VERTICAL TURBINE PUMPS

PART 1 - GENERAL

1. SCOPE

1.1 This section covers the furnishing of vertical turbine pumping unit(s) as required and to the expectations of the ENGINEER with regards to the manufacture of the equipment.

1.2 The Vertical Turbine pump(s) specified in this section shall be furnished by and be the product of one manufacturer. All components of the pumping unit must be supplied by and warranted by the pump OEM (original equipment manufacturer) including bowls, impellers, column, shafting, discharge heads, couplings, seals, suction barrels (if applicable) and motors. Well drillers, distributors, or other fabrication shops will not be allowed to furnish equipment built or modified in their local fabrication shop. A letter from the pump OEM must be provided as part of the submittal confirming that they accept responsibility for the warranty of the entire pumping unit. Equipment furnished under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by ENGINEER.

1.3 Except as modified or supplemented herein, all vertical turbine pumps shall conform to the most recent edition of ANSI/AWWA E103 and Hydraulic Institute Standards.

2. SUBMITTALS

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

- Name of manufacturer.
- Type and model.
- Design rotative speed.
- Number of stages.
- Type of bowl bearings.
- Type of line shaft bearings.
- Size of shafting.
- Size of pump column.
- Size of discharge outlet.
- OD of pump bowls.
- Weight.
- Data on shop painting.
- Max overall dimensions.
- Total Weight.
- Complete performance curves showing capacity versus head, NPSH required, efficiency, and BHP plotted scales consistent with performance requirements.
- If the pumps are operating on VFD and motor horsepower is 150 HP or greater, perform and submit Reed Critical Frequency calculations showing that the

design of the head has been engineered to push any critical 20 percent above or below the specified operating range.

2.2 Adequate operation and maintenance information shall be supplied. Operation and maintenance manuals shall be submitted in accordance with the submittals sections. The operation and maintenance manuals shall be in addition to any instruction or parts lists packed with or attached to the equipment when delivered. Operation and maintenance manuals shall include the following:

- Equipment function, normal operating characteristics, and limiting conditions.
- Assembly, installation, alignment, adjustment, and checking instructions.
- Operating instructions for startup, routine, and normal operation, regulation and control, shutdown, and emergency conditions.
- Lubrication and maintenance instructions.
- Guide to troubleshooting.
- Parts lists
- Outline, cross-section, and assembly drawings; engineering data; and wiring diagrams.
- Test data and performance curves, where applicable.

3. QUALITY ASSURANCE

3.1. The pump manufacturer shall be certified to the ISO 9001 standard for design and manufacture of vertical turbine pumps.

4. WARRANTY

4.1 The manufacturer shall warrant their pumps to be free of defects in material and workmanship for a period of one (1) year after the product is first put into operation or 18 months after date of shipment, whichever occurs first.

5. DELIVERY,STORAGE,AND HANDLING

5.1 The pumps shall be adequately supported during transit to ensure the pumping unit is not subjected to undue stresses.

5.2 Spare parts shall be furnished as specified. Spare parts shall be suitably packaged with labels indicating the contents of each package. Spare parts shall be delivered to OWNER as directed.

5.3 Final documentation shall be delivered electronically.

PART 2 - PRODUCTS

6. MANFACTURERS

6.1 SIMFLO, LLC

6.2 Or Pre-Approved Equal

Note: This specification was developed using design criteria from SIMFLO, LLC. Other manufacturers will be considered as long as they meet the performance and quality requirements specified within. Any "or equal" substitution must be submitted to the design engineer two weeks before the bid date for pre-approval. If approved, the manufacturer will be listed by addendum.

7. PERFORMANCE AND DESIGN REQUIREMENTS

7.1 Pumping units shall be designed for the performance and design requirements as required, at maximum speed unless otherwise noted.

7.2 If the pumps are to be run utilizing a variable frequency drive, the pump curve shall be continuously rising and shall be free from dips and valleys from the design point to the shutoff head. The shutoff head shall be at least **(XXX%)** of the head that occurs at the design point.

7.3 For design and rating purposes, the water to be pumped shall be assumed to have a temperature of 70°F.

7.4 Pump performance shall be stable and free from cavitation, vibration, and noise within the operating head range and shall conform to the requirements and recommendations of the latest Hydraulic Institute Standards.

7.5 The pumping application required for this project demands equipment that will operate reliably for many years. Unscheduled downtime is unacceptable to the client, and it is the objective of this specification to deliver the highest quality equipment that is fit for purpose.

7.6 The pump shall not be operated where the ratio of rotative speed to the critical speed of a unit or its components shall be less than 0.8 or more than 1.2.

7.7 The complete pumping unit shall conform to the vibration requirements set forth in Hydraulic Hydraulic Institute Standards. (SIMFLO is not responsible for field vibration testing or compliance.) (Field balancing may be required)

8. SERVICE CONDITIONS

Service	XXX
Tag Numbers	XXX
Quantity	X
Design Flow (GPM)	XXX
Design TDH (ft)	XX
Minimum Bowl Efficiency at Design Point (%)	XXX
Maximum Speed at Design Point (RPM)	XXXX
Secondary Point A Flow (GPM)	XXXX
Secondary Point A TDH (ft)	XXX
Minimum Bowl Eff at Secondary Point A (%)	XXX
Secondary Point B Flow (GPM)	XXXX
Secondary Point B TDH (ft)	XXX
Minimum Bowl Eff at Secondary Point B (%)	XXX
Minimum Shutoff TDH (ft)	XXX
Minimum Flow using VFD) (GPM)	XXX (XXX RPM)
Minimum TDH using VFD) (ft)	XXX (XXX RPM)
Minimum Bowl Efficiency at Minimum Point (%)	XXX
Maximum Motor HP	XXX
Pump Operation	Variable/Fixed Speed
Minimum Column Diameter (in)	XX
Minimum Discharge Diameter (in)	XX
Minimum Line Shaft Diameter (in)	XXX

9. PUMP CONSTRUCTION

9.1 NSF61 CERTIFICATION

9.1.1 The complete pump assembly shall be certified to NSF/ANSI standard 61. This certification shall cover all wetted components of the pump, including but not limited to the bowl assembly, column assembly, discharge head assembly and suction barrel (when applicable). Manufacturers without NSF61 certification will not be considered. The pump manufacturer's NSF listings can be found on the NSF website. The pump discharge head shall be fitted with a separate nameplate displaying the NSF61 logo. No exceptions.

9.2 BOWL ASSEMBLY

9.2.1 The pump bowl assembly shall be SIMFLO Pump model XXXX or pre-approved equal. The pump bowls shall be constructed of the material as listed under the subsection "materials of construction". The bowls shall be accurately machined and flanged with machined rabbit-fit connections. The water passages of pump bowls size 6" through 14" shall have vitreous porcelain enamel lining and 16" and larger shall have ScotchKote™ Fusion Bonded Epoxy 134 both to reduce friction losses. The waterways and diffusion vanes shall be smooth and free from nodules, bumps and dips and shall be cast of high quality free of blow holes, sand holes and other detrimental defects. The bowl assembly shall be fitted with a suction bell including integral cast ribs supporting the suction bearing and sand collar to protect the suction bearing from abrasives. The suction bearing shall be permanently packed with food grade grease, and shall have a length not less than two times the shaft diameter. The bowl bearings are to be lubricated by the product being pumped and located above and below each impeller. All bearings shall be sleeve type of the material listed in the subsection "materials of construction." When applicable, the bowl bolting material shall be as listed in the subsection "materials of construction."

9.2.2 **(Optional)** [*The bowls shall have Nitrile or Viton "O" rings fitted to custom machined grooves. There shall be zero leakage between flanged joints.]* **(Optional)** *[Fit all bowls and/or impellers with renewable wear ring(s). The wear rings shall be constructed of material as outlined in the subsection "materials of construction". The bowl and impeller wear ring faced shall have a minimum Brinnell hardness difference of 50BHN or use galling running clearance].*

9.2.3 The impellers shall be cast in one piece of the enclosed type and constructed of the material listed in the subsection "materials of construction". The impellers shall be statically or dynamically balanced. The impeller shall be securely fastened to the shaft with taper split bushings (collets) of the material listed in the subsection "materials of construction" for bowl shafts 2-3/16" nominal diameter and smaller or with keyed connections for bowl shafts larger than 2-3/16" nominal diameter. The bowl shafting shall conform to the material listed in the subsection "materials of construction" **(Optional)** *[With hard chrome plating no less than .007" hard chrome per side, and Brinell hardness no less than 500].* Shall have pump shaft quality dimensional tolerances of +.000" .002"

and shall be straightened to within .0005" total indicated reading per foot of length or .002" TIR, whichever is greater. The bowl shaft shall be of sufficient diameter to transmit the pump horsepower with a safety factor consistent with AWWA pump shaft standards. Impellers shall be adjusted vertically by external means and shall have sufficient axial clearance for reliable service in accordance with the specified operating conditions.

9.2.4 The suction bell shall be fitted with a heavy gauge wire woven basket type strainer, of the material listed in the subsection "materials of construction." The strainer shall have a net inlet equal to at least four times the suction pipe area. The maximum opening shall not be more than 75% of the minimum opening of the water passage through the bowl and impeller. The strainer shall be secured to the suction bell by means of bronze clips and 300 series stainless steel cap screws.

9.3 COLUMN ASSEMBLY

9.3.1 The column pipe shall include flanges to be made of ASTM A36 HR steel. The flanges shall include a female register to ensure proper alignment and be machined for drop-in bearing retainers. The column pipe shall be constructed of material conforming to ASTM A53 Gr. B steel with a minimum wall thickness as listed under the subsection "service conditions." The weight of the column pipe shall be no less than that stated in ANSI/AWWA Specification E103. The column diameter will be sized such that friction loss will not exceed 5' per 100', based on the rated capacity of the pump. When applicable, the column diameter shall also be sized based on the avoidance of critical speeds including a +/- 25% operational margin. Column length shall not exceed 10' for pumps running at 1800 RPM and slower and 5' lengths for pumps running at 3600 RPM. The top and bottom sections shall not exceed 5'. Flange bolting shall be provided in the materials as listed in the subsection "materials of construction."

9.3.2 The column line shaft shall be turned and ground and manufactured of the material listed in the subsection "materials of construction." **(Optional)** *[with hard chrome plating no less than .007" hard chrome per side, and Brinell hardness no less than 500]*. They shall be furnished in interchangeable sections not over 10 feet in length. The butting faces shall be machined square to the axis of the shaft with maximum permissible misalignment of the thread axis with the shaft axis 0.002" in 6". The line shaft shall be of sufficient diameter to transmit the pump horsepower with safety factor consistent with ANSI/AWWA- E101 Specifications, Section 5.5 and shall be such that elongation due to hydraulic thrust will not exceed the axial clearance of the impellers in the pump bowls. When applicable, the line shaft shall also be of sufficient diameter to avoid critical speeds including a +/- 25% operational margin. Maximum shaft run out shall not exceed 0.005" in 10 feet. The line shaft bearings shall be sleeve type provided of the material listed in the subsection "materials of construction" and are to be lubricated by the product being pumped. **(Optional)** [*Line shaft bearing spacing shall be such that the shaft first critical frequency shall include an operational tolerance of 25% above and below the operating frequency.*]

9.3.3 **(Optional)** *[The column flange joints shall have Nitrile or Viton rubber "O" rings fitted to custom machined grooves.]*

9.3.4 **(Optional)** *[Line shafts shall be coupled with split ring and key type couplings for ease of disassembly.]*

9.3.5 For 12" and smaller column diameter, bearing retainers shall be of the drop-in type held in place by compression of the butted ends of the column pipe. For 14" and larger column diameter, bearing retainer shall be fabricated carbon steel and integral to the column pipe.

9.4 DISCHARGE HEAD

9.4.1 The discharge head shall be fabricated of carbon steel materials using ASTM A181 flanges, ASTM A53 Grade B body pipe and ASTM A36 HR carbon steel plate. The discharge head shall be for above ground discharge with sufficient strength and rigidity to support the attached vertical motor or driver and carry the suspended weight of the attached column and bowl assembly. All wetted pressure retaining parts shall be designed for a maximum working pressure equal to the pump shut off head. The discharge flange shall be sized to match the column diameter and have a 150# ANSI raised face with bolt holes straddling the vertical centerline. A ¼" NPT pressure gauge connection shall be supplied on the top centerline of the discharge outlet. The base of the discharge head shall be circular and fully finished machined on the bottom. The top of the discharge head shall be machined to accept a standard NEMA P base, driver and have a diameter equal to the driver base diameter (BD). The head shaft shall be coupled to the top line shaft beneath the motor to facilitate ease of assembly and maintenance. Head shall be in all respects equal to SIMFLO type "L". All couplings and other moving or rotating parts shall be covered on all sides by a fabricated OSHA approved coupling guard. Coupling guards shall include an integrated hinged door for access to coupling and mechanical seal/packing. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. The pump shall be furnished with a SS nameplate securely mounted to the discharge head. At a minimum it shall contain information providing (design flow, design TDH, HP, RPM, bowl model number, number of stages, manufacturer serial number, pump type and impeller setting dimension).

9.4.2 A rigid flanged adjustable "spacer" type motor coupling shall be provided to couple the motor shaft to the pump shaft. The spacer shall be of sufficient length to allow the mechanical seal to be removed without disturbing the motor. The motor coupling shall be a three-piece or spacer type four-piece rigid coupling. The coupling shall be of steel, designed to transmit the required torque and horsepower of the attached pump and other rotating elements. The pump side of the coupling shall be keyed to the head shaft. The motor side shall have a radial key to support down thrust and an axial key to transmit torque. A threaded adjusting nut shall be located above the pump side coupling component to allow for the vertical adjustment of the shaft mounted impellers.

The coupling shall be designed to prevent movement due to up thrust and held concentric by means of machined registers.

9.4.3 The discharge head shall be fitted with a mechanical seal. The seal housing shall be of ASTM A48 Class 30 cast iron. The seal shall be of the cartridge type, sleeve mounted, easily replaceable and have its face continuously flushed with the product being pumped. The mechanical seal shall include 316 stainless steel metal parts. The mechanical seal shall have a carbon stationary face, a tungsten carbide rotating face, and fluorocarbon O-rings. The mechanical seal shall be rated for 600 psi and 400 Deg F. A seal housing bearing of the material listed in the subsection "materials of construction" shall be installed directly below the mechanical seal for stability. A nitrile O-ring shall be used to seal the seal housing to the discharge head. The seal shall be equivalent to the Chesterton 155 or John Crane 5610.

9.4.4 The pump shall be mounted and supported by a separate foundation baseplate. The baseplate shall be of ASTM A36 HR carbon steel. The baseplate shall be drilled to match the base flange drilling of the discharge head. The baseplate shall be square with radius corners, equal to or greater than the size of the base of the discharge head. The baseplate shall be uniformly faced on one side, with four drilled holes provided, one at each corner to accommodate anchor bolts. Abutting surfaces between the baseplate and the discharge head shall be machined to provide 100% surface contact with the discharge head base. The center opening diameter shall be of sufficient size to permit installation and removal of the complete pump assembly. The baseplate shall be permanently anchored, grouted and leveled within 0.003 inches per foot by the installation contractor.

9.4.5 **(Optional)** *[Anchor bolts of sufficient diameter and quantity shall be furnished by the pump manufacturer to restrain the pump against shutoff pressure reactionary forces. The entire anchor bolt, nuts and washers are to be on the material as listed in the subsection "materials of construction." They shall be of the sleeve type or "L" type construction.]*

9.5 FACTORY TESTING

9.5.1 Each pumping unit consisting of the actual discharge head, column and bowl assembly to be supplied in the field shall be tested at the factory for capacity, power requirement, and efficiency at minimum head, rated head, shutoff head or point of discontinuity, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall conform to the requirements and recommendations of the Hydraulic Institute Standards. Acceptance criteria shall be Grade 1U as defined by table 14.6.3.4 in Hydraulic Institute 14.6 – 2022. The owner reserves the right to witness the performance tests. When witness testing is specified, the pump manufacturer shall notify the owner at least seven (7) working days in advance of testing. The pump manufacturer will also offer the option for a remote witness test in which the owner can witness the test from their local office in lieu of traveling to the pump manufacturer's factory location. If the pump fails to operate properly or fails to

meet the specified conditions or requirements during witnessed shop testing, the pump manufacturer shall modify the pumping unit and perform additional tests. The pump manufacturer shall submit complete pump test reports, including test arrangement, instrumentation calibration data, test procedures and test data in curve format.

9.5.2 **(Optional)** *[Each pump shall be tested with the actual motor unit to be installed in the field.]*

9.5.3 ***(Optional)*** *[Each pumping unit consisting of the actual discharge head, column and bowl assembly to be supplied in the field shall be tested at the factory for vibration at as many points on the curve as necessary. All tests and test reports shall conform to the requirements and recommendations of the Hydraulic Institute Standards. Acceptance criteria shall be as defined by figure 9.6.4.2.5.1b in Hydraulic Institute 9.6.4 – 2022.*

9.5.4 The test results are to be certified correct by a licensed Professional Engineer, whom may be an employee of the pump manufacturer.

9.5.5 All test data shall be submitted to the engineer at least 5 (five) days prior to shipment.

9.5.6 The bowl assembly, column, discharge head shall be non-witness factory pressure tested in accordance with the latest edition of Hydraulic Institute Standards.

9.6 FACTORY COATING

9.6.1 The bowl assembly OD, column ID & OD, discharge head ID shall be factory painted with an NSF 61 approved coating. The coating shall be applied per manufacturer's standard process unless otherwise specified.

9.7 ENGINEERED ANALYSIS

9.7.1 Pump anchorages shall be designed for lateral earthquake effects in the appropriate zone as stated by the UBC, applied simultaneously with normal pump operation forces, as well as for maximum reactions due to other pump design events. Seismic design loads and anchoring design loads shall be calculated in accordance with ASCE 7 with supplied SDS and/or SS and Site Class values as required (III or below). Seismic calculations performed by a registered civil engineer as part of a report are to be submitted for approval to certify the forces and moments related to anchorage in the traditional X-Y-Z coordinate system. Foundation design shall be the responsibility of the CONTRACTOR.

9.7.2 The pump assembly shall be designed to safely operate free of structural natural frequencies in accordance with HI 9.6.8. Either a calculation-based method or a Finite Element Analysis (FEA) method shall be used as specified or required. A report shall be provided to demonstrate the natural frequencies of the structure that have been considered in the design of the equipment and to

certify that the primary pump assembly structural natural frequency is of sufficient margin to the specified operating speed range of the equipment. If FEA method is used, mode shapes shall be provided. All effects attributed to the supporting structure, as it pertains to the installation, foundation, or attached piping and equipment (system effects), on the pump and driver installed structural natural frequency shall be the responsibility of others.

9.7.3 A shaft torsional natural frequency analysis shall be performed on the rotating assembly. Either a calculation-based method or a Finite Element Analysis (FEA) method shall be used as specified or required. Steady state operation shall be assumed. A report shall be provided to demonstrate the torsional natural frequency has been considered in the design of the equipment and to certify that the primary rotating assembly torsional natural frequency is of sufficient margin to the specified operating speed range of the equipment. If FEA method is used, a Campbell Diagram shall be provided.

9.7.4 A shaft lateral natural frequency analysis shall be performed on the rotating assembly. Either a calculation-based method or a Finite Element Analysis (FEA) method shall be used as specified or required. Rotating assembly components shall be assumed to provide no stiffness contributions. Effects related to bearing stiffness shall be considered as needed. A report shall be provided to demonstrate the shaft lateral natural frequency has been considered in the design of the equipment and to certify that the primary rotating assembly lateral natural frequency is of sufficient margin to the specified operating speed range of the equipment. If FEA method is used, all primary mode shapes shall be provided.

9.8 ELECTRIC MOTORS

HP	XX
Shaft Type	Solid / Hollow Shaft
RPM	XXXX
Voltage	XXXX
Enclosure	Type 1
Efficiency Rating	Premium Efficiency
Non-Reverse	No / Yes
Motor Operation	Variable / Fixed Speed
Service Factor	1.15

9.9 SPECIAL TOOLS AND ACCESSORIES

9.9.1 Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments and accessories, required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

9.10 SPARE PARTS

9.10.1 If required, to be specified by the engineer and/or owner.

9.11 MATERIALS OF CONSTRUCTION

Component	**Material**
Pump Bowls	Cast Iron (ASTM A48 c130 - Enamel Lined)
Impellers	CF8m 316SS
Bowl Assembly Shaft	416 HT Stainless Steel - (ASTM A582)
Bowl Bearings	Bronze (ASTM 505 C89835)
Collets	Carbon Steel - (ASTM A519 Gr 1018)
Bowl Bolting	304SS - (ASTM F593)
Bowl Wear Rings	N/A
Impeller Wear Rings	N/A
Strainer	304 Stainless Steel
Column Pipe Thickness	AWWA Standard
Column Bolting	304 SS - (ASTM F593 Gr CW1)
Line Shaft	416 HT Stainless Steel - (ASTM A582)
Line Shaft Couplings	304 SS – (ASTM A276 Gr 304)
Line Shaft Sleeves	N/A
Line Shaft Bearings	Polychloroprene Rubber (PCR)
Bearing Retainers	316 SS – (ASTM A743 CF8)
Discharge Head	Fabricated Steel - (A36 HR-Gr 70 plt, A105 flg, A53-Gr B pipe)
Sole Plate	Fabricated Steel (A36-Gr 70 plt)
Name Plate	Stainless Steel
Anchor Bolts	**(Optional)**

PART3-EXECUTION

10. FIELD QUALITY CONTROL

10.1 A representative of the manufacturer shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are signed off by all parties.

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

10.3 **(Optional)** *[The equipment manufacturer shall furnish a qualified field installation supervisor during the equipment installation. Such services shall be included in the contract price for the number of days and round trips to the site as required. Manufacturer's' installation supervisor shall observe, instruct, guide, and direct the installing contractor's erection or installation procedures. The equipment manufacturer will be provided with written notification 10 days prior to the need for such services.]*

10.4 All costs of these services shall be agreed to in advance and included in the quoted price for the number of days and round trips to the site as required.