DEEPWELL 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:

- 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.
- 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.

PART2 - PRODUCTS

6. MANUFACTURERS

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

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). Manufactures 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 Sxxxx – x stage or pre-approved equal. The intermediate bowls, suction case, and discharge case shall be of ASTM A48 Class 30 cast iron or ASTM A536 Grade 65-45-12 ductile iron as required for pressure handling capability. The intermediate bowls shall be fitted with fluted nitrile and/or ASTM B505 C89835 bronze bearings as required to support the bowl-shaft. The suction case shall be fitted with an ASTM B505 C89835 bronze bearing and sand collar to protect the suction case bearing from abrasives and be permanently grease lubricated. The impellers shall be made of ASTM B148 C95500 Ni. AL bronze or 316 stainless steel, statically balanced, and shall be fitted with replaceable ASTM Bl48 C95500 Ni. Al. bronze wear rings. The impellers shall be securely fastened to the bowl-shaft with tapered collets of 416 stainless steel 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 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. The bowl-shaft shall be ASTM A582 Grade 416 HT stainless steel **(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 indicator reading per foot of length. The bowl-shaft shall be of sufficient diameter to transmit the pump horsepower with a safety factor consistent with AWWA pump shaft standards.

9.2.2 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."

9.2.3 **(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.*

9.2.4 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.

9.2.5 The suction bell shall be fitted with a heavy gauge wire woven cone 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 outer column pipe diameters 4" thru 14" shall be of ASTM A53 Gr. B steel pipe in interchangeable sections not over 10' in length. The top and bottom sections of column pipe for water lubricated pump shall not exceed 5' in length. The ends of each section shall be faced parallel and machined with 8 straight threads per inch permitting the ends to butt and insuring alignment. The column pipe shall be connected by "T Type straight butt style threaded couplings. The weight of the column pipe shall be no less than that stated in ANSI/AWWA Specification E103, Section 5.1 "Standard Specifications for Discharge Column Pipe". The column size shall be such that friction loss will not exceed 5' per 100', based on the design capacity of the pump or as listed under the subsection "service conditions."

9.3.2 The lineshafts shall be of ASTM A582 Grade 416 stainless steel for water lubrication applications. The lineshaft shall have pump shaft quality dimensional tolerances of +.000"/ -.002" and shall be straightened within .005" total indicator reading per 10-foot section. The lineshafts shall be of sufficient diameter to transmit the pump horsepower with a 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. Shaft shall also be sized to avoid critical speeds by a safe operational margin. The shaft threads shall be lathe cut and shall be left hand to prevent loosening during pump operation. The intermediate line-shaft sections shall be interchangeable and shall not exceed 10 feet in length. The butting ends of the lineshafts shall be machined square to axis of the shaft with a recessed center to ensure proper alignment.

9.3.3 Threaded shaft couplings are to be supplied for shafts less than 2-3/4" diameter and shall be sized per ANSI/AWWA E101 section A-4.1.4. They shall utilize left-hand threads to tighten during operation. The shaft couplings shall be threaded from ASTM A582 Grade 416 stainless steel or ASTM A276 Grade 304 stainless steel.

9.3.4 Bearing Retainers shall be of the drop-in type, held in place by compression of the butted ends of the column pipe. The bearing retainers are to be on the material listed in the subsection of "materials of construction." A nitrile rubber flanged type insert shall be utilized in the bearing retainer to act as a journal for the lineshaft.

9.3.5 During assembly, a rubber tubing stabilizer (centering spider) shall slide over the enclosing tube to keep the enclosing tube and shaft centered in the column pipe. These rubber tubing stabilizers shall be placed at 20-foot intervals.

9.4 DISCHARGE HEAD

9.4.1 The discharge head shall be f*abricated* of ASTM A53 Grade B carbon steel pipe and ASTM A36 HR carbon steel plate or cast GR 65-45-12 ductile iron. The discharge head shall be in all respects equal to SIMFLO type SL or a cast ductile iron material. 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. As required to reduce internal friction losses, for a fabricated discharge head a radius or three-piece mitered type elbow shall be used for a smooth transition. The discharge flange shall match a 150# Class ANSI flange size, bolt pattern, and rating. The discharge size shall be the same as the column pipe. The discharge head shall permit a two-piece head-shaft to be coupled above the stretch assembly to facilitate ease of assembly and maintenance. The base of the discharge head shall be circular and fully finished on bottom. The top of the discharge head shall be machined to accurately locate a standard NEMA P base driver and have a diameter equal to the driver base diameter (BD).

9.4.2 All couplings and other moving or rotating parts shall be covered on all sides by an OSHA approved coupling guard. Coupling guards shall be fabricated from 16 USS gage or thicker galvanized or aluminum-clad steel or from 1/2 inch mesh expanded metal. 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 an Aluminum 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).

9.4.3 The discharge head shall be equipped with a cast iron stuffing box rated for 150 psi of discharge pressure and shall be fitted with graphite acrylic or Teflon packing. A throttle bearing shall be installed and be of bismuth tin bronze. A packing gland shall be provided and equipped with stainless steel studs with brass or stainless steel adjusting nuts or the discharge head shall be fitted with a mechanical seal. The seal housing shall be 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. 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 A ¾" tap shall be provided through the discharge head body to allow pre-lubrication of the lineshaft bearings prior to pump starting.

9.4.5 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 installing contractor.

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

9.5.5 All test data shall be submitted to the engineer at least five (5) 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 and 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 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	XXXX
Shaft Type	Solid/Hollow Shaft
RPM	XXXX
Voltage	XXXX
Enclosure	Type 1
Efficiency Rating	Premium Efficiency
Non-Reverse	Yes/No
Motor Operation	Variable/Fixed Speed
Service Factor	XXXX

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	316 SS – (ASTM A743 CF8)
Bowl Assembly Shaft	416 HT Stainless Steel - (ASTM A582)
Bowl Bearings	Bronze - (ASTM 505 C89835)
Tube Bearing	Bronze - (ASTM C84400)
Tube Adapter	Ductile Iron - (ASTM Gr. 65-45-12)
Collets	Carbon Steel - (ASTM A519 Gr 1018)
Bowl Bolting	316 SS - (ASTM F593 Gr CW1)
Bowl Wear Rings	N/A
Impeller Wear Rings	N/A
Strainer	304 Stainless Steel
Column Pipe Thickness	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
Enclosing Tube	Gr. B Carbon Steel
Tube Bearings	Bronze - (ASTM C84400)
Centering Retainers	SBR/Buna-S
Discharge Head	Fabricated Steel - (A36 HR-Gr 70 plt, A105 flg, A53-Gr B
Sole Plate	Fabricated Steel (A36-Gr 70 plt)
Name Plate	Aluminum
Anchor Bolts	N/A

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 The 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.