CHAPTER 11 WATER PUMP STATIONS

11.01 General

A. The intent of this chapter is to provide guidelines for the design of finished water pump stations equipped with vertical turbine or horizontal, split-case pumps.

B. This chapter applies to finished water pump stations with design flows of up to 15,000 gpm and TDH of up to 462 feet where three or more pumps are required at buildout conditions.

11.02 Definitions

A. Firm Pumping Capacity: The total pumping capacity of the station at maximum day demand with the largest pump out of service, at maximum static head differential levels.

B. Definitions for technical terms used in this chapter are as defined in the ANSI/HI Pump Standards:

11.03 Concept Design Review (CDR) Phase

A. General: The CDR of the project shall be summarized and presented in a CDR report. The report will be submitted to the COS for review and acceptance. The CDR is the basis for the subsequent design process and must include the following at a minimum:

1. Executive Summary.

2. Table of Contents.

3. Project Background.

4. Description of property ownership, right-of-way, and easement information (per Chapter 1).


6. Draft Drainage Study.


11. Draft Electrical Coordination Study.

12. Topographic mapping information and survey summary.

13. Building design parameters.

14. Description of pump selection to include at a minimum:
   a) Technical selection criteria including operational scenarios of flow and head with the selected pumps.
   b) Cost considerations including capital costs and operating and maintenance costs.
   c) Description of anticipated operational set points.
   d) Summary of constructability issues.
   e) Summary of maintenance procedures.
   f) Quantity of duty and standby pumps (minimum of 3 total).
   g) Proposed pump type and configuration, including the motor horsepower, desired number of stages, and impeller diameter.
   h) Manufacturer’s curves for each type of proposed pump.
   i) Table that summarizes the pump design criteria, including design head, design flow, motor horsepower, net positive suction head available, net positive suction head required, and design efficiency.

15. Summary of demand requirements from most recent water master plan, which includes maximum day demand, peak hour demand, and total dynamic head (TDH).

16. Description of architectural features.

17. Description of security features in accordance with the current COS Security Master Plan.

18. Major equipment design criteria.


20. Noise attenuation to satisfy requirements of COS Unified Development Code.

21. Review of latest water master plan analysis and effects on existing facilities within applicable water zone(s).

22. Summary of individual electrical loads with total connected electrical load.
23. Preliminary (30 percent) Drawings, which include:
   a) Civil site plan that presents proposed grading and major yard piping.
   b) Pump Station Plan showing major dimensions and proposed locations of mechanical equipment, major piping, and electrical equipment.
   c) Process and Instrumentation Diagrams (P&IDs) in accordance with Chapter 8.
   d) Electrical single-line diagram in accordance with Chapter 7.


25. Pump and standby pump quantities:
   a) Minimum of three total pumps
   b) Maximum of ten total pumps
   c) Minimum of one standby pump.

26. Provisions for expandability and locations of future:
   a) Mechanical equipment
   b) Electrical equipment
   c) Major piping.

27. Standby generator sizing with proposed fuel type, fuel tank size, fuel consumption, and power output.

28. Summary of Community Development entitlement submittals.

29. Summary of major stakeholders and utilities with contact information for each.

30. Summary of Quality Level A subsurface utility location data in accordance with ASCE Standard Guideline 38-02 for the Collection and Depiction of Subsurface Utility Data.

31. Summary of permit requirements and submittals.

32. “Line of Sight” study for PLC/Radio Control (as requested by the COS).

33. Proposed project schedule with milestones for:
   a) Design completion
   b) Bid date
   c) Construction.

34. Preliminary cost estimate.
35. Proposed PLC and SCADA that includes discussion on integrating with existing systems.

36. Preliminary control descriptions with discussion on proposed automatic and manual modes of operation.

B. It is the responsibility of the Engineer to ensure that the design conforms to the ADEQ Engineering Design Guidelines for the Construction of Water Systems.

11.04 Agency and Utility Coordination

A. The Engineer shall initiate contact and coordinate efforts with outside utilities and agencies in accordance with Chapter 1.

11.05 Final Design Phase

A. General: The Engineer shall provide a Final Design with progress submittals to the COS at 60 percent and 90 percent level of completion in accordance with Chapter 1, which builds upon work completed during the CDR. The Final Design shall include:

1. Final design drawings.

2. Final specifications.

3. Details of security features in accordance with the current COS Security Master Plan.

4. Final cost estimate.

5. Final drawings and specifications shall meet the general requirements presented in Chapter 1.

6. Final versions of all studies and reports submitted with the CDR.

11.06 Hydraulic Analysis

A. The Engineer shall perform a hydraulic analysis for all new, upgraded, or modified pump stations. Examples of modifications that require a hydraulic analysis include:

1. Pump replacement.

2. Modifications to pumping capacity, pump control, and operation adjustment.
3. Significant changes in total dynamic head (TDH) and check valve/control, valve closure time adjustments, etc.

B. Steady State Analysis: The Engineer shall perform a steady-state hydraulic headloss analysis of the pumping and transmission system to determine the TDH requirements of the pump station. TDH calculations are required for new facilities and for modifications to existing facilities. The TDH calculations need to consider the following:

1. Vertical and horizontal alignment of transmission lines based on available information such as as-built drawings.

2. Detailed headloss analysis of the pump suction piping to determine the net positive suction head available (NPSHA) for the pumping system. NPSHA shall always be more than the net positive suction head requirement (NPSHR) of the selected pump(s).

3. A system head-capacity curve.

4. Minimize pressure fluctuation within pressure zones to be less than 10 psig.

5. If necessary, the COS will provide operating criteria of existing pumping, transmission and storage facilities such as reservoir levels, pump curves, and discharge pressures.

6. Minimum and maximum static head analysis.

7. Minimum and maximum pumping rates.

8. Pressure class and age of existing and proposed pipe.

9. Ensure pump shutoff head is less than pipe class rating.

10. Friction factors for existing and proposed pipe materials.

11.07 Surge Analysis

A. General: The Engineer shall perform a transient (surge) analysis for all pumped systems whether new or a modification of an existing system.

B. The analysis will be conducted with computer simulations of the pumping and transmission facilities. The following scenarios will be included at a minimum:

1. Normal operating conditions (pump startup and shutdown).
2. Emergency shutdown with loss of utility power with all ‘duty’ pumps in operation.

C. Surge Analysis Report: A surge analysis report that describes the methods and results of the computer simulations will be provided. The report will include:

1. Recommendations for pump operation.
2. Size, quantity, and location of all recommended surge mitigation measures such as surge tanks, combination air/vacuum relief valves, and air relief valves.
3. Maximum and minimum pipeline pressures.

11.08 Surge Mitigation Measures

A. The Engineer shall be responsible for all elements of the pump station design, including surge mitigation measures.

B. The Engineer shall utilize the pressure range derived from the surge analysis as the basis for establishing the design of the associated piping, including the design of pipe joints (gaskets), fittings, valves, surge tanks and appurtenances used in the yard, and transmission piping.

C. Acceptable surge mitigation measures include the following:

1. Attenuation of surge pressure by programmed pump control valve closure.
2. Design pipelines, valves, and flanges to withstand maximum and minimum pressures based on the surge analysis.
3. Provide freeze protection measures for exposed and outdoor piping subjected to freezing temperatures in accordance with this chapter.
4. Selection and location of air relief valves and combination air/vacuum relief valves.
5. Redundant air relief valves and combination air/vacuum relief valves are required.
6. Identification of proper startup, operation, and shutdown procedures for the system.
7. Surge tanks, if warranted by the surge analysis.
8. Surge anticipation valves, if warranted by the surge analysis.
D. Surge Tanks: Depending on the surge analysis performed, pump stations may be required to employ a surge tank on the discharge and/or supply side of the pump for surge protection. Surge tanks, if required, will be designed as follows (Figure 11.1):

1. Horizontal, above grade, center-feed, ASTM A36 steel pressure vessel as follows:
   a) Rated to withstand maximum pressure of at least 1.5 times the maximum design pressure for the system.
   b) Rated to withstand full vacuum pressure of -14.7 psig.
   c) Fabricated and tested in accordance with ASME Section VII Boiler and Pressure Vessel Code for Unfired Pressure Vessels.
   d) Provide ASME Code stamp and pressure rating on exterior.
   e) Designed with anchored supports to meet seismic criteria and wind criteria for the site.
   f) Primed and coated with an epoxy system for corrosion protection.
   g) Equipped with pressure relief valve vented and piped to a safe location.
   h) Hinged, 30-inch diameter access manways.
   i) Utilizes internal energy dissipater to attenuate surge.
   j) Provide isolation valves, drain piping, and recirculation piping.
   k) Fully-guarded glass, liquid level sight gauge with graduations to indicate normal level, low level, and high level.

2. Utilize a pad-mounted compressed air system and level sensor to maintain the air-to-water ratio and alarms.

3. Provided with packaged, pad-mounted, reciprocating air compressors equipped with the following:
   a) Integral vertical or horizontal steel reservoir.
   b) Designed to fill the surge tank in no longer than 45 minutes at a pressure of at least 10 psig above system pressure.
   c) Capable of producing a minimum of 30 scfm.
   d) A local, lockable disconnect to de-energize the panel.

E. Freeze Protection: Protect exposed and outdoor piping subjected to freezing temperatures in accordance with this chapter.
F. Surge Tank Control System: To be provided by a single entity and include:

1. An automatic air volume control system that utilizes a surge tank level probe and packaged air compressor system to control the air/water ratio and shall include the following functions at a minimum:
   a) High water level condition shall open an air supply valve after a time delay to increase the air volume in the surge tank.
   b) Low water level condition shall open an air bleed valve after a time delay.

2. Stainless steel, NEMA 4X control panel with all necessary instrumentation controls in accordance with Chapter 8, which indicates the following at a minimum:
   a) Tank liquid levels
   b) High water alarm light
   c) Low water alarm light
   d) Air compressor run light
   e) Low air pressure alarm light
   f) High air pressure alarm light
   g) Surge tank level probe fault alarm light.

11.09 Vault Standards for Water Pump Stations

A. General: The Engineer shall locate vaults in non-traffic areas whenever feasible.

B. Confined Space Entry Considerations: Because of “confined space” regulations and safety issues, the COS requires that prior to starting final design of any vaults, the Engineer must receive written approval for their use by the COS Public Works Director or his designee.

C. Interior Dimensions: Provide vaults with interior dimensions that provide sufficient clearance for maintenance and equipment removal by providing the following interior dimensions:

1. Height not less than 7’-0”
2. Walkways width not less than 3’-0”
3. Distance from walls to equipment, valves, and piping not less than 2 feet 0 inch.

D. Drainage: All vaults shall be designed to drain to a sump equipped with an 18-inch deep sump with an exterior 120 VAC/60 Hz/1 Ph ground fault circuit interrupter receptacle to be used for a portable sump pump.
E. Valve Vaults: For ease of access and maintenance, the COS requires the use of vaults to access gear boxes of buried valves for sizes 12 inches and larger.

F. Vault Access: Provide single or double leaf access hatches or manways for vault access. Entrance risers shall be a minimum of 36 inches in diameter, complete with hot-dipped galvanized access ladders.

G. Traffic Area Considerations: In traffic areas, vaults and access hatches shall incorporate heavy-duty, cast iron frames and covers capable of withstanding H2O live loads imposed by heavy maintenance equipment and vehicles.

H. Non-Traffic Area Considerations: In non-traffic areas, vaults and access hatches shall be designed for live loads due to foot traffic and maintenance equipment such as hoists.

I. Electrical and Instrumentation Considerations: Only necessary instrumentation and electrical equipment and accessories such as intrusion switches, GFCI power receptacles, and interior lighting are allowed inside vaults. Whenever possible, all electrical and instrumentation shall be located in a remote, dry, and secure area.

11.10 Flow Measurement

A. Magnetic flowmeters shall be used for flow measurement of pump stations in accordance with the requirements of Chapter 8 and as follows:

1. Located above grade to avoid confined space entry issues.

2. Provided with sufficient upstream and downstream straight runs of pipe.

3. Equipped with bypass and manual isolation valves.

4. Provided with flexible couplings or dismantling joint to facilitate removal.

B. An exterior panel shall be provided with a visual display of the flowmeter measurement in units of gallons per minute or million gallons per day with totalizers that indicate thousands of gallons or as determined by the COS.

11.11 General Structural Design Loads

A. General: Structures shall be designed to safely support the imposed live and dead loads in accordance with the more stringent requirements of Chapter 4 or this section. Loading combinations and live load reductions
shall be according to the requirements/limitations set forth in the IBC. All live and dead loads used for the purpose of design shall be developed for the intended use or occupancy of the particular structure.

B. The general service design loads provided in this section shall be used in the design of pump station and vault structures. These loads include dead loads, live loads, impact and vibration loads, wind loads, earthquake loads, hydrostatic loads, lateral soil loads, and miscellaneous loads.

C. Dead Load Unit Weights: In addition to the dead load of the basic structural elements, the following items, at a minimum shall be used:

1. Piping 12 inches in diameter and smaller shall be treated as uniformly distributed loads. Typical values are 20 pounds per square foot (psf) for extensive piping and 10 psf for light to moderate piping.

2. Piping larger than 12 inches in diameter shall be considered as concentrated loads.

3. Pipeline thrust under maximum pressure conditions.

4. Earth: 120 pounds per cubic foot (pcf), or as recommended by the project/development’s geotechnical engineer.

D. Live Loads: In addition to concentrated loads, the following items shall be used:

1. General roof live loads, walkways, platforms, and stairs shall have a minimum (unreduced live load of 100 psf). Additional consideration shall be given for the type, size, and weight of specific equipment and maintenance of equipment in determining the actual design live loads and concentrated loads. Requirements are as follows:
   a) Mechanical/Electrical Rooms: Equipment weight + 100 psf.
   b) Stairs/Walkways: Use the greatest of 100 psf or 1,000 lbs.
   c) Grating: Use a concentrated load of 250 lb/ft with less than 1/4-inch deflection.
   d) Use H20 load per AASHTO for truck loading.
   e) Electrical and pipe space areas can be estimated by using 150 psf or more as determined by the actual equipment.

E. Hydrostatic Loads and Lateral Soil Loading: The values for lateral soil pressures and soil-bearing pressures for below-grade structures or parts of structures shall be designed in accordance with the project’s geotechnical report(s)/project’s geotechnical engineer.
F. Buried reinforced concrete structures shall be designed for hydrostatic forces imposed by the presence of groundwater. The design of these structures shall include resistance to uplift forces.

G. Lateral soil loadings shall include active soil pressures for yielding walls, at-rest soil pressures for non-yielding walls, and surcharge pressures due to a soil minimum cover of 2 feet or equal to the actual depth of the soil cover above the structure.

H. Seismic soil pressures shall be used in accordance with the Geotechnical Report.

I. For buried hydraulic structures, use high operational water level without backfill (33 percent overstress).

11.12 Architecture and Landscaping

A. Design Appearance Guidelines: The appearance of the pumping facilities will reflect features of the surrounding community per the COS Community Development requirements and the Surprise Unified Development code.

B. Height of Structures: Facilities shall be kept as low in profile as is functionally possible.

C. Reflective Finishes: Visible and highly reflective materials and surface finishes should be avoided on the exterior of the facility.

D. Exterior Building Walls: Provide low maintenance material such as split-face masonry block for exterior walls of the site and pump building that matches the surrounding development and meets requirements of current COS Security Master Plan.

E. Anti-Graffiti Coating: At a minimum the exterior building walls and masonry perimeter wall shall be coated with an anti-graffiti protection system as follows:
   1. Two-component high build epoxy polymer system with at least 35 percent solids by volume.
   2. Coating shall provide resistance to weather and rain damage, abrasion, peeling, ultraviolet degradation yellowing, and chemical attack.
   3. Coating system shall withstand 120 cleaning cycles without degradation and shall allow 100 percent removal of paint and graffiti.
without signs of deterioration or change in appearance. System shall not require reapplication to maintain performance over 10 years.

4. Color shall be clear unless indicated otherwise.

5. Base Coats: Apply at least 2 coats at rate and thickness required by the manufacturer to produce a pinhole free base.

6. Finish Coats: Apply at least 2 coats.

F. Roof Hatches: Where a roof or sunshade is provided for a pump station, roof hatches are required over each pump as follows:

1. Sized to accommodate the removal of the motors and pumps.

2. Motorized, capable of operation at ground level.

G. Landscape Coordination: The landscaping of the facility is required to match surrounding community in accordance with the Surprise Unified Development Code and as follows:

1. Locate vegetation at a sufficient distance from fences and structures to prevent unauthorized access to site.

2. Consider mature vegetation height to prevent damage to adjacent facilities.

3. Provide vegetation with root system that will not damage sidewalks, pavement, or buried utilities.

11.13 Pump Systems Design

A. General: Include the following in the project design:

1. Design TDH and design flow for pump and at least 4 additional design points to define the pump curve.

2. Design requirements for the pump, motor, drive (constant or variable speed).

3. Soft-starters where starting voltage drop or current needs to be limited.

4. Materials of construction for drive shaft, barrels, couplings, supports, and impellers.

5. Instrumentation, controls, and appurtenances.
6. The pump and motor shall be provided by the pump supplier, who shall assume single source responsibility.

B. Expandability: Pump station expandability will be evaluated by the COS on a case-by-case basis. Expandability requirements, if required, include the following:

1. Reserve space for future pump and equipment.
2. Pump cans, suction, and discharge piping manifold shall be sized for future flows.
3. Electrical and control facilities such as motor control centers (MCCs), conduit, and controls shall be provided based on largest anticipated equipment at buildout conditions.

C. Pump Selection: Pump selection and quantity shall consider the following:

1. Initial and buildout firm pumping capacity of facility and for each pump.
2. Specific speed and suction specific speed at initial and buildout firm capacity.

D. System Head Curves: The Engineer shall develop a series of system head curves for pump scenarios, which include the following at a minimum:

1. Curve for low head condition, which includes consideration of high level in supply reservoir and low level in receiving reservoir.
2. Curve for high head condition, which includes consideration of low level in supply reservoir and high level in receiving reservoir.
3. Each System Head Curve shall indicate:
   a) Variation of TDH with flow.
   b) Family of curves for a variety of operating conditions, which include minimum, typical, and maximum values for:
      1) Static head
      2) Flow
      3) Pipe roughness coefficient.
   c) Number of operating pumps.
   d) Selected pump(s) and impeller characteristics.
   e) Curves at varying speed if pump speed control is required.
   f) Efficiency.
   g) Required Net Positive Suction Head (NPSHR).
   h) Brake Horsepower.
4. System Head Curve analysis that varies operating conditions as well as number of operating pumps to verify the following:
   a) Pump curve is not “flat” where small change in TDH would result in a large change in pump flow.
   b) Typical operating point on the system curve is near the maximum efficiency point or Best Efficiency Point (BEP).
   c) The pump(s) will operate such that pump shutoff or run out operation is not expected at either minimum or maximum operating conditions.
   d) The selected pump/impeller combination is located near the center of the pump-operating curve.

E. Pump Inlet Configuration: The Engineer shall evaluate NPSHR and NPSHA at maximum flow and maximum temperature as well as at minimum flow at maximum temperature. The pump inlet shall be:

1. Designed in accordance with Hydraulic Institute Standards to prevent cavitation, turbulence, vortexing, and jet velocities.
2. Designed such that the NPSHR is less than the NPSHA at the following conditions (where NPSHA is reduced by a minimum of 5 feet to provide a factor of safety):
   a) Initial minimum and maximum flow conditions.
   b) Buildout minimum and maximum flow conditions.

F. Mechanical Layout: In general, pumps shall be arranged to provide convenient access for operation, maintenance, equipment installation, and equipment removal on at least three sides. The mechanical layout shall also include:

1. Sufficient clearance around all pumps, valves, piping, panels, and other equipment based on minimum manufacturer’s recommendations and as follows:
   a) Unless otherwise required by OSHA or NEC, a minimum of 3-foot clearance around 3 sides of pump equipment.
   b) Sufficient vertical and horizontal clearance for removing and installing pumps, motors, valves, and other equipment.
   c) Unless otherwise required by IBC or manufacturer’s minimum space for maintenance, a minimum 42-inch wide walkway corridor shall be provided between walls pumps, piping, valves, and other equipment.
   d) Evaluation of multiple pump manufacturers to determine the largest possible footprint and vertical envelope required for pumps and motors.
11.14 Pump Speed Control

A. General: The COS standard is to utilize dedicated variable frequency drives (VFDs) for speed control of pumps. Approval to use of constant speed pumps for a project must be granted by the COS Public Works Director in accordance with Chapter 1, Section 1.02.

B. Variable Speed Control: Each pump shall be equipped with a dedicated VFD that meets the requirements of Chapter 7. In addition, VFDs shall include the following:

1. Complete description of the power system including requirements for operating through standby generators.

2. Power requirement as a function of pumping capacity.

3. Minimum and maximum allowable power factor over working speed range.

4. Minimum allowable efficiency at full speed and load.

5. Required operating ambient temperature range.

6. Required diagnostics provisions.

7. Control and monitoring signal interface.

8. Acceptable ambient noise level.


10. Local control functions, which include manual speed control.

11. Characteristics (available short circuit current X/R ratio) of power supply including alternate and standby power supplies.


13. Provide recommended list of VFD spare parts.

11.15 Pump Station Piping and Valves

A. General: The Engineer shall design pump station piping according to the requirements of this section. A typical pump station layout is presented in Figure 11.2. The general piping requirements include but are not limited to:

1. Flanges and pressure classes shall be compatible for all piping under all operating and surge pressures.

2. All piping and valves shall be provided with sufficient vertical and horizontal clearance for maintenance and removal.

3. Valves and operators shall be readily accessible and located not more than 5 feet above the finished floor.

4. All piping and valves shall be adequately supported such that removal will not impart loads on equipment or adjacent piping.

5. All pressurized piping shall be restrained.

B. Exposed piping within the pump station shall be flanged, welded steel pipe, or flanged, ductile iron pipe in accordance with the following:

1. Steel pipe: Conform to the requirements of ANSI/AWWA C200 and designed per AWWA M11. Piping to be cement mortar-lined with a primed epoxy coating system.

2. Ductile Iron Pipe (DIP): Shall be Class 53 cement mortar-lined with a primed epoxy coating system.

3. All flanged joints shall conform to the requirements of ANSI/AWWA C207.

4. All materials and coatings shall meet requirements of NSF 61.

C. Suction piping shall be designed to minimize long runs and high points and meet the following requirements:

1. Maximum pipe velocity of 5 ft/s based on maximum flow at buildout conditions.

2. Air relief valves to be provided at all high points, which are hard-piped to a nearby drain.

3. All joints shall be restrained.

4. Liquid-filled, damping pressure gauges within the appropriate range.
5. Reducers shall be the eccentric type with flat end on top.

6. Isolation valves shall be provided on each pump suction lateral and shall be as follows:
   a) Fully flanged butterfly valve in accordance with AWWA C504 with geared handwheel operator and position indicator for pipe sizes larger than 12 inches.
   b) Fully flanged resilient wedge gate valve, rising stem, in accordance with AWWA C515 with position indicator for pipe sizes 12 inches and smaller

D. Bypass to Discharge: Provide as recommended by the surge analysis or Engineer and approved by the COS to protect against suction surge pressures, supply low pressure flow during pump failure, or relieve discharge manifold pressure equipped with the following:

1. Check valve: Silent, globe style, non-slamming type.

2. In-line pressure relief valve with flanged, manual isolation butterfly valves in accordance with AWWA C504.


E. Discharge piping shall be designed to minimize high points and meet the following requirements:

1. Maximum pipe velocity of 10 ft/s.

2. Air relief valves to be provided at all high points, which are hard-piped to a nearby drain.

3. All joints shall be restrained.

4. Pump discharge laterals shall utilize 45-degree wyes to connect to a common discharge header.

5. Discharge header shall utilize flanged connections to pumps and valves and shall be located above grade where feasible to facilitate maintenance.

6. Spool with minimum 1-inch NPT welded coupling for steel pipe or manufactured instrument tee for ductile iron pipe to accommodate a discharge pressure gauge and pressure switch.

7. Liquid-filled, damping pressure gauges within the appropriate range.
8. Reducers of the concentric type shall be used downstream of the pump discharge. Air relief discharge shall be piped to an adjacent drain.

9. Isolation valves shall be provided on each pump discharge lateral and shall be:
   a) Fully flanged butterfly valve in accordance with AWWA C504, equipped with geared handwheel operator and position indicator.
   b) Fully flanged resilient wedge gate valve, rising stem, in accordance with AWWA C515 with position indicator for pipe sizes 12 inches and smaller.

10. Check valves to be installed in horizontal position shall be silent, globe style, non-slamming type.

11. Spool with welded outlet for steel pipe or manufactured tee for DIP to accommodate an air vacuum/air release valve, if required.

12. Provide flexible coupling on each discharge lateral to facilitate disassembly and removal.

13. Provide insulating flanges and gaskets at transition between dissimilar metals, as well as between pumps and underground piping.

F. Flexible Couplings: Provide between pump equipment and rigid connections to mitigate vibration, cushion shock loads, accommodate misalignment, and to facilitate disassembly and reassembly. Additional requirements are as follows:

1. Pump Suction: Couplings located between the pump inlet isolation valve and pump.

2. Pump Discharge: Couplings located between the pump and discharge check valve.

3. Provide anchors on pump and piping for longitudinal restraint.

G. Air Release Valves shall be sized per AWWA Manual M51 and conform to ANSI/AWWA C512. Provide at high points and shall be epoxy-coated inside and outside with stainless steel trim.

H. Combination or Vacuum/Air Release Valves shall be sized per AWWA Manual M51 and conform to ANSI/AWWA C512. Provide at locations...
determined by the surge analysis and the Engineer, and shall be epoxy-coated inside and outside with stainless steel trim.

I. Pipe restraints shall include the following at a minimum:

1. Thrust restraints designed to resist maximum operating pressures and surge pressures.

2. Anchor rings for all pipes that penetrate walls.

3. Longitudinal restraint through flanged coupling adapters and flexible sleeve couplings.

J. Pressure Gauges: Provide standard bourdon-style oil (glycerin)-filled pressure gauges with 4-inch face, constructed of Type 316 stainless steel and equipped with stainless steel corporation stop for isolation. Typical operating conditions should register at the middle of the scale.

K. Provide piping supports and straps to keep all weight off the pump and equipment. The Engineer shall be responsible to ensure that sufficient pipe supports are provided such that no loads are transferred to equipment flanges.

11.16 Pump Motors

A. General: Motors shall comply with requirements of Chapter 7.

B. Pump Motor Material: Shall be cast iron with UL, FM, CSA, or NSF International approval required.

C. Electric motors from 5 horsepower to 400 horsepower shall be rated at 460 volts, 3-phase, 60 Hz. The COS reserves the right to modify this requirement depending upon the design and operation flexibility.

D. Soft Starters: Constant speed motors will be provided with soft start and soft stop features.

E. Ratings for electrical motors larger than 400 horsepower shall be reviewed by the COS.

F. Motors 100 horsepower and larger shall be:

1. Totally Enclosed, Fan-Cooled (TEFC).

2. Premium efficiency rated as defined in NEMA MG-1.

3. Equipped with velocity transducers for vibration monitoring with alarm followed by shutdown.
4. Provided with at least two Resistance Temperature Detectors (RTDs) per phase of windings with alarm. RTDs shall be 100-ohm platinum, 3-wire type.

G. Space Heaters: Motor space heaters are not required.

H. All rotation changes (phase reversal) shall be made at the motor and not at the MCC.

I. Pump motors shall not be loaded to use more than the rated horsepower with a minimum service factor of 1.15.

J. The motor torque and locked rotor characteristics shall be specified in the NEMA standards for Design B and shall be selected to be non-overloading throughout the driven pump’s full speed performance curve.

K. The motor shall be of the solid-shaft type, steel cast, and adapted to a 4-piece flanged coupling assembly that will adapt to the bowl shaft assembly.

L. Motors located indoors shall be specified for minimum 50 degree Celsius ambient temperature as recommended by the motor manufacturer.

M. Motors located outdoors shall be specified for minimum 60 degree Celsius ambient temperature as recommended by the motor manufacturer.

N. Where used in conjunction with VFDs, provide Inverter Duty Rated electric motors fully compatible with the VFDs that comply with the requirements of NEMA MG-1 Part 31.

O. Motor connection terminals or power distribution blocks shall be provided for motors over 100 horsepower.

P. Aluminum motor rotor bars are not acceptable.

Q. Motors located in below-grade facilities shall be provided with moisture sensing devices with contacts to indicate leak detection alarms.

R. Vertical Turbine Pump Motor Requirements:

1. Access: For line shaft vertical turbine pumps, a catwalk, service grating, or some type of access/maintenance platform shall be provided in order to allow servicing of the motors.

2. Prime Mover: Vertical, electric motor of premium-efficiency design, NEMA type, open drip-proof weather protected Type I, squirrel cage induction type with Class F insulation and designed for a Class B
rise, designed and applied in compliance with NEMA, IEEE, NFPA, and the NEC.

3. Drive on each pump shall be a vertical, solid shaft, high-efficiency, high thrust, non-reverse, ratchet electric motor. Each electric motor shall be designed to accept the total, unbalanced thrust force imposed by the pump.

4. Line-shaft vertical turbine pumps shall operate between a minimum of 900 rpm and a maximum of 1800 rpm. COS reserves the right to modify these minimum and maximum requirements based on operation flexibility.

S. Horizontal Split-Case Motor Requirements:

1. Motor to be close-coupled to pump.

2. Operating speed shall be a minimum of 900 rpm and a maximum of 1800 rpm. COS reserves the right to modify these minimum and maximum requirements based on operational flexibility.

3. Provide equipment safety guards to protect personnel from rotating equipment.

T. Water-cooled motors are not acceptable.

11.17 Vertical Turbine Pumps

A. General: Section applies to vertical, multistage turbine, water lubricated pump.

B. All pumps and materials shall be UL and NSF approved.

C. All lining and coating systems in contact with potable water shall protect against corrosion in accordance with Chapter 5 and meet the NSF 61 Standard.

D. The pump manufacturer shall be responsible for providing the pump, column, can, and motor.

E. Pump Cans: Provide in accordance with the following requirements:

1. Maximum velocity shall not exceed 5 fps or as specified in the latest edition of HI.

2. Provide sufficient diameter to avoid limiting or restricting the flow of water into the pump inlet.
3. Lining and coating shall be an amine-cured epoxy or fusion bonded epoxy.

4. The can shall have bolt-on flanges to allow for removal.

5. The cans shall be of sufficient diameter depth to accommodate maximum flow of pump at buildout conditions.

F. Pump Efficiency: The Engineer shall select pumps such that pumping hydraulic efficiencies are:
   a) Not less than 84 percent at design flows.
   b) Not less than 80 percent within the full operating range of the pumps.
   c) Outside the efficiency criteria, as approved in writing by the COS Public Works Director, is required for lower efficiencies.

G. Bowls: Cast-iron with internal surfaces coated with 10 mils of an amine-cured epoxy or fusion bonded epoxy.

H. Impellers: Constructed from zinc-less bronze, Type 316 stainless steel or aluminum bronze; statically and dynamically balanced with Type 316 stainless steel bolting.

I. Shaft: Line shaft constructed of Type 410, 416, or 316 stainless steel with shaft and couplings in lengths not to exceed 10 feet. Size for a critical speed of 20 percent above maximum operating speed.

J. Shaft Couplings: Constructed of Type 316 or Type 416 stainless steel.

K. Shaft Lubrication: Shall be product water.

L. Shaft Seal: Flushed or flushless mechanical, split seal.

M. Line Shaft Bearings: Zinc-less bronze, Type 316 stainless steel, or aluminum bronze at each joint for open line shaft. Evaluate ceramic insulated bearings and grounding of motor shaft to mitigate corrosion due to stray current.

N. Wear Rings: Comprised of aluminum bronze, hard-faced replaceable (wear ring alloy shall not gall when used with impeller alloy).

O. Suction Bell: Cast iron, with bottom bearing and streamlined ribs, for lining and coating; see bowls.

P. Discharge Head: Fabricated steel or cast iron with appropriate thickness as determined by the Engineer and equipped with 1-1/4-inch connections for air valve, pressure switch, and drain connections.
Q. Motor shaft coupling shall be a flanged Type 316 stainless steel coupling.

R. Suction Bowl Bearings: Heavy-duty, grease lubricated, bronze sleeve type with self-contained grease lubrication system. Grease shall be approved by Food and Drug Administration for use in potable water. Grease tubes and fittings shall be Type 316 stainless steel.

S. Bowl and Suction Case Bearings: Water-lubricated, zinc-less bronze or aluminum bronze sleeves.

T. Provide a complete list of recommended spare parts and the following spare parts:
   1. One complete mechanical seal.
   2. One split mechanical seal rebuild kit for each pump.

U. Pump Impeller Clearance: To reduce potential for pump cavitation, the pump impeller shall be mounted a minimum of 1-1/2 times the diameter of the pump bowl away from the bottom of the pump can or as recommended by the Engineer and manufacturer based on the anticipated range of operating conditions.

11.18 Horizontal, Split-Case Pumps

A. General: Section applies to horizontal, split-case, water lubricated pumps.

B. All pumps and materials shall be UL and NSF approved.

C. All lining and coating systems in contact with potable water shall protect against corrosion in accordance with Chapter 5 and meet the NSF 61 Standard.

D. The pump manufacturer shall be responsible for providing the pump and motor.

E. Pump Efficiency: The Engineer shall select pumps such that pumping hydraulic efficiencies are:
   1. Not less than 84 percent at design flows.
   2. Not less than 80 percent within the full operating range of the pumps.
   3. Pump efficiencies that do not meet the minimum values must be approved in writing by the COS Public Works Director.
F. Casing: Provide in accordance with the following requirements:
   1. Cast iron or cast steel.
   2. Tested to 150 percent of maximum system pressure.

G. Impeller: Enclosed, single suction constructed of zinc-less bronze, Type 316 stainless steel, or aluminum bronze; hand finished; statically and dynamically balanced; keyed to shaft; Type 316 stainless steel bolting.

H. Shaft: Constructed of Type 410, 416, or 316 stainless steel. Size for a critical speed of 20 percent above maximum operating speed.

I. Shaft Sleeve: Type 316 stainless steel.

J. Shaft couplings: Constructed of Type 316 or Type 416 stainless steel; equipped with OSHA safety guard.

K. Shaft Lubrication: Shall be product water.

L. Shaft Seal: Flushed or flushless mechanical, split seal.

M. Wear Rings: Renewable, comprised of Type 316 stainless steel.

N. Bearing: Heavy-duty, grease lubricated, bronze sleeve type with self-contained grease lubrication system. Grease shall be approved by Food and Drug Administration for use in potable water. Grease tubes and fittings shall be Type 316 stainless steel.

O. Provide a complete list of recommended spare parts and the following spare parts:
   1. Two sets of all bearings.
   2. One complete mechanical seal.
   3. One mechanical seal rebuild kit for each pump.

11.19 Vibration

A. General: The Engineer shall design the pumping facility such that equipment is isolated from vibration and within the vibration limits provided herein.

B. Vibration Testing: Require field vibration tests for a representative sample of pumps as determined by the COS. Vibration measurements taken during performance testing shall be made with calibrated instruments with
certification of National Bureau of Standards (NBS) traceable reference vibration sources.

C. Vibration Limits for horizontal and vertical centrifugal pumps not exceed those delineated by the Hydraulic Institute (HI) or included in this section.

D. Horizontal Pump Vibration Limits:
   1. For pumps over 250 horsepower with sleeve bearings:
      a) Maximum allowable radial shaft vibration at maximum speed shall not exceed 2.0 Mil peak-to-peak throughout the full operating range, which applies only when the pump control valve is fully open.
      b) Maximum allowable radial shaft runout roll speeds of less than 100 rpm shall be less than 0.25 mils peak-to-peak radically, 0.5 mils peak-to-peak, axially.
   2. Maximum allowable bearing housing vibration at full operating speed shall be 0.12 IPS RMS (Root-Mean-Square) throughout the normal operating flow range, which applies only when the pump control valve is fully open. The maximum allowable transient bearing housing vibration shall be 0.40 IPS (RMS) throughout the normal startup and shutdown speed range.

E. Vertical Pump Vibration Limits:
   1. Limits shall be laterally (horizontally) not more than 3.5 mils peak-to-peak displacement and not more than 0.15 inches per second RMS velocity measured in any direction at the motor base flange.
   2. Displacement and velocity measurements shall be unfiltered, and the pump shall be operating at maximum speed and at any flow within the rated range of the pump.
   3. Field vibration levels, with pump control valve fully open, shall also be reported for the thrust bearing at the top of the motor. Acceptance limits for vibration at the motor thrust bearing shall be calculated based on the distances of the motor base flange and the motor thrust bearing above the discharge head soleplate as follows:

   \[ Au = 3.5 + 6.64 \times \log_{10} \left( \frac{D1}{Db} \right) \]

   Where: \( Au \) = unfiltered displacement, mils peak-to-peak
   \( D1 \) = distance to thrust bearing, inches
   \( Db \) = distance to motor base, inches
11.20 Heating, Ventilation, Air Conditioning (HVAC)

A. General: Provide HVAC systems for all electrical rooms, occupied spaces, and mechanical rooms, which meet requirements of Chapter 9.

11.21 Signage

A. Each pump station site shall be identified with a sign mounted on the exterior of the masonry perimeter wall adjacent to the site access gates. Exact location will be determined by the site layout on a case-by-case basis.

B. Traffic control signs shall be provided as needed per ADOT and the EDS.

11.22 Access Gates

A. Access to the pump station site shall be through a minimum 20-foot wide steel frame rolling gate. Provide sufficient space for maintenance vehicles to park out of traffic and adequate sight distance to safely enter and exit the site.

B. Gates shall be manual or automatic as determined by site security requirements. Manual gates will be provided with spare conduit for future automatic operation and security features.

C. Pull force: The maximum pull force for opening or closing manual gates is 50 pounds.

D. Automatic gates and provisions for future security features shall meet the requirements of the most current COS Security Master Plan.

E. At a minimum, one 4-foot wide pedestrian access gate, which locks from the exterior, will be provided.

F. Provide separate access for utility power to the service entrance station and meter with internal security fence to separate these from the rest of the facility in accordance with Chapter 7, Section 7.20.

11.23 Security

A. At a minimum, an 8-foot tall masonry perimeter wall with locked entrance shall be provided around the site. The perimeter wall will:

1. Be compatible with the surrounding environment, including landscaping.

2. Satisfy all COS architectural and other Community Development requirements for appearance, colors, and coatings.
B. All other security issues shall be addressed by the Engineer, which include items described in the latest version of the most current COS Security Master Plan.

11.24 Noise Attenuation

A. General: Maximum noise levels in working environments are regulated under the federal Occupational Safety and Health Act (OSHA). OSHA requirements as well as local, state, and federal regulations shall be included in the design of all facilities to mitigate noise levels. Noise discussed herein applies to both pump station facilities and facility boundaries.

B. Noise due to construction or operation of pump stations shall meet the requirements of the COS Unified Development Code. Examples of noise include the following:

1. Operating equipment such as pumps, standby generators, HVAC, and compressors.
2. Construction and maintenance activities such as operating tools and construction equipment.

C. Facility Noise Production Studies: The Engineer shall complete a Noise Production Study for all pumping stations located near residential or commercial areas or if required by the COS.

D. Noise Limits: The Engineer shall comply with the following noise limits:

1. Less than 90 dBA at a distance of five feet from the motor.
2. Less than 65 dBA outside of exterior walls.

E. Engineering Noise Controls: The Engineer is responsible for all engineering noise controls for pump stations, which shall mitigate noise to appropriate levels. Use of an experienced acoustical engineer may be required. Examples of engineering controls include:

1. Sound enclosures and/or insulated rooms for equipment.
2. Selection of pump and air compressor equipment.
3. Selection of HVAC equipment, inlets, outlets, and duct.
4. Use of sound barriers, sound traps, acoustical shrouding, and/or insulation.
5. Incorporating additional dead space at doorways and windows.
11.25 Support Systems

A. Backflow Prevention: Provide approved backflow protection devices to avoid potential contamination. If the backflow prevention device is mounted adjacent to a wall, it shall be mounted a minimum of 24 inches away and no greater than 3-feet high to allow for maintenance. Provide backflow prevention for the following water sources:

1. Potable Water.
2. Reclaimed Water.

B. Service Water: Provide for housekeeping and landscaping in accordance with the following:

1. Supply from potable water or approved reuse water source.
2. Where potable water is source, provide an approved backflow prevention.
3. Provide 3/4-inch hose bibs with vacuum breaker, galvanized or epoxy-coated steel hose rack with 50 feet of 3/4-inch rubber hose.
4. Provide a water meter located on the exterior of the site perimeter wall.

C. Drain System: Provide floor drains, hub drains, floor sinks for drainage of air relief valves, seal water, condensate, and housekeeping as follows:

1. Sanitary sewers are required at all Water Pump Stations and shall be gravity type with minimum slope of 0.007 ft/ft.
2. Drain piping shall be PVC or cast iron.
3. Provide cleanouts and vents in accordance with currently adopted plumbing code.
4. Discharge to sanitary sewer in a manner that is compliant with currently adopted codes.
5. Sump pumps, where required, shall be duplex type submersible and equipped with the following:
   a) Ductile iron or PVC discharge piping
   b) Type 316 stainless steel lifting chain
   c) Discharge check valve
   d) Float level controls
   e) High water level alarm will annunciate to SCADA
Chapter 11
Water Pump Stations

D. Telephones and Communications: Pump stations shall be supplied with a telephone board and appropriate size and number of conduit for telephone and security wiring in accordance with the following:

1. Conduits shall be extended to suitable junction box outside the pump station facility.

2. Submit approved telephone company drawings as part of project as-built drawings.

3. Coordinate design with current COS Security Master Plan.

E. Freeze Protection: Provide heat tracing and insulation for water piping less than 4 inches in diameter and/or chemical piping located outdoors that is subject to freezing temperatures in accordance with the following:


2. Pipe Insulation: Closed cell, elastomeric foam insulation suitable for temperatures of 0 degrees Fahrenheit to 220 degrees Fahrenheit. Provide UV resistant.

F. Compressed Air Systems: Where required by the COS, the Engineer shall determine the plant air demand for each individual pump station facility. Compressed air shall be used for surge tanks, maintenance air tools, etc. The capacity of the air compressors for the surge tank system shall include sufficient capacity for air tools. The plant air system shall consist of the following:

1. Lubricated motor-driven air compressors.

2. Air or liquid-cooled aftercooler.

3. Coalescing filter.

4. Air receiver.

5. Pressure switches, relief valves, pressure-reducing valves with bypasses.
6. Condensate removal system shall consist of timer-controlled solenoid valve.

7. Air tool outlets, filters, pressure regulators, and lubricators.

8. Where plant air usage is considered critical (like surge tank makeup air), a redundant compressor unit should be installed. The compressors shall be reciprocating type with ASME-approved receiver.

9. Air piping shall be designed with a separate piping header to each type of service to ensure that equipment will maintain an uninterrupted supply of compressed air.

G. Restroom Facilities: Where required by the COS, provide toilet, service sink, mop sink, and lavatory facilities. The Engineer must address the handling and disposal of the wastewater generated, which shall be in accordance with ADEQ and COS requirements.

H. Other Support Systems: Systems not specifically addressed herein, such as restroom facilities and compressed air system, may be required and will be evaluated by the COS on a project-specific basis.

**11.26 Fire Protection**

A. Fire protection measures for pump stations shall be designed in accordance with COS, IBC, and IFC requirements.

B. Fire hydrant(s) shall be provided with approved backflow prevention device for fire protection in accordance with requirements of the COS Fire Department.

C. Fire alarm systems, which annunciate to SCADA are required for facilities with occupied spaces such as offices and control rooms.

**11.27 Chlorination Provisions**

A. General: All chlorination facilities shall meet the requirements of Chapter 6.

B. Selection of Sodium Hypochlorite System: The Engineer shall consider liquid hypochlorite and onsite hypochlorite generation, and perform an evaluation to determine the most economical and reliable type of sodium hypochlorite system to be used. During the evaluation, the Engineer shall receive input from the local chemical supplier(s) to assess operational issues such as off-gassing, availability, and cost.
C. Chlorination storage and feeding system shall be provided by a single vendor in accordance with this section and where required. The system shall use commercially available sodium hypochlorite solution or onsite hypochlorite generation and shall consist of the following at a minimum:

1. Bulk storage tanks with secondary containment and local, as well as remote, level indication in accordance with Chapter 6.
2. Chemical metering pumps in accordance with Chapter 6.
3. Residual chlorine analyzers in accordance with Chapter 8.
4. Sodium hypochlorite injection diffusers, piping, valves, electrical systems, and controls.
5. All equipment shall be constructed of materials compatible with sodium hypochlorite solution.
6. Provision for using temporary bulk sodium hypochlorite tote where onsite sodium hypochlorite generation facilities are proposed.

D. Capacity: The capacity of the chlorination system shall be based on maximum discharge rate for the pump station, or designed to increase the residual free chlorine of the total reservoir volume from 0.2 mg/L to 1.2 mg/L in a 24-hour period, whichever is greater.

E. Points of Injection: The system shall be designed for a capacity of sufficient magnitude to maintain a residual free chlorine at the end of the distribution network of 0.5 mg/L to 1.0 mg/L. Sodium hypochlorite solution injection points shall be provided at the reservoir inlet, as well as reservoir outlet with 'feed-forward' and 'trim back' configuration. Provide additional injection points at the pump station suction or discharge manifold.

F. Chemical Solution Piping: Chemical solution piping shall be uncoated, Schedule 80 polyvinyl chloride (PVC) pipe. All isolation valves shall be PVC diaphragm valves with either union or flanged ends; buried underground chemical piping non-metallic type.

G. Storage Tanks or Totes: Chemical storage tanks or totes shall be provided based on 30 days of consumption, which meet the requirements of Chapter 6, equipped with secondary containment and secondary containment sump.

H. Safety: Eyewash/shower units shall be provided as required by Chapter 6.
I. Chemical Metering Pump: Chemical metering pumps for sodium hypochlorite solution service shall be provided as required by Chapter 6.

J. Residual Chlorine Analyzers: Shall be provided to sample chlorine residual as appropriate for controlling chlorine residual and equipped with 4-20 mA analog output. Discharge drainage from analyzers to sanitary sewer or back into pipe.

11.28 Analog Instrument Provisions

A. Provisions for other analog instruments such as ORP analyzers and pH analyzers will be included per COS requirements.

B. Analog instruments shall meet the requirements of Chapter 8.

11.29 Electrical Systems

A. Electrical systems such as Motor Control Centers, lighting, wire, and conduit panels shall be designed in accordance with Chapter 7.

B. Service Entrance Access: Provide separate access at service entrance to provide access power meters in accordance with Chapter 8.

C. Site Lighting: Three levels of site lighting shall be provided as follows to maintain security in accordance with the COS Security Mater Plan:
   1. Dusk to dawn lighting.
   2. Motion detection for security.

D. Exposed raceways shall be rigid steel conduit, flexible liquid tight conduit in non-corrosive areas; exposed raceways shall be plastic-coated rigid steel conduit, flexible liquid tight conduit in corrosive areas; underground conduits shall be plastic conduit with plastic-coated steel conduits for all bend greater than 45 degrees and all risers shall be encased in a concrete reinforced duct bank.
   1. Boxes available for use are pull boxes, junction boxes, outlet boxes, and terminal boxes, and shall be of the same type material as that of the conduit system.
   2. The wire and cable used shall be 600 volt and single conductor, type XHHW 2. Nameplates shall be provided on each electrical panel, motor starter, and control device.
3. Underground, non-metallic, utility marking tape shall also be provided.

4. All conduit on aboveground tank exterior wall shall be located behind the tank roof access ladder or stairway for security.

5. Pull boxes shall be identified with COS marking.

E. Standby Power: Pump station power distribution systems shall be designed with redundant or standby power in accordance with Chapter 7 such that:

1. Disruptions in electrical service are limited to no more than 30 minutes where more than one MCC is associated with critical facilities.

2. Standby generators shall be designed to operate in the event utility power is lost as follows:
   a) Start with an automatic transfer switch to standby generator and back to utility power.
   b) Operate pump stations at firm pumping capacity for not less than 24 hours with the smallest pump out of service and without load shedding.
   c) Provide fuel storage for a minimum of 24 hours of operation
   d) Equipped with automatic exercise function and cool down feature that load tests the generator once per week or as recommended by the generator manufacturer.

11.30 Instrumentation and Control

A. The Engineer shall prepare a comprehensive controls strategy for the facility with the technical specifications for all SCADA, PLC, and associated instrumentation in accordance with Chapter 8.

B. Instrumentation shall meet the requirements of Chapter 8, which includes switches, level measurement, and pressure measurement.

C. Provide a single integrator or subconsultant to be responsible for all PLC programming, and SCADA per Chapter 8 requirements.

D. The Engineer shall also require that the integrator provide detailed description of each operation for every loop associated with the facility.

E. All SCADA and PLC programming will be provided with software licenses, as well as unrestricted access so that the COS can modify as needed.
F. Pump Controls, Alarms, and Monitoring: Instrumentation and switches for controls, monitoring, and alarms to SCADA shall be provided according to the requirements of Chapter 8. Provide the following for each pump:

1. START/STOP function from remote workstation.
2. AUTO or MANUAL operation from remote workstation, where pump speed can be adjusted manually in ‘MANUAL’ mode.
3. AUTO or HAND mode of operation indication at SCADA.
4. RUN or STOP status indication at SCADA.
5. Pump speed indication at SCADA.
6. HIGH TEMPERATURE alarm indication at SCADA.
7. HIGH DISCHARGE PRESSURE alarm indication at SCADA.
8. VFD FAULT alarm indication at SCADA.
9. ALARM reset command function from remote workstation.

G. Surge Tank Controls, Alarms, and Monitoring: Instrumentation and switches for controls, monitoring, and alarms to SCADA shall be provided in accordance with requirements of Chapter 8. Provide the following:

1. HIGH DISCHARGE PRESSURE indication.
2. LOCAL /OFF/AUTO selector switch for air compressor as follows:
   a) LOCAL enables control at the air compressor control panel with LOCAL mode displayed at SCADA.
   b) OFF shuts off compressor in all modes of operation with OFF mode displayed at SCADA.
   c) AUTO enables automatic control by PLC with AUTO displayed at SCADA.
   d) RUN status indicated at SCADA if air compressor is operating in any mode.
   e) FAILURE alarm status indication at SCADA if compressor fails to operate in any mode of operation.
3. Surge tank liquid level alarms as follows:
   a) HIGH LEVEL alarm indication
   b) LOW LEVEL alarm indication
KEY NOTES

1. 90° BEND
2. REDUCER
3. BUTTERFLY VALVE
4. RESTRAINED HARNESS CPLG
5. MAGNETIC FLOW METER W/ SUFFICIENT UPSTREAM & DOWNSTREAM PIPE LENGTHS
6. DISCHARGE HEADER
7. WYE
8. FLOW METER BYPASS

SEE FIGURE 11.2B
KEY NOTES

1. HORIZONTAL SPLIT CASE PUMP AND MOTOR
2. DISCHARGE HEADER
3. WYE
4. GATE VALVE
5. SEAL WATER
6. AIR RELEASE OR COMBINATION VALVE
7. FLEXIBLE COUPLING
8. CHECK VALVE
9. PIPE SUPPORT
10. DISMANTLING JOINT

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Water and Wastewater Guidelines

PUMP STATION
MECHANICAL PLAN
PUMP LAYOUT

SCALE
FIGURE 11.2B
REV. 0

DESIGNED JBR
DRAWN PAT
CHECKED
APPROVED
APPROVED
DATE APRIL 2011
KEY NOTES

1. SUCTION PIPE
2. DISCHARGE HEADER
3. WYE
4. GATE VALVE OR BUTTERFLY VALVE
5. FLOW METER BYPASS
6. SURGE TANK (REF FIGURE 11.1)

SEE FIGURE 11.2E
KEY NOTES
1. SUCTION PIPE
2. DISCHARGE HEADER
3. WYE
4. GATE VALVE OR BUTTERFLY VALVE
5. CHECK VALVE
6. RESTRAINED COUPLING
7. VERTICAL TURBINE PUMP, BASE & BARREL
8. PIPE SUPPORT
9. AIR RELEASE VALVE
10. PRESSURE RELIEF VALVE