

ELVIN MCCORVEY MEMORIAL WATER PRODUCTION FACILITY  
FORMERLY WEST WATER TREATMENT FACILITY, BOOSTER STATION AND GAC  
SYSTEM

ECUA PROJECT NUMBER RW819

BID NO. CC2024-02

December 4, 2023

**ADDENDUM NO. 3**

This addendum forms a part of the Contract Documents and modifies the original Specifications dated October 2023, as noted below. Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject Bidder to disqualification. This addendum consists of one (28) pages, including all attachments.

RESPONSES TO QUESTIONS:

1. Is Buy American a requirement for this contract?

Response: This contract is not subject to Federal Purchasing Regulations.

2. The Specifications reference both Type 304 and 316 Stainless Steel. Which is required?

Response: All Stainless Steel for this project shall be Type 304.

3. Looking at Sheet C-601 south side retaining wall does not have any grade listed for the top or wall and top of footing.

Response: Detail 5, Sheet C-804 has been revised to add data to the retaining wall detail. The revised detail is included in the Addendum.

4. There is a detail on Sheet C-802 and S-102 for the bollard but the details are different. Which detail is correct?

Response: The detail on Sheet S-102 is the correct detail for construction of the Bollard.

5. Sheet E101 – The light by the well pump is labeled “FVB” and isn’t on the light fixture schedule. Please provide information on that light fixture type.

Response: Fixture mark FVB shall be Lithonia catalog number DMW2-L24-3000LM-ACL-MD-MVOLT-GZ10-40K-80CRI

6. Sheet E101 – Pressure sustaining valve and flow meters are shown on this sheet. Are they going to be located in a dog house? If so does the dog house require power for a receptacle, heat trace or a light?

Response: The pressure sustaining valves, and flow meters will be installed in hot boxes as indicated on sheet C-803. Provide 120 volt circuits for each. Circuits LP-43 and LP-45 each 2#10, 1#10 and  $\frac{3}{4}$  “ C.

7. Sheet E101 – The light switch shown at the well pump isn’t shown as “WP” but the receptacle is labeled “WP” Should the light switch be furnished “WP”?

Response: The light switch at the well pump shall have a weatherproof cover plate.

8. OP/CI items- Please provide a complete list of owner provided materials and equipment as well as the start up and testing services that are included in the materials and equipment furnished by the owner.

Response: The standby generator and automatic transfer will be owner furnished contractor installed. The generator manufacturer (Cummins) will provide standard startup services. The contractor shall schedule and assist the generator and start up technicians.

9. Sheet E-102- Call for the panels to be Square D. If square D has the best price on bid day we can certainly use them but to reduce project cost will other manufactures be acceptable such as ABB, Cutler hammer, Siemens or GE?

Response: Square D is the only acceptable manufacturer.

10. E104 & E116- The security panel is furnished by the integrator does that package include the mag door sensors for all the doors?

Response: It is the general contractor’s responsibility to determine which subcontractor will be responsible to supply the mag door sensors.

11. E104- Shows power to the motorized dampers but what controls are required to open and close the dampers?

Response: As indicated on sheet E104, the dampers are operated by the same switch or starter that controls the exhaust fans.

12. E104- Shows the Disconnect and starter in the lime room. Are these enclosures to be Nema 1, Nema 3r, Nema 4X?

Response: Disconnect and starter shall be NEMA 4X.

13. E104, rm.104- Ortho room, has a key note #1 shown which refers to the Lime feed system. This note is also located in the Lime room, rm 100. Does the ortho room required all items called out in note #1?

Response: Delete keynote 1 in room 104.

14. E104,rm.104- Ortho room, what enclosure is required for the disconnect to EF-3? Is it Nema 1, Nema 3R or Nema 4X?

Response: NEMA 4X enclosures are required in room 104.

15. E104- Room E104, rm.103, fluoride room. What enclosure is required for the disconnect to EF-3? Is it Nema 1, Nema 3R or Nema 4X?

Response: NEMA 4X enclosures are required in room 103.

16. E105- Room 100 light switch. Due to the lime dusting in the room should the light switch be WP like the receptacles are?

Response: The light switch in room 100 shall have a weatherproof cover plate.

17. E116,rm.101- What enclosure is required for the disconnects and starters for the UH-1 & EF-1? Nema 1, Nema3R or Nema 4X?

Response: NEMA 4X enclosures are required in room 101.

18. E116,rm.103- Chlorine room: What enclosure is required for the disconnect/starter on EF-2 & UH-2?

Response: NEMA 4X enclosures are required in room 103.

19. E104,rm 105- Chlorine room: What enclosure is required for the disconnect/starter on EF-2?

Response: NEMA 4X enclosures are required in room 105.

20. E104 rm 104- Chlorine room: What trade or spec division is required to furnish and install the CL2 vacuum alarm monitor, leak detection controller, alarm lights and horn?

Response: It is the general contractor's responsibility to determine which subcontractor will be responsible to supply the four listed items.

21. E116 rm 103- Chlorine room: What trade or spec division is required to furnish

and install the chlorine alarm monitor, lead detection controller, alarm lights and horn?

Response: It is the general contractor's responsibility to determine which subcontractor will be responsible to supply the four items listed.

22. E104, E105, E116 & E117- Can conduit systems and boxes be installed surface mounted/exposed in all areas or are they required to be in the block walls?

Response: Surface mtd is acceptable.

23. Spec section 16010-1.14- staffing requires a State of Florida Master Electrician to be on site during all electrical work being performed. The state of Florida doesn't issue an Master Electrician license any longer, currently it is called a Electrical contractors license now. The owner of the company is typically the person who holds that electrical contractor license and is responsible for all work performed under that license. That being said, typically that license holder oversees all work performed under that license but is not on all projects 100% of the time. Is it acceptable for the electrical contractor license holder to oversee this project but not be on site during all electrical operations being performed?

Response: Change the electrical staffing requirements in Section 16010 to the following:  
-The electrical contractor shall hold an EC or ER license and shall be responsible for the work performed under the license. The electrician in charge of the work onsite shall hold a journeyman's card or equivalent qualification to perform electrical work and be onsite at all times electrical work is being performed.

24. Spec section 16010- as-builts are called to be submitted in AutoCAD 2007 format. Will a PDF version be acceptable?

Response: A PDF version is acceptable.

25. Spec section 16060- Refers to an independent testing agency but also states the contractor shall perform specified test. Is an independent testing agency required for the specified electrical tests?

Response: An independent testing agency shall provide grounding system testing and reporting.

26. Spec section 16370- states VFD's are to be only Allen Bradley or Yaskawa. If AB or Yaskawa has the best price on bid day we can certainly use them but to reduce project cost will other manufactures be acceptable?

Response: Only Allen Bradley or Yaskawa VFDs are acceptable.

27. Spec section 16400 panelboards- states that Square D is the only acceptable manufacture. If square D has the best price on bid day we can certainly use them but to reduce project cost will other manufactures be acceptable such as ABB, Cutler hammer, Siemens or GE?

Response: Square D is the only acceptable manufacturer.

28. Sheet C-803 shows hot boxes but sheet E101 only calls out 1 hot box by the tank. Are others on the site, do they require electrical inside each?

Response: The pressure sustaining valves and flow meters will be installed in hot boxes as indicated on sheet C-803. Provide 120 volt circuits for each. Circuits LP-43 and LP-45 each 2#10, 1#10, and  $\frac{3}{4}$  "C.

29. Sheet C-804 shows two Scada tower types, a concrete pole and a Rohn steel tower. Which is required on site? Two are shown on sheet E101.

Response: The contractor has the option to provide either type (note on sheet indicates "1 or 2/C-804").

30. Sheet E104, key note #1 references a detail located on sheet P-103. Sheet P-103 doesn't exist in the current set of drawings. Please clarify where to find this referenced detail.

Response: The correct reference is P-203.

31. Who is expected to supply the pressure gauge & pressure switches on the Well Discharge Flange shown in Detail B on Drawing P-301?

Response: It is the general contractor's responsibility to determine which subcontractor will be responsible to supply the pressure gauges and pressure switches.

32. Who is expected to supply the door Sensors shown on E-104 & E-116?

Response: It is the general contractor's responsibility to determine which subcontractor will be responsible to supply the door sensors.

33. We can't find a reference for owner, consultant, or contractor to witness the test in 11214, 2.02, B. 5 a. However, Specification 11215 3.04, B. 1. calls for witness test in the presence of the engineer. Cost is approximately \$2,500 per pump and would take 2 days for all three pumps. You also must add the cost for food/air/lodging per person that attends. We need to be clear on who, specifically how many persons, will attend so that we can include this in our bid.

Response: The Engineer or his representative will witness the factory tests. Only one person will attend.

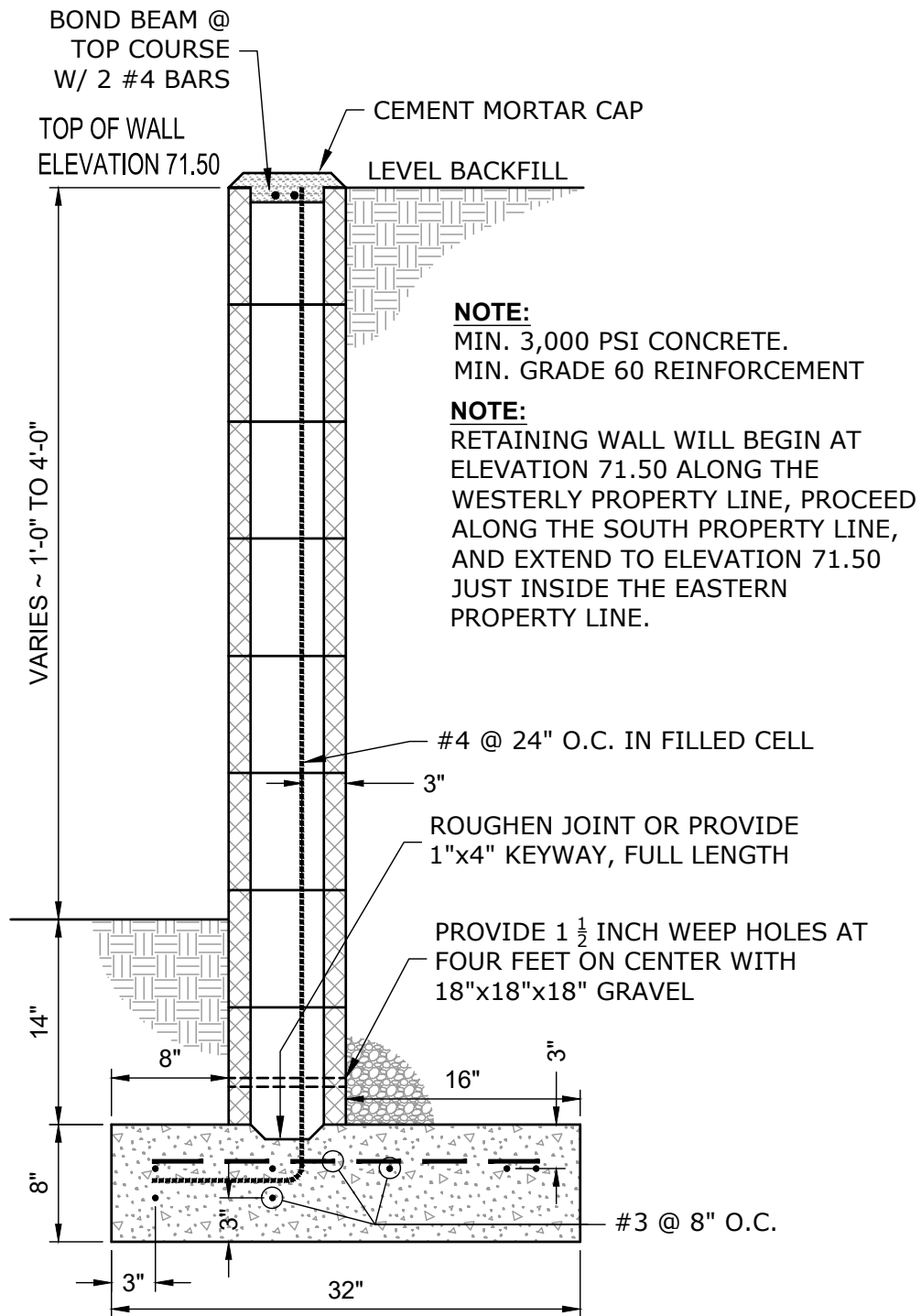
34. We assume that specification sections 11241, and 11215 are both for the same pumps and are to both be followed.

Response: Specifications 11214 and 11215 are both to be followed.

35. We assume that specification section 11005 is for reference and only to be used when directed by specification section 11214.

Response: Section 11005 applies universally.

36. Page numbers are added to sections 11214 and 11215 for reference as shown.



## RETAINING WALL DETAIL

NTS

5

C-301

## ADDENDUM #3

**PART 1 - GENERAL****1.01 SCOPE OF WORK**

- A. Furnish all labor, materials, equipment and incidentals required and install, place in operation and field test Three (3) vertical turbine pumps. Pumps must comply with the Clean Water Act of 2014, NSF61 Standards.
- B. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment application. It is, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and field testing, of all materials, equipment and all appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these Specifications or not.

**1.02 RELATED WORK**

- A. Installation, electrical work, motor, and variable frequency drive specifications are included in others sections and/or plans.

**1.02 DESCRIPTION OF SYSTEMS**

- A. Three pumping units are required under this Contract, each of which shall be driven by a squirrel cage induction motor as specified herein and/or other sections. The pumping unit shall be located and arranged as shown on the drawings.
- B. Each pumping unit will take suction from the clear well with an arrangement and water level variation as shown on the Drawings.
- C. All working parts of the pump, motor, such as bearings, wearing rings, shaft, sleeves, etc., shall be standard dimensions built to limit gauges or formed to templates, such that parts will be interchangeable between like units and such that the Owner may, at any time in the future, obtain replacement and repair parts for those furnished in the original machines. All parts shall be properly stamped for identification and location in the machines as shown on the Assembly Drawings in the Instruction books furnished.

**1.04 QUALIFICATIONS**

- A. To assure unity of responsibility, the pump, motor, shall be supplied and coordinated by the pump manufacturer. The Contractor shall assume full responsibility for the satisfactory installation and operation of the entire pumping systems including pump, motor.
- B. The equipment covered by these Specifications is intended to be standard units of proven ability as manufactured by a competent organization having long experience in the production of such equipment. A single manufacturer shall furnish units specified herein. The pump furnished shall be designed, constructed and installed in



accordance with the best practice and methods, and shall operate satisfactorily when installed. Pump shall be manufactured in accordance with the Hydraulic Institute Standards, except where otherwise specified herein.

- C. All equipment furnished under this Specification shall be new and unused and shall be the standard product of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.
- D. The pump manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components of the assembled pumping unit to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range. Design shall include all supporting sole plates and fabricated steel base plate for mounting the units.
- E. The pump manufacturer shall perform both lateral and torsional critical speed analyses to identify and ensure that (a) the first lateral critical speed shall be at least 25 percent above the maximum pump speed, and that (b) no torsional natural frequencies occur within a range extending from 25 percent below to 25 percent above the specified operating speed range, and that (c) any blade excited resonant frequency shall be no closer than plus or minus 25 percent of the natural frequency of any part of the installed assembled pumping unit. Prior to manufacture, a statement must be forwarded to the Engineer indicating that the required analyses have been made and that the specified limitations will be met.
- F. Vibration, when measured in the direction of maximum amplitude at the top motor bearing, shall not exceed 7 mils, peak-to-peak displacement at a maximum peak velocity of 0.4-in per second at any speed within the specified operating speed range.

## 1.05 SUBMITTALS

- A. Copies of all materials required to establish compliance with the specifications shall be submitted in accordance with the provisions of the General Conditions and Division 1. Submittals shall include at least the following:
  - 1. Certified shop and erection drawings showing all-important details of construction, dimensions and anchor bolt locations.
  - 2. Descriptive literature, bulletins, and/or catalogs of the equipment.
  - 3. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity, efficiency, NPSHR, and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets; at as large a scale as is practical. Curves shall be plotted from no flow at shut off head to pump capacity at minimum specified total head. Catalog sheets showing a family of curves will not be acceptable. Curves shall be plotted for both minimum and maximum speed. The minimum head system curve shall also be plotted on the submittal.
  - 4. Complete master wiring diagrams, elementary or control schematics, including coordination with other electrical control devices such as the Effluent Pump Control System and suitable outline drawings shall be furnished for approval

before proceeding with manufacture. Provide suitable outline drawings showing such details as are necessary to locate conduit stub-ups and field wiring. Due to the complexity of the system, it is imperative the above drawings be clear and carefully prepared to facilitate interconnections with other equipment. Standard preprinted sheets or drawings simply marked to indicate applicability to this contract will not be acceptable. Refer to the Electrical and Instrumentation Drawings for the control-wiring diagram of the pump motors.

5. The total weight of the equipment including the weight of the single largest item.
6. A complete total bill of materials of all equipment.
7. A list of the manufacturer's recommended spare parts to be supplied in addition to those specified in paragraph 1.07, with the manufacturer's current price for each item. Include gaskets, packing, etc., on the list. List bearings by the bearing manufacturer's numbers only.
8. Complete motor data.
9. Copies of all factory test results, as specified in PART 2 - PRODUCTS of this Section of the Specifications.

#### B. Design Data

1. Complete motor performance data shall be furnished.

#### C. Test Reports

1. A schedule of the date of shop testing and delivery of the equipment to the job site.
2. Description of pump factory test procedures and equipment.

D. Operation and Maintenance Data - Complete operating and maintenance instructions shall be furnished for all equipment included under these specifications as provided in Paragraph 1.07. The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules, and complete spare parts lists with ordering information.

E. In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

F. The submittal format shall be in the form of a booklet, suitably tabbed and divided to cover all areas noted in Paragraphs 1.06 A. and B. above for each major equipment item. The submittal booklet shall include adequate detail and sufficient information for the Engineer to determine that all of the equipment proposed meets the detailed requirements of the Specifications.

### 1.06 OPERATING INSTRUCTIONS

A. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings,

equipment lists, descriptions, etc., that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

- B. A factory representative of all major component manufacturers, who has complete knowledge of proper operation and maintenance, shall be provided for two (2) days to instruct representatives of the Owner and the Engineer on proper operation and maintenance. With the Owner's permission, this work may be conducted in conjunction with the inspection of the installation and test run as provided under PART 3. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

#### 1.07 TOOLS AND SPARE PARTS

- A. One (1) set of all special tools required for normal operation and maintenance shall be provided. All such tools shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.
- B. The pump manufacturer shall furnish the spare parts for each component of the pumping systems listed in the respective paragraphs of PART 2 – PRODUCTS. The manufacturer shall furnish a complete list of recommended spare parts necessary for the first five (5) years of operation of the pumping system.
- C. Spare Parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long term storage.

#### 1.08 PRODUCT HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. All equipment and parts must be properly protected against any damage during a prolonged storage period at the site.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- F. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.
- G. Each box or package shall be properly marked to show its net weight in addition to its contents.

#### 1.09 WARRANTY

- A. All equipment supplied under this section shall be warranted for a period of two (2) year by the Contractor and the pump manufacturer. Warranty period shall commence on the date of Owner acceptance, as outlined in Division 1.
- B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.
- C. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. The pumping units required under this section shall be complete including pumps and motors with proper alignment and balancing of the individual units. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the service to be performed. Ample room for inspection, repairs and adjustment shall be provided.
- B. All necessary anchor bolts; nuts and washers shall be furnished and installed by the Contractor. Anchor bolts, nuts and washers shall be 316 stainless steel. A molybdenum disulfide anti-seize agent shall be supplied for use with all stainless steel bolts.
- C. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed and all other pertinent data shall be attached to each pump, motor variable frequency drive and control panel.
- D. Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to back flow through the pump with the maximum TDH specified available at the pump discharge flange. The maximum reverse runaway speed shall not exceed 130 percent of the design pump maximum operating speed. A statement of compliance with this requirement must be furnished with the Shop Drawings submittal.

### **2.02 PUMPS**

#### **A. General**

- 1. The pumps shall be of the vertical turbine type.
- 2. The pumps shall be built to standard dimensions such that parts will be interchangeable between other examples of the same model and manufacturer.
- 3. The raw water pumps shall be (3) **Pentair/Fairbanks Morse Model 13H-3 stage pump**. Goulds Model 14RJHC-2 Stage pumps will be considered as an alternate to the Pentair/Fairbanks Morse pumps. All products must meet the detailed requirements of this Specification.

#### **B. Performance Requirements:**

## **VERTICAL TURBINE PUMPS**

**11214 -5**

1. When operating at the maximum output speed of the motor, each pump shall have a characteristic performance curve, which meets all the minimum conditions listed in **Table 11214-1**. The pump and drive motors shall be capable of operating satisfactorily under the full range of conditions as defined by **Table 11214-1**.
2. Each pump shall be capable of continuous adjustable speed operation over the speed range from 100 percent to 50 percent of pump design speed. There shall be no significant change in vibration and noise level over the entire listed range of speed and flow of the pumping system. (If applicable)
3. Maximum motor speeds shall not exceed those listed in **Table 11214-1**, to satisfy the specified hydraulic duty requirements. The pump design speed shall be the maximum output speed of the motor furnished, when operating at the pump's design capacity and head at 60 Hertz on utility power (full motor speed). All pumps shall have identical impeller sizes.
4. With the pumping units operating at full motor speed, the maximum brake horsepower required by the pumps shall not exceed the maximum horsepower listed in **Table 11214-1**. If the pumping units require more than the maximum horsepower listed in **Table 11214-1**, at the motor output shaft at any full motor speed operation point between primary and secondary discharge head, they will be rejected.
5. Certified Factory Tests:
  - a. Factory testing in accordance with the standards of the Hydraulic Institute shall be required for all pumps. Test shall be witnessed by a registered P.E. on staff at the pump manufacturer.
  - b. Certified pump performance curves shall be submitted, including head, capacity, brake horsepower, and pump efficiency for each pump supplied. Certified data shall be provided to indicate the NPSH required by the pumps when operating at full speed at the minimum head system conditions listed in **Table 11214-1**.
  - c. Prior to conducting a pump test, notification of such test and a list of test equipment and test procedures shall be forwarded to the Engineer at least fifteen (15) working days before the scheduled test date. All electronic transducers, meters, gauges, and other test instruments shall be calibrated in accordance with the frequency listed in the Hydraulic Institute Standards. Copies of calibration data shall be provided. Differential pressure type flow meters, such as venturis shall have been calibrated within 5 years. Mechanical variation of the meter throat diameter will be accepted as verification of calibration validity.
  - d. In lieu of testing with job equipment, pumps may be tested with a laboratory column pipe and discharge head similar in size to that furnished for final installation.
  - e. All pumps shall be tested at full speed and complete staging through the specified range of flow, and head/capacity/efficiency curves plotted at four points along its curve. During each test, the pump shall be run at each head

condition for sufficient time to accurately determine discharge, head, power input, and efficiency.

- f. If any pump tested fails to meet any specification requirement it will be modified until it meets all specification requirements. If any pump tested fails to meet the efficiency requirements at any of the listed flow or head conditions listed in **Table 11214-1**, and all reasonable attempts to correct the inefficiency and unsuccessful, the pump(s) shall be replaced with unit(s), which meets the specified requirements.

### C. Pump Construction

1. The connection of the output shaft of the motor to the head shaft shall be made with a stainless steel flanged adjustable coupling to the VSS motor. Impeller adjustments shall be made via this coupling.
2. The pump shall be furnished with a suitable, integral fabricated ASTM A-36 steel-mounting ring of adequate design with registered fit to match the mounting dimensions of the drive motor.
3. The pump's discharge head shall be fabricated steel construction of ASTM A36 of the above base type and shall be not less than diameters listed in the attached tables. The discharge flange shall be a 150 lb. flat faced flanged discharge connection conforming, dimensionally, to ANSI/AWWA A21.15/C115. The discharge head window access openings shall be of adequate size to allow for mechanical seal adjustment and replacement and shall be protected by expanded metal screens constructed of 316 stainless steel. The head shall use 4-2" sch 80 pipes set at 90 degrees apart, connecting the top motor base ring with the head support base.
4. Incorporated in the fabrication of the discharge head shall be a suitable pump support base not less than 1- inch in thickness of standard ANSI B16 B2 flanged dimensions to support both the pump and the motor. The flange bolting shall be in accordance with the requirements of ANSI B16 B2. Minimum thickness shall be 1.00 inches. The discharge head shall mount onto the suction can.
5. The discharge head will be fitted with an ASTM A-48 Class 30 box suitable for use with a Chesterton 442 split seal. Seal faces shall be silicon carbide with 316 SS components. Provisions shall be made to provide clean flush water to the seal for cooling.
6. The pump head shaft shall be constructed of ASTM A-582 416 stainless steel alloy. ANSI B58.1 standards for Deep Well Vertical Turbine Pumps, Section A4.3.3 (but in no case are less than the diameter shown in Table 11214-1) shall determine shaft diameter.
7. The pump column shall be constructed of ASTM A-36 steel, Schedule 30, flanged at each end. The column shall mate with the pump bowl assembly and the discharge head with fits to assure correct alignment. Maximum length of column sections shall be 5 feet.
8. The open pump line shaft shall be constructed of ASTM A-582 416 Stainless Steel Alloy and its diameter determined as described in 2.02 C.5 above but in no case shall it be less than the minimum diameter listed in **Table 11214-1**.

9. The line shaft couplings shall be of the threaded type constructed of ASTM A-582 416 Stainless Steel Alloy and of such design that no threaded parts, which could cause “galling”, are interconnected. Alternate constructions must be of a design acceptable to the Engineer.
10. The pump impeller shall be of the radial type constructed of Investment grade 316SS. The impeller shall be attached to the shaft by means of a key constructed of ASTM A-276 316 Stainless Steel. Impeller shall be supplied with Stainless wear rings, 300-350 BHN.
11. The pump bowl shall be constructed of ASTM A-48 Class 30 cast iron having a minimum tensile strength of 30,000 psi. The pump bowl shall be of sufficient thickness to withstand stresses and strains at full operating pressure. The bowl shall be subjected to a hydrostatic test 150 percent of that specified at the design conditions in **Table 11214-1**. The bowl shall be designed and manufactured with open and smooth water passages to assure efficient, reliable operation. Bowls shall be supplied with stainless wear rings, 300-350 BHN.
12. The suction bowl bearing, and all bowl bearings shall be constructed of ASTM B-505 alloy 932 or 836 bronze.
13. Pump Coating: All portions of the column and pump discharge head not exposed to view, except for the interior of the bowls, shall have an interior and an exterior coating of high build modified epoxy of 7 mils dry thickness, compatible with the pump service. Interior of the bowls shall be coated with Tnemec N140 Epoxy paint. Glass fused to steel will be considered as an alternate. Surface preparation shall be in accordance with the coating manufacturer's recommendations.
14. A suction can per the current H.I. standards shall be provided. The can shall be 24” in diameter with anti-vortex baffles installed per Figure 9.8.11 in the ANSI/HI 9.8-1998 Intake Design Manual. The internal baffles shall be installed regardless of the flow rate. All welds shall be full penetration, inside and outside. Top flange shall mate with the discharge head and shall be level to within 0.003” per foot.
15. All pumps shall be assembled complete less motor in Kansas City, Ks.

#### D. SPARE PARTS:

##### A. The pump manufacturer shall furnish the following spare parts:

1. One (1) complete seal per pump.
2. One (1) complete set of gaskets and O-rings required for each pump provided.
3. Two (2) sets of bearings for each pump provided.
4. One (1) set of shaft keys, dowels, and pins required for each pump.
5. One (1) set of shaft sleeves.
6. One (1) spare impeller with wear ring.
7. One (1) bowl wear ring

## 2.3 MOTORS

- A. Each pump shall be driven by a Vertical Solid Shaft TEFC Inverter Rated, Coro-Duty, electric motor, speed as listed in the data tables, 3/60/460 volt, 1.15 S.F. The motor nameplate horsepower rating shall not be exceeded by the brake horsepower requirements of the specified head and capacity requirements. Motor shall include refined balance, NRR, SS Hardware, space heaters, 50 degree C ambient, "B" rise at 1.15 S.F., VPI-1000 winding treatment. Motor Horsepowers are listed in **Table 11214-1**.



**Table 11214-1**  
**PUMPING UNIT DESIGN REQUIREMENTS**

<b>Item</b>	<b>Design Conditions</b>
Pump Model	
Number of Pumps	3
Maximum Motor Speed (rpm)	1780
Motor to be Supplied (Hp)	125
Minimum Column Wall thickness (inches)	Sch. 30
Column and Discharge Size (inches)	<b>10/12</b>
Minimum Discharge Head Wall thickness (inches)	.375
Minimum Pump Shaft Diameter (inches)	1.687
Minimum Line shaft Diameter (inches)	1.50
Pump Shut-Off Head at Design Speed (feet)(min)	230
Secondary Capacity (gpm)	1300
Minimum Bowl TDH at Secondary Capacity (feet)	200
Minimum Bowl efficiency at Secondary Capacity (%)	<b>69%</b>
Design Capacity (gpm)	2000
Minimum Bowl TDH at Design Capacity (feet)	180
Minimum Bowl Efficiency at Design Capacity (%)	<b>80%</b>
Maximum NPSHR at Design Capacity (feet)	17'
Minimum Run out Capacity (gpm)	<b>2700</b>
Minimum Bowl TDH at Run out Condition (feet)	<b>95</b>
Minimum Bowl Efficiency at Run out (%)	<b>65%</b>
Minimum eye area (in <sup>2</sup> )	28.40
Maximum Suction Bell Diameter (in)	13
Minimum Bowl weight - 1st stage (lbs)	327
Minimum Bowl pressure rating (psi)	380
Minimum Bowl Hydro Test Pressure (psi)	570

**PART 1 – GENERAL****1.01 SCOPE OF WORK**

- A. Furnish all labor, materials, equipment, and incidentals required; and install, place in operation, and field test vertical turbine pumps, motors, variable frequency drives, and coordinated speed control systems as hereinafter specified. The station shall be complete with pumps, motors, piping, valves, electrical work (including motor controls) structures, connections, and appurtenances, tested, and ready for service.
- B. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment application. It is, however, intended to cover the furnishing, the shop testing, the delivery, and complete installation and field testing, of all materials, equipment, and all appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these Specifications or not.

**1.02 DESCRIPTION OF SYSTEMS**

- A. The Booster Pump Station shall consist of three (3) variable speed vertical turbine can pumps. The pumps shall pump from the ground storage tank to the distribution system. The pumps shall pump from the ground storage tank to the distribution system. One (1) variable frequency drive (VFD) shall be provided for each pumping unit.
  - 1. The system shall be a constant pressure system and shall be capable of maintaining a set point pressure as monitored by the pump discharge header pressure transmitter, automatically and without regard to system flow.
  - 2. The pumps shall be automatically started and stopped, and speeds shall be adjusted by the controls to maintain a constant distribution set point pressure. The on/off pump operation shall be controlled by the corresponding on/off water surface levels within the storage tank. Refer to Instrumentation Specifications and Drawings for details.
    - a. The set point pressure shall be adjustable from 45 to 70 psig.
    - b. One unit shall be the first unit to start and shall operate within the limits of its pump capacity to match demand of the distribution system, and maintain a constant pressure in the pump discharge header.
    - c. The pump selected as the Lead Pump shall be started when the distribution system demand exceeds the capacity of the initial Pump. No more than two pumps are designed to operate a one time. Once started, the Lead Pump shall operate continuously until the distribution demand again falls to the set point level.
    - d. The pump selected as Lag1 Pump shall be started when the distribution demand exceeds the capacity of the Lead Pump and run continuously with the Lead Pump until the distribution demand again falls 15% below the maximum capacity of the Lead Pump.

- e. The pump selected as Lag2 Pump shall be started when the distribution demand exceeds the capacity of the Lead and Lag1 Pumps and run continuously with the Lead and Lag1 Pumps and run continuously with the Lead and Lag1 Pumps until the distribution demand again falls 15% below the maximum capacity of the Lead and Lag1 Pump combination.
- 3. In addition to the above, any one or all pumps shall be capable of manual start-stop control.
- B. The pumping systems shall be controlled by local and remote control systems as depicted on the Instrumentation Drawings and as specified.
- C. The pump manufacturer (MANUFACTURER) shall supply and coordinate the pump and can, motors, variable frequency drives, and associated control systems and shall assume unit responsibility for proper operation of all units as a system.

### **1.03 REFERENCE STANDARDS**

- A. Design, manufacturing, and assembly of elements of the equipment herein specified shall be in accordance with the standards of the below listed organizations. Where reference is made to a standard of one of these, or other organizations, the version of the standard in effect at the time of bid opening shall apply.
  - 1. American Gear Manufacturing Association (AGMA)
  - 2. American Institute of Steel Construction (AISC)
  - 3. American Iron and Steel Institute (AISI)
  - 4. American Society of Mechanical Engineers (ASME)
  - 5. American National Standards Institute (ANSI)
  - 6. American Society for Testing Materials (ASTM)
  - 7. American Water Works Association (AWWA)
  - 8. American Welding Society (AWS)
  - 9. Anti-Friction Bearing Manufacturers Association (AFBMA)
  - 10. Hydraulic Institute Standards
  - 11. Institute of Electrical and Electronics Engineers (IEEE)
  - 12. National Electrical Code (NEC)
  - 13. National Electrical Manufacturers Association (NEMA)
  - 14. Occupational Safety and Health Administration (OSHA)
  - 15. Steel Structures Painting Council (SSPC)
  - 16. Underwriters Laboratories, Inc. (UL)

### **1.04 QUALIFICATIONS**

- A. To assure unity of responsibility, the pumps suction cans, motors shall be furnished and coordinated by the pump manufacturer (MANUFACTURER). The CONTRACTOR shall assume full responsibility for the satisfactory installation of the entire pumping systems including pumps, motors, and controls as specified.
- B. The equipment covered by these Specifications shall be standard units of proven ability as manufactured by a competent organization having long experience in the production

**11215-2**

### **VERTICAL TURBINE PUMPS (INSTALLATION)**

V:\260020 - West Plant Water Treatment Facility\260020-01-001 (ENG) - West Plant Water Treatment Facility\Engineering\Project Manual 082823\11215 vertical install.docx

Elvin McCorvey Memorial Water Production Facility

ECUA CIP Project Number RW819

- of such equipment. The pumps furnished shall be designed, constructed, and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed. Pumps shall be manufactured in accordance with the Hydraulic Institute Standards, except as otherwise specified herein.
- C. All equipment furnished under this Specification shall be new and unused and shall be the standard product of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.
  - D. The MANUFACTURER shall be fully responsible for the design, arrangement, and operation of all connected rotating components of the assembled pumping unit to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range. Design shall include all supporting sole plates and fabricated steel base plate for mounting the units.
  - E. The MANUFACTURER shall perform both lateral and torsional critical speed analyses to identify and ensure the (a) the first lateral critical speed is at least 25% above the maximum pump speed or 25% below the minimum pump speed, assumed to be 50% of FLS, (b) that the first torsional critical speed is at least 25% above the maximum pump speed, and (c) that 1x frequencies or impeller blade pass frequencies within the pump speed range shall be no closer than plus or minus 25% of the natural frequency of the installed assembled pumping unit. Design shall consider the fact that the pumps discharge heads are installed with a flexible gasket. Prior to manufacture, a statement must be forwarded to the ENGINEER indicating that the required analyses have been made and that the specified limitations will be met.

## **1.05 SUBMITTALS**

- A. Copies of all materials required to establish compliance with the specifications shall be submitted in accordance with the provisions of the article title “Shop Drawings and Submittals” of the General Conditions. The submittal format shall be in the form of a booklet, suitably tabbed and divided to cover at least the areas noted below for each major equipment item. The submittal booklet shall include adequate detail and sufficient information for the ENGINEER to determine that all of the equipment proposed meets the detailed requirements of the Specifications. Incomplete or partial submittals will not be reviewed. Submittals shall include at least the following:
  - 1. Certified shop and erection drawings showing all important details of construction, dimensions, and anchor bolt locations.
  - 2. Descriptive literature, bulletins, and/or catalogs of the equipment.
  - 3. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity, efficiency, NPSHR, and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets, at as large a scale as is practical. Curves shall be plotted from no flow at shut off head to pump capacity at minimum specified total head. Catalog sheets showing a family of curves will not be acceptable.
  - 4. Complete master wiring diagrams, elementary, or control schematics, including coordination with other electrical control devices such as the pump control system and suitable outline drawings shall be furnished for approval before proceeding

**11215-3**

### **VERTICAL TURBINE PUMPS (INSTALLATION)**

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Elvin McCorvey Memorial Water Production Facility

ECUA CIP Project Number RW819

with manufacture. Provide suitable outline drawings showing such details as are necessary to locate conduit stub-ups and field wiring. Due to the complexity of the system, it is imperative the above drawings be clear and carefully prepared to facilitate interconnections with other equipment. Standard pre-printed sheets or drawings simply marked to indicate applicability to this Contract will not be acceptable. Refer to the Electrical and Instrumentation Drawings for the control wiring diagrams for the pump motors.

5. A complete total bill of materials of all equipment (may be furnished with Operation and Maintenance manuals specified under paragraph 1.06).
  6. A list of the MANUFACTURER's recommended spare parts to be supplied in addition to those specified in paragraph 1.07, with the MANUFACTURER's current price for each item. Include gaskets, packing, etc. on the list. List bearings by the bearing MANUFACTURER's numbers only.
  7. Complete motor, variable frequency drive, and control system data.
  8. A torsional mass elastic system analysis for each complete pumping assembly, with a statement to the effect that the system analysis indicates full compliance with the requirements of Paragraph 1.04E.
  9. A statement of compliance with the turbine reverse run-away speed requirements listed in paragraph 2.01.
- B. Test Reports to be Submitted:
1. A schedule of the date of shop testing and delivery of the equipment to the job site.
  2. Description of pump factory test procedures and equipment.
  3. Copies of all test results, as specified in Parts 2 and 3 of this Section.
- C. Complete operating and maintenance instructions shall be furnished for all equipment included under these specifications as provided in Paragraph 1.06 hereinafter and as required by the Engineer. The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.
- D. Submit the MANUFACTURER's Certificate of Installation, Testing, and Instruction as required by the Engineer.
- E. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

## **1.06 OPERATING INSTRUCTIONS**

- A. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The number and special requirements shall be as specified elsewhere.
- B. A trained instructor, with complete knowledge of proper operation and maintenance for all major components, shall be provided for two days to instruct representatives of the OWNER and the ENGINEER on proper operation and maintenance. With the OWNER's permission, this work may be conducted in conjunction with the inspection of the installation and test run as provided under PART 3. If there are difficulties in

**11215-4**

### **VERTICAL TURBINE PUMPS (INSTALLATION)**

V:\260020 - West Plant Water Treatment Facility\260020-01-001 (ENG) - West Plant Water Treatment Facility\Engineering\Project Manual 082823\11215 vertical install.docx

Elvin McCorvey Memorial Water Production Facility

ECUA CIP Project Number RW819

operation of the equipment due to the MANUFACTURER's design or fabrication, additional service shall be provided at no cost to the OWNER.

## **1.07 TOOLS AND SPARE PARTS**

- A. One (1) set of all special tools required for normal operation and maintenance shall be provided. All such tools shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.
- B. The MANUFACTURER shall furnish the spare parts for each component of the pumping systems listed in the respective paragraphs of PART 2 – PRODUCTS. The MANUFACTURER shall furnish a complete list of recommended spare parts necessary for the first five (5) years of operation of the pumping system.
- C. Spare Parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long-term storage.

## **1.08 PRODUCT HANDLING**

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. All equipment and parts must be properly protected against any damage during a prolonged period at the site.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the ENGINEER.
- D. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built, and securely bolted thereto.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- F. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage, and handling.
- G. Each box or package shall be properly marked to show its net weight in addition to its contents.

## **1.9 WARRANTY**

- A. All equipment supplied under this section shall be warranted for a period of two (2) years after startup by the CONTRACTOR and the MANUFACTURER and acceptance by the Owner.
- B. The equipment shall be warranted to be free from defects in workmanship, design, and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s), and the unit(s) restored to service at no expense to the OWNER.
- C. The MANUFACTURER's warranty period shall run concurrently with the CONTRACTOR's warranty period. No exception to this provision shall be allowed.

**11215-5**

### **VERTICAL TURBINE PUMPS (INSTALLATION)**

V:\260020 - West Plant Water Treatment Facility\260020-01-001 (ENG) - West Plant Water Treatment Facility\Engineering\Project Manual 082823\11215 vertical install.docx

Elvin McCorvey Memorial Water Production Facility

ECUA CIP Project Number RW819

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. The equipment covered by these Specifications is intended to be standard pumping units of proven ability as manufactured by reputable concerns having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed, as shown on the Drawings.
- B. All equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.
- C. The pumping units required under this section shall be complete. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness, and to be especially adapted for the service to be performed. Ample room for inspection, repairs, and adjustment shall be provided.
- D. Stainless steel nameplates giving the name of the MANUFACTURER, the rated capacity, head, speed, and all other pertinent data shall be attached to each pump, motor, variable frequency drive, and control panel.
- E. Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to back flow through the pump with the maximum TDH specified available at the pump discharge flange. The maximum reverse run-away speed shall not exceed 180% of the design pump maximum operating speed. A statement of compliance with this requirement must be furnished with the Shop Drawing submittal.
- F. All working parts of the pumps, motors, and variable frequency drives, such as bearings, wearing rings, shaft, sleeves, etc., shall be standard dimensions built to limit gauges or formed to templates, such that parts will be interchangeable between like units and such that the OWNER may, at any time in the future, obtain replacement and repair parts for those furnished in the original machines. All parts shall be properly stamped for identification and location in the machines as shown on the assembly drawings in the Operation and Maintenance Manuals furnished.
- G. The nameplate ratings of the motors shall not be exceeded, nor shall the design service factor be reduced when the pump is operating at any point on its characteristic curve at maximum speed. All rotating parts of the specified equipment shall be mechanically and hydraulically balanced so as to operate throughout the required range without excessive end thrust, vibration, and noise. The maximum allowable vibration measured at the top motor bearing for vertical pumps shall not exceed 75% of the maximum peak-to-peak amplitude as set forth in the Hydraulic Institute Standards, latest edition and paragraph 2.06 above, if applicable. Failure to meet these criteria shall be sufficient cause to reject the equipment.
- H. Mechanical equipment, including drives and electric motors shall be supplied and installed in accordance with applicable OSHA regulations. Stainless steel guards shall be installed on all rotation assemblies. The noise level of motors, unless otherwise noted, shall not exceed 85 dBA measured 1.5 meters from the unit under free field conditions.

**11215-6**

### **VERTICAL TURBINE PUMPS (INSTALLATION)**

V:\260020 - West Plant Water Treatment Facility\260020-01-001 (ENG) - West Plant Water Treatment Facility\Engineering\Project Manual 082823\11215 vertical install.docx

Elvin McCorvey Memorial Water Production Facility

ECUA CIP Project Number RW819

- I. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards. Fittings shall be button-head type. Lubrication fittings shall be mounted together wherever possible. Pressure grease-lubricated fittings shall be the “Zerk Hydraulic” type or the “Alemite” type. Housings of grease-lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.

## **2.02 PUMPS**

### **A. General:**

1. The pumps shall be of the vertical turbine multistage type designed to pump finished water and as specified in Section 11214-1.

### **B. Performance Requirements:**

1. When operating at the maximum output speed of the motor, each pump shall have a characteristic performance curve which meets all the conditions listed in Table 11214-1-1. The pumps, drive motors, and variable frequency drives shall be capable of operating satisfactorily under the full range of conditions as defined by Table 11214-1-1. The Intermediate pump capacity, head, and efficiency defined in Table 11214-1-1 shall be the “design point.” Pump efficiency as defined herein takes into consideration all losses from the pump intake suction bell to the pump discharge flange.
2. Each pump shall be capable of continuous adjustable speed operation over the speed range from 50% to 100% of pump design speed. There shall be no significant change in vibration and noise level over the entire listed range of speed and flow of the pumping system.
3. Maximum motor speeds shall not exceed those listed in Table 11214-1-1 to satisfy the specified hydraulic duty requirements. The pump “design speeds” shall be the maximum output speed of the motor furnished, when operating at the pump “Intermediate” capacity and head at 60 Hertz on utility power (full motor speed). All pumps within each group shall have identical impeller sizes.
4. With the pumping units operating at full motor speed, the maximum brake horsepower required by the pumps shall not exceed the maximum horsepower listed in Table 11214-1-1. If the pumping units require more than the maximum horsepower listed in Table 11214-1-1 at the motor output shaft at any full motor speed operation point between Primary and Secondary discharge head, they will be rejected.
5. The minimum operating level in the Ground Storage Tank shall be assumed to be one (1) foot above the tank bottom. When operating at the minimum tank level and the Primary Duty Point listed on Table 11214-1-1, the pump setting shown on the Drawings shall provide adequate Net Positive Suction Head to exceed that required at the Primary Duty Point by at least 10%.

## **2.03 VARIABLE FREQUENCY DRIVES**

**11215-7**

### **VERTICAL TURBINE PUMPS (INSTALLATION)**

V:\260020 - West Plant Water Treatment Facility\260020-01-001 (ENG) - West Plant Water Treatment Facility\Engineering\Project Manual 082823\11215 vertical install.docx

Elvin McCorvey Memorial Water Production Facility

ECUA CIP Project Number RW819



- A. The speed control for variable speed pumps shall be Variable Frequency Drives, and shall be furnished under Section 16900, suitable for installation as shown on the Drawings.
- B. The Variable Frequency Drives shall be supplied by the Integrator (ISS) and shall be completely coordinated with the pump and pump driving motors and shall include all internal auxiliaries required to meet the functional specifications.
- C. The Variable Frequency Drives shall conform to all requirements stipulated in this section and Division 16 – Electrical and shall be designed for a speed range of 50% to 100% of full load motor speed.
- D. The Variable Frequency Drive shall be compatible with the motors provided by the MANUFACTURER.
- E. Approved Variable Frequency Drives
  - 1. Allen Bradley Power Flex 753 Series
  - 2. Yaskawa P1000 Series

## **2.04 PUMP DISCHARGE GAUGES**

- A. Pump Discharge Gauges: The CONTRACTOR shall furnish and install for each pump in tapped holes in the discharge piping to accommodate discharge gauges which shall be supplied by the CONTRACTOR as specified and shown on the Drawings.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Installation shall be in strict accordance with the MANUFACTURER's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the MANUFACTURER's recommendations. Anchor bolts shall be set in accordance with the MANUFACTURER's recommendations.
- B. The CONTRACTOR shall submit a certificate from the MANUFACTURER stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of each unit.

### **3.02 SHOP PAINTING**

- A. Before exposure to weather and prior to shop painting all surfaces shall be thoroughly cleaned, dry, and free from all mill-scale, rust, grease, dirt, and other foreign matter.
- B. All exposed portions of the pumps and motors shall be shop primed, with primer compatible with field painting as specified in Division 9.
- C. All nameplates shall be properly protected during painting.
- D. Gears, bearing surfaces, and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust resistant coating. This coating

**11215-8**

## **VERTICAL TURBINE PUMPS (INSTALLATION)**

V:\260020 - West Plant Water Treatment Facility\260020-01-001 (ENG) - West Plant Water Treatment Facility\Engineering\Project Manual 082823\11215 vertical install.docx

Elvin McCorvey Memorial Water Production Facility

ECUA CIP Project Number RW819

shall be maintained as necessary to prevent corrosion during periods of storage and erection and shall be satisfactory to the ENGINEER up to the time of the final acceptance test.

### **3.03 FIELD PAINTING**

- A. Field painting is specified under Painting, Section 09900. The primer and paint used in the shop shall be products of the same manufacturer as the field paint to assure compatibility.
- B. All nameplates shall be properly protected during painting.

### **3.04 INSPECTION AND TESTING**

- A. General:
  - 1. The ENGINEER shall have the right to inspect, test, or witness tests of all materials or equipment to be furnished under these specifications, prior to their shipment from the point of manufacture.
  - 2. The ENGINEER shall be notified in writing prior to initial shipment, in ample time so that arrangements can be made for inspection by the ENGINEER.
  - 3. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.
- B. Factory Pump Tests:
  - 1. Factory testing in accordance with the standards of the Hydraulic Institute shall be required for all pumps. All pumps shall be witness tested by the pump manufacturer in the presence of the ENGINEER. All witness travel and out-of-pocket expenses shall be included in the CONTRACTOR's bid price.
  - 2. Certified pump performance curves shall be submitted, including head, capacity, brake horsepower, and pump efficiency for each pump supplied. Certified data shall be provided to indicate the NPSH required by the pumps at the Primary operating point listed in Table 11214-1-1.
  - 3. Prior to conducting a pump test, notification of such test and a list of test equipment and test procedures shall be forwarded to the ENGINEER at least ten (10) working days before the scheduled test date. All electronic transducer, meters, gauges, and other test instruments shall have been calibrated in accordance with the requirements of the Hydraulic Institute Standards. Copies of calibration data shall be provided. Differential pressure-type flow meters, such as venturis shall have been calibrated within five (5) years. Mechanical variation of the meter throat diameter will be accepted as verification of calibration validity.
  - 4. In lieu of testing with all job equipment, job pump bowls may be tested with a laboratory column pipe and discharge head similar in size to that furnished for final installation. The length of column pipe will be the same as will be required to set the bowl in the field.
  - 5. All pumps shall be tested at full speed and complete staging through the specified range of flow, and head/capacity/efficiency curves plotted at maximum output speed. During each test, the pump shall be run at each head condition for sufficient time to accurately determine discharge, head, power input, and efficiency. Pump

**11215-9**

#### **VERTICAL TURBINE PUMPS (INSTALLATION)**

V:\260020 - West Plant Water Treatment Facility\260020-01-001 (ENG) - West Plant Water Treatment Facility\Engineering\Project Manual 082823\11215 vertical install.docx

Elvin McCorvey Memorial Water Production Facility

ECUA CIP Project Number RW819

efficiency as defined herein will include all head losses from the bowl assembly entrance, bowl assembly, pump column, and discharge head.

6. The pumps will be tested with a suction lift, suction pressure, or submergence (including vapor pressure, velocity head, friction loss, and static suction lift) as required to demonstrate that at maximum speed the NPSH and submergence required by the pump at the primary operating point listed in Table 11214-1-1 will be satisfied by the pump setting furnished.
7. If any pump tested fails to meet any specification requirement it will be modified until it meets all specification requirements. If any pump tested fails to meet the efficiency requirements at any of the listed flow or head conditions listed in Table 11214-1-A and all reasonable attempts to correct the inefficiency are unsuccessful, the pumps(s) shall be replaced with unit(s) which meet the specified requirements.

**C. Field Inspection and OWNER Instruction:**

1. The CONTRACTOR shall furnish the services of the MANUFACTURER's field service technician, who has complete knowledge of proper operation and maintenance of the equipment, for a period of not less than two (2) days per group of pumps to inspect the installed equipment, supervise the initial test run, and to provide instruction to the plant personnel. The first visit shall be checking and inspecting the equipment after it is installed. The second visit will be to operate and supervise the initial field test.
2. At least one (1) of the two (2) days shall be allocated solely to instruction of plant personnel in operation and maintenance of the equipment. The instruction period shall be scheduled at least ten (10) days in advance with the OWNER and shall take place prior to start up and acceptance by OWNER. The final copies of operation and maintenance manuals specified in Section 01730 must be delivered to the ENGINEER prior to scheduling the instruction period with the OWNER with the permission of the ENGINEER, these services may be combined with those specified by Paragraph 1.06.

**D. Field Pump Tests:**

1. In the presence of the ENGINEER such tests as necessary to indicate that the pumps, motors, and variable speed drives conform to the operating conditions specified shall be performed. A 30-day operating period of the pumps will be required before acceptance. If a pump performance does not meet the specified requirements, corrective measures shall be taken. All test procedures shall be in accordance with factory test procedures specified above and certified results of tests shall be submitted. Provide, calibrate, and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the ENGINEER for approval 30 days prior to testing.
2. After installation of the modified pumps and as soon as conditions permit full speed operation, retain the services of a qualified independent mechanical testing firm to perform a detailed vibration signature analysis of each unit, including both "Bump Tests" and X-Y vibration profiles, to (a) prove compliance with the specified vibration limitations and (b) prove there are no field installed resonant conditions

**11215-10**

**VERTICAL TURBINE PUMPS (INSTALLATION)**

V:\260020 - West Plant Water Treatment Facility\260020-01-001 (ENG) - West Plant Water Treatment Facility\Engineering\Project Manual 082823\11215 vertical install.docx

Elvin McCorvey Memorial Water Production Facility

ECUA CIP Project Number RW819

due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range. A written report shall be submitted including a sketch of the unit indicating on where and in which direction the vibration readings were taken and recorded showing (a) peak-to-peak displacement, in mils, (b) frequency and (c) peak velocity level, in inches per second. The report shall contain a complete analysis of their findings, describing any problems encountered, if any, probable cause, and specific recommendations for any required corrective action.

3. Noise and vibration tests shall be conducted in conformance with the Hydraulics Institute Test Codes and OSHA Standards for Occupational Noise Exposure. Maximum allowable noise level, corrected for background sound, shall not exceed 85 dBA when measured at a horizontal distance of 1.5 meters from the equipment being tested, at a height of 1.5 meters above floor level. Maximum allowable vibration, as measured by an IRD Model 330 Vibration Analyzer or equal, shall not exceed the maximum recommended limits established by Paragraph 2.01G. The actual natural frequency of the installed pumping units will be verified using industry accepted procedures.
4. All pump operating settings, alarms, controls, and shutdown devices shall be calibrated and tested during the field tests.
5. The CONTRACTOR shall furnish all power, water, facilities, labor, materials, supplies, and test instruments required to conduct field test.
6. Deliver to the ENGINEER, upon completion of satisfactory testing of the equipment, reports as specified in Part 1.

**E. Field Electric Control System Tests:**

1. The variable frequency drive and electric control system shall be test operated for proper functioning prior to the pump mechanical test. The control system shall be checked out using simulated operating signals as per VFD manufacturer's recommendations.
2. The CONTRACTOR shall check all drives for correct clearances, alignment, and lubrication, prior to start up, in accordance with the respective MANUFACTURER's instructions.

**F. Field Motor Tests:**

1. The CONTRACTOR shall megger each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the ENGINEER and shall not energize the motor.
2. The CONTRACTOR shall check all motors for correct clearances and alignment and for correct lubrication in accordance with MANUFACTURER's instructions. The CONTRACTOR shall check direction of rotation of all motors and reverse connection if necessary.
3. The CONTRACTOR shall meet all the testing requirements of Division 16.

**G. Field Alarm System Testing:**

1. Check each alarm and detection device for proper operation.