APPENDIX 11A

Example Pump Station CSI Specifications

The following specification are examples only. They are presented in Construction Specifications Institute (CSI) MasterFormat (MF04). Revise, add, or delete these specifications based on project- specific needs:

These specifications have not been reviewed or approved for wide use. They are provided as informational only. The design engineer may use this, but it should be thoroughly checked.

- 26 24 19 Motor Control Centers
- 35 20 17 Valves, Gates and Appurtenances
- 43 21 01 Horizontal Split-Case Centrifugal Pumps
- 43 21 37 Submersible Wastewater Pump
- 43 21 38 Submersible Wastewater Pump Mounted in Dry Pit
- 43 21 39 Submersible Pumps Constant Speed
- 43 21 43 Submersible Sump Pump

SECTION 26 24 19

MOTOR CONTROL CENTERS

PART 1--GENERAL

1.01 DESCRIPTION

A. This section specifies freestanding, factory assembled 600 volt motor control centers (MCCs). MCCs specified herein shall be furnished by a single manufacturer.

B. Related Sections: The work of the following Sections is related to the work of this Section. Other Sections, not referenced below, may also be related to the proper performance of this work. It is the Contractor's responsibility to perform all the Work required by the Contract Documents.
1. Section 01 33 10, Submittals
2. Section 01 86 02, Seismic Anchorage and Bracing Requirements
3. Section 26 00 00, Electrical
4. Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables
5. Section 26 05 73, Overcurrent Protective Device Coordination Study
6. Section 26 08 01, Testing
7. Section 26 22 00, Low Voltage Transformers
8. Section 26 27 15, Miscellaneous Electrical Devices
9. Section 26 36 23, Automatic Transfer Switches

1.02 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ANSI/NEMA ICS 1	Industrial Control Systems: General Requirements
ANSI/NEMA ICS 18	Motor Control Centers
NFPA 79	Electrical Standards for Industrial Machinery
UL 845	Motor Control Centers

B. CODES AND STANDARDS: Motor Control Centers and all components shall be Underwriters Laboratory listed to UL 845 and shall conform to NEMA ICS-1 and ICS-18 standards.

1.03 SUBMITTALS

A. Procedures: Section 01 33 10, Submittals.

B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested

deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

C. Elementary connection and interconnection diagrams as required in paragraph 2.07 of this section, in accordance with NFPA 79 and/or NEMA ICS 18 Part 1 standards.

D. Time current curves for all protection devices.

E. List of starters and feeder tap compartments indicating the size and type of circuit protection.

F. Interrupting, withstand, and continuous current rating of:
   1. Bus bars
   2. Feeder tap units
   3. Starter units
   4. Main incoming units

G. Nameplate schedule

H. Arrangement and layout drawings of the motor control center enclosures depicting equipment and bus arrangement and dimensions including areas of permissible cable entries. A list of material and components shall accompany the layout drawings.

I. Front view elevation with starter and component schedule

J. Manufacturer's certification and calculations that the equipment complies with the seismic requirements of Sections 01 86 02, Seismic Anchorage and Bracing Requirements, and 26 00 00, Electrical, and this Section.

K. Information needed for the electrical system analyses reports specified in Section 26 05 73, Overcurrent Protective Device Coordination Study.

L. Results of factory tests as specified within this Section.

M. Results of field tests as specified within this Section.

N. Manufacturer's certification that the following items are capable of interrupting and/or withstanding the specified short circuit condition:
   1. Bus bar bracing
   2. Feeder tap units
   3. Starter units

O. Operation and maintenance information as specified in Section 01 73 00, Operations and Maintenance Information.

P. Dimensions and weights.

Q. Installation instructions.

R. Manufacturer's product data.

1.04 FACTORY TESTS

A. All system components shall be factory-wired and tested as a system prior to shipment. Testing shall verify system operation.

1.05 SPATIAL LAYOUT

A. The motor control center overall dimensions shall not exceed the available space allocated for installation indicated on the Drawings.

PART 2—PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Motor Control Centers shall be Allen Bradley Centerline, or Square D Model 6.

2.02 SERVICE

A. Motor control centers shall be rated 600 volts, 60 Hertz, 3 phase, 3 wire as specified and shall be suitable for operation at the specified voltages and short circuit capacities.

2.03 STRUCTURE AND CONSTRUCTION

A. STRUCTURE:
1. Motor control centers shall be made of No. 14 gage steel minimum and, unless otherwise shown, each section shall be 90 inches high by 20 inches wide by 20 inches deep. The individual unit compartments shall be a minimum of 12 inches high. There shall be 72 inches available for stacking starter units. Compartments shall have pan-type doors with a minimum of two quarter-turn hold-down latches; and neoprene gaskets.
2. A full height vertical wireway, 30 square inch minimum, shall be provided for each vertical motor control center section. The wireway shall contain full height removable doors. Horizontal wireways shall be provided top and bottom, extending the length of motor control centers.
3. Bottom channel sills shall be mounted front and rear of the vertical sections extending the full length of the motor control center lineup. A removable lifting angle shall be mounted on top and shall extend the width of the motor control center lineup.

B. CONSTRUCTION:
1. Motor control centers located indoors shall have NEMA 1, gasketed enclosures.
2. Starter units, size 4 and smaller, and feeder tap units less than 225 amperes shall be drawout plug-in construction with hardened, tin-plated copper free-floating stabs, steel spring backups. The door shall have interference tabs which prevent door closure if unit is improperly installed.
3. Units shall be latched in the position to assure proper bus contact. The unit disconnect device shall be interlocked to prevent removal or reinsertion of a unit when the disconnect is in the "ON" or "TRIPPED" positions.
4. Fusible switch or circuit breaker disconnect operators shall be capable of accommodating three padlocks for locking in the "OPEN" position.
5. Hardware for mounting future starter and feeder tap units shall be provided at compartments specified as "FUTURE."
6. The motor control center shall have a minimum overall short circuit withstand rating of 42,000 amps RMS symmetrical unless specifically noted otherwise with a higher rating on the Drawings. The overall withstand shall apply to the buses and down to the lowest rated component in the overall motor control center assembly.

C. SEISMIC BRACING: Motor control centers and related equipment shall conform to the seismic anchorage and bracing requirements of Section 01 86 02, Seismic Anchorage and Bracing Requirements.

2.05 FINISH AND COLOR

A. The finish and color shall be in accordance with Section 26 00 00, Electrical.

2.06 BUS

A. GENERAL: Bus shall be tin-plated copper with bolted connections between vertical and horizontal bus bars. Access for tightening these connections shall be from the front, without the need for tools on the rear of the connection. Insulated horizontal and vertical bus barriers shall be provided. Barriers shall be fabricated from high-strength, glass-filled polyester resin.

B. HORIZONTAL BUS: Horizontal bus minimum continuous amps rating shall be as shown on the Drawings.

C. VERTICAL BUS: Unless otherwise specified or shown, the vertical bus shall be insulated and rated a minimum 300 amperes continuous.

D. GROUND BUS: A 1/4-inch by 2-inch ground bus shall be provided the full length of the motor control center. Ground bus shall be located at the bottom of the motor control center. Provide a lug to terminate a bare 4/0 AWG copper ground conductors at each end of the ground bus.

2.07 WIRING

A. GENERAL:
1. Motor control centers shall be provided with NEMA ICS 18 Class II**,** Type B wiring. All starter units shall have terminal blocks for control wiring. Terminal blocks shall be provided for power wiring for starters size 2 and smaller.
2. Motor control centers shall be provided with all necessary interconnecting wiring and interlocking. When a MCC control section is specified on the drawings or schedules, wire directly to the relays or programmable controller's input/output modules as part of the interconnecting wiring.
3. Provide elementary and connection diagrams for each starter unit and an interconnection diagram for the entire motor control center.

B. POWER WIRE: Power wire shall be copper 90 degrees C insulated, sized to suit load; minimum power wire size shall be No. 12 AWG copper stranded.

C. CONTROL WIRE: Control wire shall be No. 16 AWG stranded copper wire, rated 90 degrees C machine tool wiring (MTW) and UL listed for panel wiring.

D. TERMINATIONS AND CABLE CONNECTIONS:
1. TERMINALS: Control wiring shall be lugged with ring-tongue or locking spade crimp type terminals made from electrolytic copper, tin-plated.
2. CABLE CONNECTORS: Cable connectors for use with stranded copper wire, sizes No. 8 AWG to 1000 kCmil shall be UL listed. Dished conical washers shall be used for each bolted connection. Connectors shall be reusable and shall be rated for use with copper conductors. Incoming line and outgoing feeder compartments shall be provided with crimp type lugs, 3M Company, Burndy Company, or equal.

E. CONDUCTOR MARKERS: Markers used for identification shall meet the requirements of Section 26 00 00, Electrical.

2.08 MAIN AND FEEDER BRANCH CIRCUIT PROTECTION

A. GENERAL: Main and feeder tap units shall consist of fused disconnect switches or circuit breakers, as specified or shown. Series ratings for overcurrent devices to meet specified short circuit withstand ratings is prohibited.

B. FUSED DISCONNECT SWITCHES:
   1. Fused disconnect switches shall be equipped with visible knife blades, shielded line terminals, and a quick-make, quick-break switch operator. Fuse clips shall be UL Class R rejection type. Type RK-1 dual-element fuses shall be used for both motor and nonmotor loads.
   2. Fuses shall be nonrenewable. Fuse removal shall be readily accomplished with the use of a fuse puller.
   3. Fused switches used to feed automatic transfer switches provided under Section 26 36 23, Automatic Transfer Switches, that are rated in conjunction with the transfer switches to meet a coordinated withstand rating shall have fuses that are identified by the transfer switch manufacturer that meet their requirements for the coordinated withstand rating.

C. CIRCUIT BREAKERS (THERMAL MAGNETIC):
   1. Thermal-magnetic circuit breakers shall be molded case equipped with toggle type handle, quick-make, quick-break over center switching mechanism that is trip-free so that breaker cannot be held closed against short circuits and abnormal currents. The tripped position shall be clearly indicated by breaker handle maintaining a position between "ON" and "OFF." All poles shall open, close, and trip simultaneously.
   2. Circuit breakers used to feed automatic transfer switches provided under Section 26 36 23, Automatic Transfer Switches, that are rated in conjunction with the transfer switches to meet a coordinated withstand rating shall be as identified by the transfer switch manufacturer to meet their requirements for the coordinated withstand rating.

D. CIRCUIT BREAKERS (MAGNETIC ONLY): Magnetic circuit breakers shall be molded-case equipped with toggle type handle, quick-make, quick-break over center switching mechanism that is trip-free so that breaker cannot be held closed against short circuits and abnormal currents. The tripped position shall be clearly indicated by breaker handle maintaining a position between "ON" and "OFF." All poles shall open, close, and trip simultaneously. Minimum short circuit capacity shall be 42,000 amperes symmetrical.

2.09 MOTOR STARTER UNITS

A. GENERAL: Motor starter units shall be combination type with contactor and fused disconnect switch, thermal magnetic circuit breaker, or motor circuit protector, and bimetallic type overload unit as indicated on the drawings or specified in the MCC schedule.

B. FUSED DISCONNECT SWITCHES: Not used.

C. MOTOR CIRCUIT PROTECTORS: The molded case motor circuit protector (MCP) shall operate on the magnetic principle with a current sensing coil in each of the three poles to provide an instantaneous trip for short circuit protection. The trip setting shall be adjustable from 700 to 1300 percent of the motor full load amperes from the front of the MCP. The motor circuit protector shall be set at its lowest position at the factory.

D. CONTROL TRANSFORMERS:
   1. Each control transformer shall be rated 480/240-120V, single phase, 2-wires, 60 Hertz. The transformer shall be sized for the load it feeds but shall not be less than the minimum ratings as follows unless noted otherwise on the Drawings:

NEMA starter size	Minimum transformer volt-ampere rating
1	100
2	150
3	200
4	300

2. Each control transformer shall be provided with time-delay, slow-blow secondary fuse rated to interrupt 10,000 amperes short circuit at 250 volts AC. Two primary fuses rated to interrupt 200,000 amperes at 600 volts shall be provided on all starters.
3. Fuse holder for secondary fuse shall be drawout indicating type and mounted on the door of the compartment. Fuse holders for primary fuses shall be fuse clips with full barriers between fuses.

E. CONTACTORS:
1. Unless otherwise specified or shown, contactors shall be full voltage, 3-pole, 600 volt AC, NEMA Size-1 minimum. Contacts shall be double break, silver-cadmium oxide, and weld resistant. Contacts shall be isolated to prevent arcing. Coils and magnets shall be capable of being removed or replaced without special tools. IEC contactors are prohibited.
2. Reversing, multispeed, and reduced voltage starters shall have additional contactors, overload relays, and auxiliary relays as required, and shall have mechanically interlocked contactor coils to prevent simultaneous engagement.

F. TRANSIENT VOLTAGE SURGE SUPPRESSOR:
1. Provide metal oxide varistor (MOV) surge protective device (SPD) integral within each motor control center that indicates the status and condition of the SPD, tested per NEMA LS-1, rated IEEE C3 Combined Wave of 20kV and 10kA with 200kAIC internal fusing and listed / labeled per UL 1449. Minimun surge rating: 160kA per phase. SPD's shall include overcurrent protection via a fused switch or circuit breaker integral to the MCC.
2. Provide a factory selected transient surge suppressor rated for each motor starter and power contactor encapsulated in a small module and mounted directly to the starter or contactor coil.

G. AUXILIARY CONTACTS: Contactors shall be equipped with auxiliary contacts, rated 10 amperes at 120 volts AC. Unless otherwise specified on the drawings, each contactor shall be equipped with two normally open and two normally closed electrically isolated auxiliary contacts. Auxiliary contacts shall be wired out to terminal blocks. Refer to drawings for actual quantities required.

H. OVERLOAD RELAY: All motor starters shall include bimetallic thermal overload relays with local manual overload reset . Overload relays shall monitor all three phases individually for current .

I. TERMINAL BLOCKS:
1. Terminal blocks shall be screw type rated 600 volts; 20 amperes for control wiring and 30 amperes power wiring with starters Size 3 and larger shall terminate the power leads directly to the contactor.
2. The number of terminal blocks shall be specified on the drawings. Terminal blocks shall be provided with integral marking strips and shall be permanently marked with the conductor number as specified on the drawings. Internal wiring shall be connected on one side of the terminal block; outgoing conductors shall be connected to the other side.

J. REDUCED VOLTAGE SOLID STATE STARTERS:
1. Reduced voltage starters (RVSS) shall be solid state, rated for a minium of 400 percent of motor full load current for 20 seconds and shall include an automatic bypass contactor that bypasses the solid state circuitry upon reaching full voltage.
2. The RVSS shall have programmable starting and stopping including soft start voltage ramp up, current limit start, soft start with start boost, and coast stop and soft stop. Pump control

for reduced surge on starting and stopping for centrifugal pump applications shall be provided.

3. RVSS shall include a door mounted graphical user interface with keyboard programming capability, monitoring and diagnostics.
4. The operator interface station shall allow programming of the operating features of the starter, monitor operating functions, and provide diagnostic information for the specified malfunctions plus any internal diagnostics.
5. The operator interface shall include indication of the following monitored features:
   a. Motor current in amperes
   b. Motor kilowatts
   c. Motor power factor
   d. Motor run time.
6. Provide thermal monitoring for the controller for protection from controller overheating.
7. Include an isolated output contact for remote monitoring of a common alarm condition and for run status. Include front of starter panel indication for these status points via the operator interface panel.
8. Where indicated on the contract drawings, include provision for an emergency stop input that causes immediate shutdown of the starter and motor.
9. Provide a fault reset function either as a discrete pushbutton on the panel door or as a function in the graphical operator interface station panel included with the starter.

2.10 MISCELLANEOUS

A. GENERAL:
   1. Control devices such as pushbuttons, selector switches, indicating lights and overload reset pushbuttons shall be mounted on the unit compartment door.
   2. The control devices shall comply with the requirements of Section 26 27 15, Miscellaneous Electrical Devices.

B. ELAPSED TIME INDICATOR: Where specified, the elapsed time indicator shall be as specified in Section 26 27 15, Miscellaneous Electrical Devices. The indicator shall be mounted on the unit compartment door.

C. NAMEPLATES: Nameplates shall be provided in accordance with the requirements of Section 26 00 00, Electrical. Nameplates shall be provided for all cubicles and compartments and identify the load per NEC. A Nameplate shall be provided identifying the motor control center. Provide equipment tag numbers and descriptions as shown.

2.11 DRY-TYPE TRANSFORMERS

A. Dry-type power transformers shall meet the requirements of Section 26 22 00, Low Voltage Transformers. The size and voltage shall be as specified.

2.12 POWER MONITORS

A. Provide power monitors where shown on the Drawings.

B. Power monitors shall monitor line to line voltage and line current per phase and watts, vars, volt-amperes, displacement power factor, and frequency and shall include an analog output for a 4-20 ma dc power signal and a normally open contact output that closes upon loss of monitored voltage on the bus.

C. Power monitors shall be furnished with required CT’s and PT’s and shall be Electro Industries DMMS 300+ or equal.

2.13 SPARE PARTS

A. One set consisting of the following spare parts shall be provided:
1--set each fuse size and type
10--indicating light bulbs

PART 3--EXECUTION

3.01 GENERAL

A. The motor control centers shall be erected in accordance with the recommendations of the manufacturer and with the details specified herein.

B. Field wiring shall meet the requirements of paragraph 3.02 of Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables. Cables larger than No. 6 AWG which hang from their vertical connections shall be supported within 2 feet of the connection.

C. The overload relays, shall be coordinated by the Contractor with the heater elements selected based on the actual full load amperes of the motor connected to the starter and the requirements of the motor driven equipment.

D. The motor circuit protectors shall be adjusted by the Contractor to the lowest setting not causing false tripping.

E. Install motor control centers level and plumb on 3-1/2-inch concrete housekeeping pads per the manufacturer's installation instruction.

F. Seismic anchorage shall be per Section 01 86 02, Seismic Anchorage and Bracing Requirements.

G. Program and configure the soft starters for pump soft start and stop operation to minimize hydraulic surge.

3.02 FIELD TESTS

A. Motor control centers shall be tested in accordance with Section 26 08 01, Testing.

3.03 MANUFACTURER'S SERVICES

A. Provide a factory-trained representative at the site for the specified quantity and duration of the following activities. Specified durations do not include travel time to or from the project site.
1. Training Sessions:
a. Procedures: Section 01 66 00, Testing, Training, and Commissioning.
b. Provide a minimum of 2 hours of classroom training on the motor control center installation. Certify completion of training on Form 11000-B, Section 00 60 00, Sample Forms.
2. Start up and Testing Assistance:
a. Provide a minimum of 4 hours of on site support for start up and testing. Complete form 11000-A, Section 00 60 00, Sample Forms.

3.04 COORDINATION WITH SHORT CIRCUIT AND ARC FLASH REQUIREMENTS

A. Provide information required to support the short circuit and coordination and arc flash study specified in Section 26 05 73, Overcurrent Protective Device Coordination Study.

END OF SECTION

Summary Sheet

SECTION NAME: VALVES, GATES and APPUTENANCES

SECTION NUMBER: 35 20 17

PREPARED BY: SPU to Provide Primary Contact Person

REVIEWED BY: SPU to Provide Primary Reviewer Contact Info

DATE ISSUED: SPU to Insert Final Issue Date

DESCRIPTION: Valves, Gates, and Appurtenances related to applications for typical municipal water and wastewater pump station service

REVISION #	DATE	PARAGRAPH(S) Revised
1		

These specifications are draft only. They are currently in review.

WARNING: The standards and guidelines being provided do not relieve the licensed engineers from their responsibilities as outlined by the code of ethics and rules of practice. All specifications require editing and review by the project's licensed engineer and must be tailored to the conditions and needs of the project. The guidelines provide policy, clarity, and advice on how design should be conducted by and for Seattle Public Utilities. However, it remains the responsibility of the licensed engineer to properly interpret and apply the guidelines as appropriate to meet the needs of the project. If these standards and guidelines contain any contradictions with other standard engineering practices, the licensed engineer is responsible for identifying and resolving them.

VALVES, GATES AND APPURTENANCES

SECTION 35 20 17

PART 1 GENERAL

1.01 Work Included

A. Furnish all labor, materials, equipment and incidentals required to install and test, complete and ready for operation, all valves as shown on the Contract Drawings and as specified herein.

NOTE: Coordinate with Drawings and Valve/Equipment list. Valve/Equipment list should be thoroughly checked by all designers on the project. Watch the use of certain valves with solids bearing fluids (e.g. wastewater) as some are not designed for such applications.

B. The equipment shall include, but not be limited to, the following. All items specified herein may not be included in this project.

1. Valve Actuators General
2. Valve Actuators Electrically Powered
3. Butterfly Valves for Fluid Service (Me
4. tal Body)
5. Gate Valves
6. Resilient Seated Gate Valves
7. Plug Valves
8. Globe Valves
9. Ball Valves
10. Check Valves
11. Pressure Regulating Valves
12. Solenoid Valves
13. Air Release Valves

14. Combination Air and Air/Vacuum Valves

NOTE: The following Paragraph should be used only to reference other Sections or Divisions that have a major impact on the design or bidding requirements of this Section. Include items that are furnished by others or the Owner for installation under this Section; items that are installed under other Sections or by others but furnished herein; and items that could possibly effect the way a bid is prepared if responsibility is not clear. This is an IMPORTANT Paragraph in Multiple Prime Contracts.

1.02 Related Contract Documents

A. Mechanical wall seals are included in Section XX.

B. Piping and disinfection for potable water systems is included in the respective Sections of Divisions XX and YY respectively.

NOTE: Coordinate with all designers on the Project. Other designers may specify certain items in their separate Sections or require language herein.

C. Valves on all HVAC systems, plumbing and/or chemical systems, not noted herein are included in their respective Sections of Division XX.

D. Pipeline appurtenances are specified in Section XX, including the following:

1. Unions
2. Flanged Joints
3. Dielectric Connectors
4. Plugs and Caps
5. Miscellaneous Adaptors
6. Vents and Drains
7. Shock Absorbers
8. Line Strainers
9. Service Clamps
10. Cleanouts
11. Floor Drains

12. Quick Connect Couplings
13. Mechanical Sleeve Seals
14. Flexible Connectors
15. Expansion Joints
16. Harnessing and Restraints
17. Pressure Gauges
18. Diaphragm Seals
19. Thermometers
20. Rotameters, Flow Indicators and Flow Meters
21. Static Mixers
22. Pipe Cleaning Equipment
23. Spray Nozzles
24. Batch Meters
25. Chemical Diffusers
26. Diffuser Sockets
27. Eductor for Dry Chemical Handling

E. Pipe hangers and supports are included in Section XX.

F. Instrumentation and Electrical, not specified herein, are included in Divisions XX and YY respectively.

G. Valve tags are included in Section XX.

H. Field painting is included in Section XX.

I. Sluice and Slide and Butterfly Gates are included in Division XX

J. Certain items similar to those specified in this Section may be specified to be furnished and installed with other individual equipment or systems specified in other Sections. In case of a conflict, those individual equipment or system requirements shall govern.

NOTE: Coordinate the following with Electrical and Instrumentation. It is typically best if all information is carried in this specification.

K. Electric valve operators of all types, rate of flow controllers (including modulating valves and operators) and other types of valves which are part of the automated instrumentation (such as some solenoid valves) if not included herein, are included in Division XX. However, all valve operators shall be mounted at the factory on the valves as specified herein, as part of the Work of this Section.

NOTE: All buried valves can be included here. This is typically done when all Work under the Contract is included in the General Contract.

L. Buried valves and appurtenances not specified herein are included in Division XX.

1.03 Reference Standards

A. American Society for Testing and Materials (ASTM)

1. ASTM A48 Standard Specification for Gray Iron Castings.
2. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
3. ASTM A159 Standard Specification for Automotive Gray Iron Castings.
4. ASTM A240 Standard Specification for Heat Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
5. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes.
6. ASTM A436 Standard Specification for Austenitic Gray Iron Castings.
7. ASTM A536 Standard Specification for Ductile Iron Castings.
8. ASTM B30 Standard Specification for Copper Base Alloys in Ingot Form.
9. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings

B. American Water Works Association (AWWA)

1. AWWA C111 Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
2. AWWA C500 Metal-Seated Gate Valves Supply Service

3. AWWA C504 Rubber Seated Butterfly Valves

4. AWWA C507 Ball Valves, 6 in Through 48 in (150mm Through 1200mm)

5. AWWA C508 Swing Check Valves for Waterworks Service, 2 in (50mm) Through 24 in (600mm) NPS

6. AWWA C509 Resilient Seated Gate Valves for Water Supply Service

7. AWWA C540 Power Actuating Devices for Valves and Sluice Gates

8. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

9. AWWA C800 Underground Service Line Valves and Fittings

C. American National Standards Institute (ANSI)

1. ANSI B2.1 – Specifications for Welding Procedures and Performance Qualifications

2. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125 and 250

3. ANSI B16.10 Face to Face and End to End Dimensions of Valves

4. ANSI B16.104 Butterfly Valves

D. American Iron and Steel Institute (AISI)

E. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS SP 61 Pressure Testing of Steel Valves.

2. MSS SP 67 Butterfly Valves.

3. MSS SP 70 Cast Iron Gate Valves, Flanged and Threaded Ends.

4. MSS SP 71 Gray Iron Swing Check Valves, Flanged and Threaded Ends.

5. MSS SP 72 Ball Valves with Flanged or Butt Welding Ends for General Service.

6. MSS SP 78 Cast Iron Plug Valves, Flanged and Threaded Ends

7. MSS SP 80 Bronze Gate, Globe, Angle and Check Valves.

8. MSS SP 82 Valve Pressure Testing Methods

9. MSS SP 98 Protective Coatings for the Interior of Valves, Hydrants and Fittings.

F. National Electrical Manufacturers Association (NEMA)

G. Underwriters Laboratories (UL)

H. Factory Mutual (FM)

I. National Sanitary Foundation (NSF)

J. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 Design Requirements

A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of wastewater, sludges, air, chemicals, and raw, filtered or finished water as noted on the Contract Drawings.

B. Valves, appurtenances and miscellaneous items shall be installed as shown on the Contract Drawings and as specified, so as to form complete workable systems.

NOTE: Coordinate with Electrical and Contract Drawings. Where "fail open" or "fail closed" is critical, provide notes on the Contract Drawings or details.

C. Unless otherwise noted all powered valve operators shall conform to the following:

1. Valves larger than 3 in: electric operators shall be suitable for use with 460 Volt, 3 Phase, 60 Hz electric service.

2. Solenoid valves: [XX] volt, single phase, 60 Hz, NEMA 4 enclosure, continuous duty Class F coils and manual operator.

D. Reference is made to Division XX for additional requirements, including nameplates, provisions for temporary pressure gauges, protection against electrolysis and anchor bolts.

NOTE: Coordinate with equipment tagging section.

E. Valves and appurtenances shall have the name of the manufacturer, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or indelibly marked upon some appropriate part of the body.

NOTE: Verify pressure requirements with system pressures for each process pipe. Consider especially that valves on pump discharges may be subject to the pump shut-off head under certain failure conditions. Suggest including more stringent pressure requirements, where applicable, in the individual valve Articles contained in Part II of this specification.

F. Unless otherwise noted, equipment shall have a minimum working pressure of 150 psi or be of the same working pressure as the pipe they connect to, whichever is higher and shall be suitable for the pressures noted at the locations where they are installed.

G. Joints, size and material:

1. Except where noted, all joints referred to herein shall be of the same type, nominal diameter, material and with a minimum pressure rating equal to the pipe or fittings they are connected to.

2. Unless otherwise noted, valves and appurtenances shall be of the same nominal diameter as the pipe or fittings they are connected to.

3. All valves exposed to view, or in vaults:

a. 3 in and smaller threaded ends

b. 4 in and larger flanged ends.

H. Provide all special adaptors as required to ensure compatibility between valves, appurtenances and adjacent pipe.

I. Valves and actuators located outdoors; within maximum 2 ft above liquid; in vaults; or where otherwise noted shall be especially designed for submerged service where water may completely submerge the valve and operator. All other units shall be weather tight at a minimum.

1.05 Submittals

A. Submit to the Engineer, in accordance with Section XX, materials required to establish compliance with this Section. Submittals shall include the following, at a minimum:

1. Certified drawings showing all important details of construction and dimensions.

2. Descriptive literature, bulletins and/or catalogs of the equipment.

3. The total weight of each individual item and assembled units (i.e. valves + actuators).

4. A complete bill of materials.

5. Additional submittal data, where noted with individual pieces of equipment.

6. Certification that all materials intended to be in contact with potable water shall be NSF 60/61 certified for potable water service.

7. Equipment anchorage calculations, demonstrating the ability to properly anchor equipment of the type and size specified herein, and demonstrating conformance to applicable seismic codes shall be submitted. Calculations shall be prepared and stamped by a licensed Professional Engineer in the state of Washington.

8. Spare parts information as specified herein.

B. Test Reports

1. Provide certified hydrostatic test data in accordance with MSS SP 61 for all valves.

C. Certificates

1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required tests and certification of proper installation.

D. Manufacturer's Installation and Application Data

E. Operating and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section XX. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

F. Warranties

1. A copy of all required warranties, both from the manufacturer and the Contractor, shall be submitted.

1.06 Quality Assurance

A. Qualifications

1. Valves and appurtenances shall be products of well established firms, with a minimum of 10 years of experience, that are reputable and qualified in the manufacture of the particular equipment to be furnished.

2. All units of the same type shall be the product of a single manufacturer.

B. Provide the services of a qualified and factory trained service representative of the manufacturer to provide operational and maintenance instruction, for a 1 day, 8 hour period for each of the following:

1. Valve motor operators.

2. Pressure regulating valves.

3. Valves with air release functions.

C. Inspection of the units may also be made by the Engineer or other representative of the Owner after delivery. The equipment shall be subject to rejection at any time due to failure to meet any of the specified requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be immediately removed from the job site.

1.07 Delivery, Storage and Handling

A. Delivery, storage and handling shall conform to the requirements of Section XX.

B. Packing and Shipping

1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. All valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired to the satisfaction of the Engineer.

2. Prior to shipping, the ends of all valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.

a. All valves 3 in and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.

b. Valves smaller than 3 in shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.

c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.

d. Any corrosion in evidence at the time of acceptance by the Owner shall be removed, or the valve shall be removed and replaced.

C. Storage and Protection

1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer's information for further requirements.

NOTE: Consider requiring additional sets of spare parts if a large number of valves of a single type and size are included on a given project. Consider deleting/modifying Article 1.08.D if many different sizes of the same valve type are included on a given project.

1.08 Spare Parts

A. Special tools and manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment in accordance with Section XX and where noted on the Contract Drawings or specified herein.

B. Provide all special tools required for normal maintenance. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate the equipment for which the tools are intended.

C. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than 1 year after start up and final acceptance.

D. One set of all special tools and spare parts described above shall be furnished for each type and size of valve furnished.

1.09 Seismic Requirements (NOT USED)

1.10 Warranty

A. Unless otherwise specified herein, valves shall be furnished with a minimum one year manufacturer's warranty. The warranty period shall commence upon final acceptance of Work by the Owner in accordance with Section XX.

1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer's information for further requirements.

PART 2 PRODUCTS

2.01 Valve Actuators - General

A. The valve manufacturer shall supply and integrally, rigidly mount all actuators, including any type of manual or powered actuators, on valves at the factory. The valves and their individual actuators shall be shipped as a unit.

B. Unless otherwise noted, valves shall be manually actuated.

1. Non-buried valves shall have an operating wheel, handle or lever mounted on the operator

2. Buried valves and those with operating nuts shall have a non rising stem with an AWWA 2 in nut. At least two tee handles shall be provided for all operating nuts.

C. Except as otherwise shown on the Contract Drawings or specified herein, all valves 3 in diameter or larger, with the valve center line located 7 ft or more above the operating floor, shall be provided with chain wheel operators complete with chain guides and hot dipped galvanized steel chain, made to loop within 4 ft of the operating floor.

D. All actuators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.

E. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.

F. Floor boxes for operating nuts recessed in concrete shall be standard cast iron type, cast in place, with fastening top by Clow or equal.

G. Stem guides shall be of the adjustable wall bracket type, bronze bushed, with maximum spacing of 10 ft as manufactured by Clow; Rodney Hunt or equal. Extended operating nuts and/or stems shall have universal joints and pin

couplings, if longer than 10 ft and a rating of at least five times the maximum operating torque. Stem adaptors shall be provided.

H. Where required by the installation, or as specified, provide the following: extended stem; floor stand and handwheel; position indicator and etched or cast arrow to show direction of rotation to open the valve; resilient, moisture-resistant seal around stem penetration of slab.

I. Gear Actuators

1. Unless otherwise noted, gear actuators shall be provided for the following: all valves larger than 8 in nominal diameter; all buried valves with operating shaft mounted horizontally (butterfly, etc); where specified and/or indicated on the Contract Drawings; where manual operator effort is greater than 80 ft lbs rim pull.

2. Gear actuators shall be of the worm or helical gear type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on the output shaft. Unless noted they shall conform to AWWA C504, but except with butterfly valves, need not be certified.

3. Actuators shall be capable of being removed from the valve without dismantling the valve or removing the valve from the line.

4. Gearing shall be machine cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take all thrusts and seals and to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow the reduction mechanisms to operate in lubricant and be of the same material as the valve body.

5. Manual operator input effort to the handwheel shall be a maximum of 40 ft lbs for operating the valve from full open to full close, under all conditions. Gear actuators shall indicate valve position and have adjustable stops. Maximum handwheel size shall be 24 in diameter.

J. All position indication and direction of opening arrows shall be embossed, stamped, engraved, etched or raised decals.

K. Unless otherwise noted, all valves larger than 3 in nominal diameter shall be provided with position indicators at the point of operation.

2.02 Valve Actuators – Electrically Powered

NOTE: Motorized actuators should be located in a vault if buried.

NOTE: Make sure to specify if explosion-proof equipment is required (this is a function of the area classification where the valve and actuator is to be located).

A. Electrical actuators furnished as part of this Section shall comply with AWWA C540.

B. Unless otherwise noted all electric actuators shall utilize worm gear or helical gearing for all size valves.

NOTE: Verify all the requirements in the following article are desired and add additional requirements for each project as required.

C. The motorized actuator shall comprise motor, reduction gearing, detachable drive bushing, thrust bearing and emergency hand wheel local position indicator, together with torque and position limit switches, thermostatically controlled space heater, terminals and integral controls. The actuator shall be a self contained, totally enclosed unit with position lights, push buttons and position and status contacts.

D. Electric actuators shall be as manufactured by Limitorque or approved equal. Any modifications required to the control and/or wiring indicated in these Contract Documents, in order to utilize other equipment, shall be the Contractor's responsibility and be incorporated at no additional cost to the Owner.

E. Failure of motor drive or gearing should not prevent manual operation. Handwheel shall not operate when motor operates. Motor shall be unable to operate when handwheel is operating.

F. Continuous mechanical dial indication of valve end positions shall be incorporated.

G. Open and close torque and/or position limit switches to suit the valve type shall be provided for travel control, with means to prevent unwanted tripping on torque during initial unseating.

NOTE: Edit as required for area classifications and desired instrumentation. Coordinate with electrical designers as well.

H. Where required on the Contract Drawings, furnish position indicating switches on valves. Switches shall be single pole, double throw, at either limit of open or close or both limits as shown. Switches shall be enclosed in a NEMA 4 enclosure and contacts shall be rated 10 Amps at 120 VAC.

2.03 Butterfly Valves for Fluid Service (Metal Body)

NOTE: These valves should only be used for clean or screened water applications.

NOTE: AWWA C504 covers 3 in through 72 in up to 150 psi. Consult with manufacturers for larger valve sizes and higher pressures

A. Butterfly valves and operators up to 72 in diameter shall conform to AWWA C504, Class B, except as specified herein. The manufacturer shall submit an affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504 and specifically listing all exceptions. Valves shall have a minimum 150 psi pressure rating and be manufactured by Dezurik; Henry Pratt; Keystone or approved equal.

B. Butterfly valves for above grade service shall be flanged end with face to face dimensions in accordance with Table 2 of AWWA C504 for short-body valve. All valves for dead end, shut off service shall be flanged type.

C. Valve seats shall be full resilient seats retained in the body or on the disc edge in accordance with AWWA C504. Valve discs shall be constructed of cast iron, ASTM A48, Class 40.

NOTE: Stainless steel grades in the following paragraphs are to be selected by the designer. If corrosion is a concern, select only Type 316 stainless steel; otherwise Type 304 stainless steel should be used as it is a lower cost item.

1. For valves 24 in in diameter and larger, when the resilient seats are attached to the body, discs shall have Type [304] [316] stainless steel seating edges. When the resilient seat is attached to the disc, it shall be fastened with a one piece Type [304] [316] stainless steel retaining ring, Type [304] [316] stainless steel Nylock set screws and a mating Type [304] [316] stainless steel ring shall be installed in the valve body.

2. Resilient seats shall be Hycar or equal. Seats shall be fully adjustable and replaceable with the valves in place for all valves 24 in in diameter and larger.

D. The valve body shall be constructed of close grain cast iron per ASTM A126, Class B with integrally cast hubs for shaft bearing housings of the through boss-type. Permanently self-lubricating body bushings shall be provided and shall be sized to withstand bearing loads. Stuffing box of liberal dimensions shall be provided at the operator end of the vane shaft.

1. Packing shall be of the self compensating V type. A sealing element utilizing O-rings shall also be acceptable for up to and including 24 in valves. Over 24 in, pull down seals using a square braid of graphite fiber is an acceptable alternate.

2. Packing shall be held in place by a bolted corrosion resistant retainer plate or gland; retainer clips are not acceptable. For 30 in or larger, use a stuffing box with a follower gland.

3. Replacement of seals, for all size butterfly valves, shall not require removal of the valve from the line. In addition adjustment or replacement of seals on valves of 30 in or larger shall not require disturbing any part of the valve or operator assembly, except any packing follower gland.

E. The valve shaft shall be of Type [304] [316] stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque. No reductions of shaft diameter will be allowed except at the operator connection. Any reduction shall have a full radius fillet.

F. In general, the butterfly valve actuator shall conform to the requirements of AWWA C504, insofar as applicable and as specified herein.

G. Gearing for the actuators where required shall be totally enclosed in a gear case in accordance with AWWA C504.

H. Manual actuators shall conform to AWWA C504. Actuators shall have permanent indicators with raised or engraved marks to show position of the valve disc.

NOTE: Requirements for small diameter gate valves should be dictated by the surrounding process piping and materials. Designer to delete materials, end connections, etc. information that is not required or each project or leave the paragraph intact for generic use.

2.04 Gate Valves (2 1/2 In and Smaller)

A. Gate valves 2-1/2-in diameter and smaller shall have flanged, screwed, or solder ends as required and shall be brass, or bronze, or Type 304 stainless steel solid wedge, union bonnet, rising-stem gate valves such as Figures 47 and 48 as manufactured by Jenkins Brothers or similar products as manufactured by Crane; Fairbanks; Kennedy Valve Manufacturing Co.; Lukenhiemer or approved equal.

B. All water valves 2 1/2 in and less, unless noted otherwise, shall be brass body gates and shall be Jenkins No. 1240, or Hammond 1B 647.

2.05 Gate Valves (3 In and Larger)

A. General Requirements

1. Unless otherwise specified below, these requirements shall apply to all gate valves.

2. Gate valves shall meet the requirements of AWWA C500 and AWWA C509 as applicable to the type of valve specified.

3. Buried and submerged valves shall be furnished with mechanical joints and stainless steel hardware; non rising stem design.

NOTE: Revise flange rating if service pressures require Class 300 flanges.

4. Exposed valves shall be furnished with Class 125 flanged ends; provide valves with outside screw and yoke.

5. All metal valves shall be manufactured of ASTM A126 Cast Iron, Class B, with bronze mounting design.

6. Rising stem valves shall be sealed with adjustable and replaceable packing; valve design must permit packing replacement under operating system pressures with only moderate leakage.

7. Non rising stem valves shall use a double O ring stem seal, except that packing shall be used where geared operators are required.

8. Except as otherwise specified, valves shall be rated for the following working water pressures:

Valve Size	Pressure (psig)
3 in to 12 in	200
14 in to 20 in	150
24 in and greater	50

   a. All valve bodies shall be hydrostatically tested to at least twice the rated working water pressure. In addition, valves shall be bi-directionally seat tested, at the rated working pressure, with seat leakage not to exceed one fluid ounce per inch of valve diameter per hour. Provide certificates of testing.

9. Flanged valves to have face to face dimensions per ANSI B16.10 and flanges per ANSI B16.1.

10. Exposed valves 16 in and larger shall be equipped with a valve by pass.

11. All bonnet and packing gland bolts shall be zinc or cadmium electroplated steel; packing gland bolts shall have bronze nuts.

12. Exposed valves 16 in and greater indicated for horizontal stem installation shall be furnished with rollers, tracks and scrapers and enclosed bevel gear grease case.

13. Provide geared operator and chainwheel, chain and chain guides for valves with handwheel centerline more than 7 ft above operating level.

14. All valves shall be marked per AWWA Standards, including name of manufacturer, valve size and working pressure and year of manufacture.

15. Unless otherwise indicated, valves 12 in and smaller shall be capable of installation in the vertical or horizontal position, and sealing in both directions at the rated pressure.

16. Valve operation shall be counterclockwise for potable water; clockwise for wastewater and other non potable waters. Provide permanent label showing "OPEN" and arrows.

17. Metal seated valves shall be coated internally and externally with an asphaltic varnish, per AWWA C500. Resilient seated valves shall be coated, interior and exterior, with fusion bonded epoxy per AWWA C550.

B. Valve Applications

1. Valves for Potable Water Service.

   a. Double disc design manufactured by American Darling Valve; Kennedy Valve; M&H Valve Company or approved equal.

2. Valves for Wastewater Service

   a. Resilient seated design manufactured by American Darling Valve; Kennedy Valve; M&H Valve; Clow Corp or approved equal.

3. At the Contractor's option and unless otherwise indicated, any of the listed valve styles may be used, at no additional cost to the Owner.

C. Valve Requirements

1. Double Disc

   a. Conform to AWWA C500.

   b. Wedging surfaces shall be bronze, monel or stainless steel.

2. Resilient Seated

a. Conform to AWWA C509. Also UL and FM approved.

b. Internal and external epoxy coating of valve body, including bonnet, per AWWA C550.

c. Gate shall be encapsulated with synthetic rubber. It shall be bonded and vulcanized in accordance with ASTM D429 Method B.

d. No recesses in valve body.

D. Buried Valves

1. Conform to the requirements above, except mechanical joint bell ends per AWWA C111.

a. All exposed valve hardware (nuts, bolts, washers, etc) including bonnet, bonnet cover, stuffing box, gear adapter and joints shall be Type 304 stainless steel.

2. Non rising stem design, double O ring seals for non geared valves and shall incorporate packing for geared valves.

3. Provide valve box, 2 in operating nut and extension stem and stem cover.

2.06 Plug Valves

A. Plug valves shall be of the offset disc type, 1/4 turn, non-lubricated, serviceable (able to be repacked) under full line pressure and capable of sealing in both directions at the rated pressure. The disc shall be completely out of the flow path when open. Plug valves specified herein shall be as manufactured by DeZurik; Keystone or approved equal. All manufacturers named or otherwise, must comply completely with this Section.

1. For clean water applications, all plug valves shall have a minimum port area of 80 percent.

2. For all other applications, including but not limited to wastewater, Stormwater and CSO, all plug valves shall have port area of 100 percent.

3. All plug valves shall be capable of passing "pigging" cleaning equipment (using a Girard or similar cleaning pig of full nominal pipeline diameter) in either direction and manufacturer shall so certify that this may be done without the use of special equipment.

B. All plug valves shall be rated for a working pressure of 150 psig minimum, unless otherwise noted in the Contract Documents.

C. All plug valves under this Paragraph shall be performance, leakage and hydrostatically tested in accordance with AWWA C504, except as modified herein.

NOTE: Some manufacturers, including Keystone, do not normally provide 100 percent pressure rating in both directions. If bi-directional shutoff is necessary, replace the clause "to the seating face" with the clause "in either direction."

D. At the above rated minimum working pressures, the valves shall be certified by the manufacturer as permitting zero leakage for a period of at least 1/2 hour with pressure applied to the seating face.

E. Valve bodies shall be of cast iron, 30,000 psi tensile strength, ASTM A126, Grade B and of the top entry, bolted bonnet design, cast with integral flanges conforming to the connecting piping. All exposed bolts, nuts and washers shall be zinc or cadmium-plated, except for buried or submerged valves, which shall have Type 316 stainless steel hardware.

F. Valve disc shall be cast iron ASTM A126, Grade B, removable without removing the valve from the process line and shall have an integral upper and lower shaft which shall have seals on the upper and lower journals to prevent entrance of solids into the journals. Valve discs shall be a maximum of two piece assemblies.

G. Shaft bearings shall be permanently lubricated, rigidly backed TFE, stainless steel or bronze at both upper and lower stem journals. The operator shaft shall have easily replaceable seals, which shall be externally adjustable and repackable without removing the bonnet from the valve, or shall have self adjusting packing.

H. The valve seating surface shall provide full 360 degree seating by contact of a resilient seating material on the disc mating with welded-in high nickel content overlay seating surface in the body.

1. The seating design shall be resilient and of the continuous interface type having consistent opening and closing torques and shall be non-jamming in the closed position. Screw-in seats shall not be acceptable.

2. Discs shall have a full resilient facing of neoprene or Buna-N.

I. The mounting of the actuator to the valve shall provide an air gap between the two. The actuator shall clearly indicate valve position and an adjustable stop shall be provided. Construction of actuator housing shall be semi-steel. Hardware on actuators shall be of the same materials as the valves.

J. Unless otherwise required, due to location or operation, each valve 6-in and smaller shall be provided with its own securely attached lever. Adjustable limit stops, for both opening and closing, and a clearly marked position indicator shall be provided.

K. Plug valves shall be installed so that the direction of flow through the valve and the shaft orientation is in accordance with the manufacturer's recommendations. Unless otherwise noted, shaft shall be horizontal, with plug opening up.

2.07 Globe Valves

A. Globe valves for non-stainless steel process lines shall have a bronze body, renewable full plug stainless steel disc, renewable stainless steel seat and 400 lb cold water non shock working pressure. Globe valves shall be Nibco Class 300 or Figure 3245P as manufactured by Walworth Co. or approved equal.

B. Globe valves for stainless steel process lines shall have a stainless steel body, Type 316 stainless steel plug type disc, stainless steel seat and Teflon packing with threaded end connections. Globe valves shall be as manufactured by Stockham, WM Powell Co., or approved equal.

2.08 Ball Valves

A. Ferrous Ball Valves

NOTE: AWWA C507 covers 6 in through 48 in to 300 psi metal or rubber seat.

NOTE: Use metal seat for shutoff difference greater than 250 psi or throttling service at pressure of 150 psi or greater. Pratt only has experience with rubber-seated valves

1. Ball valves shall be furnished with carbon steel body, full bore, fire safe, rated for a line pressure of 150 psig. Except as noted, ball valves shall comply with AWWA C507.

NOTE: Choose seating direction requirement and preferred materials

2. The design of the valve shall be such that it shall provide suitable seating in [one] [both] directions. In order to determine the position of the ball within the valve (open or closed), there shall be an easily visible, permanent, indicator located conspicuously on the valve. Ball valves shall have Type 316 stainless steel seating surfaces. Seats shall be [Nitrile,] [Type [304] [316] stainless steel] [Butadiene]. The fully open port area shall be approximately 100 percent of the nominal pipe area.

3. Valve shafts shall be ground and polished and shall be Type 304 stainless steel. Teflon lined bearings shall be supplied in both trunnions of the valve body.

4. The valves shall be constructed so that the seals, seats and balls are accessible for replacement without dismantling the piping. The valves shall not require lubrication but shall have stuffing boxes which can be packed with the valve in service without undue leakage. Ball valves shall be as manufactured by Henry Pratt Co., Aurora, IL; Willamette, Portland, OR or approved equal.

5. Valve actuators shall conform to AWWA C507 and as specified herein.

B. Ball valves for on-site utility water piping shall be electric actuated, bronze, resilient seated, regular port, threaded two piece bolted body type valves. The body and cap shall be of brass, ASTM B30, the ball and stem of Type 316 stainless steel and the seats and seals of TFE. The valves shall have full floating ball and shall be non lubricated. Valve seats shall be easily accessible and replaceable. Valves shall be rated to 250 psi and shall be as manufactured by Neles Jamesbury; WKM or approved equal.

2.09 Check Valves

NOTE: AWWA C508 covers 2 in through 24 in for horizontal installation. Verify system pressure. If used for wastewater, valves should not be located in vertical.

A. Check valves for metallic lines of 2 in to 24 in diameter shall be swing type and shall meet the requirements of AWWA C508. The valves shall be iron body, bronze mounted, single disc, 150 psi working water pressure, nonshock and hydrostatically tested at 300 psi.

1. When there is no flow through the line, the disc shall hang lightly against its seat in practically a vertical position. When open, the disc shall swing clear of the waterway.

2. Check valves shall have bronze seat and body rings, extended bronze hinge pins and bronze nuts on the bolts of bolted covers.

3. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and weight. The position of the weight shall be adjustable. Various weights shall be provided and installation approved by the Engineer. Lever shall be

installed to the horizontal in the closed position, for both horizontal and vertical pipeline installations.

NOTE: If water hammer is a concern, consider the following cushioned valve on pump discharges.

4. The pump discharge check valves shall have two weighted arms, one located at each end of the pivot arm. Each arm shall be equally weighted. The valve shall be for heavy duty service that requires very rapid closure. In addition, these valves shall incorporate a hydro viscous damping system to cushion the final closure of the valve. The damper(s) shall be installed either on each valve arm or internally adjacent to the valve seating surface.

NOTE: The following Paragraph may be used if the check valve is to be equipped with a limit switch to monitor pump operation and detect failure of the valve to close properly.

5. Each pump discharge check valve as designated on the Contract Drawings shall be equipped with a limit switch set to operate the contacts when the valve is closed. The limit switches shall be shaft actuated type using a lever arm with a roller cam. The limit switches shall be mounted such that they are actuated by the outside lever of the check valve and designed so as to require no modification to the valve for mounting. The mounting shall allow for adjustment of the switch in relation to the lever arm. The initial setting of the limit switch shall be such that the switch closes when the valve opening is greater than 10 percent. The switch shall have two normally open and two normally closed contacts and shall have a NEMA 4 enclosure. The limit switches shall be as manufactured by Cutler Hammer; Square D Company; General Electric Company or equal.

6. Check valves shall be as manufactured by American Darling; M&H; Golden Anderson; Clow; Mueller or approved equal.

B. Check valves 2 in and smaller for installation in copper and steel pipes shall be bronze, swing type, 125 lb with solder or screwed ends.

C. Wafer style check valves shall be of the dual disk type with bodies constructed of cast iron, ASTM A126, Class B. Disc shall be fabricated of ductile iron, ASTM A536 and shall be electroless nickel plated. Body seat material shall be Buna N. Spring material shall be Type 316 stainless steel. The ends shall be plain. The valve shall be as manufactured by APCO; Val Matic; Golden Anderson or approved equal.

D. Ball check valves shall have bodies constructed of cast iron, ASTM A159, Class 35. Sinking ball shall be type fabricated of hollow steel with vulcanized Nitrile

rubber covering. Ball check valves shall be Type 2016 as manufactured by Flygt Corporation, similar by GA; Empire or approved equal.

2.10 Pressure Regulating Valves

NOTE: These controls valves may be used to hold a constant upstream or downstream pressure, a fixed differential pressure, an altitude (holds reservoir level, pressure relief flow controls constant) as well as other various pressure regulating/control/surge function. Revise as required.

A. Pressure regulating valves shall be factory tested. Outlet pressure shall be easily field adjustable over the pressure ranges and meet the criteria noted on the Contract Drawings.

NOTE: Put Design Data in tabular format similar to below, include on Drawings if possible.

System No.	Size (in)	Flow Range (gpm)	Pressure Range (psig)	
			Upstream	Downstream

B. All pressure regulating valves shall have flanged connections, or shall have unions mounted in the pipe on each side of the valve.

C. Strainers for installation upstream of pressure regulating valves are specified elsewhere. The pressure regulating valve manufacturer shall specify the screen mesh or size of perforations that are required to protect the regulating valve. The valve supplier shall furnish both valve and strainer.

D. Pressure Regulating Valves 3 in and larger

NOTE: For higher pressures (usually above about 250 psi) and/or critical areas revise specification to only allow a piston type valve, typically by GA Industries; Ross, etc. Diaphragm types will likely be submitted otherwise as they are less expensive. Designer to choose noted items or delete if only piston style valves are to be used.

1. Valves 3 in and larger and for pressure regulating shall be flanged with globe body, fully bronze mounted, external pilot operated, [piston] [diaphragm] type single seat with seat base equal to size of valve and shall be equal to the [Figure 4500D Pressure Reducing Valve as manufactured by GA Industries Inc., Pittsburg, PA; Clayton Model 90 by Cla Val Company,

Newport Beach, CA; Bailey, Fresno, CA; similar models by Ross; OCV; Watts/Muesecos] or approved equal.

2. The valve shall be packed to ensure tight closure and prevent metal to metal friction and sticking. The valve shall be furnished with indicator rod, to show position of opening of the piston, and pet cocks for attachment to valve body for receiving gauges for testing purposes.

3. The pilot valve, controlling operation of the main valve, shall be easily accessible and so arranged to allow for its removal from the main valve, while the main valve is under pressure. The pilot valve shall be easily adjustable without removal of the springs, weights or use of special tools. The control piping on the valves shall have strainers to prevent plugging of control mechanisms.

4. The design shall be such that repairs and dismantling internally of main valve may be made without its removal from the line.

5. The unit shall be flanged. The valve body shall be constructed of cast iron.

NOTE: The following Paragraph is typical only. Specific performance and control requirements must be stated for each control valve.

6. The valve shall maintain pre adjusted downstream pressure for varying rates of flow through the positioning of the [piston] [diaphragm] by the pilot without causing water hammer or waste of water and without cavitation.

E. Pressure Regulating Valves 2 in and Smaller

1. Pressure regulating valves 2 in and smaller shall be rated 150 psig working pressure, with bronze and brass body; renewable stainless steel seat and flexible diaphragm of suitable material. Outlet pressure shall be easily field adjustable over the pressure ranges tabulated.

2. Pressure regulating valves 2 in and smaller shall be Figure No. 43D as manufactured by GA Industries, Inc.; Model 30A by Bailey or approved equal.

2.11 Solenoid Valves

A. Solenoid valves shall be packless piston type direct acting for sizes less than 1 in and internal pilot operated for sizes 1 in and larger, 2 way or 3 way, valves and shall be ASCO Valve; Red Hat by Automatic Switch Co., similar by Atkomatic Valve Co. or equal.

NOTE: If flow of seal water to a pump stuffing box is critical (such as with mechanical seals or in a remote pumping station), consider having the valves energize to close instead o energize to open. In this way, failure of the valve will allow flow of water to the stuffing box.

B. Valves shall energize to open.

NOTE: Verify material – use Type 304 unless corrosion is a concern.

C. Valves shall have forged brass bodies, NPT end connections of the connected piping Type [304] [316] stainless steel internal parts, and Buna N or Ethylene Propylene valve seats. Valves shall have a minimum 150 psig safe working pressure and zero minimum operating pressure differential. Connections shall be threaded.

D. Solenoid valves on bypass piping shall be installed whether shown or not.

2.12 Air Release Valves

A. Air release valves shall be installed to release any small accumulations of air which may collect while pipe is in operation and under pressure.

B. The small orifice assembly air release valve shall automatically release air accumulations from the pipe while under positive pressure. When the valve body fills with air, the float ball shall fall to open the small orifice and exhaust the air to atmosphere. When the air has been exhausted, the float ball shall be buoyed up and tightly close the small orifice.

C. The small orifice assembly shall be furnished with cast iron body and cover (ASTM A126 Class B). The float ball shall be constructed of stainless steel and attached to a stainless steel lever mechanism. A resilient, Buna N seat shall be attached to the lever mechanism for drop tight closure.

D. Air release valves shall be manufactured by APCO; Val Matic; GA; Crispin or approved equal.

2.13 Combination Air and Air/Vacuum Valves

NOTES:

1) Type(s) and/or combination of individual types of valves and their placement will be determined by water hammer evaluation. Contact a hydraulics specialist for evaluation.

2) Properly size air release venting orifices, size of all valves, and their spacing.

3) Put valve schedule chart on the Contract Drawings showing: location, valve size, vent size plus additional information.

4) Watch freezing potential and headroom difficulties in shallow bury areas. Can sometimes pipe to a valve location on side of paved area.

5) Make sure valve outlet is not pointed at people.

6) Best location for these valves is on top of a "tee" section in the main pipeline or a "tee" at an elbow. Use a drilled and tapped blind flange on top of tee to mount valve.

7) Consider in critical areas, and for all sewage service, use 2 or more valves to minimize potential if failure of 1.

8) Remember to allow room and convenient access for flushing, O&M, etc.

A. Valves shall be supplied with shutoff gate or ball valves with operator handle or lever removed. Valves shall be properly vented and piped to drain.

B. Units shall be a small orifice (air release) valve mounted on a large orifice [air/vacuum] valve of the proper type and size as noted on the Drawings. Air release valves shall be as specified previously.

C. The small orifice valve shall be piped to the body of the large orifice valve by non corrosive piping equal in size to the small orifice inlet connection. An isolating stop valve (with operator removed) shall be furnished between the small and large orifice valves.

D. The large orifice assembly air and vacuum valve shall automatically exhaust air from a pipeline during the initial filling of the pipeline. The large orifice assembly shall not blow shut while exhausting air, even while venting air at sonic velocity. When all air has been exhausted from the pipeline, the large orifice float ball shall be buoyed up to seat tightly against a resilient seat ring. The large orifice float ball shall remain tightly closed while the pipeline is under positive pressure. Should the pipeline pressure fall below atmospheric pressure (such as during draining or a line break), the large orifice float ball shall automatically fall away from the seat ring and permit air to enter the pipeline.

E. The large orifice assembly shall be furnished with cast iron body and cover (ASTM A126 Class B). A resilient, Buna N seat ring shall be affixed to the valve cover. The float ball shall be constructed of stainless steel with a minimum pressure rating of 1,000 psi. The float ball shall be free floating within the valve body.

F. Units shall be as manufactured by GA; APCO; Val Matic or approved equal. One piece units performing all functions may be utilized, subject to the approval of the Engineer. Component valves shall be furnished by a single manufacturer.

G. For service on sewage and non screened water, the valves shall be of the special sewage type, performing similar functions for specific type of valve as noted for water.

1. The valves shall have Type 316 stainless steel trim and float, with an adjustable viton seat and be supplied with backwash accessories

2. A valved outlet with hose connections for flushing water connection (where flushing accessories are required) shall be provided within a distance that hoses, supplied with the valve, may reach. Proper cross connection prevention shall be provided.

PART 3 EXECUTION

3.01 Installation - General

A. All valves and appurtenances shall be installed per the manufacturer's instructions in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.

B. Install all brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Contract Drawings, or otherwise required. Before setting these items, check all Contract Drawings and figures which have a direct bearing on their location. The Contractor shall be responsible for the proper location of valves and appurtenances during the construction of the Work.

C. All materials shall be carefully inspected for defects in construction and materials. All debris and foreign material shall be cleaned out of openings, etc. All valve flange covers shall remain in place until connected piping is in place. All operating mechanisms shall be operated to check their proper functioning and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.

D. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and the Contractor shall certify such installations have been performed accordingly.

E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint and all valves and other items shall be installed in the proper position as recommended by the manufacturer. Contractor shall be responsible for verifying manufacturers' torquing requirements for all valves.

3.02 Installation of Manual Operational Devices

A. For manually operated valves 3-in in diameter and smaller, valve operators and indicators shall be rotated to display toward normal operation locations.

B. Floor boxes, valve boxes, extension stems and low floor stands shall be installed vertically centered over the operating nut, with couplings as required and the elevation of the box top shall be adjusted to conform with the elevation of the finished floor surface or grade at the completion of the Contract. Boxes and stem guides shall be adequately supported during concrete pouring to maintain vertical alignment.

3.03 Inspection, Testing and Correction of Deficiencies

A. See also Division 1. Take care not to over pressurize valves or appurtenances during pipe testing. If any unit proves to be defective, it shall be replaced or repaired at no additional cost to the Owner.

NOTE: Include for complex, large and/or motorized units.

B. No testing shall be performed until the manufacturer's service engineer has provided written certification that the following installed equipment has been examined and found to be in complete accordance with the manufacturer's requirements:

1.

2.

3.

NOTE: Include functional test requirement if desired for larger or more complex valves. Designer to choose duration, typically 24 hours.

C. Functional Test: Prior to startup, all items shall be inspected for proper alignment, quite operation, proper connection and satisfactory performance. All units shall be operated continuously while connected to the attached piping for at least 24 hours, without vibration, jamming, leakage, or overheating and perform the specified function.

D. The various pipe lines in which the valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed and replaced, or otherwise made acceptable to the Engineer.

E. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected or the device replaced or otherwise made acceptable to the Engineer.

3.04 Cleaning

A. All items (including valve interiors) shall be cleaned prior to installation, testing disinfection and final acceptance.

NOTE: Include for potable water

3.05 Disinfection

A. Disinfection of valves and appurtenances on all potable water lines and where otherwise noted, shall be as noted in Section XX.

End of Section

SUMMARY SHEET

SECTION NAME: Horizontal Split-Case Centrifugal Pumps

SECTION NUMBER: 43 21 01

PREPARED BY:

REVIEWED BY:

DATE ISSUED: January 4, 2008

DESCRIPTION: Horizontal Split-Case Centrifugal Pumps for units using 50 hp drivers or larger. Section is written for constant or variable speed units and for raw or finished water service. Section requires system loss curves included at end of Section

REVISION #	DATE	PARAGRAPH(S) Revised

WARNING: This is an Example Only.

HORIZONTAL SPLIT-CASE CENTRIFUGAL PUMPS

SECTION 43 21 01

PART 1 GENERAL

1.01 Work Included

NOTE: Select and edit for specific project.

A. Furnish all labor, materials, equipment and incidentals required and install, place in operation, and start up variable frequency drive (VFD) and constant speed electric motor driven, horizontal, axially split case, double suction pumps as specified herein and shown on the Drawings.

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 start up (including field testing) of all materials, equipment and appurtenances for the complete pumping unit as herein specified, whether specifically mentioned in these specifications or not.

1.02 Related Contract Documents

A. Concrete pump supports, concrete work, and the installation of anchor bolts are included in Division XX; however, anchor bolts for this pump shall be furnished under this Section.

B. Field painting is included in Section **XX**.

C. Electrical work is included in Division **XX**, except as specified herein.

D. Electric motors are included in Section **XX**.

E. Instrumentation and control work, except specified herein, is included in Division **XX**. Instrumentation and controls provided in this section shall adhere to Instrumentation and Control Specifications Sections in Division **XX**.

F. Piping, valves, and appurtenances are included in Division **XX**.

G. Variable Frequency Drives are specified in Section **XX**.

1.03 Reference Standards

A. Design, manufacture and assembly of elements of the equipment herein specified shall be in accordance with, but not limited to, the latest edition of the following published standards, as applicable:

1. American Gear Manufacturers 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 Welding Society (AWS)
8. American Bearing Manufacturers Association (ABMA)
9. Hydraulic Institute Standards (current edition)
10. Institute of Electrical and Electronics Engineers (IEEE)
11. National Electric Code (NEC)
12. National Electrical Manufacturers Association (NEMA)
13. Occupational Safety and Health Administration (OSHA)
14. Steel Structures Painting Council (SSPC)
15. Underwriters Laboratories, Inc. (UL)
16. NSF / ANSI Standards 60 and 61

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 Design Requirements

NOTE: Edit for specific project – remove reference to VFD if not required.

A. The equipment to be furnished under this section shall include horizontal split-case pumps, motors, variable speed drives and accessories, as specified herein and as shown on the Drawings.

B. All working parts of the pumps, motors and drives, such as bearings, wearing rings, shaft sleeves, motor windings, etc., shall be of 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 machine. All parts shall be properly stamped for identification and location in the machine as shown on the assembly drawings in the instruction books furnished.

NOTE: The following Paragraph should be used only to reference other Sections or Divisions that have a major impact on the design or bidding requirements of this Section. Include items that are furnished by others or the Owner for installation under this Section; items that are installed under other Sections or by others but furnished herein; and items that could possibly effect the way a bid is prepared if responsibility is not clear. This is an IMPORTANT Paragraph in Multiple Prime Contracts. Add to or delete from as required.

1.05 Submittals

NOTE: Select and edit for specific project.

A. Shop drawings and product data, in accordance with Section **XX**, shall include the following:

1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.

2. Certified foundation, pump support and anchor bolt plans and details.

3. Schematic electrical wiring diagram and other data as required for complete pump installation.

4. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the detail specifications.

5. Total weight of pumping unit.

6. A statement of guarantee that the critical speed analyses as required under Paragraph 1.05E have been completed and that the specified limitations will be met.

7. Motor manufacturer data sheets.

8. Variable Frequency Drive data sheets.

9. Written certification that all parts, components, and materials in contact with potable water are certified suitable for such intended service in accordance with NSF 60/61.

B. Design Data

1. Manufacturer's certified rating curves, to satisfy the specified design conditions, showing pump characteristics of discharge, head, brake horsepower, efficiency and guaranteed net positive suction head required (NPSHR). Curves shall show the full recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.

C. Test Reports

1. Certified motor test data as described in Section **XX**.

2. Tabulated data for the drive motors including rated HP, full load RPM, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and KW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply without affecting their design life for bearings or windings.

3. A schedule of the date of shop testing and delivery of the equipment to the job site.

4. Description of pump factory test procedures and equipment.

5. A statement that the pump will function properly as installed with respect to the suction piping layout as shown on the Drawings.

D. Operation and Maintenance Data

1. Complete operating and maintenance instructions shall be furnished for all equipment included under these specifications as provided in Section **XX**. The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.

1.06 Quality Assurance

NOTE: Edit for specific project – remove reference to VFD if not required.

A. To assure unity of responsibility, the motors, variable frequency drives, base plates, and controls shall be furnished and coordinated by the pump manufacturer (Manufacturer). The Contractor and Manufacturer shall assume responsibility for the satisfactory installation and operation of the entire pumping system including pumps, motors, and base plates as specified.

B. The equipment covered by these specifications is intended to be standard pumping equipment of proven ability as manufactured by concerns having extensive experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed to operate satisfactorily when installed as shown on the Drawings and as specified herein.

C. Pump shall be manufactured in accordance with the Hydraulic Institute Standards, except where otherwise specified herein.

D. The Manufacturer shall be fully responsible for the design, arrangement and operation of all connected rotating components, of the assembled pumping unit mounted on a fabricated steel baseplate, to ensure that neither harmful nor damaging vibrations occur anywhere within the specified operating range.

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 shall be forwarded to the Engineer indicating that the required analyses have been made and that the specified limitations will be met.

1.07 Delivery, Storage, and 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 operational.

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 or by other approved means.

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.

1.08 Spare Parts

NOTE: Edit for specific project.

A. One (l) 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, properly labeled to clearly identify the contents, complete with lock and duplicate keys.

B. The manufacturers of the equipment specified herein shall furnish a complete set of recommended spare parts necessary for the first five (5) years 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. The following spare parts should be provided in addition to those required above:

1. Complete set of wearing rings.
2. Complete set of radial and thrust bearings.
3. Complete sets of gaskets.
4. Two complete sets of packing with spare followers **(or 1 set of mechanical seals)**.
5. Complete set of shaft sleeves, keys and accessories.
6. 2 - spare lantern rings.
7. 1 - spare set of coupling rubber bushings.
8. One year's supply of all required lubrication grease and oil.

1.09 Seismic Requirements (Not USED)

1.10 Warranty

A. All equipment supplied under this section shall be warranted for a period of one (1) year by the Contractor and the pump Manufacturer. Warranty period shall commence on the date of Owner acceptance, as outlined in Division XX.

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 Material and Equipment

NOTE: Edit to include equipment requirements for each specific project.

A. The pumping units required under this section shall be complete including pumps, motors, baseplates and couplings with proper alignment and balancing of the individual unit. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the work to be done. Ample room shall be provided for inspection, repairs, and adjustment.

B. The baseplate for the pump shall be rigidly and accurately anchored into position. The pumping equipment shall have seismic anchorage calculations prepared by a Professional Engineer registered in the State of Washington. The Manufacturer shall list all necessary foundation bolts, plates, nuts, and washers for purchase and installation by the Contractor.

NOTE: Delete reference to variable frequency drives if not applicable.

C. A stainless steel nameplate giving the name of the manufacturer, the rated capacity, head, speed, and all other pertinent data shall be attached to each pump, motor, and variable frequency drive.

D. The pumping units, electric motors and all clutch equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to back flow through the pump.

2.02 Pumps - General

NOTE: List two or three pump manufacturers.

A. The pumps shall be of the horizontal, centrifugal, axially split case, double suction, double or single volute type. The pumps shall be of standard dimensions, built to limit gauges or formed to templates. The pumps shall be as manufactured by Fairbanks Morse, Patterson, ITT Goulds, or equal.

B. The pumps shall have a continuously rising head with reduction in flow from the pump runout condition to the shut-off head.

NOTE: Reference a Table 43-21-01-1, -2, -3… etc. for each pump model referenced in the Section.

C. See the Pumping Station Data Table(s) (Table 43-21-01-1) at the end of this section for the pump performance requirements.

D. Certified Factory Tests:

1. Factory testing in accordance with the standards of the Hydraulic Institute shall be required for the pump. Certified pump performance curves shall be submitted, including head, capacity, brake horsepower, and pump efficiency for the pump supplied. Certified data shall be provided to indicate the NPSH required by the pump at the primary operating point listed in Table 43-21-01-1. 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. A representative of the Engineer and Owner will have the opportunity to witness all acceptance testing of the pumps. All electronic transducers, meters, gauges, and other test instruments shall be calibrated within forty-five (45) days of the scheduled test and certified calibration data shall be provided to the Engineer at least ten days prior to the Factory Witness test. 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.

2. The pump shall be tested 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. The pump will be tested with a suction head (including vapor pressure, velocity head friction loss and static suction head) as required to demonstrate the NPSH required by the pump at the primary operating point listed in Table 43-21-01-1. If the pump fails to meet any specification requirement it will be modified until it meets all specification requirements.

NOTE: Include ONLY when performance testing will be witnessed

3. The Contractor shall include in his price a sum sufficient to reimburse the Engineer for all reasonable expenses which the Engineer will incur in order to witness the test. Expenses are defined here as all direct expenses plus the Engineer's time billed at an average of $1,200.00 per day. The Engineer's time shall include the round trip travel time to and from the factory shop. The sum shall include repetitive visits, if required, and shall be deducted from payments due the Contractor by the Owner.

E. Pump Casing Construction:

1. The pump case shall be of cast iron construction ASTM A-48, Class 30, having a tensile strength of not less than 30,000 pounds per square inch.

2. Casing shall be free from blowholes, sand pockets or other imperfections. The casings shall be given a hydrostatic pressure test to at least 1.5 times the maximum pump shutoff head and an affidavit that the case has withstood this pressure test shall be furnished to the Engineer before shipment.

3. The interior and exterior surfaces of the casing shall be smooth with matching flanges.

4. The horizontal casing joint shall be a machined fit, requiring a gasket not more than 0.032-inch thick. These joints shall be made up with stud bolts screwed into the lower casing flange or bolts and nuts. Cap screws will not be considered. Joints shall be fitted with jacking screws.

5. Suction and discharge flanges shall be faced and drilled ANSI Class 125 **[or 250 lb]** Standard. There shall be 1/4-inch I.P.T. tapped holes in both the suction and discharge flanges of the pump for test gauge connections.

6. All holes for flange bolts, studs and cap screws in the casing shall be spot faced.

7. The top half of each case at the topmost part shall have a bossed pipe tap opening for mounting priming air chamber specified under Paragraph 2.02 I herein. Pipe taps shall be not less than 1-inch I.P.T.

8. At the highest part of the case over each suction eye there shall be a pipe tap, not less than 1/4-inch I.P.T. for air release from the suction chambers.

9. The casing at both suction inlets to the impellers shall be protected with renewable nickel aluminum bronze wearing rings. They shall be of one-piece construction, held rigidly in slots in the case and shall not be held in place by the clamping action of the case alone.

F. Pump Impeller Construction:

1. The impeller shall be of cast bronze ASTM B584, Alloy No. C83600 (certified analysis of the impeller pour metal required) enclosed double suction type of one-piece construction. Impeller shall be machined outside and smoothly finished on the internal water passages and shall be statically and dynamically balanced. Rotation of the impeller shall correspond to the pump discharge orientation as indicated on the Drawings. The impeller shall be keyed to the shaft and firmly held in place. The arrangement shall be such that the impeller cannot be loosened by torque from either forward or reverse rotation.

2. Impeller shall be protected from wear at both suction inlets with renewable nickel aluminum bronze wearing rings. These rings shall be fastened to the impeller such that they cannot loosen in service.

G. Pump Bearings:

1. The weight of the pump shaft and impeller assembly shall be carried on journal or anti-friction bearings at each end of the pump shaft. Bearings shall be cast iron or steel shell, babbitt lined, ring oiling type, split along the centerline of the shaft or oil lubricated, double roll tapered type anti-friction bearings designed for an ABMA L-10 life of 50,000 hours for any point within the pump operating conditions specified. Alternate bearing designs shall be of a design acceptable to the Engineer.

2. The outboard bearing of the pump shall be designed to support the weight of the rotating assembly and accept all thrust loads and shall function so that the impeller rotor will be centered in the end play (axial movement) of the wearing rings.

3. At the inner end of each bearing housing the shaft shall be equipped with a slinger type water deflector, fastened to the shaft with set screws, to prevent water from the stuffing boxes entering the bearing housings. Over the stuffing box glands, and supported by the bearing brackets, shall be provided readily removable fabricated or cast aluminum spray guards so that any water spray from the stuffing boxes or shaft will be deflected into the drip pockets.

H. Pump Shaft:

1. The pump shaft shall be of high-grade open-hearth machinery or alloy steel SAE-1045 or better, ground and polished over the entire length.

2. The shaft shall be protected from corrosion at the stuffing boxes by renewable 316 stainless steel sleeves on which the mechanical seals shall be mounted.

3. Sleeves shall be fastened to the shaft such as to prevent leakage between the sleeve and the shaft.

I. Pump Stuffing Boxes:

1. The pump stuffing boxes shall designed to accommodate either packing or mechanical seals and be sufficiently deep for not less than five rings of graphited square braided packing. The boxes shall be designed for external water flushing from the pump volute.

2. Water seal piping shall be furnished and installed by the pump manufacturer.

3. Drip pockets shall be provided in the bearing brackets under the packing glands to catch any water dripping from pump stuffing boxes. These drip pockets shall be furnished with tapped drain connections and drip from these pockets shall be piped to waste.

NOTE: Delete for systems that do not require priming systems.

J. Pump Priming Provisions:

1. Under the conditions of positive suction pressure as specified under Performance Requirements, the pump shall be arranged such and equipped so it will be under continuous prime ready for start up at any time.

2. The top of the pump case shall be equipped with an air-collecting chamber constructed for 150-psi service. Each chamber shall be equipped with an automatic vacuum type air release valve and an electrode to function with the pump control to prevent pump startup if the pump is not primed and to shut the pump down with loss of prime.

3. The topmost part of the pump case over each suction eye shall be vented to the air chamber through a venting orifice such that when the pump is not in operation so no air can collect at the suction eyes.

2.03 Gauges

NOTE: Edit as necessary. A vacuum priming system must be designed and specified for static water levels below the top of the pump casing.

A. The pump shall be equipped with glycerin-filled pressure gauges on the suction and discharge of the pumps. The gauges will have ¼-in NPT inlet and 4½-in dials.

B. The discharge gauge on the pump shall be dual scale and shall be calibrated **0-xx psi and 0-xx feet of water**. The suction gauge shall be calibrated **minus xx feet of water to plus xx feet of water**. Gauge cases shall be phenolic shock resistant ABS or 316 stainless steel, flanged mounted, back or bottom connected with "snap-on" ring or bezel. Bourdon tubes shall be of 316 stainless steel or Inconel. The pointers shall be adjustable for field calibration and setting. Window shall be shatterproof glass or acrylic.

C. The discharge gauge shall be equipped with a surge suppression snubber. Each gauge shall be equipped with a lever handle gauge cock and union.

D. Connection of the gauges to the pressure taps in the pump flanges shall be with hard drawn copper tubing and solder fittings or with screwed brass pipe neatly installed with straight runs and right angle bends.

E. Gauges shall be manufactured by **3D Instruments, Ashcroft or McDaniel Controls.**

2.04 Couplings and Accessories

A. Based on lateral critical, torsional critical and/or other computations, the Manufacturer shall select and supply suitable coupling size, intermediate bearing(s) and location, if required, so that operating speed is a minimum of 10% below one-half critical speed or critical speed which could cause damage to the drive shafting.

B. The Manufacturer shall provide adequate protective screening around the rotating shaft and couplings to meet OSHA and Washington Industrial Safety Laws.

C. The couplings connecting the pump with the motor shall be sized and arranged to transmit all expected torque and loads.

2.05 Base Plates

A. The pump shall be mounted on an extended fabricated steel base plate, with provision to collect any leakage, and shall be of sufficient size and rigidity to support the unit and prevent harmful or damaging vibration. A 3/4-in drain tap and copper pipe nipple shall be provided. The steel base shall be anchored to the level surface of a concrete pad with suitably sized 302 stainless steel anchor bolts.

2.06 Motors

A. Motors shall be furnished by the Manufacturer and shall be as specified in Section **XX**.

B. The motors shall be provided with a fabricated steel base support. Motor support shall be suitable for carrying the entire weight of the supplied motor.

NOTE: Delete VFD reference if not applicable.

2.07 VFD

A. VFDs shall be furnished by the pump supplier and shall be as specified in Section **XX**.

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 recommendations of a Professional Engineer in the State of Washington, including appropriate seismic considerations.

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. Refer to Section XX.

C. Connection of piping to pumps shall be done in presence of the Engineer. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections.

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 pumps and motors shall be shop primed with primer compatible with field painting as specified in Division **X**.

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 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 Section **XX**. The primer and paint used in the shop shall be products of the same manufacturer as the field paint to assure compatibility. Finish colors shall match existing pumping equipment.

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 equipmentto 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. The Engineer or its representative shall be allowed proper time for inspection and testing of material and equipment. The Contractor shall anticipate that delays may be caused because of the necessity of inspection, testing and accepting materials and equipment before their use is approved.

4. The Manufacturer shall furnish the services of a competent and experienced representative who has complete knowledge of proper operation and maintenance of the equipment for a period of not less than **two (2)** days in two separate visits to inspect the installed equipment, supervise the initial test run, and to provide instructions to the plant personnel. The first visit will be for checking and inspecting the equipment after it is installed. The second visit will be to operate and supervise the initial field test. This instruction period shall be scheduled at least ten days in advance with the Owner and shall take place prior to plant startup and acceptance by the Owner. The final copies of operation and maintenance manuals specified in Section **XX** must have been delivered to the Engineer prior to scheduling the instruction period with the Owner.

5. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing. All field tests shall be

coordinated with the Owner to allow for scheduling of downtime and to meet current water demands.

B. Pumps:

1. After the pumps have been completely installed, and working under the direction of the Manufacturer, conduct in the presence of the Engineer, such tests as necessary to indicate that the pumping system operates satisfactorily and generally meets the conditions of service specified. The factory witnessed tests are the basis of equipment efficiency demonstration. The field test shall demonstrate correct mechanical operation after pump startup. Supply all water, labor, equipment and incidentals required to complete the field tests. Power will be furnished by the Owner.

2. If the pump performance does not meet the Specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps which satisfy the conditions specified. A 24-hour continuous operating period of the pump will be required before acceptance. During this 24-hour operating period, the Owner shall supply all power necessary.

C. Motors:

1. The Contractor shall megger the 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 the motor for correct clearances and alignment and for correct lubrication in accordance with the motor manufacturer's instructions. The Contractor shall check direction of rotation of the motor and reverse connections if necessary.

NOTE: Delete for systems not equipped with VFDs.

D. Variable Frequency Drives

1. Refer to Section **XX** for Variable Frequency Drive testing.

TABLE 43-21-01-1

HORIZONTAL SPLIT-CASE PUMPS DATA SHEET

Add values for design conditions to complete table based on design requirements. Vendor to fill in any blanks.

Project:			Location: Washington		
Tag No(s).:			Service:		
No. Pumps Req'd:		Provided By: Contractor	No. Motors Req'd:		Provided By: Contractor
Pump Mfr.:	Fairbanks Morse, Patterson, ITT Goulds, or Equal		Model/Size:		

OPERATING CONDITIONS					
Liquid :		Per Pump Range of Flows (gpm):			
PT °F Range:	40-85	Parallel Op: YES	Disch. Press. psig :		
Sp GR @PT:	1.0		Suct. Press psig: Max.		Rated
Vap Press @PT, psia:	0.5		Diff. Press. Above Min Water Level psi:		
Visc @PT cp :	1.0		Diff Head Above Min Water Level ft :		
Elev. Ft:	500	Installation:	NPSH Avail. ft :		Submergence ft:
Corr/Eros. Caused By:					

PERFORMANCE		
Proposal Curve No.		
Primary Design Point Flow (gpm)	Primary Design Point Head (ft)	Primary Design Point Efficiency (%)
Intermediate Design Point Flow (gpm)	Intermediate Design Point Head (ft)	Intermediate Design Point Efficiency (%)
Secondary Design Point Flow (gpm)	Secondary Design Point Head (ft)	Secondary Design Point Efficiency (%)
NPSHR Primary	NPSHR Max	Min Submergence
BHP Primary	BHP EOC	BHP Max.
Pump Shut-Off Head (ft)	Min. Continuous Safe Flow (gpm)	

CONSTRUCTION							
Pump Type	Horizontal Split-Case						
Impeller: Dia.		Max. Dia.		Type	ENCLOSED	Stages	
Suction Size:		Rating					
Discharge Size		Rating					
Mech. Seal: Mfr/Model				Materials			
Casing Material:				Piping Materials			
Pump Max. Allowable Working Press: Suction			Disch.		Hydrotest Press		
Pump Wt.	LBS (pump + motor)					Gage	YES

End of Section

SUMMARY SHEET

SECTION NAME: Submersible Wastewater Pump

SECTION NUMBER: 43 21 37

PREPARED BY:

REVIEWED BY:

DATE ISSUED: January 3, 2008

DESCRIPTION: Submersible Wastewater Pumps for units using 5 hp motors or larger. Section is written for constant or variable speed units and for raw wastewater service. Section requires system loss curves included at end of Section

REVISION #	DATE	PARAGRAPH(S) Revised

This is an example only. It is not intended for wide use. It is for informational purposes only.

SUBMERSIBLE WASTEWATER PUMP

SECTION 43 21 37

PART 1 GENERAL

1.01 Work Included

NOTE: Edit for specific project – remove reference to VFD if not required.

A. The Contractor shall furnish all labor, materials, equipment and incidentals required and install, place in operation and field test the submersible wastewater pumps and accessories as shown on the Drawings and specified herein. The equipment to be furnished and installed for the station shall be as shown on the Drawings and shall include pumps, motors, variable frequency drives, pump accessories and appurtenances, all tested and ready for operation.

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 as offered. It is, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and field testing of all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these Specifications or not.

1.02 Related Contract Documents

A. Concrete pump supports, concrete work, and the installation of anchor bolts are included in Division XX; however, anchor bolts for this pump shall be furnished under this Section.

B. Field painting is included in Section **XX**.

C. Electrical work is included in Division **XX**, except as specified herein.

D. Instrumentation and control work, except specified herein, is included in Division **XX**. Instrumentation and controls provided in this section shall adhere to Instrumentation and Control Specifications Sections in Division **XX**.

E. Piping, valves, and appurtenances are included in Division **XX**.

F. Variable Frequency Drives are specified in Section **XX**.

1.03 Reference Standards

A. Design, manufacturing and assembly of elements of the equipment herein specified shall be in accordance with, but not limited to, published standards of the following, as applicable:

1. American Gear Manufacturers 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 Welding Society (AWS)
8. Anti-Friction Bearing Manufacturers Association (AFBMA)
9. Hydraulic Institute Standards (current edition)
10. Institute of Electrical and Electronics Engineers (IEEE)
11. National Electric Code (NEC)
12. National Electrical Manufacturers Association (NEMA)
13. Occupational Safety and Health Administration (OSHA)
14. Steel Structures Painting Council (SSPC)
15. Underwriters Laboratories, Inc. (UL)
16. National Fire Protection Association (NFPA)

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 Design Requirements

NOTE: Edit for specific project – remove reference to VFD if not required.

A. The equipment to be furnished under this section shall include submersible wastewater pumps, motors, variable speed drives and accessories, all as specified herein and as shown on the Drawings.

NOTE: The following Paragraph should be used only to reference other Sections or Divisions that have a major impact on the design or bidding requirements of this Section. Include items that are furnished by others or the Owner for installation under this Section; items that are installed under other Sections or by others but furnished herein; and items that could possibly effect the way a bid is prepared if responsibility is not clear. This is an IMPORTANT Paragraph in Multiple Prime Contracts. Add to or delete from as required.

1.05 Submittals

A. Copies of all materials required to establish compliance with the Specifications shall be submitted with the proposal in accordance with the provisions of the General Conditions and Section **XX**. Submittals shall include at least the following:

1. 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. Sufficient data shall be submitted to document previous production of each pump model proposed for use on this Contract.

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, submergence 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 zero flow at Shut Off Head to Pump Capacity at minimum specified TDH. Catalog sheets showing a family of curves will not be acceptable.

4. The total weight of the equipment.

5. The pump anchorage calculations, including seismic considerations prepared by a Professional Engineer in the State of Washington.

6. Drawings showing the layout of the Control Panels and where applicable, Instrumentation Panel. The layout shall show front and side elevations and shall indicate every device mounted on the inner or exterior door and subpanel with complete identification.

7. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, control panels, starters and related systems.

8. A complete total bill of materials of all equipment.

9. A list of the manufacturer's recommended spare parts with the respective manufacturer's current price for each item. Include gaskets, seals, etc. on the list. Bearings shall be listed by the bearing manufacturer's numbers only.

10. All submittal data required by the General Conditions.

11. Complete motor data, including, but not limited to: type of enclosure design, rated horsepower, rated voltage, FLA, Starting Current, LRA, LR KVA, NEMA Code Letter, rpm, input power in kw at nameplate rating, starting calculations, cable size, efficiency at 50%, 75% & 100% load, and power factor at 50%, 75% & 100% load.

12. Certified agreement to the conditions of the warranty.

B. Test Reports

1. Certified motor test data as described in Section XX.

2. Tabulated data for the drive motors including rated HP, full load RPM, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and KW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply without affecting their design life for bearings or windings.

3. A schedule of the date of shop testing and delivery of the equipment to the job site.

4. Description of pump factory test procedures and equipment.

5. A statement that the pump will function properly as installed with respect to the suction piping layout as shown on the Drawings.

C. Operating and Maintenance Manuals: Operating and Maintenance Manuals shall be furnished. The manuals shall be prepared specifically for equipment furnished and installed on this contract and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

D. In the event that the equipment offered does not conform with all of the detailed requirements of the Specifications, describe completely all nonconforming aspects. Failure to describe any and all deviations from the specifications will be cause for rejection.

1.06 Quality Assurance

NOTE: Edit for specific project – remove reference to VFD if not required.

A. To assure unity of responsibility, the pumps, motors, variable frequency drives and other auxiliary equipment, and materials specified in this Section shall be furnished and coordinated by the pump manufacturer (Manufacturer) who, along with the Contractor, shall assume responsibility for the satisfactory operation of the entire pumping system including pumps, motors, variable frequency drives and accessories.

B. The pumps and other equipment covered by these Specifications shall be standard production units of the manufacturers, currently available and listed in the respective manufacturer's catalog. The pumps furnished shall be in accordance with the Hydraulic Institute Standards and shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

C. The pump manufacturer shall have an authorized warranty center within a 350-mile radius of the job site, fully staffed with factory trained mechanics, and equipped with a stock of all necessary spare parts for each model of pump furnished under this contract. The service facility shall be an established entity prior to delivery of equipment for this project, completely equipped with loaner pumps, spare parts and crane equipped truck. The service facility shall also be capable of providing a 48 hour turnaround time on any pumps brought in for repair. The warranty center shall maintain an inventory of original factory replacement parts, including but not limited to, mechanical seals, bearings, O-rings, stators, impellers and wear rings.

D. All equipment furnished under this Specification shall be new and unused, 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.

E. The pump manufacturer shall have a guaranteed parts stock program, at a distribution center within a 350 mile radius of the job site. The guaranteed stock shall include at least one set of spare parts, as listed below, for each pump model and size supplied under this Contract. As a part of the shop

drawing submittal, the Manufacturer shall furnish a notarized statement that the parts are in stock and available for inspection by the Engineer.

1. Upper and lower mechanical seals
2. Wear Rings
3. Motor Cable
4. Cable Entry Washer/Grommet
5. All O-Rings
6. Inspection plugs and washers
7. Impeller bolts and keys
8. Upper and lower bearing

1.07 Delivery, Storage, and Handling

A. All equipment and parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication until final delivery to the job site.

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 or by other approved means.

E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

F. After factory testing, 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.

1.08 Spare Parts

A. One (1) set of all special tools required for normal maintenance shall be provided by the Manufacturer. All such tools shall be furnished in a suitable steel tool chest, properly labeled to clearly identify the contents, complete with lock and duplicate keys.

B. The Manufacturer shall furnish a complete set of recommended spare parts necessary for the first five (5) years of operation for each pumping station.

C. All spare parts shall be properly protected for long periods of storage and packed in containers which are clearly identified with indelible markings as to the contents.

1.09 Seismic Requirements (Not Used)

1.10 Warranty

A. All equipment supplied under this section shall be warranted for a period of one (1) year by the Contractor and the Manufacturer. Warranty period shall commence on the date of Owner acceptance, as outlined in Division **XX**.

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 Materials and Equipment

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 work to be done. Ample room shall be provided for inspection, repairs, and adjustments.

B. Each foundation plate for each pump shall be designed to be rigidly and accurately anchored into position. The pumping equipment shall have seismic

anchorage calculations prepared by a Professional Engineer registered in the State of Washington. All necessary foundation bolts, plates, nuts, and washers shall be furnished by the Manufacturer for installation by the Contractor.

C. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed, and all other pertinent data shall be permanently attached to each pump and/or motor.

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.

2.02 Pumping System - General

NOTE: Delete reference to variable frequency drives if not applicable.

NOTE: List two or three pump manufacturers.

A. The pumps shall be totally submersible, non-clog centrifugal pumps with submersible close coupled motors designed to pump raw, unscreened wastewater. The design shall be such that the pumping units shall be automatically connected to the discharge piping when lowered into place on the discharge connection. The pumps shall be designed to be easily removed from their discharge connections and the wet well for inspection or service. Lifting the pumps from their discharge connections or the wet well shall require neither the removal of any bolts, nuts or other fastenings nor the need for personnel to enter the pump well. The pumps shall be as manufactured by Wilo, Flygt, or equal.

NOTE: Reference a Table 43-21-37-1, -2, -3… etc. for each pump model referenced in this specification.

B. See the Pumping Station Data Table(s) (Table 43-21-37-1) at the end of this section for the pump performance requirements.

C. Certified Factory Tests:

1. Factory testing in accordance with the Hydraulic Institute standards shall be required for the pumps. 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 pump at the primary operating point listed in Table 43-21-37-1.

NOTE: Delete reference to witness testing if not applicable.

2. 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. A representative of the Engineer and Owner will have the opportunity to witness all performance testing of the pumps. All electronic transducers, meters, gauges, and other test instruments shall be calibrated within forty-five (45) days of the scheduled test and certified calibration data shall be provided to the Engineer at least ten days prior to the Factory Witness test. Differential pressure type flow meters, such as venturis shall have been certified calibrated within 5 years. Mechanical variation of the meter throat diameter will be accepted as verification of calibration validity.

NOTE: Delete reference to NPSH testing if not applicable. NPSH Testing is typically only applicable when the pump model selected has not had prior NPSH testing. For pump models where prior NPSH testing has been conducted, the results of this testing is acceptable.

3. The pump shall be tested 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. The pump will be tested with a suction head (including vapor pressure, velocity head friction loss and static suction head) as required to demonstrate the NPSH required by the pump at the primary operating point listed in Table 43-21-38-1. If the pump fails to meet any specification requirement it will be modified until it meets all specification requirements.

4. The pump manufacturer shall perform the following test on each pump prior to shipment from factory:

   a. Megger motor for insulation breaks or moisture.

   b. Prior to submergence, the pump shall be run dry and checked for correct rotation.

   c. Pump shall be run for a minimum of thirty (30) minutes in a submerged condition.

   d. The pump shall be removed from test tank, meggered immediately for moisture and upper and lower seal unit shall be checked for water intrusion.

NOTE: Edit as necessary if performance test is not to be witnessed. Witness tests are typically only necessary for larger installations where it is critical to achieve the advertised pump performance and to avoid delays during start-

up. Whether or not to witness the test is generally a judgment that must be made based on economic considerations of the cost to attend the witness test relative to the consequences if the equipment does not perform at the advertised efficiency and/or capacity. The amount of confidence that SPU and the engineer has in the pump manufacturer to conduct a proper factory test is also a consideration.

e. Each pump provided under this section shall receive a witnessed performance test in accordance with the Test Code for Centrifugal Pumps, Hydraulic Institute Standards, latest edition.

NOTE: Include ONLY when performance testing will be witnessed

5. The Contractor shall include in his price a sum sufficient to reimburse the Engineer for all reasonable expenses which the Engineer will incur in order to witness the test. Expenses are defined here as all direct expenses plus the Engineer's time billed at an average of $1,200.00 per day. The Engineer's time shall include the round trip travel time to and from the factory shop. The sum shall include repetitive visits, if required, and shall be deducted from payments due the Contractor by the Owner.

2.03 Pump Construction

A. The overall pump design shall combine high efficiency, low required NPSH, large sphere passage and the ability to handle high solids concentrations efficiently. The impeller/casing design shall result in a passage free of surfaces to which solid or fibrous materials can adhere. The design shall permit low liquid velocities and gradual acceleration and change of flow direction of the pumped media.

B. Impellers shall be constructed of ASTM A 48 Class 30 gray cast iron, coated with Rilsan or PVC epoxy. The impeller shall be of a centrifugal enclosed, non-clog type, capable of passing fibrous material and 3-inch (minimum) diameter solids.

C. A wear ring system shall be installed to provide efficient sealing between the volute and the impeller. The wear ring system shall consist of a stationary ring made of stainless steel, drive fitted to the volute inlet. Pumps shall also be fitted with a rotating stainless steel wear ring drive fitted to the impeller. The wear rings shall be constructed of 400 series stainless steel having a minimum 300 Brinell hardness.

D. All external pump and motor parts shall be of close grained cast iron, ASTM A48 Class 30, or 300 series stainless steel construction. All external bolts and nuts shall be of 316 stainless steel.

E. A sliding guide bracket shall be an integral part of the pumping unit. The pump casing shall have a machined connection system to attach to the ASTM A48, Class 30 cast iron discharge connection. The sealing system shall consist of two machined metal to metal flanges or flanges with a replaceable rubber seal, form fitted to the machined discharge coupling to insure and guarantee a positive leak proof system and to provide ease of pump removal. The discharge connection shall be bolted to the floor of the sump with 316 stainless steel anchor bolts and so designed as to receive the pump connection without the need of any bolts or nuts. The pump shall be tightly sealed against the discharge connection and shall be accomplished by a simple linear downward motion of the pump with the pumping unit guided by two 2-inch diameter, Schedule 40, 316 stainless steel guides. No portion of the pump shall bear directly on the floor of the sump.

F. The minimum discharge size for the pumps as stated in the Pump Station Data Tables shall be the minimum allowable nominal diameter of the discharge connection provided for attachment of the discharge piping except as allowed otherwise by these specifications. The diameter of the opening at the connection between the pump and the discharge connection should normally be the same as the specified minimum discharge size.

G. Each pump shall be fitted with a 1/4 inch diameter 316 stainless steel lifting cable and 18-inches of 3/8-inch minimum 316 stainless steel chain of adequate strength to lift double the pump's weight. Minimum cable size shall be 1/4-inch. The lifting cable and chain's combined length shall be equal to the wet well depth (top slab finished grade to wet well bottom) plus two feet to permit raising the pump for inspection and removal.

H. The lifting cable shall be attached to a bail on the pump. Eyebolts will not be considered as an acceptable alternate to a lifting bail.

2.04 Submersible Motors

A. Pump motors shall be of the explosion-proof design, Class 1, Division 1 and shall be housed in an air or oil filled water-tight casing, and shall have Class F insulated windings which shall be moisture resistant. The stator shall be dipped and baked three times in Class F varnish and heat shrunk fitted into the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. Motors shall be NEMA Design B with a 1.10 service factor based upon the nameplate horsepower rating. De-rating the motors to achieve the specified service factor will not be acceptable. The motor shall be rated at 155^{o} C or better while operating in an ambient temperature of 40^{o} C. The motor shall be NEMA Code Letter G or H, or better.

B. Motors shall be non-overloading and capable of a minimum of 10 starts per hour across the line, and unlimited number of starts per hour while working on variable frequency drives.

C. Motors shall be provided with the following minimum efficiency at full load:

HP	EFFICIENCY
5	80%
7.5 - 15	82%
20 - 30	84%
40 - 50	85%
60 - 100	88%

D. The pump motors shall be non-overloading within the range of operation between shutoff and the low head run-out conditions shown on the pump station data tables. Maximum brake horsepower (BHP) load of each pump unit shall not exceed the motor full load horsepower rating, excluding service factor, at full load speed.

E. Pump motors shall have cooling characteristics suitable to permit continuous operation in a totally submerged condition. Each motor shall incorporate temperature monitoring devices in the motor windings for use in conjunction with, and supplemental to, external motor overload protection. The temperature device shall be wired into the pump controls in a manner such that if they operate, the pump will shut down. The temperature device shall be self-resetting. All motors shall be provided with a monitoring system to indicate seal leakage. The seal leakage sensor shall indicate the presence of moisture prior to its introduction into the motor chamber or lower bearing assembly. A separate moisture sensor shall be mounted in the motor stator cavity to allow a control panel relay to indicate leakage into the motor.

F. Unless otherwise noted or shown on the Drawings, motors shall be rated at 460 volts, three phase.

G. The pump/motor shaft shall be constructed of ASTM A576 Grade 1035 carbon steel and shall be isolated from the pumped media by a replaceable 316 stainless steel shaft sleeve under the lower mechanical seal. When operating at the pump design point, the shaft shall have a maximum deflection of 0.0002 inches at the lower seal face. The shaft shall rotate on permanently lubricated ball bearings properly sized to withstand the axial and radial forces. The AFBMA Minimum B-10 bearing life shall be at least 50,000 hours.

H. Each pump shall be provided with a tandem mechanical shaft seal system. The upper of the tandem set of seals shall operate in an oil chamber located just

below the stator housing. This set shall contain one stationary silicon carbide or ring and one positively driven rotating carbon ring and shall function as an independent secondary barrier between the pumped liquid and the stator housing. The lower of the tandem set of seals shall function as the primary barrier between the pumped liquid and the stator housing. This set shall consist of a stationary ring and a positively driven rotating ring, both of which shall be either tungsten carbide or silicon carbide. Each interface shall be held in contact by its own spring system. The seals shall not require maintenance or adjustment, but shall be easily inspected and replaceable. Shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower units are not acceptable nor equal to the dual independent seal specified.

I. The pump motor with its appurtenances and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet. All mated surfaces shall be machined, fitted with O-rings for watertight sealing.

J. The pumps shall be provided with a cable entry design that shall preclude specific torque requirements to insure a water tight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet flanked by stainless steel washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function separate from the function of sealing the cable. The assembly shall bear against the shoulder in the pump motor top. The cable entry junction chamber and motor shall be separated by a stator lead, sealing gland or terminal board, which shall isolate the motor interior from foreign material gaining access to the pump motor top. The cable entry system shall be field serviceable.

K. The pumps shall be supplied with power and sensor conductors encapsulated in a single cable. Pump motor cables shall be sized to meet applicable NEC requirements. The cable shall consist of an approved type SPC insulated cable with a double jacketed protection system. The cable shall have a neoprene outside and synthetic rubber inside, and shall exceed industry standards for oil gas and sewage resistance. Individual conductors shall be of type RUW.

L. Watertight connectors, equal to Crouse Hinds Type CGB, with neoprene lands shall be furnished with and installed in the control panel enclosure or disconnect to terminate each conduit and seal each cable entry. Pump cables shall be provided of sufficient length so that the cables will be continuous between the pump and the control panel, main panel or disconnect with no splices being allowed.

NOTE: Delete variable frequency drive references if not applicable.

2.05 Variable Frequency Drives

A. Variable Frequency Drives shall be provided for each pumping system.

B. The variable frequency drives shall be PWM type suitable for use with the submersible motors, as specified above.

C. The variable frequency drives shall be as specified in Section **XX**.

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. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer's recommendations. Anchor bolts shall be set in accordance with the recommendations of a Professional Engineer in the State of Washington, including appropriate seismic considerations.

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. Refer to Section XX.

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 pumps and motors shall be shop coated.

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 shall be of the type required to prevent corrosion during the period of storage and shall be satisfactory to protect the pumps up to the time of the final acceptance test.

3.03 Inspection and Testing

A. General

1. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.

2. In the event that the equipment does not meet the Final Acceptance Test, the Contractor shall, at its own expense, make such changes and adjustments in the equipment which it deems necessary and shall conduct further tests until full satisfaction is indicated by the Engineer and written certification is received thereof.

3. 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. 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.

B. Pumps

1. After all pumps have been completely installed, and working under the direction of the Contractor, conduct in the presence of the Engineer such tests as are necessary to indicate that pumps conform to the Specifications. Field tests shall include all pumps included under this Section. The Contractor shall supply all electric power, water or wastewater, labor, equipment and incidentals required to complete the field tests.

2. The Final Acceptance Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:

   a. That the quick release lift out feature functions properly and allows the pump to be raised and lowered without draining the pit.

   b. That all units have been properly installed and are in correct alignment.

   c. That the units operate without overheating or overloading any parts and without objectionable vibration.

   d. That there are no mechanical defects in any of the parts.

   e. That the pumps can deliver the specified pressure and quantity of raw, unscreened sewage.

   f. That the pump sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper level alarm functions.

3. If the pump performance does not meet the Specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps which satisfy the conditions specified. A 24-hour operating period of the pumps will be required before acceptance.

C. Motors

1. The Contractor shall check all motors for correct clearance and alignment and for correct lubrication in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections if necessary.

TABLE 43-21-37-1

VERTICAL CENTRIFUGAL PUMPS DATA SHEET

Add values for design conditions to complete table based on design requirements. Vendor to fill in any blanks.

Project:		Location: Washington	
Tag No(s).:		Service:	
No. Pumps Req'd:		Provided By: Contractor	No. Motors Req'd: Provided By: Contractor
Pump Mfr.:	Flygt, Wilo, or Equal	Model/Size:	

OPERATING CONDITIONS			
Liquid :	Municipal Wastewater	Per Pump Range of Flows (gpm):	
PT °F Range:	40-85	Parallel Op: YES	Disch. Press. psig :
Sp GR @PT:	1.0	Suct. Press psig: Max.	Rated
Vap Press @PT, psia:	0.5	Diff. Press. Above Min Water Level psi:	
Visc @PT cp :	1.0	Diff Head Above Min Water Level ft :	
Elev. Ft:	500	Installation:	NPSH Avail. ft : Submergence ft:
Corr/Eros. Caused By:	Wastewater		

PERFORMANCE		
Proposal Curve No.	Rotation (View From Top)	
Primary Design Point Flow (gpm)	Primary Design Point Head (ft)	Primary Design Point Efficiency (%)
Intermediate Design Point Flow (gpm)	Intermediate Design Point Head (ft)	Intermediate Design Point Efficiency (%)
Secondary Design Point Flow (gpm)	Secondary Design Point Head (ft)	Secondary Design Point Efficiency (%)
NPSHR Primary	NPSHR Max	Min Submergence
BHP Primary	BHP EOC	BHP Max.
Pump Shut-Off Head (ft)	Min. Continuous Safe Flow (gpm)	

CONSTRUCTION						
Pump Type	Submersible Solids-Handling					
Impeller: Dia.	Max. Dia.	Type	ENCLOSED	Stages		
Suction Size:	Rating					
Discharge Size	Rating					
Mech. Seal: Mfr/Model		Materials				
	Piping Materials					
	Pit Depth	PER DWG				
Pump Max. Allowable Working Press: Suction		Disch.	PSI	Hydrotest Press		
Pump Wt.	LBS (pump + motor)			Gage	YES	

End of Section

SUMMARY SHEET

SECTION NAME: Submersible Wastewater Pump Mounted in Dry Pit

SECTION NUMBER: 43 21 38

PREPARED BY:

REVIEWED BY:

DATE ISSUED: January 3, 2008

DESCRIPTION: Submersible Wastewater Pumps Mounted in a Dry Pit for units using 5 hp motors or larger. Section is written for constant or variable speed units and for raw wastewater service. Section requires system loss curves included at end of Section

REVISION #	DATE	PARAGRAPH(S) Revised

This is an example only. It is not intended for wide use. It is for informational purposes only.

SUBMERSIBLE WASTEWATER PUMPS MOUNTED IN DRY PIT

SECTION 43 21 38

PART 1 GENERAL

1.01 Work Included

NOTE: Edit for specific project – remove reference to VFD if not required.

A. The Contractor shall furnish all labor, materials, equipment and incidentals required and install, place in operation and field test dry pit mounted submersible wastewater pumps as specified herein and as shown on the Drawings. The equipment to be furnished and installed for each station shall include pumps, motors, pump accessories, variable frequency drives compatible with the pumps and all appurtenances, all tested and ready for operation.

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 as offered. It is, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and field testing of all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these Specifications or not.

1.02 Related Contract Work

A. Concrete pump supports, concrete work, and the installation of anchor bolts are included in Division XX; however, anchor bolts for this pump shall be furnished under this Section.

B. Field painting is included in Section **XX**.

C. Electrical work is included in Division **XX**, except as specified herein.

D. Instrumentation and control work, except specified herein, is included in Division **XX**. Instrumentation and controls provided in this section shall adhere to Instrumentation and Control Specifications Sections in Division **XX**.

E. Piping, valves, and appurtenances are included in Division **XX**.

F. Variable Frequency Drives are specified in Section **XX**.

1.03 Reference Standards

A. Design, manufacturing and assembly of elements of the equipment herein specified shall be in accordance with, but not limited to, published standards of the following, as applicable:

1. American Gear Manufacturers 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 Welding Society (AWS)
8. Anti-Friction Bearing Manufacturers Association (AFBMA)
9. Hydraulic Institute Standards (current edition)
10. Institute of Electrical and Electronics Engineers (IEEE)
11. National Electric Code (NEC)
12. National Electrical Manufacturers Association (NEMA)
13. Occupational Safety and Health Administration (OSHA)
14. Steel Structures Painting Council (SSPC)
15. Underwriters Laboratories, Inc. (UL)
16. National Fire Protection Association (NFPA)

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 Design Requirements

NOTE: Edit for specific project – remove reference to VFD if not required.

A. The equipment to be furnished under this section shall include dry-pit submersible wastewater pumps, motors, variable speed drives and accessories, all as specified herein and as shown on the Drawings.

NOTE: The following Paragraph should be used only to reference other Sections or Divisions that have a major impact on the design or bidding requirements of this Section. Include items that are furnished by others or the Owner for installation under this Section; items that are installed under other Sections or by others but furnished herein; and items that could possibly effect the way a bid is prepared if responsibility is not clear. This is an IMPORTANT Paragraph in Multiple Prime Contracts. Add to or delete from as required.

1.05 Submittals

NOTE: Edit for specific project.

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 Section **XX**. 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" x 11" 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.

4. The total weight of the equipment.

5. Drawings showing the layout of the Control Panels and where applicable, Instrumentation Panel. The layout shall show front and side elevations and shall indicate every device mounted on the inner or exterior door and subpanel with complete identification.

6. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, control panels, starters and related systems.

7. A complete total bill of materials of all equipment.

8. A list of the Manufacturer's recommended spare parts with the respective manufacturer's current price for each item. Include gaskets, packing, etc. on the list. Bearings shall be listed by the bearing manufacturer's numbers only.

9. All submittal data required by the General Conditions.

10. Complete motor data, including, but not limited to: type of enclosure design, rated horsepower, rated voltage, FLA, Starting Current, LRA, LR KVA, NEMA Code Letter, rpm, input power in kw at nameplate rating, starting calculations, cable size, efficiency at 50%, 75% & 100% load, and power factor at 50%, 75% & 100% load.

11. Certified agreement to the conditions of the warranty.

B. Test Reports

1. Certified motor test data as described in Section XX.

2. Tabulated data for the drive motors including rated HP, full load RPM, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and KW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply without affecting their design life for bearings or windings.

3. A schedule of the date of shop testing and delivery of the equipment to the job site.

4. Description of pump factory test procedures and equipment.

5. A statement that the pump will function properly as installed with respect to the suction piping layout as shown on the Drawings.

C. Operating and Maintenance Manuals: 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.

D. In the event that the equipment offered does not conform with all of the detailed requirements of the Specifications, describe completely all nonconforming aspects. Failure to describe any and all deviations from the specifications will be cause for rejection.

1.06 Quality Assurance

NOTE: Edit for specific project – remove reference to VFD if not required.

A. To assure unity of responsibility, the pumps, motors, variable frequency drives and other auxiliary equipment, and materials specified in this Section shall be furnished and coordinated by the pump manufacturer (the Manufacturer) who, along with the Contractor, shall assume responsibility for the satisfactory operation of the entire pumping system including pumps, motors, variable frequency drives, controls and accessories.

B. The pumps and other equipment covered by these Specifications shall be standard production units of the manufacturers, currently available and listed in the respective manufacturer's catalog. The pumps furnished shall be in accordance with the Hydraulic Institute Standards and shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

C. The pump manufacturer shall have an authorized warranty center within a 350-mile radius of the job site, fully staffed with factory trained mechanics, and equipped with a stock of all necessary spare parts for each model of pump furnished under this contract. The service facility shall be an established entity prior to delivery of equipment for this project, completely equipped with loaner pumps, spare parts and crane equipped truck. The service facility shall also be capable of providing a 48 hour turnaround time on any pumps brought in for repair. The warranty center shall maintain an inventory of original factory replacement parts, including but not limited to, mechanical seals, bearings, O-rings, stators, impellers and wear rings.

D. All equipment furnished under this Specification shall be new and unused, 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.

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 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 the allowable values as presented in the

Hydraulic Institute Standards at any speed within the specified operating speed range.

G. The pump manufacturer shall have a guaranteed parts stock program, at a distribution center within 350 miles of the job site. The guaranteed stock shall include at least three sets of spare parts, as listed below, for each pump model and size supplied under this Contract. As a part of the shop drawing submittal, the Manufacturer shall furnish a notarized statement that the parts are in stock and available for inspection by the Engineer.

1. Upper and lower mechanical seals
2. Wear Rings
3. Motor Cable
4. Cable Entry Washer/Grommet
5. All O-Rings
6. Inspection plugs and washers
7. Impeller bolts and keys
8. Upper and lower bearing

1.07 Delivery, Storage, and Handling

A. All spare parts shall be properly protected for long periods of storage and packed in containers which are clearly identified with indelible markings as to the contents.

B. All equipment and parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication until final delivery to the job site.

C. All equipment and parts must be properly protected against any damage during a prolonged period at the site.

D. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

E. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto or by other approved means.

F. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

G. After factory testing, 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.

H. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.08 Spare Parts

A. One (1) set of all special tools required for normal maintenance shall be provided by the Manufacturer. All such tools shall be furnished in a suitable steel tool chest, properly labeled to clearly identify the contents, complete with lock and duplicate keys.

B. The Manufacturer shall furnish a complete set of recommended spare parts necessary for the first five (5) years of operation for each pumping station.

1.09 Seismic Requirements (Not Used)

1.10 Warranty

A. All equipment supplied under this section shall be warranted for a period of one (1) year by the Contractor and the pump Manufacturer. Warranty period shall commence on the date of Owner acceptance, as outlined in Division XX.

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 Materials and Equipment

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 work to be done. Ample room shall be provided for inspection, repairs, and adjustments.

B. Each foundation plate for each pump shall be designed to be rigidly and accurately anchored into position. The pumping equipment shall have seismic anchorage calculations prepared by a Professional Engineer registered in the State of Washington. All necessary foundation bolts, plates, nuts, and washers shall be furnished by the Manufacturer for installation by the Contractor.

C. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed, and all other pertinent data shall be permanently attached to each pump and/or motor.

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.

2.02 Pumps - General

NOTE: Delete reference to variable frequency drives if not applicable.

NOTE: List two or three pump manufacturers.

A. The pumps shall be totally submersible, non-clog centrifugal pumps with submersible close coupled motors designed to pump raw, unscreened wastewater. The pumps shall be designed to operate in a dry pit environment with no outside cooling water or water jackets, while operating at varying speeds on variable frequency drives supplied by the Manufacturer. The pumps shall be as manufactured by Wilo, Flygt, or equal.

NOTE: Reference a Table 43-21-38-1, -2, -3… etc. for each pump model referenced in this specification.

B. See the Pumping Station Data Table(s) (Table 43-21-38-1) at the end of this section for the pump performance requirements.

C. Certified Factory Tests:

1. Factory testing in accordance with the Hydraulic Institute standards shall be required for the pumps. 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 pump at the primary operating point listed in Table 43-21-38-1.

NOTE: Delete reference to witness testing if not applicable.

2. 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. A representative of the Engineer and Owner will have the opportunity to witness all performance testing of the pumps. All electronic transducers, meters, gauges, and other test instruments shall be calibrated within forty-five (45) days of the scheduled test and certified calibration data shall be provided to the Engineer at least ten days prior to the Factory Witness test. Differential pressure type flow meters, such as venturis shall have been certified calibrated within 5 years. Mechanical variation of the meter throat diameter will be accepted as verification of calibration validity.

NOTE: Delete reference to NPSH testing if not applicable. NPSH Testing is typically only applicable when the pump model selected has not had prior NPSH testing. For pump models where prior NPSH testing has been conducted, the results of this testing is acceptable.

3. The pump shall be tested 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. The pump will be tested with a suction head (including vapor pressure, velocity head friction loss and static suction head) as required to demonstrate the NPSH required by the pump at the primary operating point listed in Table 43-21-38-1. If the pump fails to meet any specification requirement it will be modified until it meets all specification requirements.

4. The pump manufacturer shall perform the following test on each pump prior to shipment from factory:

   a. Megger motor for insulation breaks or moisture.

   b. Prior to submergence, the pump shall be run dry and checked for correct rotation.

   c. Pump shall be run for a minimum of thirty (30) minutes in a submerged condition.

   d. The pump shall be removed from test tank, meggered immediately for moisture and upper and lower seal unit shall be checked for water intrusion.

NOTE: Edit as necessary if performance test is not to be witnessed. Witness tests are typically only necessary for larger installations where it is critical to achieve the advertised pump performance and to avoid delays during start-

up. Whether or not to witness the test is generally a judgment that must be made based on economic considerations of the cost to attend the witness test relative to the consequences if the equipment does not perform at the advertised efficiency and/or capacity. The amount of confidence that SPU and the engineer has in the pump manufacturer to conduct a proper factory test is also a consideration.

e. Each pump provided under this section shall receive a witnessed performance test in accordance with the Test Code for Centrifugal Pumps, Hydraulic Institute Standards, latest edition.

NOTE: Include ONLY when performance testing will be witnessed

5. The Contractor shall include in his price a sum sufficient to reimburse the Engineer for all reasonable expenses which the Engineer will incur in order to witness the test. Expenses are defined here as all direct expenses plus the Engineer's time billed at an average of $1,200.00 per day. The Engineer's time shall include the round trip travel time to and from the factory shop. The sum shall include repetitive visits, if required, and shall be deducted from payments due the Contractor by the Owner.

2.03 Pump Construction

A. The overall pump design shall combine high efficiency, low required NPSH, large sphere passage and the ability to handle high solids concentrations efficiently. The impeller/casing design shall result in a passage free of surfaces to which solid or fibrous materials can adhere. The design shall permit low liquid velocities and gradual acceleration and change of flow direction of the pumped media.

B. Impellers shall be constructed of ASTM A 48 Class 30 gray cast iron. The impeller shall be of a centrifugal enclosed, non-clog type, capable of passing fibrous material and minimum 3-inch diameter solids.

C. Each pump shall be provided with stainless steel and/or spheroidal graphite (ductile) cast iron wear rings. The wear ring system shall consist of a stationary and rotating wear rings. The rotating wear ring shall be attached to the impeller and shall be of 400 series stainless steel. The stationary wear ring shall either be of 400 stainless steel, or ductile iron for pumping units 200 HP and above.

D. All external pump and motor parts shall be of close grained cast iron, ASTM A48 Class 30, or 300 series stainless steel construction. All external bolts and nuts shall be of 304 stainless steel.

E. The pump casing shall have machined ANSI 125 lb. flanges.

2.04 Submersible Motors

A. Pump motors shall be of the Class 1, Division 1 explosion-proof design.

B. Motors shall be mounted integral to the pump and shall have cooling characteristics suitable to permit continuous variable speed operation in a dry pit installation. All motors shall be capable of operating continuously in a completely dry (non-submerged) condition on a PWM inverter power source with speed ranges from 50 - 100% of full load without the need for external cooling devices and without damage or overheating to the motor or seals. Unless otherwise noted or shown on the Drawings, motors shall be rated at 460 volts, three phase.

C. Motors shall be non-overloading and capable of a minimum of ten starts per hour across the line, and unlimited number of starts per hour while working on variable frequency drives.

D. Motors shall be provided with the following minimum efficiency at full load:

HP	EFFICIENCY.
5	80%
7.5 - 15	82%
20 - 30	84%
40 - 50	85%
60 - 100	88%

E. The pump motors shall be non-overloading within the range of operation between shutoff and the low head run-out conditions shown on the pump station data tables. Maximum brake horsepower (BHP) load of each pump unit shall not exceed the motor full load horsepower rating, excluding service factor, at full load speed.

F. The insulation system of the submersible squirrel cage induction type motor shall be of NEMA Class F using NEMA Class H slot liners. The copper wound stator shall be triple-dipped in epoxy enamel to withstand a temperature of 155^{o} C as defined in NEMA Standard MG-1. De-rating the motors to achieve the specified service factor will not be acceptable. The motor shall be NEMA Code Letter G or H, or better. The motor shall meet NEMA Type B design category requirements for design and construction.

G. Motors shall be cooled by way of a closed loop positively circulated oil system whereby a dielectric type transformer grade oil is pumped via an oil impeller

located on the motor shaft through a labyrinth type heat exchanger and back through the motor thereby completing the loop. The design of this system shall be such that the heat transmission shall take place directly at the pump end of the motor. Motor cooling by circulating the pumped fluid through a cooling jacket will not be accepted.

H. The pump/motor shaft shall be constructed of ASTM A276 420 Stainless Steel or AISI C1034 carbon steel isolated from the pumped liquid by a 316 stainless steel shaft sleeve upon which the outboard mechanical seal shall be mounted. When operating at the pump design point, the shaft shall have a maximum deflection of 0.0002 inches at the lower seal face. The shaft shall rotate on permanently lubricated or regreasable ball bearings properly sized to withstand the axial and radial forces. The AFBMA Minimum B-10 bearing life shall be at least 50,000 hours. If regreasable type bearings are used, the pumps shall be provided with relubrication ports with positive anti-leak plugs for periodic addition of grease to the motor.

I. Two totally independent mechanical shaft seals shall be provided, installed in tandem, each with its own independent spring system acting in a common direction. The upper seal shall be constructed of silicon carbide and shall operate in an oil filled chamber with drain and inspection plug (with positive anti-leak seal) for easy access from external to the pump. The lower seals shall be of the bellows type with both faces of either Tungsten or Silicon Carbide. The seals shall not require routine maintenance or adjustment but shall be capable of being easily inspected and/or replaced.

J. The pump motor with its appurtenances and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet. All mated surfaces shall be machined, fitted with O-rings for watertight sealing.

K. The pumps shall be provided with a cable entry design that shall preclude specific torque requirements to insure a water tight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet flanked by stainless steel washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function separate from the function of sealing the cable. The assembly shall bear against the shoulder in the pump motor top. The cable entry junction chamber and motor shall be separated by a stator lead, sealing gland or terminal board, which shall isolate the motor interior from foreign material gaining access to the pump motor top. The cable entry system shall be field serviceable.

L. The pumps shall be supplied with power and sensor conductors. Pump motor cables shall be sized to meet applicable NEC requirements. The cables shall consist of approved type SPC insulated cables with double jacketed protection system. The cable shall have a neoprene outside and synthetic rubber inside, and shall exceed industry standards for oil gas and sewage resistance. Individual conductors shall be of type RUW.

M. Watertight connectors, equal to Crouse Hinds Type CGB, with neoprene lands shall be furnished with and installed in the control panel enclosure or disconnect to terminate each conduit and seal each cable entry. Pump cables shall be provided of sufficient length so that the cables will be continuous between the pump and the control panel, main panel or disconnect with no splices being allowed.

NOTE: Delete variable frequency drive references if not applicable.

2.05 Variable Frequency Drives

A. Variable Frequency Drives shall be provided for each pumping system.

B. The variable frequency drives shall be PWM type suitable for use with the submersible motors, as specified above.

C. The variable frequency drives shall be as specified in Section **XX**.

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. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer's recommendations. Anchor bolts shall be set in accordance with the recommendations of a Professional Engineer in the State of Washington, including appropriate seismic considerations.

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. Refer to Section XX.

C. Connection of piping to pumps shall be done in presence of the Engineer. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections.

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 pumps and motors shall be shop coated.

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 shall be of the type required to prevent corrosion during the period of storage and shall be satisfactory to protect the pumps up to the time of the final acceptance test.

3.03 Inspection and Testing

A. General

1. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.

2. In the event that the equipment does not meet the Final Acceptance Test, the Contractor shall, at its own expense, make such changes and adjustments in the equipment which it deems necessary and shall conduct further tests until full satisfaction is indicated by the Engineer and written certification is received thereof.

3. 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. 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.

B. Pumps

1. After all pumps have been completely installed, and working under the direction of the Contractor, conduct in the presence of the Engineer such tests as are necessary to indicate that pumps conform to the Specifications. The Contractor shall supply all electric power, water or wastewater, labor, equipment and incidentals required to complete the field tests.

2. The Final Acceptance Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:

a. That all units have been properly installed and are in correct alignment.

b. That the units operate without overheating or overloading any parts and without objectionable vibration.

c. That there are no mechanical defects in any of the parts.

d. That the pumps can deliver the specified pressure and quantity of raw, unscreened sewage.

e. That the pump sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper level alarm functions.

3. If the pump performance does not meet the Specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps which satisfy the conditions specified. A 24-hour operating period of the pumps will be required before acceptance.

C. Motors

1. The Contractor shall check all motors for correct clearance and alignment and for correct lubrication in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections if necessary.

TABLE 43-21-38-1

VERTICAL CENTRIFUGAL PUMPS DATA SHEET

Add values for design conditions to complete table based on design requirements. Vendor to fill in any blanks.

Project:		Location: Washington	
Tag No(s).:		Service:	
No. Pumps Req'd:		Provided By: Contractor	No. Motors Req'd: Provided By: Contractor
Pump Mfr.:	Flygt, Wilo, or Equal	Model/Size:	

OPERATING CONDITIONS			
Liquid :	Municipal Wastewater	Per Pump Range of Flows (gpm):	
PT °F Range:	40-85	Parallel Op: YES	Disch. Press. psig :
Sp GR @PT:	1.0	Suct. Press psig: Max.	Rated
Vap Press @PT, psia:	0.5	Diff. Press. Above Min Water Level psi:	
Visc @PT cp :	1.0	Diff Head Above Min Water Level ft :	
Elev. Ft:	500	Installation:	NPSH Avail. ft : Submergence ft:
Corr/Eros. Caused By:	Wastewater		

PERFORMANCE		
Proposal Curve No.	Rotation (View From Top)	
Primary Design Point Flow (gpm)	Primary Design Point Head (ft)	Primary Design Point Efficiency (%)
Intermediate Design Point Flow (gpm)	Intermediate Design Point Head (ft)	Intermediate Design Point Efficiency (%)
Secondary Design Point Flow (gpm)	Secondary Design Point Head (ft)	Secondary Design Point Efficiency (%)
NPSHR Primary	NPSHR Max	Min Submergence
BHP Primary	BHP EOC	BHP Max.
Pump Shut-Off Head (ft)	Min. Continuous Safe Flow (gpm)	

CONSTRUCTION						
Pump Type	Submersible Solids-Handling					
Impeller: Dia.	Max. Dia.	Type	ENCLOSED	Stages		
Suction Size:	Rating					
Discharge Size	Rating					
Mech. Seal: Mfr/Model		Materials				
	Piping Materials					
	Pit Depth	PER DWG				
Pump Max. Allowable Working Press: Suction		Disch.	PSI	Hydrotest Press		
Pump Wt.	LBS (pump + motor)			Gage	YES	

End of Section

SECTION 43 21 39

SUBMERSIBLE PUMPS CONSTANT SPEED

PART 1—GENERAL

1.01 DESCRIPTION

A. SCOPE:
1. This section specifies submersible pumps for constant speed (on/off cycling) pumping complete with motor, inlet nozzle and discharge fitting, guide bar brackets, access frames, covers and accessories suitable for pumping storm water runoff at constant speed.
2. Manufacturers proposing to furnish equipment specified under this section shall hold current certification under ISO 9001. Application for certification under ISO 9001 shall not be deemed as an acceptable substitute for current certification. Documentation attesting to current certification shall be signed by an officer of the manufacturer's corporation and shall be notarized.

B. TYPE: The pump shall be of the heavy-duty, submersible, vertical shaft, centrifugal nonclog type, suitable for pumping surface water runoff. The pump shall be designed for continuous or cyclic operation under submerged or partially submerged conditions without damage to the pump and motor. Special attention shall be devoted to the shaft design to limit deflection under all operating conditions, as specified in this section.

C. EQUIPMENT LIST:

Item	Equipment number
Pump 1	PMP-201
Pump 2	PMP-202
Pump 3	PMP-203

D. RELATED SECTIONS: The work of the following Sections is related to the work of this Section. Other Sections, not referenced below, may also be related to the proper performance of this work. It is the Contractor's responsibility to perform all the work required by the Contract Documents.
1. Section 01 33 10, Submittals
2. Section 01 66 00, Testing, Training, and Commissioning
3. Section 01 86 01, Structural Data for Architectural Components and Mechanical/Electrical Equipment
4. Section 08 18 00, Floor Access Door
5. Section 40 05 01, General Requirements For Equipment
6. Section 40 05 05, General Requirements for Centrifugal Pumping Equipment
7. Section 40 90 00, Instrumentation and Control for Process Systems

1.02 REFERENCES

A. References shall be as set forth in Section 40 05 05, General Requirements for Centrifugal Pumping Equipment. In addition, this Section contains references to the following documents. They are a part of this section and any referencing section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section or any referencing section and those of the listed documents, the following order of precedence shall prevail (in the order of primacy):
1. This Section
2. Section 40 05 05, General Requirements for Centrifugal Pumping Equipment

3. The referencing Section.
4. The referenced document.

Reference	Title
ASTM B584	Copper Alloy Sand Castings for General Applications
ISO 1940	Mechanical Vibration – Balance Quality Requirements of Rigid Rotors
NEMA MG 1	Motors and Generators
ISO 9001	Quality Systems
UL 674	Motors and Generators, Electric, for Use in Hazardous Locations, Class I, Groups C and D, Class II, Groups E, F, and G.
UL 1207	Sewage Pumps for Use in Hazardous (Classified) Locations

1.03 SUBMITTALS

A. Procedures: 01 33 10, Submittals.

B. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

C. Proof of service of previously installed units of similar size and configuration

D. Shaft deflection calculations

E. Anchorage calculations and required documentation

F. Cooling system calculations.

G. Field vibration test protocol.

H. Warranty.

I. Spare Parts.

J. Setting Plan.

K. Product Data.

L. In addition to the requirements of this section, submittals shall conform to the requirements of the following:

Section 40 05 01 General Requirements For Equipment
Section 40 05 05 General Requirements For Centrifugal Pumping Equipment

1.04 QUALITY ASSURANCE

A. PERFORMANCE CONFIRMATION:
   1. The pump shall be subject to a non-witnessed factory test in accordance with the requirements of Section 40 05 05, General Requirements for Centrifugal Pumping Equipment. The test procedure shall follow the requirements of ANSI/HI 11.6 for Submersible Pump Tests if that document is in force and effect at the time bids are opened for this project. If not, the factory test shall conform to the requirements of ANSI/HI for testing of submersible pumps. Test acceptance criteria shall be Acceptance Level A as established in Table 11.6.3 of ANSI/HI 11.6. Any deviations from specified limiting values shall be subject to review by the Engineer. In addition, the following procedures shall be followed:
      a. Impeller, motor rating and electrical connections shall first be checked for compliance with the specifications.
      b. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
      c. The pump shall be run for 30 minutes submerged, with a minimum of 6 feet of water over the top of the motor. Following this warm-up period, the pump shall be subjected to the performance and NPSHR tests specified in Section 40 05 05, General Requirements for Centrifugal Pumping Equipment.
      d. After satisfactory completion of the performance and NPSHR tests, the motor shall be subjected to a housing leakage test performed under vacuum in accordance with paragraph 11.6.7.2.2 of ANSI/HI 11.6.
      e. All motor circuits, including thermal and moisture sensors and the moisture sensors in the shaft seal area shall be subjected to electrical resistance tests to determine functionality. In addition, the motor shall be subjected to a dielectric high potential test in accordance with paragraph 11.6.7.2.5 of ANSI/HI 11.6.
   2. A written report stating the tests have successfully been completed along with the results of the tests required under Section 40 05 05, General Requirements for Centrifugal Pumping Equipment shall be provided, certified in accordance with Section 40 05 05, General Requirements for Centrifugal Pumping Equipment, as product data.

1.05 PUMPED FLUID AND OPERATING CONDITIONS

A. The fluid to be pumped is screened surface water runoff. The fluid to be pumped will pass through a coarse, fixed metal screen with two inch spacing. The fluid temperature is anticipated to range between 40 degrees F and 90 degrees F and contain solids consisting of grit, street debris accumulations, and organic material with small quantities of petroleum products. Salinity intrusion could potentially occur should the upstream tide gate fail and allow tidal waters into the wet well.

B. The pump will be operated by a control system that will start and stop the pump at constant speed in accordance with Section 40 90 00, Instrumentation and Control for Process Systems.

C. The pumps will be installed in a reinforced concrete wet well designed to provide sufficient space for access to install and remove the equipment. The pumps will be operated at constant speed, responding to a control system that will cycle the pumps in accordance with the specified program..

1.06 PERFORMANCE REQUIREMENTS

A. The performance requirements presented in tabular form below represent the limits of expected extremes in variation of static head, coefficients for pipeline resistance and turbulence losses through fittings and valves. Equipment furnished under this section shall be suitable for continuous operation at any specified condition or any condition lying between the extremes of the operating conditions specified in the following table. The notes presented at the end of the table are intended to be complimentary to the information presented in the table.

Operating condition	PMP-201 and PMP-202	PMP-203
Condition A[1]		
Capacity, cfs	10	20
Total head[3], feet	32	31
NPSHA[3], feet	38	40
Condition B[2]		
Capacity, cfs	11	22
Total head[3], feet	31	30
NPSHA[3], feet	40	40
Condition C[4]		
Capacity, cfs	16	32
Total head[3], feet	20	23
NPSHA[3], feet	48	48

NOTES:

1. Condition A head is presented to indicate operating conditions when the pump is operating **against maximum anticipated system head**, assuming a head-capacity curve attached at the end of this Section. Pumps with head-capacity curves steeper than that assumed will produce somewhat less flow at somewhat lower head. The reverse will occur with pumps having a shallower head-capacity curve. Performance at the rated condition shall be guaranteed in accordance with Section 40 05 05, General Requirements for Centrifugal Pumping Equipment. It is not intended that the pumps be selected for maximum efficiency at Condition A. Pumps furnished under this section should be selected to achieve Condition A performance, but also operate continuously without objectionable vibration or cavitation at the head specified under Condition B. Condition A shall be located in the Allowable Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and published in the manufacturer's published application data for the specific model proposed for this application.

2. Condition B shall be taken as the rated operating condition. **Condition B shall be used for pump selection. Condition B shall be located within the Preferred Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and listed in the manufacturer's published application data for the specific model proposed for this application.** NPSHA, as listed for Condition B is calculated on a pumped flow of 11 cfs.

3. Total head in the above tabulation is the algebraic difference between the discharge head and suction head as defined in ANSI/HI 1.1 through 1.6. Net positive suction head available (NPSHA) in the above tabulation is referred to in ANSI/HI as shown on the drawings and is calculated in accordance with ANSI/HI 1.3 for average barometric pressure and maximum temperature conditions. An allowance of five feet has been included for the presence of volatile constituents in the pumped fluid. NPSHA at the pump impeller eye can be determined by adjusting the given value by proposed pump dimensions and the indicated requirements for pump installation details. ***It is the Contractor's responsibility to make this adjustment and produce calculations justifying the proposed selection.*** Required NPSHA margin shall be as specified in Section 40 05 05, General Requirements for Centrifugal Pumping Equipment.

4. Condition C head is presented to indicate operating conditions when the pump is operating **against minimum anticipated system head**, assuming a head-capacity curve attached at the end of this Section. Performance at the rated condition shall be guaranteed in accordance with Section 40 05 05, General Requirements for Centrifugal Pumping Equipment. It is not intended that the pumps be selected for maximum efficiency at Condition C. Pumps furnished under this section should be selected to

achieve Condition C performance, but also operate continuously without objectionable vibration or cavitation at the head specified under Condition B. Condition C shall be located in the Allowable Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and published in the manufacturer's published application data for the specific model proposed for this application.

1.07 DESIGN REQUIREMENTS

A. Equipment provided under this section shall conform to the following:

Item	PMP-201 and PMP-202	PMP-203
Pump		
Rigid sphere, inches diameter (minimum), capable of passing through the pump from inlet to discharge[1]	3	4
Maximum efficiency, minimum, percent[2]	83	77
Piping connection size, inches, minimum		
Inlet	12	14
Inlet nozzle[3]	26	31
Discharge	16	20
Operating speed, rpm, maximum	705	705
Motor		
Horsepower, maximum	60	125
Motor voltage	460	460

NOTES:

1. The sphere shall be a solid sphere, incapable of compression or distortion of any kind.
2. Efficiency is the minimum acceptable value at the maximum efficiency point on the pump's efficiency/capacity curve for the selected impeller, and is not necessarily to be associated with any specified operating condition. The efficiency stated shall include losses from the inlet through the pump to the discharge fitting. Any additional losses associated with the cooling water system shall also be included.
3. The inlet velocity shall not exceed 4.5 feet per second at Condition Point B as specified in paragraph 1.01 E of this section. A suction nozzle will be required to reduce the suction velocity to 4.5 feet per second or less, and the nozzle length must exceed the difference between the inlet and outlet diameter of the nozzle.

B. Not Used.

C. Pump anchorage systems shall be designed to restrain the unbalanced hydraulic thrust developed by the pump at the specified speed and during the starting and stopping conditions. The pump anchorage provisions shall be designed in accordance with Section 01 86 01, Structural Data for Architectural Components and Mechanical/Electrical Equipment. The analysis for the anchorage system shall include the affect of differential loads imposed by water in the wet well moving in response to the design seismic event.

D. During startup and shutdown of a constant speed pump, the unit may pass through its critical frequency, and vibration will occur. Generally, this vibration is not destructive because of its short duration.

1.08 VIBRATION AND CRITICAL SPEEDS

A. The pump, when operating within the manufacturer's listed POR, as specified in Section 40 05 05, General Requirements for Centrifugal Pumping Equipment, with wet well levels as indicated

for normal (not cleaning) operation, shall comply with the requirements of ISO 1940, GRADE G2.5. Vibration at any specified operating condition that is located outside the manufacturer's listed POR shall not exceed 125 percent of the limiting values in ISO 1940, GRADE G2.5. Vibration levels shall be subject to field verification as specified in paragraph 3.02 of this section.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

A. Wet well and hydraulic design has been based around constant speed submersible pumps provided by Fairbanks Morse. Pump 1 and Pump 2 shall be Fairbanks Morse 16"D5731MV and Pump 3 shall be Fairbanks Morse 20"5731LM&LW or approved equals. All pumps shall be by the same manufacturer. If the Contractor selects an alternate manufacturer, the Contractor shall be responsible for any additional design costs required as a result.

2.02 MATERIALS

A. Material employed for the construction of equipment provided under this specification shall be as follows:

Component	Material
Pump and motor casing	Cast iron, ASTM A48, Class 30
Discharge elbow	Cast iron, ASTM A48, Class 30 or Fabricated Steel
Inlet nozzle and bell	Cast Iron, ASTM A48, Class 30 or forged steel
Impeller	Cast Bronze, ASTM B584
Motor and pump shaft	Stainless steel, ASTM A276 Type 329, 403, or 416
Wearing rings	Cast Bronze, ASTM B584
External bolts and nuts	Stainless steel, ASTM A276 Type 316
Guide bar brackets	Stainless steel, ASTM A276 Type 316
Anchor bolts	Stainless steel, ASTM A276 Type 316
Guide rails, lifting assemblies	Stainless steel, ASTM A276 Type 316

B. Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.03 EQUIPMENT FEATURES

A. GENERAL: The motor and rotating parts shall be removable from the motor end of the pump. All motor mating surfaces where watertight sealing is required shall be machined and fitted with nitrile O-rings. The pump shall be fitted with a dynamically balanced nonclog impeller designed to pass coarse solids and stringy materials. The pump shall conform in all respects to the requirements in UL 1207.

B. CASING: The volute casing shall be a one-piece casting with a tangential or center discharge nozzle. The volute shall be designed for efficient conversion of kinetic to potential energy and shall have clear passageways designed to pass the solid sphere specified under paragraph 1.07

of this section. The cutwater shall be specifically designed for use in fluids with stringy solids and rags. The volute casting shall be specifically designed to bear the loads associated with removal and placement of the pump and to withstand the loads imposed by the operations specified under paragraphs 1.06 and 1.07 of this section. The discharge nozzle shall be not less than the diameter specified under paragraph 1.07 of this section. and shall be reinforced for the loads imposed by the specified conditions of service. The nozzle flange face shall be designed to mate with the discharge fitting specified in paragraph 2.03 L of this section. The volute casing shall be drilled and tapped or otherwise fitted with an inlet nozzle conforming to the requirements specified in paragraph 2.03 K of this section.

C. SHAFT: The pump shaft shall be turned, ground and polished, of proportions suitable for use in the specified application. The shaft shall be of sufficient section to limit deflection at the shaft seal to not more than 1.5 mils when the pump is operating at any continuous-duty point defined by the envelope of conditions specified under paragraph 1.06 of this section. The method for calculating shaft deflection shall be as established in Section 40 05 05, General Requirements for Centrifugal Pumping Equipment. The documentation required under Section 40 05 05, General Requirements for Centrifugal Pumping Equipment shall be included as a submittal along with all other documentation required by paragraph 1.03 of this section.

D. BEARINGS: Bearings shall be heavy-duty, oil lubricated or permanently greased lubricated anti-friction type double shielded and factory sealed. Bearings shall be designed for an L-10 rating life of at least 50,000 hours at any operating condition specified under paragraph 1.06 of this section. Loads for radial bearing calculations shall be calculated in accordance with paragraph 2.03 C of this section.

E. IMPELLER: The impeller shall be dynamically balanced, and have a nonclog design capable of passing solids, fibrous materials, and other matter found in normal storm water runoff applications through to the discharge nozzle. Impellers shall be not less than two-vane design. Fit between the impeller and the shaft shall be a sliding fit with a taper-lock bushing pressed by a screw, which is threaded into the end of the shaft, or a slip fit onto the shaft and drive key and fastened to the shaft by an impeller nut having cover for protection from pumped fluid. A wearing ring system designed for abrasion resistance shall provide efficient sealing between the volute and impeller.

F. MECHANICAL SEALS:
1. The pump shall be provided with a tandem double mechanical seal running in an oil reservoir, composed of two separate lapped face seals. The lower seal unit, between the pump and oil chamber, shall consist of one stationary and one positively driven, rotating tungsten-carbide or silicon-carbide ring, with each pair of rings held in contact by a separate spring. The upper seal unit, between the oil sump and the motor housing, shall consist of one stationary tungsten-carbide or silicon-carbide ring and one positively driven silicon-carbide or rotating carbon ring. Ceramic seals will not be acceptable. The seals shall require neither maintenance nor adjustment and shall be easily replaceable. Conventional double mechanical seals with a single or a double spring between the rotating faces, or that require constant differential pressure to effect sealing and are subject to opening and penetration by pumping forces, will not be acceptable. The pump shall be capable of continuous submergence without loss of watertight integrity to a depth of 65 feet.
2. Each pump shall be provided with a seal lubricant chamber for the shaft sealing system. The seal lubricant chamber shall be designed to assure that an air pocket is provided in the seal lubricant chamber, to absorb the expansion of the seal lubricant due to temperature variations. The drain and inspection plug with positive anti-leak seal shall be easily accessible from the outside.

G. CABLE SEAL: The cable entry water seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet having a close tolerance fit against the cable outside diameter and

the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland, potting chamber or terminal board, which shall isolate the motor interior from foreign material gaining access through the pump top. If a potting chamber is used, the potting procedure shall employ an epoxy-potting compound combined with a procedure that insures penetration of the compound into the individual cable conductor strands to prevent development of wicking pathways for entrance of water into the motor.

H. MOTOR:
1. The pump motor shall be a squirrel-cage induction, shell type design, housed in an air-filled or an oil-filled, watertight chamber, NEMA B type with a service factor of 1.15 based upon nameplate rating and shall be suitable for reduced voltage start via a solid state reduced voltage starter.. The manufacturer shall furnish an unqualified warranty guaranteeing (full replacement at no cost to the Owner) the performance of the motors furnished under this project for a period of five years when operating under the specified conditions. The stator winding and stator leads shall be insulated with moisture resistant Class H insulation, which shall be rated at a temperature of 155 degrees C. The motor shall be designed for continuous duty, capable of sustaining a minimum of 12 starts per hour. The temperature rise of the motor shall not be in excess of that specified in NEMA MG-1 for class B insulating materials when operating continuously under load. Motors shall be Factory Mutual or UL listed in accordance with UL 674 and 1207 for Class I, Group D, Division 2 hazardous atmospheres. The junction chamber, containing the terminal board, shall be hermetically sealed from the motor. Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to a terminal board. The submersible electrical cable shall be of sufficient length to reach the terminal junction box indicated.
2. The cooling system may be of the oil filled or air filled motor housing type. Thermal sensors shall be provided to monitor stator temperatures. The stator shall be equipped with three thermal sensors, embedded in the end coils of the stator winding (one sensor in each stator phase). These shall be used in conjunction with external motor overload protection and wired to the control panel. The design shall be suitable for continuous motor operation at listed motor rating in 90 degree F water.
3. The cooling system may rely on radiation of excess heat energy to the fluid in the wet well or, alternatively, the pumped fluid via a closed circuit circulating system utilizing either oil or glycol, or a combination of these. It is specifically required that the cooling system must be compatible with the contemplated control schedule, which may require that the motor case to be exposed continuously or intermittently. Cooling systems shall not employ the pumped fluid to directly cool the motor through storm water passageways incorporated into the motor shell. It is preferred that the motor be cooled by the storm water via fins incorporated into the motor shell. If an internal liquid circulation system is employed for cooling purposes, the liquid shall be glycol or heat transfer oil, which shall in turn circulate past heat exchange surfaces incorporated into the cavity behind the pump impeller.
4. If the motor is an oil-filled type, it shall be positively cooled by circulating oil through the windings to passages within the pump designed as a heat exchanger to transfer heat to the pumped fluid. Vanes cast into the rear impeller shroud shall be provided to circulate pumped flow past a heat exchanger in the shaft seal area to provide the required cooling. Cooling water passages in the motor's shell are specifically prohibited. The system shall be designed to prevent clogging by virtue of dimensions and configuration and shall be specifically configured to maintain motor temperatures within conservative limits when the pump is operating at any speed under the operating conditions specified.

I. MOISTURE DETECTORS: An electronic moisture detection system shall be provided with leakage sensors. A leakage sensor shall be located in the motor housing and shall be specifically designed to detect the presence of water in the motor housing. A second moisture sensor shall be provided between the tandem mechanical seals. All leakage sensors shall be wired to a relay box. Dry contacts rated for 24 Vdc shall be provided for connection to the station's PLC.

J. VENDOR RELAY BOX: A NEMA 7X (stainless steel) vendor relay box shall be provided for termination of the thermal sensor and moisture detector leads to and connection to the monitoring system indicated. The vendor relay box shall be a separate box from that shown for the motor power terminal junction box used to transition the manufacturer power supplied cable to Division 26 cable. 120 volt AC power shall be provided to the vendor relay box.

K. INLET NOZZLE: The inlet nozzle may be of commercially available forged steel fittings or cast iron. The final configuration of the inlet bell and nozzle shall be selected to efficiently convey the pumped fluid into the impeller eye. Dimensions shall be as specified in paragraph 1.01 F of this section.

L. PUMP ANCHORAGE, GUIDE SYSTEM AND ACCESS COVER:
1. The pump shall be provided with a guide system to allow easy removal of the pump without entering the wet well. The guide rail system shall be of the dual rail type. The discharge connection shall be bolted to the structure as indicated and shall serve as a lower attachment for the guide rails. The discharge connection shall be elbow discharge type. The anchorage system shall be designed to transmit the forces safely to the structure. Calculations and supporting documentation justifying the support design shall be provided with the submittals required under Section 40 05 05, General Requirements for Centrifugal Pumping Equipment.
2. The pump and guide rail system shall be designed to automatically connect the pump to the discharge piping when lowered into place on the discharge connection. The design shall be non-sparking and shall conform to UL requirements for installation in a location classified in accordance with NFPA 70, Article 500 for Class 1, Group D, Division 2 locations. When in place, the connection shall form a watertight seal with the discharge fitting. The pump shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be removed for this purpose, and no need for personnel to enter the pump wet well or sump. Sealing of the pumping unit to the discharge connection shall be accomplished by a simple linear downward motion of the pump with the entire weight of the pumping unit guided to and pressing tightly against the discharge connections. No portion of the pump shall bear directly on the floor of the sump and no rotary motion of the pump shall be required for sealing. Guide bars provided for directing the pump into position or for removing the pump for maintenance shall steer the pump into proper contact with the discharge elbow. Once the pump has been positioned on its support fitting at the discharge fitting, the guide bar system shall not be required for pump support.
3. Access doors shall provided for access to pumps where specified. Doors shall be provided in accordance with Section 08 18 00, Floor Access Door.

2.04 ACCESSORIES

A. The pump shall be provided with lifting chains, guide bars, upper guide bar brackets, intermediate guide bar brackets, cable holder assemblies, safety chain hook assemblies, discharge elbow connections, anchor bolts, and all other accessories necessary to complete the installation as specified. All connecting hardware and miscellaneous attachments shall be constructed out of ASTM A276, Type 316 stainless steel.

2.05 SPARE PARTS

A. The following spare parts shall be provided for each pump:
2 sets--all gaskets
2 sets--all bearings
2 sets--mechanical seals

B. Spare parts shall be packed and boxed as specified in paragraph 2.12 of Section 40 05 01, General Requirements for Equipment.

PART 3--EXECUTION

3.01 INSTALLATION

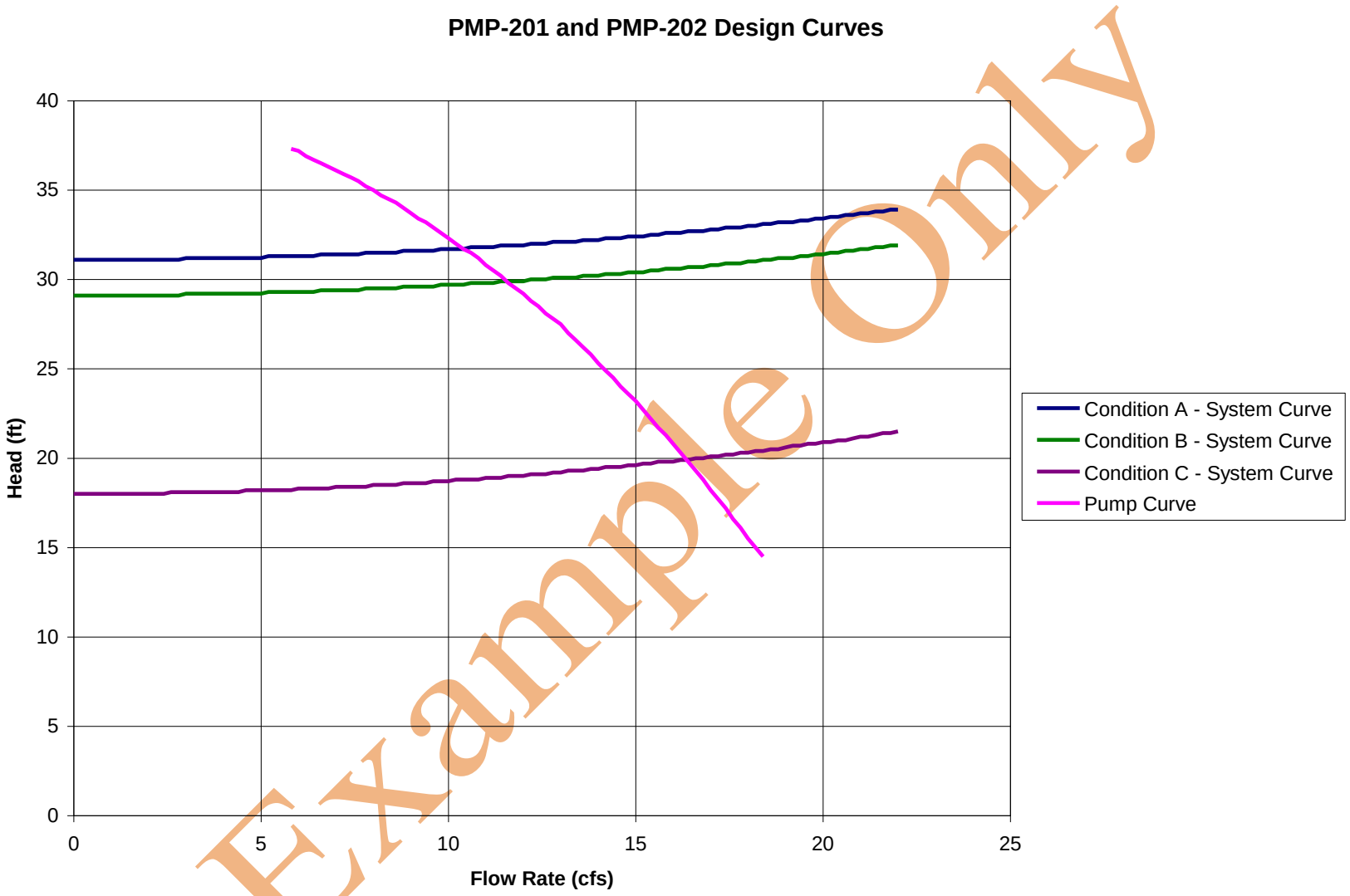
A. Execution shall conform to the requirements set forth in Section 40 05 05, General Requirements for Centrifugal Pumping Equipment.

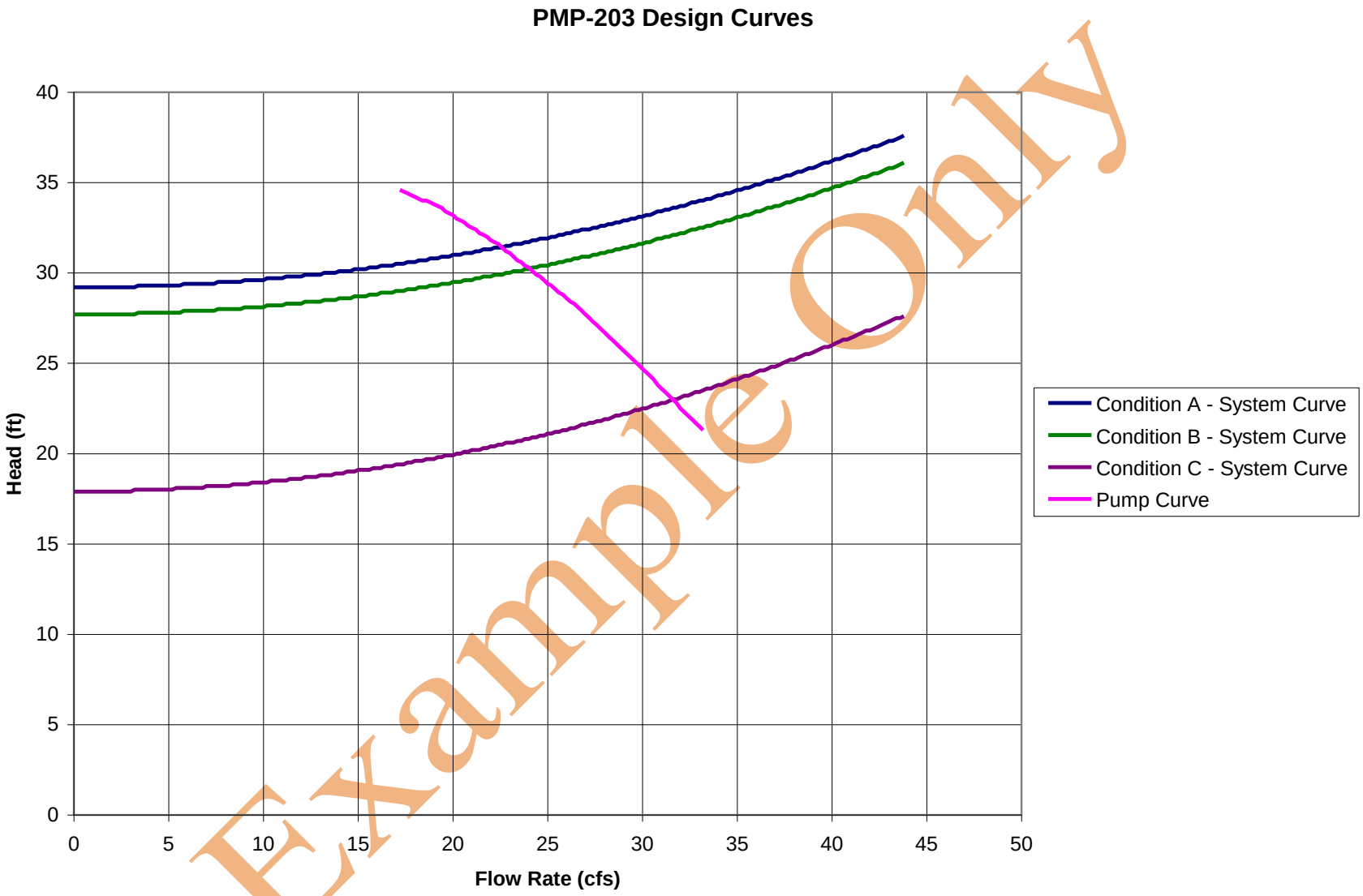
3.02 FIELD TESTS

A. In addition to the field test required under Section 01 66 00, Testing, Training, and Commissioning, each pump shall be subject to a field vibration test. Vibration levels shall be determined by affixing suitable sensors to the top of the motor housing in both the x-x (parallel to the nozzle) and y-y (perpendicular to the nozzle) directions. The Contractor shall provide all sensors and monitoring equipment. As a condition precedent to final acceptance of the equipment, the pumps shall be individually operated at all specified operating conditions. The Contractor shall provide the means to recirculate pumped fluid or alternatively throttle the pumps to achieve the specified head at specified flow. Vibration levels shall not exceed that specified in paragraph 1.08 of this section when the pump is operating within the manufacturer's listed POR as determined in accordance with Section 40 05 05, General Requirements for Centrifugal Pumping Equipment. When operating at conditions outside the POR, vibration levels shall be no more than 125 percent of that specified in paragraph 1.08 of this section.

3.03 WARRANTY

A. In addition to the guarantee requirements specified in Section 00 72 00, General Conditions, the Contractor shall cause the pump manufacturer to warrant the units against defects in materials and workmanship for a period of 5 years or 10,000 hours under the specified uses and with normal operation and service. This warranty shall be delivered, in writing, to the Owner and shall include, as a minimum, 100 percent full payment coverage for parts and labor during the first 60 months or 10,000 hours of operation, whichever occurs first.





END OF SECTION

SUMMARY SHEET

SECTION NAME: Submersible Sump Pump

SECTION NUMBER: 43 21 43

PREPARED BY:

REVIEWED BY:

DATE ISSUED: January 4, 2008

DESCRIPTION: Submersible Sump Pumps for pumping of nuisance water that accumulates in a wastewater pump station dry pit

REVISION #	DATE	PARAGRAPH(S) Revised

This is an example only. It is not intended for wide use. It is for informational purposes only.

SUBMERSIBLE SUMP PUMP

SECTION 43 21 43

PART 1 GENERAL

1.01 Work Included

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install, complete and ready for operation submersible sump pumps as shown on the Drawings and as specified herein.

1.02 Related Contract Documents

A. Piping, valves, and supports are specified in Division **XX**.

B. All the equipment specified herein is intended to be standard equipment for pumping solids-bearing water that has been collected in sumps.

1.03 Reference Standards (Not Used)

1.04 Design Requirements (Not Used)

1.05 Submittals

A. Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with the provision of the General Conditions and Section **XX**. Submittals shall include at least the following:

1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations and sizing.

2. Descriptive literature, bulletins, and/or catalogs of the equipment.

3. Data on the characteristics and performance of each size pump. Data shall include guaranteed performance curves, based on actual shop tests of duplicate units, which show that they meet the specified requirements for head, capacity, efficiency, allowable NPSH, allowable suction lift, and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets.

4. The total weight of the equipment including the weight of the single largest item.

5. A complete total bill of materials for all equipment.

6. A list of the Manufacturer's recommended spare parts 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.

1.06 Quality Assurance

A. All pumps shall be the product of a single Manufacturer.

B. The pumps covered by these Specifications shall be standard production units of the manufacturers, currently available and listed in the respective manufacturer's catalog. The pumps furnished shall be in accordance with the Hydraulic Institute Standards and shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

1.07 Delivery, Storage, and Handling (Not Used)

1.08 Spare Parts (Not Used)

1.09 Seismic Requirements (Not Used)

1.10 Warranty

A. The equipment supplied under this section shall be warranted for a period of one (1) year by the Contractor and the Manufacturer. Warranty period shall commence on the date of Owner acceptance, as outlined in Division **XX**.

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.

PART 2 PRODUCTS

2.01 Materials and Equipment

A. The equipment covered by these Specifications is intended to be standard pumping equipment of proven ability as manufactured by a manufacturer 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. The pumps shall be manufactured by Hydromatic or equal.

B. The equipment shall be installed as shown on the drawings. If equipment is provide with connections different than that shown on the drawings, the Contractor shall provide the necessary fittings and components to provide a workable system as approved by the Owner.

C. Brass or stainless steel nameplates giving the name of the Manufacturer, the rated capacity, head, speed, serial number, model number, horsepower, voltage, amperes and all other pertinent data shall be attached to each pump.

D. The nameplate ratings for the motors shall not be exceeded at any point on the pump curve, nor shall the design service factor be reduced when its pump is operating at any point on its characteristic curve at maximum speed. The pump curve shall have a continuously rising head along the entire curve to shut-off head.

2.02 Submersible Sump Pumps

A. General:

1. The sump pumps shall be heavy duty submersible type with impellers designed to handle solids. The pump shall be installed in the sump as shown on the Drawings. One additional pump of the same design shall be provided to the Owner as a spare.

B. Performance Requirements:

1. The sump pumps shall be designed and manufactured as specified for the following conditions of service:

   a. Discharge size – _____inches (minimum)

   b. Capacity - _____ gpm @ _____ ft of head

   c. Shut-off Head - _____ feet (minimum)

   d. Solid passing size – _____-inch

   e. Motor horsepower (maximum) - _____

C. The casing shall be cast iron.

D. Impeller shall be bronze of the solids-handling type.

E. Motor shall be oil filled for continuous duty and be controlled by a diaphragm switch. Motor shall be rated for 120V, single phase 60 Hz.

Note: Delete reference to explosion proof design for applications such as potable water pump stations that do not require a n explosion proof rating

F. Pump motors shall be of the Class 1, Division 1 explosion-proof design.

G. Shaft shall be heavy-duty Type 304 or 316 stainless steel.

2.03 Tools and Spare Parts

A. One set of all special tools required for normal operation and maintenance shall be provided by the Manufacturer.

B. Provide one additional pump of the same design as a spare.

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.

B. Supply all anchor bolts, power, water, labor, and all other incidentals required for the proper installation of the pumps.

NOTE: Confirm that the diameter of discharge line is compatible with the pump discharge

C. Each sump pump installation shall be installed complete with 1¼-inch PVC discharge line as required, with ball valve, check valve, PVC discharge pipe and stainless steel pipe supports (max. 5 feet on center).

D. Core drill new penetrations, or use available existing penetrations to run the sump pump discharge lines to the wet wells (minimum four feet above the high water level).

E. 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 and care of each unit.

3.02 Surface Preparation and Shop Painting

A. All surfaces shall be prepared and shop primed as part of the work under this Section. Surface preparation and shop priming shall be as specified in Division **XX**.

3.03 Field Painting

A. Field painting is included in Division **XX**.

3.04 Inspection and Testing

A. Contractor shall perform a drawdown test of each sump pump to confirm it is operating on its pump curve.

B. Vendor Test and Start-Up Services

1. The equipment manufacturer(s) shall furnish the services of a competent and experienced representative(s), who has complete knowledge of proper operation and maintenance of the equipment to inspect the installed equipment, supervise the initial test runs, provide start-up support, and perform field performance testing.

2. The factory representative shall be on-site for one (1) 8-hour day to instruct representatives of the Owner and the Engineer on proper operation and maintenance of the equipment.

3. If there are difficulties in start-up, testing, or operation of the equipment additional services may be required and shall be provided at no travel additional cost to the Owner.

4. 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. 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

TABLE 43 21 43-1

SUMP PUMP DATA SHEET

Add values for design conditions to complete table based on design requirements. Vendor to fill in any blanks.

Project:		Location: Washington	
Tag No(s).:		Service:	
No. Pumps Req'd:		Provided By: Contractor	No. Motors Req'd: Provided By: Contractor
Pump Mfr.:	Hydromatic, Zoeller, or Equal	Model/Size:	

OPERATING CONDITIONS			
Liquid :	Municipal Wastewater	Per Pump Range of Flows (gpm):	
PT °F Range:	40-85	Parallel Op:	Disch. Press. psig :
Sp GR @PT:	1.0		Suct. Press psig: Max. Rated
Vap Press @PT, psia:	0.5		Diff. Press. Above Min Water Level psi:
Visc @PT cp :	1.0		Diff Head Above Min Water Level ft :
Elev. Ft:	500	Installation:	NPSH Avail. ft : Submergence ft:
Corr/Eros. Caused By:			

PERFORMANCE			
Proposal Curve No.			
Primary Design Point Flow (gpm)		Primary Design Point Head (ft)	
NPSHR Max			Min Submergence
BHP Max			
Pump Shut-Off Head (ft)			

CONSTRUCTION					
Pump Type	Submersible Solids-Handling				
Impeller: Dia.		Max. Dia.		Type	
Suction Size:		Rating			
Discharge Size		Rating			
				Piping Materials	
				Pit Depth	PER DWG
Pump Max. Allowable Working Press: Suction		Disch.	PSI	Hydrotest Press	
Pump Wt.	LBS (pump + motor)			Gage	YES

End of Section