

## SECTION 11314

### RECESSED IMPELLER PUMPS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

###### A. Scope

1. Furnish and install two recessed impeller, vortex type, grit pumps in the Pump Room of the Headworks Building; GP-1 and GP-2
  - a. Pumping units to pump grit from the grit chambers to the grit separator
2. Provide electric motors, adjustable speed V-belt drives, belt guards, anchor bolts, and all other appurtenances
3. Provide appurtenant non-potable water system components for pump seal supply

###### B. Additional Requirements Specified Elsewhere

1. Section 01340: Shop Drawings, Product Data, and Samples
2. Section 01400: Quality Control
3. Section 01600: Materials and Equipment
4. Section 01730: Operating and Maintenance Data

###### C. Related Requirements Specified Elsewhere

1. Section 02615: Ductile Iron Pipe
2. Section 02641: Valves and Accessories
3. Section 03600: Grout
4. Section 05501: Anchor Bolts and Drilled-In Anchors
5. Section 09900: Painting
6. Section 11321: Grit Separator Equipment
7. Section 11322: Vortex Grit Chambers
8. Section 13300: Utility Control Systems
9. Section 15060: Pipe and Pipe Fittings
10. Division 16: Electrical

###### D. Definitions: Definitions of terms and other hydraulic considerations as set forth in the Hydraulic Institute Standards

##### 1.2 QUALITY ASSURANCE

###### A. Design Basis

1. Wemco Model C Torque Flow Pump
2. Equivalent products of other manufacturers may be accepted subject to compliance with design, function, materials, performance of the specified items and acceptance by Owner and Engineer

B. Reference Standards

1. Hydraulic Institute Standards

1.3 SUBMITTALS

A. In accordance with Section 01340

B. Shop Drawings and Product Data

1. Submit complete fabrication, assembly, foundation, and installation drawings
2. Submit detailed specifications and data describing materials, parts, devices, and accessories
3. Pump
  - a. Name of manufacturer
  - b. Type and model
  - c. Rotative speed
  - d. Size of suction nozzle
  - e. Size of discharge nozzle
  - f. Type of bearings
  - g. Net weight of pump
  - h. Complete performance curves
    - 1) Capacity versus head
    - 2) NPSH required
    - 3) Brake horsepower at pump impeller rotative speeds specified
  - i. Type of drive
  - j. Type of shaft seal
    - 1) Manufacturer and model
  - k. Data on shop coatings
4. Motors
  - a. Name of manufacturer
  - b. Type and model
  - c. Type of bearings and lubrication
  - d. Rated motor horsepower (hp)
  - e. Service factor
  - f. Temperature rating
  - g. Full load rotative speed
  - h. Net weight
  - i. Efficiency at full load and rated pump conditions
    - 1) Efficiency at specified variable rotative speeds
  - j. Full load current
  - k. Locked rotor current
  - l. Motor current draw at specified variable rotative speeds

C. Test Reports

1. Submit copies of field test reports
2. Reports shall include
  - a. Description of test equipment calibration and testing procedure
  - b. Field performance data
    - 1) Elevation of water surface in each grit chamber

- 2) Centerline (pump input shaft) elevation for each pumping unit
- 3) Suction and discharge pressure at each pumping unit in feet of water
- 4) Pressure at inlet to Grit Separator cyclone in feet of water
- 5) Discharge rate for each pumping unit in gpm
- 6) Pump speed for each pumping unit in rpm
- 7) Motor input current, voltage and calculated horsepower for each pumping unit
- 8) Wire to water efficiency for each pumping unit
- 9) Measure and record all operating characteristics at no less than three (3) operating points over the specified rotative speed range

D. Certificate of Compliance

1. Manufacturer's affidavit of compliance certifying
  - a. All equipment and materials comply with these specifications
  - b. Pumps have been properly installed and are operating within specification tolerances
  - c. All tests have been performed with satisfactory results

E. Operating and Maintenance Manuals in accordance with Section 01730

F. Installation check, review and certification as to conformance with manufacturer's requirements and specifications

G. Operator training, supply of spare materials and other miscellaneous items required

1.4 JOB CONDITIONS

A. Location

1. Pump Room of the Headworks Building
2. Indoor heated location
  - a. Minimum air temperature: 40°F
  - b. Maximum air temperature: 90°F
3. Altitude: 5405' above sea level

B. Headworks Design Influent Flows

1. Initial average day flow: 0.75 MGD
2. Initial peak hour flow: 1.3875 MGD
3. Design average day flow: 2.50 MGD
4. Design peak hour flow: 4.625 MGD

C. Grit Pumps: GP-1 and GP-2

1. Pumped liquid
  - a. Grit slurry from grit chamber to grit separator equipment
  - b. Solids concentration: 2% maximum
2. Operation
  - a. Initial flow: Cycle time - once every 4 hours, run time 5 minutes
  - b. Design flow: Cycle time - once every 2 hours, run time 5 minutes

- c. Future build-out condition: Run 5 minutes of every hour
- D. Electrical equipment components and work in the Pump Room of the Headworks Building
  - 1. Local motor disconnect and lockout
- E. Motor starters, control and SCADA system interface in motor control room of Headworks Building

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE AND DESIGN REQUIREMENTS

#### A. General

- 1. Stable and free from cavitation and noise throughout the specified operating range
- 2. Minimum hydrostatic test pressure: 1.5 x shutoff head plus suction pressure
- 3. Performance requirements based on specified liquid characteristics and 5,405' AMSL elevation

#### B. Grit Pumps: GP-1 and GP-2

- 1. Number of units: 2
- 2. Rated total head: 27.8 feet
  - a. Heads given are based on 5 psi inlet pressure requirement of cyclone grit separator
- 3. Normal operating head range: 26' to 29'
- 4. Rated capacity at rated head: 220 gpm
- 5. Normal operating capacity range: 180 to 270 gpm
  - a. Discharge rate based on manually selectable drive belt and sheaves with minimum of three (3) rotative speeds
- 6. Maximum pump operating speed: 900 rpm
- 7. Minimum pump operating speed: 500 rpm
- 8. Maximum motor operating speed: 1800 rpm
- 9. Maximum bhp required at input shaft of pump for any point in normal operating range: 7.0
- 10. Maximum motor nameplate horsepower: 7.5
- 11. Suction inlet condition (based on horizontal center line elevation of pump suction nozzle): Flooded during normal operation; 1.5' suction lift during maintenance procedures
- 12. Maximum required NPSH at center line of pump shaft for any point in normal operating range: 19'
- 13. Minimum diameter of test sphere: 3.5"
- 14. Minimum suction nozzle diameter: 4"
- 15. Minimum discharge nozzle diameter: 4"

### 2.2 MATERIALS

#### A. Grit Pumps

1. Casing: NiHard, ASTM A532, Brinell 650+
2. Impeller: NiHard, ASTM A532, Brinell 650+
3. Wear plate: NiHard, ASTM A532, Brinell 650+
4. Bearing housing and cap: Cast iron, ASTM A48
5. Shaft: Alloy steel, ASTM A108
6. Shaft sleeve: Stainless steel (410 or 416), hardened
7. Impeller lock screw and snap ring: Steel
8. Stuffing box hardware: Non-corrosive metal
9. Mechanical seal
  - a. Metal components: 316 stainless steel
  - b. Stationary face: Tungsten carbide
  - c. Rotary face: Tungsten carbide
  - d. Elastomer: Viton
10. Case and shaft sleeve gaskets: Neoprene or Buna-N
11. Bearings: Heavy duty, ball-type
12. Base: Fabricated steel
13. Belt guards: Non-corrosive metal, fiberglass or plastic
  - a. Metal: 316 stainless steel with lifting eyes or lugs

B. Anchor Bolts, Nuts, and Washers: Refer to Section 05501

## 2.3 FABRICATION AND MANUFACTURE

### A. Pump Casing

1. Two-piece, radially split type or one-piece casting type
2. For two-piece, radially split type
  - a. Separate removable suction design so that the impeller can be withdrawn without removing the discharge casing or disturbing the discharge piping
  - b. Constructed so that it can be reversed for opposite operation
3. For one-piece casting type
  - a. Foot mounted casing providing full casing support
  - b. Back pullout design so the impeller can be withdrawn without disturbing suction and discharge piping
  - c. Integral suction and discharge nozzles
4. For either casing type
  - a. Nozzles: 125 lb flange
    - 1) Discharge nozzle vertical
    - 2) Impeller rotation when viewed from suction nozzle side of casing: Counterclockwise
  - b. Fully recessed impeller
    - 1) Flow clearances within pump to be equal to or greater than the discharge diameter
  - c. Parts to have registered fit for alignment
  - d. Case thickness: 0.75" minimum

### B. Impeller

1. Fully recessed
2. Cup-type or semi-open design

3. For cup-type design
  - a. Blades surrounded by integral rim to direct flow to suction piece
  - b. Integral rim and impeller vanes of tapered design with area of highest wear corresponding to thickest portion of taper
  - c. Statically balanced
4. For semi-open design
  - a. Full back pump-out vanes
  - b. Impeller vanes of tapered design
  - c. Keyed to shaft
  - d. Secured to shaft by bolt and washer assembly protected by stainless steel shroud
  - e. Statically balanced

#### C. Wearing Plate

1. Removable
2. Designed to direct flow from behind the impeller to the center of the volute
3. Positively locked in place
4. Separate packing housing secured to bearing housing

#### D. Shaft and Shaft Sleeves

1. Shaft completely machined
2. Shaft protected throughout packing area by removable shaft sleeve
3. Shaft deflection at stuffing box not more than 0.002" at any operating head
4. Sleeve positively locked against rotation and axial movement
5. Sleeves sealed to prevent leakage between shaft and sleeve
6. Total shaft runout less than 0.002"

#### E. Mechanical Seals

1. Single cartridge seal system design with sleeve, gland, and seal all in one unit
2. Balanced O-ring seal design
3. Flushless seal design
4. Field replaceable stationary and rotary face elements
5. Acceptable equipment
  - a. Chesterton
  - b. John Crane
  - c. Wemco Slurry Seal

#### F. Bearing and Bearing Housing

1. Oil bath lubricated
2. Oil reservoir sealed at both ends
3. Thrust bearing
  - a. Minimum of two ball bearings mounted back to back
  - b. Maximum protection from all thrust loads
4. Bearing rated for B10 life of 100,000 hours
5. Rated for maximum shaft speed
6. Bearing housing
  - a. Pressure venting device

- b. Oil fill, level and drain taps
- 7. Ample clearance for sealing mechanism maintenance
- 8. Integral oil level site glass

#### G. Baseplates

- 1. Common pump and top mounted motor base
  - a. Motor base adjustable to facilitate belt tensioning and replacement
  - b. Assure motor base plate and support do not interfere with maintenance access to pump assembly
- 2. Rigidly support rotating elements
- 3. All seams and contact edges continuously welded and ground smooth or bent steel
- 4. Provide adequate openings to facilitate grouting

#### H. Drive Assemblies

- 1. Motor connected to pump through adjustable V-belt drive
- 2. Conform with the requirements of Section 01600-Materials and Equipment or as specified herein
- 3. Adjustable speed V-belt drive
  - a. Adjustable pitch annealed cast-iron sheaves with split wedging type hubs
  - b. Nonstick system for sheave face movement
  - c. Both sheave faces must be movable on shaft and provided with keyways and locking screws
  - d. Design equipment: TB Wood's Incorporated V-belt adjustable speed sheaves, SVS Series, B-section, Type 1
- 4. Manual speed adjustment at pump while pump is stopped
- 5. Provide belt guards

#### I. Motors

- 1. Conform with the requirements of Section 01600-Materials and Equipment or as specified hereinafter
  - a. Conform with NEC requirements for Class I, Division 1, Group D locations unless otherwise indicated on drawings
  - b. 480 volt, 3-phase, 60 Hz
  - c. TEFC or TENV
  - d. Service factor: 1.15
  - e. Premium efficiency

#### J. Accessories

- 1. Lifting eyebolts, lugs, or other suitable means for lifting pump and motor assembly
- 2. Provide plugged gauge cock connections in piping adjacent to suction and discharge nozzles

#### K. Painting and Coatings

- 1. Shop prime in accordance with Section 01600 and Section 09900

2. Manufacturer's standard coating system
  - a. Provide manufacturer's standard finish coating color
  - b. Owner to select color from manufacturer's standard color chart
3. Use only mercury-free, lead-free, fume-proof paint or coatings
4. Paint or coatings must be suitable for atmosphere containing hydrogen sulfide

L. Balance

1. Place pump in as near perfect rotational balance as practicable
2. Equipment which vibrates excessively will be rejected
3. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided
4. Limits
  - a. Maximum peak to peak vibration displacement at any point on the machine: 3.5 mils
  - b. Maximum peak to peak vibration displacement at shaft at face of stuffing box: 2.0 mils
  - c. Ratio of rotative speed to critical speed of unit or components: Less than 0.8 or more than 1.3

2.4 ANCHOR BOLTS

- A. Manufacturer to specify type, size, number required and placement template
  1. Refer to Section 05501 for general requirements
- B. Manufacturer to provide anchor bolt setting template and/or setting instructions
- C. Anchor bolts will be furnished by installation contractor

2.5 SPARE PARTS

- A. One wearing plate
- B. One complete set of bearings
- C. One spare seal kit
- D. One matched set of V-belts

2.6 CONTROLS

- A. Provide one control panel for each grit pump
  1. Each grit pump shall be independently operated through its own control panel
- B. Control panels to be wall-mounted in the Electrical and Control Room of the Headworks Building
- C. Grit pump operation shall be initiated and terminated by adjustable timers



- D. The operations area of the Headworks Building will include hazardous environment monitoring devices. Should a hazardous environment condition occur, it will be indicated by the SCADA system which will in turn send a shut down signal to the equipment in the operations area. The grit pump control panel must be able to accept this signal and upon its activation immediately de-energize all associated equipment in the Pump Room
- E. Provide a local emergency stop pushbutton at each grit pump in a NEMA 7 enclosure
  - 1. Local stop pushbutton will serve as local disconnect switch
  - 2. Provide stop pushbutton with locking hasp or cover for equipment lockout
- F. Control Panel
  - 1. Number required: 2
  - 2. Enclosure rating: NEMA 4
  - 3. Control panel component rating: NEMA 4X
  - 4. Completely prewired and factory tested prior to shipment
  - 5. Main disconnect switch capable of being locked in the Off position
  - 6. Accept input power of 480 VAC, 3-phase, 60 hertz
  - 7. Include the following minimum electrical devices
    - a. FVNR motor starter and motor overload protection
      - 1) FVNR for motors less than 10 hp
      - 2) RVSS for motors 10 hp and above
    - b. Transformer for 120 VAC control system power
    - c. Main circuit breaker
  - 8. Include the following minimum pilot and control devices
    - a. Hand/Off/Auto selection switch
      - 1) When in Hand, grit pump to operate continuously
      - 2) When in Auto, grit pump to operate as follows
        - a) The frequency of run timer shall automatically initiate grit pump operation based on time setpoints
        - b) When the frequency of run timer calls for grit pump operation, the pump shall be energized along with the run duration timer and the grit pump run signals out. The grit pump shall continue to run until it receives a fault signal from the grit separator equipment or the run duration timer times out, at which time the grit pump and its run signals will be de-energized
        - c) The start pushbutton shall energize the pump motor, its run signals out and the run duration. Once started in this fashion, the grit pump shall operate under the same conditions described in previous paragraph b), as if started automatically
        - d) When the grit pump is de-energized, the frequency of run timer shall reset and all signals out shall be de-energized
    - b. Start pushbutton
    - c. Emergency stop pushbutton
    - d. System reset pushbutton
    - e. Run indicating light: Green
    - f. Fault indicating light: Red
    - g. Hour meter/run time meter
      - 1) Nonresettable

- h. Solid state frequency of run timer with a minimum adjustable range of 0 to 480 minutes at intervals of 10 minutes
  - i. Solid state run duration timer with a minimum adjustable range of 0 to 30 minutes at intervals of one (1) minute
  - j. Run output contact to SCADA system
  - k. Run output contact to grit separator equipment
  - l. Fault output contact to SCADA system
  - m. Input contact for grit separator equipment fault signal
  - n. Input contact for equipment shutdown signal from SCADA system
9. Provide circuitry and devices to shut down the equipment upon the following conditions
    - a. Motor overload/fault
    - b. Control panel emergency stop pushbutton activation
    - c. Local emergency stop pushbutton activation
    - d. Receipt of SCADA system shutdown signal
    - e. Receipt of grit separator equipment fault signal
  10. Clearly label all front panel mounted items and devices on the outside front of the panel
  11. Clearly label all wires and terminal points inside the control panel
  12. All power and control wiring shall be 600 Volt insulated copper and sized for the required load, 14 AWG minimum
  13. All circuit breakers shall be thermal magnetic molded case units
  14. All selector switches, pushbuttons and pilot lights shall be heavy-duty, water/oil tight, corrosion resistant units rated for NEMA 4X service
  15. All terminal blocks shall be pressure connector type with marking strips and covers suitable for copper connectors sized for the application
  16. All control relays shall be industrial plug in type rated for the appropriate application load

## PART 3 - EXECUTION

### 3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01600 for requirements

### 3.2 INSTALLATION

- A. Inspection

1. Inspect materials and equipment for signs of damage, pitting, rust, decay or other deleterious effects of storage, transportation, handling, etc.
  - a. Replace or repair any materials or equipment showing such effects to the satisfaction of the Engineer and Owner
  - b. Replace damaged materials or equipment with identical new materials or equipment

- B. Equipment Installation

1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements

- a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner
  - b. Perform all work in accordance with manufacturer's instructions
    - 1) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents
    - 2) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding
  - c. Shimming between machined surfaces is not permitted
2. Provide lubricants as recommended by the manufacturer
- a. Provide sufficient quantity to
    - 1) Fill all lubricant reservoirs
    - 2) Replace all lubricant consumed during testing, startup and operation prior to acceptance of equipment by Owner

#### C. Paint and Coatings

- 1. Recoat all coated surfaces damaged prior to product acceptance to the satisfaction of the Engineer and Owner
  - a. Use paint and/or coating materials identical to those used in the field and by the manufacturer for shop coating
  - b. Utilize surface preparation procedures as specified herein or as may be appropriate for repairs needed

#### D. Adjustment and Cleaning

- 1. Perform all required adjustments, tests, operational checks, cleaning and other procedures required for the preparation and performance of startup activities

### 3.3 FIELD TESTING

- A. Ensure all bearings and drive components are properly lubricated
- B. Make all necessary initial adjustments to put equipment into operation
- C. Test pump each unit to verify design operating heads and capacities are achieved
  - 1. Operate equipment for 24 hours
  - 2. Adjust V-belt sheaves as necessary to achieve design operating heads and capacities
- D. Verify operational compatibility with grit separator equipment for both solids and hydraulic loading
- E. Log drive motor amperages and voltages
- F. Perform all other manufacturer's standard battery of tests
- G. Equipment: No indication of binding, unusual loads, intermittent operation, vibration or other problems

### 3.4 FIELD QUALITY CONTROL

- A. Provide Manufacturer's Field Service
  - 1. Minimum two trips to project site at one half (½) day each
  - 2. Qualifications of manufacturer's representative
    - a. Authorized representative of the manufacturer
    - b. Experienced in the application and installation of the subject work, materials and equipment
  - 3. Services provided by representative
    - a. Provide guidance regarding proper installation
    - b. Supervise installation of equipment furnished under this section
    - c. Inspect, check, adjust and test equipment installed, as required, and approve final installation
    - d. Be present when equipment is placed in operation
    - e. Revisit site as often as required to correct all problems and until equipment installation and operation are acceptable to Engineer and Owner
  - 4. Manufacturer's representative to instruct Owner's personnel in the operation and maintenance of the equipment furnished. Minimum one half (½) day including classroom and field training. May be combined with startup services
  
- B. Furnish three (3) copies of written report to Engineer certifying that
  - 1. Equipment is properly installed and lubricated
  - 2. Equipment is in accurate alignment and balance
  - 3. Equipment is free from any undue stress imposed by connecting piping, anchor bolts, etc.
  - 4. Equipment has operated satisfactorily under full load conditions and as specified through full operating range
  
- C. Coordinate preparation, presentation and use of Operation and Maintenance Manual at installation check, startup and operator training

END OF SECTION