no flow and shall not "hunt" under ordinary flow conditions. Pressure reducing valves shall be selected and sized as recommended by the valve manufacturer. Valve pressure setpoint shall be adjustable to at least 20 percent above and below the reduced pressure setpoint.

2-2. ACCEPTABLE MANUFACTURERS. Acceptable manufacturers and specific products are listed in the Construction paragraph.

2-3. MATERIALS. Valve materials shall be as indicated below and in the Construction paragraph.

Shop Coatings

Epoxy Enamel, NSF certified Service)	(Liquid Coating",	Ameron "Amerlock 400 High-Solids Epoxy Coating",	Carboline "Carboguard 891",	or Tnemec "Series N140 Pota-Pox Plus"; immersion service.
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2-4. CONSTRUCTION.

2-4.01. Water Service. Pressure reducing valves for water service shall be direct-acting or pilot-operated type as indicated in the Pressure Reducing Valve Schedule.

Direct-acting valves shall be globe type with threaded connections and union assembly. The valves shall be provided with bronze body and cover, stainless steel trim, reinforced neoprene diaphragm, Buna-N disc, and stainless steel strainer. Direct-acting pressure reducing valves shall be Cla-Val "Model 990", Cash-Acme, or Watts.

Pilot-operated valves shall be globe type with flanged ends. The valves shall be provided with epoxy coated ductile iron body, bronze trim, and Buna-N rubber diaphragm and disc. The pilot regulating valve shall be bronze with stainless steel trim. Pilot-operated pressure reducing valves shall be Cla-Val "Model 90-01", Watts, or OCV.

When indicated in the schedules, pilot-operated valves shall be equipped with a low flow bypass. The low flow bypass shall consist of a direct-acting pressure reducing valve in parallel with the pilot-operated valve. The valves and required piping assembly shall be factory assembled and shall be Cla-Val "Model 90-48", Watts, or OCV.

2-4.02. Gas Service. Not Used.

2-5. SHOP PAINTING. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop painted for corrosion protection in accordance with the following list. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the field painting specified in the Protective Coatings section.

Interior Surfaces

Liquid Service
Exterior Surfaces

Epoxy (NSF certified).

Universal primer with epoxy finish coat.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with the Valve Installation section.

End of Section

Section 15101

AWWA BUTTERFLY VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing AWWA butterfly valves for cold water service as indicated in the AWWA Butterfly Valve Schedule. All other butterfly valves are specified in the Industrial Butterfly Valves section.

AWWA butterfly valves shall be furnished complete with actuators and accessories as specified herein, as indicated in the schedule, and as specified in the Valve and Gate Actuators section.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standard. Except as modified or supplemented herein, all butterfly valves and manual actuators shall conform to the applicable requirements of ANSI/AWWA C504.

1-2.03. Marking. Supplementing the requirements of Section 6.1 of the governing standard, the country of origin of all castings and an identifying serial number shall be stamped on a corrosion-resistant plate attached to the valve body.

1-2.04. Temporary Number Plates. Not used.

1-2.05. Permanent Number Plates. All AWWA butterfly valves, except buried or submerged valves, that have been assigned a number on the drawings or in the AWWA Butterfly Valve Schedule, shall be provided with a permanent number plate. The location of number plates and the method of fastening shall be acceptable to Engineer. Numerals shall be at least 1 inch [25 mm] high and shall be black baked enamel on anodized aluminum plate.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with the Submittals section. Included in the submittal shall be drawings by the valve manufacturer to indicate the position of the valve actuator and valve shaft.

Drawings shall include separate wiring diagrams for each electrically operated or controlled valve and the electrical control equipment. Each drawing shall be identified with the valve number or name as specified in this section.

Certified copies of test results as required by Section 5 of ANSI/AWWA C504, with an affidavit of compliance as indicated in Section 6.3 of C504, shall be submitted to Engineer before the valves are shipped.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. ACCEPTABLE PRODUCTS. Butterfly valves shall be limited to the manufacturers listed below.

<u>Manufacturer</u>	<u>Acceptable Sizes and Styles</u>
DeZurik	All.
Pratt (Mueller)	All.
M&H	All.
Val-Matic	All.

2-2. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of butterfly valves shall conform to the requirements of ANSI/AWWA C504.

Acceptable shop coatings are listed in the following table.

Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Epoxy	
For Liquid Service other than in potable water facilities	Ameron "Amercoat 385 Epoxy", Carboline "Carboguard 890", or Tnemec "Series N69 Hi-Build Epoxoline II".
For Raw or Treated Water Service in potable water facilities (NSF certified)	Ameron "Amercoat 400 High Solids Epoxy", Carboline "Carboguard 891", or Tnemec "Series N140 Pota-Pox Plus".
Rust-Preventive Compound	As recommended by manufacturer.

2-3. VALVE CONSTRUCTION.

2-3.01. Valve Bodies. Valves shall be short-body type unless otherwise specified in the AWWA Butterfly Valve Schedule. The use of a stop or lug cast integrally with or mechanically secured to the body for the purpose of limiting disc travel by means of direct contact or interference with the valve disc (in either the open or closed position) will not be acceptable.

2-3.02. Flanges. Flanges shall be finished to true plane surfaces within a tolerance limit of 0.005 inch [125 µm]. The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.002 inch per foot (0.017 percent) of flange diameter.

2-3.03. Mechanical Joint Ends. Mechanical joint ends shall be either mechanical joint or push-on ends conforming to ANSI/AWWA C111/A21.11.

2-3.04. Valve Shafts. Valve shafts shall be fabricated of AISI Type 304 or 316 stainless steel. The use of shafts having a hexagonal cross section will not be acceptable. The connection between shaft and disc shall be in accordance with ANSI/AWWA C504.

The connection between the shaft and the disc shall be mechanically secured by means of solid, smooth sided, stainless steel or monel taper pins or dowel pins. Each taper pin or dowel pin shall extend through or shall wedge against the side of the shaft and shall be mechanically secured in place. The use of set screws, knurled or fluted dowel pins, expansion pins, roll pins, tension pins, spring pins, or other devices instead of the pins specified herein will not be acceptable.

2-3.05. Valve Seats. Acceptable seating surfaces mating with rubber are AISI Type 304 or 316 stainless steel, monel, or plasma-applied nickel-chrome overlay for all valves; bronze for 20 inch [500 mm] and smaller valves; and alloy cast iron for 20 inch [500 mm] and smaller manually operated valves.

Seats shall be located on the valve body. Seats shall be located on the valve body or disc. Valve seat configurations which rely on the mating pipe flange to hold the seat in position in the valve body will not be acceptable.

2-3.06. Shaft Seals. Shaft seals shall be of the chevron type.

2-3.07. Thrust Bearings. Each valve shall be provided with one or more thrust bearings in accordance with the governing standard. Thrust bearings which are directly exposed to line liquid and which consist of a metal bearing surface in rubbing contact with an opposing metal bearing surface will not be acceptable.

2-4. VALVE ACTUATORS. Requirements for valve actuators shall be as specified herein, as indicated in the AWWA Butterfly Valve Schedule, and as specified in the Valve and Gate Actuators section.

All 8 inch [200 mm] and larger valves shall have geared actuators.

If valves with an AWWA class designation higher than specified are furnished, actuator torque capabilities shall be increased accordingly and be acceptable to Engineer.

2-4.01. Actuator Sizing. The valve manufacturer shall size the actuator in accordance with AWWA C504, and the valve manufacturer's requirements.

Unless otherwise indicated or specified, actuator torque requirements shall be based on a maximum differential pressure across the valve equal to the valve class and a maximum velocity through the valve of 16 feet per second [4.9 m/s].

Valves with operating stands shall have actuator torques increased by 25 percent. Actuator torques determined by the above requirements shall be increased by any safety factors required by AWWA C504, paragraphs 4.5.8.6.1 and 4.5.8.7 or indicated or specified herein.

2-5. SHOP PAINTING. All interior and exterior ferrous metal surfaces, except finished surfaces, bearing surfaces, and stainless steel components, of valves and accessories shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting. Epoxy enamel coatings shall be ANSI/NSF 61 certified.

Surfaces shall be painted as follows:

Unfinished Surfaces

Interior Surfaces	Epoxy enamel.
Exterior Surfaces of Valves To Be Buried	Coal tar epoxy.
Exterior Surfaces of Valves To Be Submerged, or Installed in Manholes or Valve Vaults	Epoxy enamel.
Exterior Surfaces of All Other Valves	Universal primer.

Polished or Machined Surfaces

Flange Faces	Rust-preventive compound.
Other Surfaces	Epoxy enamel.

Interior coatings shall comply with AWWA C550 and shall be free of holidays. The total dry film thickness of shop-applied coatings shall be not less than:

<u>Type of Coating</u>	<u>Minimum Dry Film Thickness</u>
Coal Tar Epoxy	15 mils [380 µm]
Epoxy Enamel	10 mils [250 µm]
Universal Primer	3 mils [75 µm]

2-6. ACCESSORIES. Requirements for extension stems and stem guides, position indicators, floor boxes, operating stands, torque tubes, valve boxes, and extension bonnets shall be as indicated in the AWWA Butterfly Valve Schedule 15101-S01 and as specified in the Valve and Gate Actuators section.

PART 3 - EXECUTION

3-1. INSTALLATION. Valves will be installed in accordance with the Valve Installation section.

3-1.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Startup Requirements section, and shall revisit the job site as often as necessary until any problems are corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping and appurtenances; and has been operated under full load conditions and that it has operated satisfactorily.

All costs for these services shall be included in the contract price.

End of Section

RESILIENT-SEATED GATE VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing resilient-seated AWWA gate valves for clear water service and as indicated in the Resilient-Seated Gate Valve Schedule. Resilient-seated gate valves shall be furnished complete with actuators and accessories as specified herein and as specified in the Valve and Gate Actuator section.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standard. Except as modified or supplemented herein, all resilient-seated gate valves shall conform to the applicable requirements of ANSI/AWWA C515.

1-2.03. Temporary Number Plates. Not used.

1-2.04. Permanent Number Plates. Not used.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with the Submittals section.

All valves shall be tested in accordance with Section 5 of the governing standard. Certified copies of the results of all tests, together with an affidavit of compliance as indicated in Section 6.3 of the governing standard, shall be submitted to Engineer before the valves are shipped.

PART 2 - PRODUCTS

2-1. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of resilient-seated gate valves shall conform to the requirements of the governing standard.

2-1.01. Bronze Components. All bronze valve components in contact with liquid shall contain less than 16 percent zinc. All aluminum bronze components in contact with liquid shall be inhibited against dealuminization in accordance with Section 4.2.2.4.3 of ANSI/AWWA C509.

2-1.02. Gaskets. Gaskets shall be free of asbestos and corrosive ingredients.

2-1.03. Shop Coatings.

Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Epoxy	Manufacturer's standard fusion-bonded or liquid epoxy.
Rust-Preventive Compound	As recommended by manufacturer.

2-2. VALVE CONSTRUCTION.

2-2.01. Valve Ends. Valve ends shall be compatible with connecting piping. Except as modified or supplemented herein, the ends shall conform to the applicable requirements of the governing standard.

Flanges shall be finished to true plane surfaces within a tolerance limit of 0.005 inch [125 µm]. The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.001 inch per inch [1 µm/mm] of flange diameter.

2-2.02. Stem Seals. Valve stems shall be the non-rising type. O-ring stem seals shall be provided for all buried gate valves, and for all gate valves with non-rising stems.

2-2.03. Rotation. The direction of rotation of the handwheel or the wrench nut to open the valve shall be to the left (counterclockwise).

2-2.04. Shop Coating. All interior and exterior ferrous metal surfaces of valves and accessories shall be shop coated for corrosion protection. Except as specified below, the valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field coating.

Surfaces shall be coated as follows:

Interior surfaces	Epoxy.
Interior surfaces (potable water)	Epoxy (NSF certified).

Exterior surfaces of valves to buried, submerged, or installed in manholes or valve vaults	Epoxy or coal tar epoxy
Exterior surfaces of all other valves	Universal primer.
Polished or machined surfaces	Rust-preventive compound.

The protective epoxy coating on the interior surfaces of each valve shall be applied in three coats, with a minimum total dry film thickness of 13 mils [325 µm]. Alternatively, the manufacturer's standard coating may be used and the interior surfaces of each valve shall be subjected to a nondestructive holiday test in accordance with ASTM G62, Method A, and shall be electrically void-free.

Interior coatings shall comply with AWWA C550. The total dry film thickness of shop-applied coatings shall be not less than:

<u>Type of Coating</u>	<u>Minimum Dry Film Thickness</u>
Coal Tar Epoxy	15 mils [380 µm].
Epoxy	10 mils [250 µm] or 13 mils [325 µm] where specified herein.
Universal Primer	3 mils [75 µm].

2-3. VALVE ACTUATORS. Requirements for valve actuators shall be as specified in the Valve and Gate Actuator section.

2-4. ACCESSORIES. When the drawings indicate the need for extension stems, stem guides, position indicators, floor boxes, valve boxes, or operating stands, refer to the Valve and Gate Actuator section.

PART 3 - EXECUTION

3-1. INSTALLATION. Valves will be installed in accordance with Valve Installation section.

3-1.01. Installation Check. An installation check by an authorize representative of the manufacturer is not required.

End of Section

Section 15180

VALVE AND GATE ACTUATORS

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing manual and powered valves and gate actuators and accessories as specified herein.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Actuators shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of actuators.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standards. Except as modified or supplemented herein, all powered actuators shall conform to applicable requirements of ANSI/AWWA C540.

Except as modified or supplemented herein, all manual and cylinder actuators for butterfly and eccentric plug valves shall conform to the applicable requirements of ANSI/AWWA C504.

Except as modified or supplemented herein, all manual actuators for ball valves shall conform to the applicable requirements of ANSI/AWWA C507.

Except as modified or supplemented herein, all manual actuators for sluice and slide gates shall conform to the applicable requirements of ANSI/AWWA C560.

1-2.03. Power Supply. Power supply to electric actuators will be as indicated on the valve or gate schedule.

1-2.04. Marking. Each actuator shall be marked with the manufacturer's name, model number, and the country of origin. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the actuator.

1-2.05. Temporary Number Plates. Each actuator shall be factory tagged or marked to identify the actuator and the applicable valve or gate by number or service as indicated in the valve or gate schedule.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the actuators and their appurtenances shall be submitted in accordance with the Submittals section. Submittal drawings shall clearly indicate the country of origin of each actuator and its components.

The drawings shall include separate wiring diagrams for each electrically operated or controlled actuator and the electrical control equipment. Each actuator drawing shall be identified with the respective valve number or name.

For networked valve actuators, information on the available input and output assemblies shall be submitted for the protocol(s) specified to be provided.

For electric or cylinder actuators, certified copies of reports covering proof-of-design testing of the actuators as set forth in Section 5 of ANSI/AWWA C540, together with an affidavit of compliance as indicated in Section 6.3 of ANSI/AWWA C540, shall be submitted to Engineer before the actuators are shipped.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN REQUIREMENTS.

2-1.01. General. Actuators and appurtenances shall be designed for the conditions and requirements as indicated in the respective valve and gate sections.

Liberal factors of safety shall be used throughout the design, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of each material.

2-1.02. Valve Actuators. Each actuator shall be designed to open or close the valve under all operating conditions. Actuators shall be designed for the maximum pressure differential across the valve and maximum velocities through the valve where indicated in the respective valve schedules.

Valve actuators shall be provided and adjusted by the valve manufacturer. Actuator mounting arrangements and positions shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the drawings or directed by Engineer.

When valves are to be buried, submerged, or installed in vaults, the actuators and accessories shall be sealed to prevent the entrance of water. The design water depth shall be as indicated in the respective valve schedules but not less than 20 feet [6.1 m].

2-1.03. Gate Actuators. Actuators shall be sized to produce the torque or thrust required to operate the gate when subject to the seating and unseating operating heads as indicated in the respective gate schedules.

Both the design head and the operating head shall be measured from the surface of the liquid to the center line of the gate.

2-1.04. Limit Switches. Limit switches shall be provided as indicated on the drawings or in the valve and gate schedules.

For manual or cylinder type actuators, each limit switch shall be heavy duty type, with a cast NEMA Type 4 enclosure, a spring return roller lever, and four isolated contacts (two normally open and two normally closed) rated 10 amperes at 120 to 480 volts ac and 5 amperes at 125 volts dc. The switches shall be Allen Bradley "802T" or Square D "9007 Type C".

Limit switches for programmable and standard electric actuators shall be as indicated in their respective paragraphs.

2-2. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of actuators shall conform to the requirements of ANSI/AWWA C504 and C540.

2-3. VALVE MANUAL ACTUATORS. Not used.

2-3.01. General. Manual actuators of the types listed in the valve specifications or schedules shall be provided by the valve manufacturer.

Unless otherwise indicated or specified, each geared manual actuator shall be equipped with an operating handwheel.

The direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the left (counterclockwise). Each valve body or actuator shall have cast thereon the word "Open" and an arrow indicating the direction to open.

The housing of traveling-nut type actuators shall be fitted with a removable cover which shall permit inspection and maintenance of the operating mechanism without removing the actuator from the valve. Travel limiting devices shall be provided inside the actuator for the open and closed positions. Travel limiting stop nuts or collars installed on the reach rod of traveling-nut type operating mechanisms shall be field adjustable and shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device. The use of stop nuts or adjustable shaft collars which rely on clamping force or setscrews to prevent rotation of the nut or collar on the reach rod will not be acceptable.

Each actuator shall be designed so that shaft seal leakage cannot enter the actuator housing.

Valves for throttling service shall be equipped with an infinitely variable locking device or a totally enclosed gear actuator.

Actuators shall produce the required torque with a maximum pull of 80 lbs [356 N] on the lever, handwheel, or chain. Actuator components shall withstand, without damage, a pull of 200 lbs [890 N] on the handwheel or chainwheel or an input of 300 foot-lbs [407 J] on the operating nut.

2-3.02. Handwheels. Handwheel diameters shall be at least 8 inches [200 mm] but not more than 24 inches [600 mm] for 30 inch [750 mm] and smaller valves and not more than 30 inches [750 mm] for 36 inch [900 mm] and larger valves.

2-3.03. Chainwheels. Unless otherwise specified in the valve schedules, all valves with center lines more than 7'-6" [2.3 m] above the floor shall be provided with chainwheels and operating chains. Each chainwheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot-dip galvanized or zinc plated carbon steel and shall be looped to extend to within 4 feet [1.2 m] of the floor below the valve.

2-3.04. Levers. Levers shall be capable of being locked in at least five intermediate positions between fully open and fully closed. In any building or structure containing lever operated valves, at least two operating levers shall be provided for each size and type of lever operated valve.

2-3.05. Chain Levers. Suitable actuator extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot-dip galvanized carbon steel and shall be looped to extend to within 4 feet [1.2 m] of the floor below the valve.

2-3.06. Wrench Nuts. Unless otherwise specified in the valve schedules or on the drawings, wrench nuts shall be provided on all buried valves and on all valves that are to be operated through floor boxes. Unless otherwise directed by Owner, all wrench nuts shall comply with Section 4.4.13 of AWWA C500. At least two operating keys shall be furnished for operation of the wrench nut operated valves.

2-3.07. Operating Stands. Operating stands shall be provided in the locations indicated on the drawings or as indicated in the valve and gate schedules. Operating stands shall support the handwheel approximately 36 inches [900 mm] above the floor. A sleeve made from standard weight galvanized steel pipe shall be provided for the opening in the floor beneath each operating stand. When stems are 10 feet [3 m] or longer, a suitable thrust bearing shall be provided in each operating stand to carry the weight of the extension stem.

2-3.08. Wall Brackets. Wall brackets shall be provided to support manual actuators in the locations indicated on the drawings or in the respective valve schedules. The horizontal face of the bracket shall be predrilled to accept the actuator and the stem without modification. The top of the bracket shall extend sufficiently to bear on and transfer thrust loads to the top of the supporting structure.

2-4. GATE MANUAL ACTUATORS.

2-4.01. General. Manual actuators of the types listed in the gate schedules shall be provided by the gate manufacturer. Unless otherwise specified, actuators shall conform to ANSI/AWWA C560.

All bearings and gears shall be totally enclosed in a weathertight housing having a sufficient number of fittings to permit periodic lubrication of all internal moving components without partial or total disassembly of the mechanism. The pinion shaft of crank-operated mechanisms shall be supported by roller bearings or needle bearings.

The direction of rotation of the wheel, crank, or wrench nut to open the gate shall be to the left (counterclockwise).

Actuators for rising stem self-contained gates shall be designed for mounting directly on the frame yoke.

When indicated in the gate schedules, crank-operated actuators shall be suitable for operation with a portable actuator specified herein. A suitable adapter coupling shall be furnished with each crank actuator to couple the portable actuator to the crank actuator pinion shaft as required.

2-4.02. Remote Actuators. Not used.

2-4.03. Dual Actuators. Dual actuators shall be provided where indicated in the gate schedules. Dual actuators shall be interconnected by a cross shaft complete with required couplings so both stems move at the same rate. Each cross shaft shall be protected by a full length removable aluminum or stainless steel cover attached to the yoke beam or actuator.

2-4.04. Floorstands. Floorstands shall be designed to transfer operating thrusts to the supporting structure. Each floorstand shall be designed to position the crank or the handwheel approximately 36 inches [900 mm] above the frame yoke, supporting surface, or adjacent operating floor or platform.

2-4.05. Wall Brackets. Wall brackets shall be provided to support manual actuators in the locations indicated on the drawings or indicated in the respective gate schedules. The horizontal face of the bracket shall be predrilled to accept the actuator and the stem without modification. The top of the bracket shall extend sufficiently to bear on and transfer thrust loads to the top of the supporting structure.

2-4.06. Stem Covers. Rising stem manual actuators shall be provided with a stem cover as indicated in the gate schedules. Stem covers shall conform to Section 4.4 of ANSI/AWWA C560.

2-4.06.01. Plastic Covers. Covers shall be constructed of transparent plastic pipe and shall be furnished with an end cap, condensation vents, and a clear mylar position-indicating marking tape. The marking tape shall be adhesive backed and shall be permanently marked and calibrated in feet and inches [meters and millimeters]. The tape shall be applied to the stem cover after the gate has been installed and shall be so positioned that the height of the slide will be indicated by reference to the top of the stem.

2-4.06.02. Steel Covers. Covers shall be constructed from steel pipe and shall be furnished complete with a threaded end cap. All steel components of each cover shall be hot-dip galvanized following fabrication.

The operating mechanism shall be furnished with a digital or dial type mechanical position indicator. The indicator mechanism shall be installed inside a weatherproof housing and shall be clearly visible through a transparent, weatherproof window.

2-5. PROGRAMMABLE ELECTRIC ACTUATORS. Not used.

2-6. STANDARD ELECTRIC ACTUATORS.

2-6.01. General. Standard electric actuators as listed in the valve and gate schedules shall be provided by the valve or gate manufacturer.

Standard electric actuators for 12 inch [300 mm] and smaller butterfly valves and eccentric plug valves shall be quarter-turn type and shall be Auma "SGBV05" through "SGBV12", EIM "Series P, Q, or R", Limitorque "LY", or Rotork "AQ", without exception.

All other standard electric actuators shall be multiturn type and shall be Auma "SABV07.1" through "SABV48.1", EIM "Series 2000", Limitorque "L120", or Rotork "A Range", without exception.

Standard electric actuators produced by other manufacturers are not acceptable.

Each standard electric actuator shall be furnished complete with a motor, gearing, handwheel, limit switches and torque sensors, lubricants, heating elements, wiring, and terminals. Each actuator shall be constructed as a self-contained unit with a cast iron or aluminum alloy housing, of a type as indicated in the valve and gate schedules, and shall be integrally assembled on the applicable valve or gate by the valve or gate manufacturer.

Actuators shall be designed to cycle the valve or gate from the fully open to the fully closed position or the reverse in approximately 60 seconds or as indicated in the valve and gate schedules.

Actuator motors may be mounted horizontally adjacent to or vertically above the reduction gearing. All gearing shall be oil or grease lubricated.

2-6.02. Motors. Motors shall be totally enclosed, high torque design made expressly for valve actuator service, capable of operating the valve under full differential pressure for two complete strokes or one complete cycle of travel without overheating. Motors shall be designed in accordance with NEMA standards and shall operate successfully at any voltage within 10 percent above or below rated voltage. Motor bearings shall be permanently lubricated.

2-6.03. Power Gearing. Power gearing shall consist of hardened steel spur or helical gears and alloy bronze or hardened steel worm gear, all suitably lubricated, designed for 100 percent overload, and effectively sealed against entrance of foreign matter. Steel gears shall be hardened to at least 350 Brinell. Planetary or cycloidal gearing or aluminum, mild steel, or nonmetallic gears will not be acceptable. Gearing shall be designed to be self-locking so that actuation of a torque switch by a torque overload condition will not allow the actuator to restart until the torque overload has been eliminated. If a secondary gear box is required, it shall be designed to withstand the locked rotor torque of the actuator.

2-6.04. Handwheel Mechanism. The handwheel shall not rotate during motor operation. During handwheel operation the motor shall not affect the actuator operation. The actuator shall be responsive to electrical power and control at all times and, when under electrical control, shall instantly disengage the handwheel. The handwheel shall rotate counterclockwise to open the valve. An arrow indicating the opening direction and the word "Open" shall be cast on the

handwheel. The force required to operate the handwheel shall not exceed 80 lbs [350 N]. The handwheel shall have a padlockable declutch lever.

2-6.05. Torque Sensing. Torque and thrust loads in both closing and opening directions shall be limited by a torque sensing device. Each torque sensing device shall be provided with an adjustment setting indicator. The adjustment shall permit a variation of approximately 40 percent in torque setting. Switches shall have a rating of not less than 6 amperes at 120 volts ac and 0.5 ampere at 115 volts dc.

2-6.06. Limit Switches. Each standard electric actuator shall be designed to be readily field adaptable for four limit switch assemblies. Each switch assembly shall consist of at least three separate limit switches, shall be operated by the driving mechanism, and shall be independently adjustable to trip at any point at and between the fully open and fully closed valve positions. All switches shall have an inductive contact rating of not less than 6 amperes at 120 volts ac, 3 amperes at 240 volts ac, 1.5 amperes at 480 volts ac, and 0.5 ampere at 115 volts dc.

Each quarter-turn actuator shall be provided with end-of-travel limit switches in addition to four SPDT switches, each independently adjustable at any point of valve travel.

2-6.07. Position Transmitter. When indicated in the valve and gate schedules, actuators shall be provided with an electronic type position transmitter. The transmitter output shall be an isolated 4-20 mA dc capable of driving an external load of 0 to 500 ohms. Accuracy of the transmitted signal shall be ± 2 percent of span. Repeatability and hysteresis shall be within 1 percent. The transmitter shall transmit to a remote position indicator which is specified in the Instrumentation section.

2-6.08. Heating Elements. Space heating elements shall be provided to prevent condensation in the motor and limit switch housing. Heating elements shall be rated 120 volts ac. Heaters shall be continuously energized.

2-6.09. Terminal Facilities. Terminal facilities for connection to motor leads, switches, position transmitter, and heating elements shall be provided in readily accessible terminal compartments. Each terminal compartment shall have at least two openings for external electrical conduits, one sized at least 3/4 inch [19 mm] and the other at least 1-1/4 inches [31 mm]. Each terminal compartment shall be large enough to allow easy routing and termination of fifteen 12 AWG [4 mm²] conductors.

2-6.10. Controller. Each valve or gate shall be furnished with a reversing controller located inside the actuator enclosure and shall have controller devices as indicated in the valve and gate schedules. The controller shall be equipped with:

A motor overload protective device in each phase or solid state motor protection.

A space heater element, rated 120 volts ac, sized to be continuously energized for prevention of condensation within the controller enclosure.

A fused control power circuit taken from one power lead on the load side of the breaker and line side of the reversing starter to ground. If power supply is greater than 120 volts ac, a control power transformer with fused secondary, with volt-ampere capacity suitable for starter control plus continuous service to space heater elements in motor housing, limit switch compartment, and controller enclosure.

A terminal block with connectors for all external controls. All leads from the actuator motor and limit switch assembly shall be routed to terminal connections in the controller for external connections to all other control devices.

Auxiliary control contacts as indicated in the electrical schematics.

Reversing controllers shall be both mechanically and electrically interlocked and shall be provided with the necessary direct-operated auxiliary contacts for required interlocking and control.

Valve controllers shall be expressly selected for long life and reliable, low maintenance service under rugged service conditions.

2-6.11. Control Module. Valves or gates indicated for modulating service in the valve and gate schedules shall be provided with a control module for position modulating type service. The control module shall be mounted within the valve actuator limit switch housing. The module shall accept a standard 4-20 mA dc analog input signal with a load impedance of not greater than 400 ohms. The control module shall contain adjustments for span, zero, gain, and deadband.

The actuator shall have a slide-wire type position feedback potentiometer which provides a position feedback signal to the control module.

2-6.11.01. Control Performance. For any operating torque within the specified range of the valve actuator, the valve and actuator shall perform within these specified limits:

Linearity	Linearity of actual valve position as compared to demand signal shall be within ± 4 percent of span over the entire operating range.
Repeatability	For any repeated demand signal to the valve actuator, the actual valve position shall be repeated.
Deadband	Deadband of the valve actuator shall be adjustable from 1 to 10 percent of span.
Hysteresis	For any repeated demand signal to the valve actuator, from either an increasing or a decreasing direction, the actual valve position shall be repeated within 1 degree of valve shaft rotation.

2-7. HYDRAULIC CYLINDER ACTUATORS. Not used.

2-8. AIR CYLINDER ACTUATORS. Not used.

2-9. AIR-OIL CYLINDER ACTUATORS. Not used.

2-10. PORTABLE ELECTRIC ACTUATORS. Not used.

2-11. PORTABLE HYDRAULIC ACTUATORS. Not used.

2-12. ACTUATOR ACCESSORIES.

2-12.01. Extension Stems. Extension stems and stem guides shall be furnished when indicated in the respective valve schedules, indicated on the drawings, or otherwise required for proper valve operation. Extension stems shall be of solid steel and shall be not smaller in diameter than the stem of the actuator shaft. Extension stems shall be connected to the actuator with a single Lovejoy "Type D" universal joint with grease-filled protective boot. All stem connections shall be pinned.

At least two stem guides shall be furnished with each extension stem, except for buried valves. Stem guides shall be of cast iron, bronze bushed, and adjustable in two directions. Stem guide spacing shall not exceed 100 times the stem diameter or 10 feet [3 m], whichever is smaller. The top stem guide shall be designed to carry the weight of the extension stem. The extension stem shall be provided with a collar pinned to the stem and bearing against the stem thrust guide.

Extension stems for chemical resistant butterfly valves located in drainage sumps shall be the two-piece type with stainless steel stem, PVC housing, wall support, and collar. Unless otherwise indicated on the drawings, the length of the stem extension shall be as necessary to position the valve operator 12 inches above the maximum liquid level in the immediate area.

Extension stems for buried valve actuators shall extend to within 6 inches [150 mm] of the ground surface, shall be centered in the valve box using spacers, and shall be equipped with a wrench nut.

Extension stems for buried valve actuators shall be provided with position indicators as specified in the valve schedules.

2-12.02. Position Indicators. Unless otherwise specified, each valve actuator shall be provided with a position indicator to display the position of the plug or disc relative to the body seat opening.

For quarter turn plug, ball, or cone type valves installed in interior locations, the indicating pointer shall be mounted on the outer end of the valve operating shaft extension and shall operate over an indicating scale on the operating mechanism cover. Where the shaft passes through the cover, a suitable stuffing box or other seal shall be provided to prevent the entrance of water.

Each actuator for butterfly valves, except where located in manholes, buried, or submerged, shall have a valve disc position indicator mounted on the end of the valve shaft. A disc position indicator shall also be provided on each operating stand or the actuator mounted thereon.

2-12.02.01. Position Indicators for Buried Actuators. Not used.

2-12.03. Floor Boxes. Openings through concrete slabs provided for key operation of valves shall be provided with a cast iron floor box complete with cover. The floor box shall be of the depth indicated on the drawings. Where the operating nut is in the slab, the stem shall have a guide to maintain the nut in the center of the box; where the nut is below the slab, the opening in the bottom of the box shall accommodate the operating key.

Each floor box and cover shall be shop coated with manufacturer's standard coating.

2-12.04. Torque Tubes. Torque tube shall utilize pipe rather than solid shafting between the valve input shaft and the output shaft of the valve floorstand operator. An adjustment of 2 inches [50 mm] shall be provided in the torque tube installation. Torque tube shall be coated with the same material as the submerged valve.

2-12.05. Valve Boxes. Not used.

2-13. SHOP PAINTING. All ferrous metal surfaces, except bearing and finished surfaces and stainless steel components of valve actuators and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.

The following surfaces shall be painted:

Polished or Machined Surfaces	Rust-preventive compound.
Other Surfaces	Epoxy enamel.
Actuators and Accessories	Universal primer.

PART 3 - EXECUTION

3-1. INSTALLATION. Actuators will be installed on the valves in accordance with the Valve Installation section and gates in accordance with the Gate Installation section.

End of Section

Section 16150

ADJUSTABLE FREQUENCY DRIVES

PART 1 - GENERAL

1-1. SCOPE. This section covers pulse width modulated (PWM) type adjustable frequency drives (AFD) for the equipment and locations as specified. AFDs shall meet the design conditions and features specified herein.

Driven equipment 11141
specification number.

Unit designations. HSP-1, HSP-3

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Equipment provided under this Section shall be fabricated as specified in this Section and as shown on the schematics and one line diagrams on the Contract Drawings.

Unless otherwise indicated on the drawings, one adjustable frequency drive, complete with all required control components, shall be furnished for each motor.

AFDs shall be manufactured and assembled in their entirety at the manufacturer's factory. Systems fabricated or assembled in whole or in part by parties other than the drive manufacturer will not be acceptable.

1-2.01. Coordination. The design of the adjustable frequency drive shall be coordinated with the driven equipment. Contractor shall be responsible for coordinating the collection of data and the design effort to limit harmonics to the levels specified.

The manufacturer of the driven equipment shall be responsible for furnishing the adjustable frequency drive.

1-2.02. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.03. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the drawings is based on typical values. The supplier shall review the Contract Drawings, the manufacturer's layout drawings and installation requirements, and make any modifications required for proper installation subject to acceptance by Engineer.

1-2.04. Workmanship and Materials. Equipment supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with applicable governing standards. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

1-2.05. Governing Standards. The adjustable frequency drive shall be designed, constructed, and tested in accordance with the applicable standards of NEMA, ANSI, UL, and IEEE, and shall be designed for installation in accordance with the NEC.

The equipment covered by this section shall be listed by UL or a nationally recognized third-party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of Contractor. In the event no third-party testing laboratory provides the required listing, an independent test shall be conducted at Contractor's expense. Before the test is conducted, Contractor shall submit a copy of the testing procedure to Engineer.

1-2.06. Nameplates. Nameplates with the description and designation of each control or indicating device shall be provided. Unless specified otherwise, each drive enclosure shall be provided with a nameplate bearing the unit designation as indicated above. Nameplates shall be black and white laminated phenolic material of suitable size, and shall be engraved with 3/8 inch [10 mm] high letters for the drive designation and 3/16 inch [5 mm] letters for other information. The engraving shall extend through the black exterior lamination to the white center.

Each control device and each control wire terminal block connection inside the enclosure shall be identified with permanent nameplates or painted legends to match the identification on the manufacturer's wiring diagram.

1-3. DESCRIPTION. The AFD shall produce an adjustable ac voltage/frequency output and shall be equipped with an output voltage regulator to maintain correct output V/Hz despite incoming voltage variations.

1-3.01. Six-Pulse Drives. Not used.

1-3.02. Eighteen-Pulse Drives. Drives for motors rated 100 horsepower and above, shall be of the pulse-width modulated type and shall consist of an 18-pulse, full-wave diode or gated-open SCR bridge. The rectifier shall convert incoming fixed voltage and fixed frequency to a fixed dc voltage. The pulse-width modulation technology shall be of the space vector type, implemented in a microprocessor that generates a sine-coded output voltage.

The phase shifting transformer required to produce the phase shifted input to the 18-pulse rectifier shall be factory wired and mounted within the drive enclosure as an integral part of the drive assembly. External transformers shall not be required.

The AFD inverter output shall be generated by insulated gate bipolar transistors (IGBT) which shall be controlled by identical base driver circuits. The AFD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque, and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation.

1-4. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the drive shall be submitted in accordance with the submittals section. The drawings and data shall include, but shall not be limited to, the following:

- a. Name of manufacturer.
- b. Types and model numbers.
- c. Rated drive input kVA and output kVA.
- d. Percent efficiency at 100 percent speed and 60 percent speed.
- e. Maximum Btu [kJ] heat release data and verification of the drive cooling requirements.
- f. Total weight and lifting instructions, height, mounting, and floor space required.
- g. Panel interior and front and side exterior view details showing maximum overall dimensions of all transformer, bypass contactor, ac line filter, ac line reactor, and drive compartments.
- h. Schematics, including all interlocks.
- i. Wiring diagrams, including all internal and external devices and terminal blocks.
- j. Locations and sizes of electrical connections, ground terminations, and shielded wires.
- k. List of diagnostic indicators.
- l. List of fault and failure conditions that the drive can recognize and indicate for simultaneous occurrence.
- m. List of standard features and options.
- n. List of spare parts to be furnished.
- o. Input line protection model numbers and manufacturer's data sheets.
- p. Output filter model number and manufacturer's data sheets.
- q. UL 508C Certificate of Compliance for short circuit current rating.
- r. Certification of conformal coating on all printed circuit boards.
- s. Harmonic calculations by the drive manufacturer at the points of analysis. Detailed drawings and information showing how protection is applied to comply with harmonic limits.
- t. Submit a detailed harmonic testing plan. The test plan should include instruments to be used, verification of testing locations for voltage and current harmonic metering, verification of maximum allowable voltage and current distortion, and drive load and speed test parameters.

1-5. OPERATION AND MAINTENANCE DATA AND MANUALS. Adequate operation and maintenance information shall be supplied. Operation and maintenance manuals shall be submitted in accordance with the submittals section.

Operation and maintenance manuals shall include the following:

- a. Manufacturer's operation and maintenance manual for each size of adjustable frequency drive.
- b. Manufacturer's standard manuals for each size and type of bypass contactor, transformer, line reactor, and filter.
- c. Schematics, wiring diagrams, and panel drawings in conformance with construction record.
- d. Model numbers and up-to-date cost data for spare parts.
- e. Troubleshooting procedures, with a cross-reference between symptoms and corrective recommendations.
- f. Connection data to permit removal and installation of recommended smallest field-replaceable parts.
- g. Information on testing of power supplies and printed circuit boards and an explanation of the drive diagnostics.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-6. SPARE PARTS. The drive manufacturer shall provide spare parts for each type and size of drive supplied. The spare parts shall include at least one complete set of all plug-in components for each size and type of drive, and shall include the following:

- Power fuses
- Control fuses
- Indicating lights
- Rectifier power semiconductors
- Inverter power semiconductors
- One of each type printed circuit board and gate firing board
- Other field-replaceable component parts

Spare parts shall be suitably packaged, as specified herein, with labels indicating the contents of each package. Spare parts shall be delivered to Owner as directed.

1.7. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and Storage shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS. All drives shall be pulse-width modulated type, as manufactured by Yaskawa by ICON Technologies without exception. The products of other manufacturers will not be acceptable.

All adjustable frequency drives shall be a product of the same manufacturer.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS.

2-2.01. Performance. The adjustable frequency drive controller shall be of sufficient capacity and shall produce a quality output waveform for stepless motor control from 10 to 100 percent of base speed. The adjustable frequency drive shall be suitable for loads and shall have voltage ratings as follows:

Unit designations	HSP-1, HSP-3
Load type	Variable torque (VT)
Input voltage	480 volt, 3 phase

The adjustable frequency drive shall be suitable for operation at an elevation below 3300 ft [1000 m], and shall meet the following ratings and parameters:

Input frequency	60 Hz
Input voltage and frequency variation	±10 percent voltage variation, ±2 Hz; imbalance, 2 percent maximum. Continued operation with additional momentary 25 percent voltage dip of 0.5 second duration from nominal input voltage level.
Minimum drive efficiency	95 percent at 100 percent speed, 90 percent at 60 percent speed.
Ambient temperature	0 to 40°C.
Relative Humidity	0 to 95 percent non-condensing.
Displacement Power Factor	95 percent or higher throughout the entire operating speed range, measured at drive input terminals.
Drive service factor	1.0.
Overcurrent capability	110 percent for 1 minute for variable torque; 150 percent for 1 minute for constant torque.

Volts/Hz ratio	Voltage varies as the square of frequency over the entire range of the unit for variable torque drives, linear over the entire range of the unit for constant torque drives; except under voltage boost condition.
Acceleration/deceleration time	Adjustable over a range that meets the requirements of the drive equipment.
Output speed regulation	0.5 percent.
Output frequency stability	0.5 percent of nominal.

2-2.02. Adjustments. The following drive adjustments shall be provided:

- Maximum speed.
- Minimum speed.
- Linear acceleration time.
- Linear deceleration time.
- Volts/Hz ratio; linear, squared, and automatic settings.
- Voltage boost.
- Process follower gain, offset, and bias.
- Torque limit.
- Critical frequency avoidance with adjustable bandwidth.

2-2.03. Fault Protection. Design of the power circuit shall include provisions for protection against fault conditions as follows.

2-2.03.01. Input Protection.

- The drive assembly shall be UL 508C listed. A UL Certificate of Compliance shall be submitted to confirm product compliance with UL 508C and to indicate the short circuit current rating. The short circuit current rating shall meet or exceed the available short circuit current indicated on the Contract Drawings.
- Solid state instantaneous overcurrent trip set at 180 percent.
- Adjustable overvoltage and undervoltage protection with automatic restart.
- Phase loss and reverse phase trip with manual restart.

2-2.03.02. Internal Protection.

- AC line, phase-to-phase transient voltage surge suppression utilizing metal oxide varistors. Drive shall meet the requirements of IEEE C62.41.
- Power device snubbers.
- Power devices rated 2.5 times line voltage.
- Instantaneous overcurrent.

Static overspeed (overfrequency) protection.

DC bus overvoltage trip.

Components and labeling that comply with UL 508 requirements. Drives shall be equipped with an automatic discharge circuit to deplete the charge on the DC capacitor bank to less than 50 volts within 60 seconds after main input power is removed. Labels indicating derivative voltage sources and required wait time for servicing after power removal shall be placed on all applicable enclosures.

Individual transistor overtemperature and overcurrent protection.

Control logic circuit malfunction indication.

2-2.03.03. Output Protection.

Inverse-time motor overload protection adjustable from 10 percent to 100 percent.

Overvoltage protection.

Overfrequency protection.

Short circuit protection (three phase, phase to phase, and ground fault protection).

Protection against opening or shorting of motor leads.

Static overspeed protection.

Stall protection on overload with inverse time overcurrent trip, adjustable current limit from 10 percent to 120 percent.

2-2.04. Harmonic Distortion Abatement. The electrical system shall be provided with the necessary equipment to protect the drive and the power system ahead of the drive from harmonic distortion, as described below. The harmonic distortion abatement analysis shall be based on the information on the Contract Drawings and on the follow:

Short circuit current at utility 30,000 amps
interface at the Smith Street Pump
Station

Total maximum running amperes of 800 amps
all equipment powered from the
utility connection

The drive shall operate satisfactorily when connected to a bus supplying other solid-state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500 volt-microseconds.

Harmonic distortion abatement equipment shall be provided to bring the facility and its electrical system into compliance with IEEE 519, 1992 at the points of analysis defined below and indicated on the Contract Drawings. The supplier shall review the existing facility loads and shall take note of the equipment listed above. All distortion reports and/or testing shall include the existing facility loads. The maximum total harmonic distortion (THD and TDD) allowed at

the points of analysis shall include harmonics from the existing equipment as well as the harmonics from equipment provided under this Section.

2-2.04.01. Current Distortion Limits. Maximum allowable total and individual harmonic current distortion limits for each odd harmonic shall not exceed limits set forth in IEEE 519, 1992. The utility connection shall be the primary point of analysis for current distortion. The values of utility short circuit current at the utility interface and the total maximum running amperes of all equipment powered from the utility connection shall be as indicated above.

2-2.04.02. Voltage Distortion Limits. Individual or simultaneous operation of the drives shall result in a maximum total harmonic voltage distortion of 5 percent on the bus feeding the drives. Individual or simultaneous operation of the drives shall not add more than 10 percent total harmonic voltage distortion to the bus feeding the drives while operating from a standby generator. The point(s) of analysis for harmonic voltage distortion testing shall be the nearest electrical bus on the supply side of each drive. The three phase fault current at the bus feeding the drives is 30,000 amps.

2-3. CONSTRUCTION. Construction requirements shall be as follows and as specified below:

Unit designations	HSP-1, HSP-3
Cable entry	Bottom
Cable exit	Bottom
Enclosure type	NEMA Type 1 with fans, filters, and gasketed doors
Maximum drive dimensions	76" Wide, 36" Deep, 91.5" High

2-3.01. Fabrication and Assembly. The adjustable frequency drive system shall be shop assembled in a single enclosure using interchangeable plug-in printed circuit boards and power conversion components wherever possible. Shop assembly shall be performed by the drive manufacturer; systems fabricated or assembled in whole or in part by parties other than the drive manufacturer will not be acceptable. Changes to the drive manufacturer's product by a distributor or system integrator are not allowed.

Input line reactors, fuses, circuit breakers, and filters, where required, shall be mounted within the drive enclosure, without exception. Isolation/voltage matching transformers, where required, may be enclosed separately from the remaining drive equipment.

The adjustable frequency drive system shall be designed to fit in the space indicated on the drawings.

2-3.02. Wiring. Internal cabinet wiring shall be neatly installed in wireways or with wire ties where wireways are not practical. Where wireway is used, they are to be mounted to the panel surface with a continuous run of 3M brand, or equal, industrial two-sided adhesive strip. For 12 AWG wire sizes and smaller, and in bundles of six or less, wire tie-down square mounting straps

shall be permitted. Tie-down mounts shall be installed at 8" increments or less. All mounting surfaces shall be pre-cleaned with isopropyl alcohol to ensure proper adhesion over the life of the equipment.

Terminal blocks shall be nonbrittle, interlocking, track-mounted type, complete with a marking strip, covers, and pressure connectors. Screw terminals will not be acceptable. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. In freestanding panels, 8 inches [200 mm] of clearance shall be provided between terminals and the panel base for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. Terminals shall be labeled to agree with the identification on the submittal drawings. Each control loop or system shall be individually fused, clearly labeled, and located for ease of maintenance.

All grounding wires shall be attached to the sheet metal enclosure with a ring tongue terminal. The surface of the sheet metal shall be prepared to ensure good conductivity and corrosion protection.

Wires shall not be kinked or spliced and shall be color coded or marked on both ends. The markings or color coding shall agree with the submittal drawings.

With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for at least 600 volts, with a moisture-resistant and flame-retardant covering rated for at least 90°C.

2-3.03. Enclosures. The drive shall consist of factory mounted and wired components within an enclosure, arranged so no electrically live components, terminals, or conductors are accessible on the front panel or door when the enclosure door is open.

The complete drive package, including accessories, shall fit into the space indicated on the drawings.

Freestanding panels shall be suitable for mounting on a concrete pad and shall include provisions for anchoring to the supporting structure. Suitable lifting facilities shall be provided for handling and shipment.

Relays, terminals, and special devices inside the control enclosure shall have permanent markings to match the identification on the manufacturer's wiring diagrams.

2-3.04. Printed Circuit Boards. All printed circuit boards shall be sprayed on both sides with a conformal coating. The conformal coating shall be a part of the AFD manufacturing process and shall be selectively applied to the circuit board connections only. Heat sinks and resistors on the circuit board shall not be coated. Conformal coating shall be Konform "C416", HumiSeal, or equal.

All plug-in type boards shall be mechanically held at the circuit board connector. Compression fit only at the connector will not be acceptable.

2-3.05. Shop Painting. All iron and steel surfaces, except machined surfaces and stainless steel, shall be shop cleaned in accordance with the coating manufacturer's recommendations, and

finished with the drive manufacturer's standard coating. Finish color shall be manufacturer's standard color. Dry film thickness of the finish coat shall be at least 4 mils [100 µm]. Field painting, other than touch up, will not be required. A sufficient quantity of additional coating material and thinner shall be furnished for field touch up of damaged coatings. A corrosion resistant coating shall be furnished.

All intermediate and finish coating materials shall be fumeproof and suitable for a wastewater treatment plant atmosphere that contains hydrogen sulfide. Documentation verifying that the coating material is fumeproof shall be submitted. Coatings shall be lead-free and mercury-free.

2-4. OPTIONAL EQUIPMENT.

2-4.01. Bypass Switch. Not used.

2-4.02. AC Line Reactors. Each six-pulse AFD, where isolation/voltage matching transformers are not used, shall be supplied with an input ac line reactor. AC line reactors shall be designed to address performance issues of NEMA MG1-20.55 and to provide proper transient protection of the AFD input power devices. AC line reactors shall be factory mounted and wired within the AFD enclosure. AC line reactors shall be K-rated per IEEE C57-110 and shall be TCI Model KLR, or equal.

2-4.03. Harmonic Filters. When harmonic filters are required to comply with the total harmonic distortion limits specified herein, the AFD manufacturer shall design and provide the required filters. The harmonic filters shall utilize an interlocking contactor that shall be automatically operated by the AFD run circuit. The AFD manufacturer shall be responsible for the complete filter unit, including the filter contactor. Harmonic filters shall be TCI Harmonic Guard HG7 Series, or equal.

2-4.04. Isolation/Voltage Matching Transformers. Not used.

2-4.05. Power Factor Correction Capacitors. Not used.

2-4.06. Output dV/dt Filters. Not used.

2-5. CONTROLS.

2-5.01. Features. Each drive shall include the following features in addition to those indicated on the drawings:

A door mounted membrane keypad with integral two-line, 24 character minimum LCD display that is capable of controlling the AFD and setting drive parameters. The keypad module shall be programmed with factory set drive parameters in nonvolatile EEPROM or FLASH memory and shall be resettable in the field through the keypad.

Control switches and pilot lights shall be provided as indicated on the schematic diagrams. Manual-automatic and start-stop controls included as features of the drive keypad shall be password protected or disabled to prevent override of control switches and safety interlocks shown on the schematic diagrams.

Control switches and pilot lights shall be 30.5 mm heavy-duty, oiltight construction. Pilot lights shall be full voltage type with LED lamps.

Microprocessor-based regulator. Nonvolatile memory modules shall have a useful life of at least 20 years without requiring battery or module replacement.

Input thermal-magnetic molded-case circuit breaker disconnect with interrupting capacity rated in RMS symmetrical amperes as required, and labeled in accordance with UL standard 489. The disconnect shall be mounted inside the controller enclosure and shall have door interlocks and a handle with provisions for padlocking in the "Off" position.

Manual speed adjustment.

Indications of power "On", drive "Run", and drive "Fault". Indication of these parameters shall be provided by pilot lights that utilize 6 volt LED lamps with built-in transformers. Lamps shall be easily replaceable from the front of the indicating light.

Elapsed time meter.

Speed indication - calibrated in percent rpm.

Control circuits of not more than 115 volts supplied by internal control power transformers. Control power transformers shall have additional capacity as required by external devices indicated on the drawings. Control power transformers shall be equipped with two primary leads fused, one secondary lead fused, and one secondary lead grounded.

Automatic controller shutdown on overcurrent, overvoltage, undervoltage, motor overtemperature and other drive fault conditions. Controller shutdown shall be manually reset type. Terminals shall be provided for control wiring from motor temperature switches, or a motor protection relay located in the drive enclosure.

Diagnostic indicators that pinpoint failure and fault conditions. Indicators shall be manually reset to restore operation after abnormal shutdown.

Accept a remote 4-20 mA speed control signal.

Process control output for remote 4-20 mA speed indication, rated 0 to 100 percent speed.

Spare interlock contacts rated 5 amperes at 120 volts ac, wired separately to the unit terminal board. One NO and one NC isolated spare interlock shall be furnished with each drive. Additional interlock contacts shall be provided as indicated on the drawings.

Drive fault and run status contacts for remote indication, rated 5 amperes at 120 volts ac.

Speed droop feature, which reduces the speed of the drive on transient overloads. The drive shall return to set speed after the transient is removed. If the acceleration or deceleration rates are too rapid for the moment of inertia of the load, the drive shall automatically compensate to prevent drive trip.

Individual adjustable speed profile settings for start, stop, entry, slope, and minimum and maximum speed points.

Coast, controlled ramp, or dc injection selectable modes of stopping.

PID setpoint control selection.

Adjustable PWM carrier frequency. The inverter output section shall be provided with adjustable PWM carrier frequency from 500 Hz to at least

8 kHz.

Noise level of installed equipment shall not exceed 85 dB, as measured by an appropriate calibrated instrument. The required sound level limit shall be met at a minimum of four locations, each not more than 3 feet [0.9 m] above the floor and not more than 10 feet [3 m] from the equipment. This requirement shall apply to all drives, motors, filters, reactors, and transformers supplied with the drive.

2-5.02. Diagnostics. Diagnostic indicators on the face of the drive shall display the type of fault responsible for drive shutdown, warning, or failure. If two or more faults occur simultaneously, the diagnostic segment shall record or indicate each condition. The drive shall be capable of storing 6 events.

2-5.03. Motor Protection Relay. Not used.

2-6. TESTING. All power switching components shall be pre-run under anticipated operating temperature and load conditions. Any alternative testing procedures shall be submitted and pre-approved before proceeding.

2-6.01. Factory Testing. After the drive system has been assembled at the manufacturer's facility, it shall be tested for at least 24 hours before it is shipped.

The complete drive system, including all peripherals, shall be factory tested under simulated operating conditions, including normal operating sequences and fault conditions. Contact closure inputs and simulated driven-outputs shall be connected to the system input/output modules.

A test report summary indicating satisfactory final test results shall be submitted to Engineer before shipment of the equipment.

2-6.02. Secondary Factory Testing. The drive units shall be assembled with the driven equipment for shop testing. The drive manufacturer shall provide the services of a qualified representative to work with the equipment manufacturer at the equipment manufacturer's facility. The representative shall advise and assist in assembling and testing the equipment and drive unit packages.

Personnel conducting the tests shall be competent, authorized representatives of the equipment and drive manufacturers who are familiar with operation of the equipment furnished and who have satisfactory experience in conducting similar tests. Qualified personnel shall perform the tests, record the data, make the required calculations, and prepare a report on the results. Five copies of the report shall be submitted in accordance with the submittals section. The information collected shall be used as a basis for determining acceptability of the manufacturer's test results. In case of conflict, interpretations and calculations made by Engineer will govern.

Testing shall be conducted in a manner acceptable to Engineer. At least 2 weeks before the proposed testing date, Contractor shall notify Engineer of the testing date and shall submit a report from the equipment manufacturer detailing the proposed performance testing.

PART 3 - EXECUTION

3-1. INSTALLATION. Installation will be in accordance with Section 16100.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, set all relays in accordance with the settings designated in the coordination study, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Section 01650, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price.

3-2.02. Installation Supervision. The equipment manufacturer shall furnish a qualified field installation supervisor during the equipment installation. Such services shall be included in the contract price.

Manufacturers' installation supervisor shall observe, instruct, guide, and direct the installing contractor's erection or installation procedures. The equipment manufacturer will be provided with written notification 10 days prior to the need for such services.

All costs for these services shall be included in the Contract Price.

3-3. FIELD HARMONIC DISTORTION TEST. Contractor shall provide temporary four-channel power line monitoring equipment at the site to graph and record the harmonic line distortion for ac voltage and current, and to compute individual harmonic values up to the 50th harmonic as well as total harmonic distortion (THD) and total demand distortion (TDD). Distortion testing shall include all drives furnished under this Section and all existing drives as specified in paragraph 2-2.04.

The monitoring equipment shall include a four-channel power line monitor, temperature and humidity compensation probes, a recorder, and any additional instruments required to compute harmonic values, THD, and TDD. The equipment shall be Dranetz-BMI Power Platform PP1, or equal.

Measurements shall include phase-to-phase, phase-to-neutral, and neutral-to-ground. The harmonic distortion shall be monitored at the primary and secondary points of common coupling. The test shall be run for the full range of drive operation to the extent practicable.

Graphs of harmonic spectra and of current waveforms shall be submitted for the following running conditions of the equipment.

- a. All drives at 100 percent speed.
- b. Half, two-thirds, or three-fifths of each type of drive at 60 percent speed and the others at 100 percent speed.
- c. All drives at 60 percent speed.
- d. All drives off.

The test shall be conducted by qualified personnel acceptable to Engineer.

3-4. TRAINING OF OWNER'S PERSONNEL. Up to 10 employees of Owner, shall be trained in the proper operation, troubleshooting, and maintenance of the equipment. Training shall be conducted by a qualified representative, and shall consist of combined classroom and hands-on instruction. Training shall be conducted at a place and time mutually agreeable to Owner and the drive manufacturer.

All costs for these services shall be included in the Contract Price.

End of Section

GENERAL PURPOSE INDUCTION MOTORS

PART 1 - GENERAL

1-1. SCOPE. This section covers single and three-phase, small (fractional) and medium (integral) horsepower, alternating current motors rated 500 horsepower and less (NEMA MG1).

Motors shall be designated and coordinated with the driven equipment and shall be located as indicated on the drawings.

1-2. GENERAL. Motors furnished under Driven Equipment Specification sections shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by the ENGINEER.

Where applicable, individual motor data sheets have been developed which specify additional requirements for specific motors.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all motors, unless otherwise specified. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standards. Motors furnished under this section shall be designed, constructed, and tested in accordance with the latest version of NEMA MG 1 and IEEE 112, Test Method B.

1-2.03. Nameplates. All motor nameplate data shall conform to NEMA MG 1 requirements.

1-3. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the motor shall be submitted in accordance with the submittals section. The drawings and data shall include, but shall not be limited to, the following:

1-4.

Motors

- Name of manufacturer.
- Type and model.
- Type of bearing and method of lubrication.
- Rated size of motor, hp [kW], and service factor.
- Temperature rise and insulation rating.
- Full load rotative speed.
- Net weight.
- Efficiency at full, 3/4, and 1/2 load.
- Full load current.
- Locked rotor current.
- Space heater wattage, where applicable.
- Motor temperature switch data, where applicable.
- RTD data, where applicable.

OPERATION AND MAINTENANCE DATA AND MANUALS. Adequate operation and maintenance information shall be supplied. Operation and maintenance manuals shall be submitted in accordance with the submittals section.

Operation and maintenance manuals shall include the following:

Assembly, installation, alignment, adjustment, and checking instructions.

Lubrication and maintenance instructions.

Guide to troubleshooting.

Parts lists and predicted life of parts subject to wear.

Outline, cross-section, and assembly drawings; engineering data; and wiring diagrams.

Test data and performance curves, where applicable.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. Service conditions for motors shall be as specified in the driven equipment specification sections. Motors shall be designed for special conditions such as area classification, altitude, frequent starting, intermittent overload, high inertia, mounting configuration, or service environment. Where site elevation and ambient temperature is not specified in the driven equipment specification sections, the motors shall be designed for the following.

Site elevation	Below 3,300 ft [1,000 m]
Ambient temperature	50 °C

Unless specified otherwise, all motors shall be designed for full voltage starting and to operate from an electrical system that may have a maximum of 5 percent voltage distortion according to IEEE 519.

Motors utilizing a reduced-voltage, autotransformer starter shall be capable of reduced-voltage starting at a 65 percent tap setting.

Motors utilizing a reduced voltage solid state starter shall be capable of starting at 50% of the specified voltage.

When powered from an adjustable frequency drive (AFD), motors shall be inverter duty and specifically selected for service with an adjustable frequency type speed controller and shall be derated as required to compensate for harmonic heating effects and reduced self-cooling capability at low speed operation. Each motor shall not exceed a Class B temperature rise when operating in the installed condition at load with power received from the adjustable frequency drive. All motors driven by AFDs shall be supplied with full phase insulation on the end turns and shall meet the requirements of NEMA MG 1, Part 31. In addition to the requirements of NEMA MG 1, Part 31, motors shall be designed to be continually pulsed at the motor terminals with a voltage of 1600 volts ac.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. Unless otherwise specified in the attached motor data sheet(s), design and construction of each general-purpose motor shall be as specified herein. Motor voltage, frequency, speed, service factor, and insulation class shall be as follows:

Motor voltage.	460, 3 phase for ½ horsepower and larger, 120, single phase for smaller than ½ horsepower
Frequency.	60 Hz
Speed.	Constant speed
Service factor.	1.0 , except for AFD driven motors which shall be 1.15
Insulation class and temperature rise above 40° C design ambient (by resistance method.	Class F with 90° C rise at 1.15 SF
Enclosure.	Totally enclosed fan cooled
Main conduit box sized to include.	Main motor leads and space heater leads where space heaters are specified

2-2.01. Nameplate Horsepower. Motor nameplate horsepower [kW] shall be equal to or greater than the maximum load imposed by the driven equipment.

2-2.02. Enclosures. All motors shall be self-ventilated. All self-ventilated open type motors, including those with dripproof, splashproof, and weather protected enclosures, and the fan covers of totally enclosed fan cooled motors shall meet NEMA MG 1 requirements for a fully guarded machine.

2-2.02.01. Totally Enclosed Motors. Totally enclosed motors shall be furnished with drain holes and rotating shaft seals. Frames, bearing brackets, external terminal housings, and fan covers for fan cooled motors shall be cast iron. External cooling fans for fan cooled motors shall be fabricated of brass, bronze, aluminum alloy containing not more than 0.2 percent copper, malleable iron, or plastic. All plastic fans shall be fabricated of a reinforced thermosetting plastic and shall be UL approved.

2-2.02.02. Outdoor Motors. Outdoor motors shall have NEMA weather protected enclosures. All exposed metal surfaces shall be protected, where practical, with a corrosion resistant polyester coating. Exposed uncoated surfaces shall be of a corrosion resistant metal. Enclosure exterior and interior surfaces, air gap surfaces, and windings shall be protected with a corrosion resistant alkyd enamel, polyester, or epoxy coating.

2-2.02.03. Motors for Hazardous Locations. Motors for hazardous locations shall be in accordance with the NEC and of the correct type enclosures for the particular service as specified in NEMA MG 1. Motors shall meet the requirements of UL 674.

2-2.02.04. Encapsulated Windings. Not used..

2-2.02.05. Severe Duty Chemical Service Motors. Not used..

2-2.03. Main Conduit Boxes. The main conduit box shall be in accordance with NEMA MG 1. The main conduit boxes shall be diagonally split for easy access to the motor leads, and designed for rotation in 90-degree increments. A gasket shall be furnished between the halves of the box. Conduit openings in the main conduit box shall match the size and quantity of conduits indicated on the one line drawings.

The main conduit box shall be oversized at least one size larger than NEMA standard. The main conduit box shall be sized for all indicated accessory leads.

Motors furnished in NEMA 320 frame series and larger shall have conduit boxes designed and constructed to permit motor removal after installation without disconnecting raceways.

2-2.04. Leads. Motor power leads shall be wired into the main conduit box. Unless otherwise specified, space heater leads shall be wired into the main conduit box. All motor leads and their terminals shall be permanently marked in accordance with the requirements of NEMA MG 1, Part 2. Each lead marking shall be visible after taping of the terminals.

All motors rated 100 horsepower [74 kW] and larger, and all vertical motors shall have the direction of rotation marked by an arrow mounted visibly on the stator frame near the terminal housing, or on the nameplate, and the leads marked for phase sequence T1, T2, T3, to correspond to the direction of rotation and supply voltage sequence.

Leads for dual-voltage rated or for multispeed motors shall be easily connected or reconnected in the main conduit box for the operating voltage or for the specified speeds. Permanent instructions for making these connections shall be furnished inside the main conduit box or on the motor frame or nameplate.

2-2.05. Terminals. Cable type leads shall be provided with Burndy Type YA or acceptable equal compression type connectors.

2-2.06. Grounding Connections. All motors shall be furnished with a ground connection.

2-2.07. Bearings. All bearings shall be self-lubricating, shall have provisions for relubrication, and shall be designed to operate in any position or at any angle.

Motor bearings shall be antifriction type with L_{10} life rating of 40,000 hours in accordance with AFBMA Standards.

All bearing mountings shall be designed to prevent the entrance of lubricant into the motor enclosure or dirt into the bearings, and shall be fitted with pipes, drain plugs, and fittings arranged for safe, easy relubrication from the outside of the motor while the motor is in service, as necessary.

2-2.08. Rotors. All induction motors shall have squirrel-cage rotors adequately sized to avoid overheating during acceleration of the motor and driven equipment. Rotors shall be dynamically balanced to 0.08 in./sec [2.03 mm/s] or less.

2-2.09. Shafts. Shafts shall be furnished with corrosion resistant treatment or shall be of a corrosion resistant material.

2-2.10. Torque Characteristics. Motors rated 200 horsepower [149 kW] and less shall have torques and locked-rotor current in accordance with NEMA MG 1, Part 12.

2-2.11. Motor Space Heaters. Unless otherwise specified in the attached motor data sheet(s), motors 1 horsepower and larger shall be provided with a space heater element sized to prevent condensation on the core and windings. The space heaters shall be isolated or so located as to prevent heat damage to adjacent painted surfaces and shall be suitable for 120 volt, 60 Hz, single phase power supply.

2-2.12. Temperature Sensing Devices. Each motor controlled by an adjustable frequency drive shall be furnished with at least one automatic reset winding temperature switch per phase. Temperature switch contacts shall be normally closed and rated 5 amps at 120 volts ac. The contacts shall be wired in series with the end leads brought out to the motor terminal box.

Where specified in the attached motor data sheet(s), motors shall be furnished with a pair of resistive temperature devices (RTDs) placed in each phase winding to sense winding temperature. All RTDs shall be 100 ohm, platinum type, and shall be connected with a twisted shielded triad to the motor protection relay as indicated on the drawings.

An auxiliary conduit box shall be provided for termination of RTD or temperature switch wiring.

2-2.13. Assembly. All motors shall be completely assembled with the driven equipment, lubricated, and ready for operation.

2-2.14. Efficiency. Unless otherwise specified in the attached motor data sheet(s), motors shall be premium efficiency type and shall have a NEMA nominal efficiency nameplate value equal to or greater than values indicated in the following table. Efficiency shall be determined in accordance with IEEE 112, Test Method B.

Vertical motors shall have efficiency values equal to or greater than those indicated in the following table minus 0.50.

Motor		Nominal Efficiency Values				Nominal Efficiency Values			
kW	hp	Open Drip Enclosure				TEFC Enclosure			
		3600 rpm	1800 rpm	1200 rpm	900 rpm	3600 rpm	1800 rpm	1200 rpm	900 rpm
0.7	1	84.0	85.5	82.5	75.0	77.0	85.5	82.5	75.5
1.1	1.5	84.0	86.5	86.5	78.0	84.0	86.5	87.5	80.0
1.5	2	85.5	86.5	87.5	86.5	85.5	86.5	88.5	85.5
2.2	3	85.5	89.5	88.5	89.5	87.0	89.5	89.5	86.5

Motor		Nominal Efficiency Values				Nominal Efficiency Values			
kW	hp	Open Drip Enclosure				TEFC Enclosure			
		3600 rpm	1800 rpm	1200 rpm	900 rpm	3600 rpm	1800 rpm	1200 rpm	900 rpm
3.7	5	86.5	89.5	89.5	89.5	88.5	89.5	89.5	85.5
5.6	7.5	88.5	91.0	90.2	88.5	90.0	91.7	91.0	86.5
7.5	10	89.5	91.7	91.7	91.0	91.0	91.7	91.0	91.0
11.2	15	90.2	93.0	91.7	91.0	91.0	92.4	92.0	91.0
14.9	20	91.7	93.0	92.4	92.0	92.0	93.0	92.0	91.0
18.7	25	92.4	93.6	93.0	92.0	92.0	93.6	93.0	91.0
22.4	30	93.0	94.1	93.6	93.0	92.4	93.6	93.0	93.0
29.8	40	93.0	94.1	94.1	93.0	92.4	94.1	94.1	93.0
37.3	50	93.0	94.5	94.1	93.0	93.0	94.5	94.1	93.0
44.8	60	93.6	95.0	94.5	94.0	93.6	95.0	94.5	93.0
56	75	94.0	95.0	95.0	94.0	93.6	95.4	95.0	94.0
74.6	100	94.5	95.4	95.0	95.0	94.1	95.4	95.0	94.0
93.2	125	95.0	95.4	95.0	95.0	95.0	95.4	95.0	94.0
112	150	95.0	95.8	95.4	95.0	95.0	95.8	95.8	94.0
149	200	95.4	95.8	95.4	95.0	95.4	96.2	95.8	94.1
186	250	95.0	95.8	95.4	95.0	95.8	96.2	95.8	94.5
224	300	95.4	95.8	95.4		95.8	96.2	95.8	
261	350	95.4	95.8	95.4		95.8	96.2	95.8	
298	400	95.8	95.8	95.8		95.8	96.2	95.8	
336	450	95.8	96.2	96.2		95.8	96.2	95.8	
373	500	95.8	96.2	96.2		95.8	96.2	95.8	

2-3. ACCESSORIES.

2-3.01. Special Tools and Accessories. Motors requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Each motor shall be provided with lifting eyebolts or lugs and appropriate fittings for adding bearing lubricant. Grease lubricated units shall be provided with a means of venting the casing. Oil lubricated units shall be provided with constant level oilers or with sight glasses arranged to indicate operating and static oil levels.

2-4. ANCHORS. CONTRACTOR shall furnish suitable anchors for each item of equipment as required for driven equipment.

2-5. BALANCE. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case, the unfiltered vibration displacement (peak-to-peak), as measured at any point on the machine, shall not exceed the limits as required. At any operating speed, the ratio of rotative speed to the critical speed of a unit or its components shall be less than 0.8 or more than 1.3.

PART 3 - EXECUTION

3-1. INSTALLATION. Each motor will be installed in accordance with the Equipment Installation section.

End of Section

PUMP SELECTION TABLE

	Selection Four Manufacturers	Pump Position Number		
		1	2	3
Smith Street P3 VFDs				
Pump Make	Fairbanks Morse	16E.2+ 2 stage	16E.2+ 2 stage	16E.2+ 2 stage
Pump Model				
Impeller Size (In)		12.6875	12.6875	12.6875
Pump HP		198	198	198
Motor HP		250	250	250
Pump Make	American-Marsh	20MC-4 stage	20MC-4 stage	20MC-4 stage
Pump Model				
Impeller Size (In)		13.125	13.125	13.125
Pump HP		197	197	197
Motor HP		250	250	250
Pump Make	Patterson- Gorman Rupp	16RHC 2 stage	16RHC 2 stage	16RHC 2 stage
Pump Model				
Impeller Size (In)		12.1875	12.1875	12.1875
Pump HP		215	215	215
Motor HP		250	250	250
Pump Make	Flowserve	18ENL 4 stage	18ENL 4 stage	18ENL 4 stage
Pump Model				
Impeller Size (In)		14.15	14.15	14.15
Pump HP		225	225	225
Motor HP		250	250	250

	Selection Four Manufacturers	Pump Position Number				
		1	2	3	4	5
Glencoe WTF Transfer						
		Smith Street		Daily/ Swing	On-site	
Pump Make	Fairbanks Morse	19B.1+ 3 stage	19B.1+ 3 stage	141.2 2 stage	23HH.1	23HH.1
Pump Model						
Impeller Size (In)		13.9375	13.9375	10.625	11.75	11.75
Pump HP		205	205	89	68	68
Motor HP		250	250	100	100	100
Motor Speed (RPM)		1180	1180	1180	885	885
Pump Make	American-Marsh	20 LC 4 stage	20 LC 4 stage	18LC	14ZC	14ZC
Pump Model						
Impeller Size (In)		13.375	13.375	12.25	10.75	10.75
Pump HP		166	166	62	65	65
Motor HP		200	200	100	100	100
Motor Speed (RPM)		1160	1160	1760	1760	1760
Pump Make	Patterson- Gorman Rupp	17JMC 2 stage	17JMC 2 stage	18KMC	16 MPVT-A-1 1 stage	16 MPVT-A-1 1 stage
Pump Model						
Impeller Size (In)		11.1875	11.1875	12.3125	15.6875	15.6875
Pump HP		219	219	75	54	54
Motor HP		250	250	100	100	100
Motor Speed (RPM)		1770	1770	1150	880	880
Pump Make	Flowserve	15EBL 3 stage	15EBL 3 stage	18ENL 2 stage	18ENH	18ENH
Pump Model						
Impeller Size (In)		10.9	10.9	13.21	13.9	13.9
Pump HP		200	200	96	62	62
Motor HP		250	250	100	100	100
Motor Speed (RPM)		1775	1775	1185	1185	1185