End Suction Split Coupled Pump with Integrated Variable Frequency Drive Specification

Part I – GENERAL

1.1 WORK INCLUDED

A. Contractor shall furnish and install Grundfos end suction split coupled pump, Grundfos Model NBS complete with pump, motor, and coupling in accordance with manufacturer's recommendations and plans.

B. Pump unit shall have machined registered fits between volute, motor bracket and motor. No factory or field alignment shall be required on this pump unit.

C. The coupling design shall permit replacement of the mechanical seal without requiring removal of the impeller, system piping, pump volute or drive motor.

1.2 REFERENCE STANDARDS

The work in this section is subject to the requirements of applicable portions of the following standards:

A. HI – Hydraulic Institute

B. ANSI – American National Standards Institute

C. ASTM – American Society for Testing and Materials

D. IEEE – Institute of Electrical and Electronics Engineers

E. NEMA – National Electrical Manufacturers Association

F. NEC – National Electrical Code

G. ISO – International Standards Organization

H. UL – Underwriters Laboratories, Inc.

I. CSA –Canadian Standards Association

J. OSHA – Occupational Safety & Health Administration

K. ASME – American Society of Mechanical Engineers

L. IEC– International Electrotechnical Commission

M. ETL – Electrical Testing Laboratories

N. NSF – National Sanitation Foundation

Part 2 – PRODUCTS

2.1 End Suction Split Coupled Pumps

A. Furnish and install end suction split coupled pumps as per plans and pump schedule.

B. The pump, electric motor, motor support bracket, coupling and coupling guard shall be factory assembled at the pump manufacturer's facility. The pump manufacturer shall have complete unit responsibility.

2.1.1 PUMPS

A. The pumps shall be split coupled, single stage, end suction top discharge design, cast iron stainless steel fitted construction. Pumps up to 6" discharge shall be centerline discharge, 8" and 10" discharge shall be tangential discharge.

B. The pumps shall have the following features:

1. Seal replacement shall be possible by only removing the coupling and seal cap.
2. Pump shall not require a baseplate or grouting to maintain correct alignment and maintain vibration levels to Hydraulic Institute standards (HI 9.6.4).
3. All pumps shall be of the back pull-out design so that the rotating element can be removed from the casing without disconnecting the suction or discharge piping. Motors shall pull back without requiring lifting.
4. The casing material shall be close-grained cast iron ASTM A48 - Class 35 with a minimum tensile strength of 35,000 P.S.I.
5. Volute shall have integrally cast suction and discharge ports, vent and drain ports. Pump volute shall have and integrally cast diffuser vane to provide balanced flow to the eye of the impeller reducing axial forces and improving efficiency. Casings shall be designed for scheduled working pressure and can withstand hydrostatic test at 150% of the maximum working pressure under which the pump could operate at design speed.
6. Suction and discharge flanges shall be flat-faced and be drilled to ANSI Class 125 standards.
7. Pump shall be constructed such that grouting and field alignment are not required and that proper alignment tolerances are continuously maintained throughout the lifetime of the pump.
8. Pump volutes shall have an integrally cast foot to eliminate deflections and distortions.
9. The pump shaft shall be of solid stainless steel AISI 420.
10. The mechanical seal shall have as standard Silicon Carbide – Silicon Carbide rotating and stationary faces with EPDM elastomers. The silicon carbide shall be of the advanced type having optimized hydrodynamic properties for long life and emergency dry running. The pump manufacturer shall recommend the proper mechanical seal based on the pressure, temperature and liquid outlined on the equipment schedule. On request, application of a mechanical seal shall be internally flushed type, without requiring external flushing lines. Seals shall be capable of being inspected and easily replaced without removing the piping or volute.
11. [OPTIONAL]: Recirculation line of copper tubing with brass fitting (optional nylon or stainless) shall be provided to vent the mechanical seal.

12. Impeller shall be of the enclosed single suction design, made of Stainless Steel 304 (UNS S30400), dynamically balanced to ISO 1940-1:2003 balance grade G6.3 and keyed to the shaft.

13. Pump Construction. The standard material of construction for the pump shall be as below. Special material shall be available as an option to suit the liquid pumped.

- Volute: Cast iron ASTM A48 - Class 35
- Impeller: Stainless Steel 304 (UNS S30400)
- Shaft: Stainless Steel AISI 420
- Coupling: Ductile Iron (ASTM 70-50-05)
- Motor Support Rails: Carbon Steel (ASTM A36)
- Mechanical Seal: Silicon Carbide – Silicon Carbide, EPDM Elastomers and Stainless Steel hardware
- [OPTIONAL] Recirculation Line: Copper Tubing with Brass Fittings

C. Pump rotating assembly shall be connected to the drive motor by a rigid, ductile iron, axially split coupling capable of maintaining alignment under all torsional, radial and axial loads. The coupling design shall facilitate alignment of the motor and pump shaft.

D. The motor support rails shall be structural steel. The entire unit shall not require grouting for operation within Hydraulic Institute Standards for Vibration.

E. Pump shall be of a maintainable design for ease of maintenance and should use machine fit parts that are easily disassembled.

F. Each pump shall be painted with one coat of high quality factory approved paint and name-plated before shipment from the factory.

G. Pumps shall be manufactured and assembled in an ISO-14001 and ISO-9001 certified facility.

2.1.2 INTEGRATED VARIABLE FREQUENCY DRIVE MOTORS

A. Each motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (VFD) with a built-in pump system controller. The complete VFD/motor assembly shall be built and tested as one unit by the same manufacturer.

B. The VFD/motor shall have an IP55 (TEFC) enclosure rating as a complete assembly. The motor shall have a standard NEMA C-Face, Class F insulation with a Class B temperature rise.

C. The VFD shall be of the PWM (Pulse Width Modulation) design using up to date IGBT (Insulated Gate Bipolar Transistor) technology.

D. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

E. The VFD shall have, as a standard component, an RFI filter (Radio Frequency Interference) to minimize electrical noise disturbances between the power electronics and the power supply. The VFD/motor shall meet all requirements of the EMC directive concerning residential and light industry equipment (EN 61800-3).

F. Efficiency: The motors shall be of permanent magnet design meeting IE5 efficiency levels where the combined motor and VFD efficiency exceed NEMA Premium Efficiency standards.

G. Bearing Current Mitigation: Motors shall use WSB (Winding Set Back) and/or CHS (Coil Head Shield) designs that reduce the Bearing Voltage Ratio (BVR) far enough to eliminate damaging bearing currents. Shaft grounding rings/brushes or common mode filters shall not be required.

H. Motor Enclosure/Cooling: The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face with Class F insulation and a temperature rise class no higher than Class B. The cooling design of the motor and VFD shall be such that a Class B motor temperature rise is not exceeded at full rated load and speed at a minimum switching frequency of 9.0 kHz.

I. The power and control electronics shall be housed in a UL Type 3 enclosure and the combined motor/VFD rating shall be IP55 (protection against dust and nozzle directed water from any direction).

J. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.

K. The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.

L. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.

M. The VFD shall have internal solid-state overload protection designed to reduce the motor output when the load reaches 110% of rated current.

N. The integrated VFD motor shall include protection against input transients, phase imbalance (via DC bus monitoring), loss of AC line phase (via DC bus monitoring), over-voltage, under-voltage, VFD over-temperature, and motor over-temperature.

O. The integrated VFD motor shall have, as a minimum, the following input/output capabilities:

1. Speed Reference Signal: 0-10 VDC, 4-20mA
2. Digital remote on/off
3. Fault Signal Relay (NC or NO)
4. Fieldbus communication port (RS485)

P. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 20,000 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

2.1.3 INTEGRAL CONTROLLER OPERATING MODES

The pump shall have the following control mode and operating modes:

A. Proportional Differential Pressure – The head delivered shall be reduced from the programmed setpoint linearly or quadratically in accordance with decreases in flow demand in the system.

B. Constant Differential Pressure – A programmed constant head is maintained, irrespective of flow up to the maximum speed of the pump.

C. Constant Temperature – the pump shall adjust speed to maintain a constant media temperature in the flow pipe in which the pump is installed.

D. Constant Differential Temperature - the pump shall adjust speed to maintain a constant temperature drop between the flow pipe in which the pump is installed and a user installed temperature sensor.

E. Constant Curve – The pump runs as an uncontrolled pump by the means of a set of pump curves. The pump curve shall be adjustable between maximum and minimum from the control panel or through an analog input.

F. Alternating Operation – Two pumps shall communicate wirelessly to one another. In alternating operation, only one pump shall operate at a time. The operation shall alternate based on time or energy to ensure even run time of both pumps. If a pump stops due to fault the other pump shall take over automatically.

G. Back-Up Operation – Two pumps shall communicate wirelessly to one another. In Back-Up operation one pump shall operate continuously. If the duty pumps stops due to fault the back-up pump shall take over automatically.

2.1.2 INTERFACE AND COMMUNICATION

A. The pump shall have an integrated operator interface consisting of:

i. Minimum 2.4” (measured diagonally) color TFT display

ii. 7 push buttons for navigation of menu

iii. Push Buttons must be able to operate at minimum 25,000 times

iv. Push Buttons must be isolated from the main supply by reinforced insulation according to UL60730

v. LEDs to signal pump status for quick indication

vi. The pump shall have two analog inputs configurable for either 4-20mA or 0-10VDC input. Each analog input shall be configurable for pressure, flow, or temperature measurement. Differential pressure or differential temperature control shall be possible using two separate analog signals. Connection can be made to a screw terminal capable of wire sizes up to AWG16.

B. The pump shall have 3 Digital Inputs galvanically isolated from the main supply by a reinforced insulation according to UL60730.

i. Start/Stop –Used to start or start the pump. The pump shall be enabled when connected to common ground by an external potential free short circuit. An open circuit to this input shall disable the pump. Connection can be made to a screw terminal capable of wire sizes up to AWG16.

ii. Minimum – used to force the pump to run at minimum load (curve). When connected to common ground by an external potential free short circuit the pump must run at minimum load. Connection can be made to a screw terminal capable of wire sizes up to AWG16.

iii. Maximum - used to force the pump to run at maximum load (curve). When connected to common ground by an external potential free short circuit the pump must run at maximum load. Connection can be made to a screw terminal capable of wire sizes up to AWG16.

C. The pump shall have two Output Relays. Each relay shall be configurable for Alarm, Ready, or Operating indication. Output relay contacts shall be rated for maximum 250VAC at 2A and minimum 5VDC at 20mA. Each must have galvanic isolation from the internal supply by reinforced insulation according to UL60730.

D. Shall be capable of accepting an optional add-on module for integration into Building Management Systems:

i. LonWorks

ii. Bacnet IP or MSTP Modbus

iii. Profibus

2.2 INSTALLATION

The pump shall be installed per manufacturer's recommendations and according to the standard s Page 4 of 4 of the Hydraulics Institute.

2.3 TESTING

Where noted on schedule, pumping equipment may require one or more of the following:

Certified Performance test

Hydro static test

NPSH Test

Any other factory test as noted in the pump Schedule

The testing shall be in accordance with Hydraulic Institute level 2B or the latest HI standard as noted in the pump schedule.

2.4 WARRANTY

The warranty period shall be a non-prorated period of 24 months from date of installation, not to exceed 30 months from date of manufacture. Warranty shall cover against defective material and/or faulty workmanship.

END OF SECTION