Split Coupled Vertical In-Line Pump with Integrated Variable Frequency Drive Specifications

Part I – GENERAL

1.1 WORK INCLUDED

A. Contractor shall furnish and install Grundfos In-line split coupled pump, Grundfos Model VLSE complete with pump, motor with integrated variable frequency drive (VFD), coupling, and coupling guard in accordance with manufacturer's recommendations and plans.

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

Part 2 – PRODUCTS

2.1 SPLIT COUPLED IN-LINE PUMPS

A. Furnish and install split coupled in-line pumps as per plans and pump schedule.
B. The pump, integrated VFD motor, 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, in-line design, cast iron bronze fitted construction.
B. The pumps shall have the following features:
    1. 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. The casing material

shall be close-grained cast iron ASTM A48 - Class 30 with a minimum tensile strength of 30,000 P.S.I. Volute shall have integrally cast suction and discharge connections, gauge ports at nozzles, and vent and drain ports. Pumps suction and discharge shall be of same size. Pumps with 3" and above suction/discharge sizes shall have double volute casing and shall have suction splitter to reduce pre-rotation and improve 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.

2. Pumps shall be fitted with bronze renewable case wear rings.
3. Suction and discharge flanges shall be drilled to ANSI Class 125# standards and be machined flat face.
4. The pump shaft shall be of solid stainless steel AISI 303.
5. The pump manufacturer shall recommend the proper inside mechanical seal based on the pressure, temperature and liquid outlined on the equipment schedule. Mechanical seals, at a minimum, shall have ceramic stationary seats, carbon rotating rings, buna elastomers and stainless steel hardware. 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.
6. Recirculation line of nylon tubing with brass fitting shall be provided to vent the mechanical seal.
7. Impeller shall be of the enclosed francis vane type, single suction design, made of silicon bronze, ASTM B584 C87600, both hydraulically and dynamically balanced to ISO 1940-1:2003 balance grade G6.3 and keyed to the shaft. The impeller shall be trimmed to meet the specific hydraulic requirements.
8. Pump Construction. The standard material of construction for the pump shall be as below. Special material shall be available as option to suit the liquid pumped.
    - Volute: Cast Iron ASTM A48 - Class 30 or Ductile Iron ASTM A536- Class 65
    - Case Wear ring: Tin Bronze ASTM B584-90500
    - Impeller: Silicon Bronze ASTM B584 C87600
    - Shaft: Stainless Steel AISI 303
    - Coupling: 2011-T3, 2017-T4, or 2024-T351 Aluminium
    - Motor Bracket: Cast Iron ASTM A48- Class 30
    - Mechanical Seals: Carbon – Ceramic with Buna Elastomers and Stainless Steel hardware
    - Recirculation Line: Nylon Tubing with Brass Fittings

C. Pump rotation shall be clockwise as viewed from the motor end.

D. Pump shall be connected to the drive motor with integrated VFD by a rigid, aluminum, axially split coupling capable of withstanding all torsional, radial and axial loads. The coupling design shall

facilitate alignment of the motor and pump shaft. The coupling design shall also permit replacement of mechanical seal without requiring removal of the drive motor.

E. The pump manufacturer shall provide an OSHA approved coupling guard, which shall be mounted between the pump and motor.

F. Optional Supports: Pump shall be mounted on a heavy duty cast iron support stand or on steel flange supports for floor mounting.

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

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

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

2.1.2 INTEGRATED VARIABLE FREQUENCY DRIVE MOTOR

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

G. The VFD shall have internal solid-state overload protection designed to trip within the range of 125-150% of rated current.

H. The VFD/motor shall include protection against input transients, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. The motor over-temperature protection shall consist of three series connected PTC thermistors, one for each motor phase.

I. The VFD/motor shall provide full nameplate output capacity (horsepower and speed) within a balanced voltage range.

J. Automatic De-Rate Function: The VFD/motor shall reduce speed during periods of overload allowing for reduced capacity pump operation without complete shut-down of the system. Detection of overload shall be based on continuous monitoring of current, voltage and temperature within the VFD/motor assembly.

K. The VFD/motor shall have, as a minimum, the following input/output capabilities:
   1. Two Analog Inputs: 0-10 VDC or 4-20mA
   2. One Analog Output
   3. Four Digital Inputs
   4. Fault Signal Relay (NC or NO)
   5. Fieldbus communication port (RS485)

L. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

2.1.3 PUMP SYSTEM CONTROLLER AND USER INTERFACE

A. The pump system controller (Proportional-Integral) shall be an optional component of the integrated variable frequency drive motor developed and supported by the pump manufacturer.

B. The pump system controller shall have an easy to use interface mounted on the VFD/motor enclosure. Pump system start/stop and set-point adjustment shall be possible through the use of two push buttons located on the drive enclosure.

C. The VFD/motor shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote on/off (digital) signal.

D. Pump status and alarm state shall be indicated via two LED lights located on the VFD/motor enclosure.

E. Advanced programming and troubleshooting shall be possible via an infra-red hand held programmer or a field connected personal computer. Pump system programming (field adjustable) shall include as a minimum the following:

System Pressure set-point, psig	System start pressure, psig
System Stop pressure, psig	Minimum Pump Speed, %
Pressure Transducer supply/range	Maximum Pump Speed, %
System Time (Proportional Gain)	Integral Action Time

F. The infra-red programmer shall be capable of displaying the following status readings:

Pump Status (on, off, min., max.)	System Set-point, psig
Actual system pressure, psig	Remote set-point, %
Pump speed, rpm	VFD/Motor input power, kW
VFD/Motor total cumulative kWh	VFD/Motor total operating hours

G. The infra-red programmer shall also be capable of displaying the following alarms, with the last five alarms stored in memory:

Loss of sensor signal	Loss of external set-point signal

Under-voltage & Over-voltage	Motor overload (blocked pump)
Motor over-temperature	Drive over-temperature
Drive Over-current	

H. Control Modes:

Proportional differential pressure	Constant curve
Constant differential pressure	Constant flow
Constant pressure	Constant temperature
Constant level	

2.1.4 SEQUENCE OF OPERATION

The system controller shall receive an analog signal [4-20mA] from the transducer indicating the actual system pressure, flow, level, etc. As demand changes the VFD/motor shall increase or decrease the speed until the actual system matches the system set-point.

2.1.5 PRESSURE TRANSDUCER

A. Pressure transducer will be manufactured by Grundfos.

B. A pressure transducer (optional) shall be factory installed on the pump discharge side with copper tubing. The pressure transducer shall be installed on the motor by the manufacturer and electrical connection shall be finalized in the factory.

C. Pressure transducers shall be made of 316 Stainless Steel.

D. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 0-10 VDC.

2.2 INSTALLATION

The pump shall be installed per manufacturer's recommendations and according to the standards 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 B 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