

Hydro Multi-B / E (CME based booster) Guide Specification

Part I – GENERAL

1.1 WORK INCLUDED

- A. Variable Speed Packaged Pumping System

1.2 REFERENCE STANDARDS

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

- A. 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.

Part 2 – PRODUCTS

2.1 VARIABLE SPEED PACKAGED PUMPING SYSTEM WITH INTEGRATED VARIABLE FREQUENCY DRIVE MOTORS

- A. Furnish and install a pre-fabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure: **Grundfos Hydro Multi-B CME**

Acceptable manufacturers:

1. Grundfos
 2. Peerless
 3. PACO
- B. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pumps and pump logic controller, shall be designed, built, and tested by the same manufacturer.
 - C. The complete packaged water booster pump system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. and Canadian Standards.
 - D. The complete packaged pumping system shall be NSF372 Listed for drinking water and low lead requirements.

2.2 PUMPS

- A. The pumps shall be NSF 372 Listed for drinking water.
- B. The pumps shall be of the end-suction horizontal multi-stage design with the discharge vertical on the centerline of the pump.
- C. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

- D. Cast Iron Horizontal End-suction Multi-Stage Pumps (12mm or 16mm shaft, Nominal flow from 10 to 130 gallons per minute) shall have the following features:
1. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement with a Stop Ring and Nord-lock® washer or similar, which makes it possible to disassemble the pump from the pump side.
 2. The suction/discharge shall have internal pipe thread (NPT) connections as determined by the pump station manufacturer.
 3. On the top of the inlet part should be a priming plug to allow the pump to be nearly completely filled with the liquid to be pumped.
 4. On the lower side of the inlet part should be a drain plug.
 5. Pump Construction.

a. Inlet Part, Discharge Part:	Cast iron (Class 30)
b. Impellers, chambers:	304 Stainless Steel
c. Shaft:	431 Stainless Steel
e. Spacing Pipe:	316 Stainless Steel
f. O-rings:	EPDM
 6. The shaft seal shall be an o-ring seal with fixed driver type with the following features:

a. Retainer and Driver for Seal Ring:	304 or 316 Stainless Steel
b. Spring:	304 or 316 Stainless Steel
c. Stationary Seal:	Silicon Carbide (Graphite Imbedded)
d. Rotating Seal:	Silicon Carbide (Graphite Imbedded)
e. O-rings:	EPDM
- E. AISI 304 or 316 Stainless Steel End-suction Horizontal Multi-Stage Pumps (12mm or 16mm shaft, Nominal flow from 10 to 130 gallons per minute) shall have the following features:
1. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement with a Stop Ring and Nord-lock® washer or similar, which makes it possible to disassemble the pump from the pump side.
 2. The suction/discharge shall have internal pipe thread (NPT) connections as determined by the pump station manufacturer.
 3. On the upper area of the flange should be a priming port to allow the pump to be nearly completely filled with the liquid to be pumped.
 4. On the bottom side of the pump sleeve should be a drain hole
 5. Pump Construction.

a. Flange:	Cast Iron
b. Impellers, Chambers, Sleeve:	304 or 316 Stainless Steel
c. Shaft:	304 or 316 Stainless Steel
e. Spacing Pipe:	316 Stainless Steel
f. O-rings:	EPDM
 6. The shaft seal shall be an o-ring seal with fixed driver type with the following features:

a. Retainer and Driver for Seal Ring:	304 or 316 Stainless Steel
b. Spring:	304 or 316 Stainless Steel
c. Stationary Seal:	Silicon Carbide (Graphite Imbedded)

d. Rotating Seal:

Silicon Carbide (Graphite Imbedded)

e. O-rings:

EPDM

2.3 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) built and tested as one unit by the same manufacturer.
- B. The VFD shall be of the PWM (Pulse Width Modulation) design using current IGBT (Insulated Gate Bipolar Transistor) technology.
- C. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of 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.
- D. The VFD shall utilize an energy optimization algorithm to minimize energy consumption. The output voltage shall be adjusted in response to the load, independent of speed.
- E. 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.
- F. An integral RFI filter shall be standard in the VFD.
- G. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.
- H. The VFD shall have internal solid-state overload protection designed to trip within the range of 125-150% of rated current.
- I. The integrated VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.
- J. 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)
- K. The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face, Class F insulation with a temperature rise no higher than Class B.
- L. 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.
- M. 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.

2.4 PUMP SYSTEM CONTROLLER

- A. The pump system controller shall be a standard product developed and supported by the pump manufacturer.

- B. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller shall be designed specifically for control of parallel connect pumps in constant pressure applications.
- C. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.
- D. The controller shall display the following as status readings from a single display on the controller (this display shall be the default):
- Current value of the control parameter, (typically discharge pressure)
 - Alarm indication (if any)
- E. The controller shall have as a minimum the following hardware inputs and outputs:
- Two analog inputs (4-20mA or 0-10VDC)
 - Two digital inputs
 - Two digital outputs
 - Three PTC connections for motor monitoring
 - Field Service connection to PC for advanced programming and data logging
- F. Pump system programming (field adjustable) shall include as a minimum the following:
- Current setpoint
 - Pump control Off/Auto
 - System control On/Off
 - Alarm reset
- G. Pump system programming (field Service connection to PC for advanced programming) shall include as a minimum the following:
- Water shortage protection (analog or digital)
 - Transducer Settings (Suction and Discharge Analog supply/range)
 - PI Controller (Proportional gain and Integral time) settings
 - High system pressure indication and shut-down
 - Low system pressure indication and shut-down
 - Low suction pressure/level shutdown (via digital contact)
 - Low suction pressure/level warning (via analog signal)
 - Low suction pressure/level shutdown (via analog signal)
 - Flow meter settings (if used, analog signal)
- H. The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.
- I. The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions.

Control panel options shall include:

Emergency/Normal Operation Switches, located on front of panel.

- J. The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).
- K. The controller shall have the ability to communicate common field-bus protocols, (BACnet, Modbus, Profibus, and LON), via optional communication expansion card installed inside controller.

2.5 SEQUENCE OF OPERATION

- A. The system controller shall operate equal capacity variable speed pumps to maintain a constant discharge pressure (system set-point). The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure. As flow demand increases the pump speed shall be increased to maintain the system set-point pressure. When the operating pump(s) reach 97% of full speed (adjustable), an additional pump will be started and will increase speed until the system set-point is achieved. When the system pressure is equal to the system set-point all pumps in operation shall reach equal operating speeds. As flow demand decreases the pump speed shall be reduced while system set-point pressure is maintained. When all pumps in operation are running at low speed the system controller shall switch off pumps when fewer pumps are able to maintain system demand.
- B. The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.
- C. All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable.

2.6 LOW FLOW STOP FUNCTION

The system controller shall be capable of stopping pumps during periods of low-flow or zero-flow without wasting water or adding unwanted heat to the liquid. Temperature based no flow shut-down methods that have the potential to waste water and add unwanted temperature rise to the pumping fluid are not acceptable.

Standard Low Flow Stop and Energy Saving Mode

If a low or no flow shut-down is required (periods of low or zero demand) a bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When only one pump is in operation the system controller shall be capable of detecting low flow (less than 10% of pump nominal flow) without the use of additional flow sensing devices. When a low flow is detected, the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50% of programmed on/off band). The pump shall remain off until the discharge pressure reaches the start pressure (system set-point minus 50% of programmed on/off band). Upon low flow shut-down a pump shall be restarted in one of the following two ways:

- A. Low Flow Restart: If the drop in pressure is slow when the start pressure is reached (indicating the flow is still low), the pump shall start and the speed shall again be increased until the stop pressure is reached and the pump shall again be switched off.
- B. Normal Flow Restart: If the drop in pressure is fast (indicating the flow is greater than 10% of pump nominal flow) the pump shall start and the speed shall be increased until the system pressure reaches the system set-point.

2.6 SYSTEM CONSTRUCTION

- A. Suction and discharge manifold construction shall be in way that ensures minimal pressure drops, minimize potential for corrosion, and prevents bacteria growth at intersection of piping into the manifold. Manifold construction that includes sharp edge transitions or interconnecting piping protruding into manifold is not acceptable. Manifold construction shall be such that water stagnation can not exist in manifold during operation to prevent bacteria growth inside manifold.
- B. The suction and discharge manifolds shall be constructed of 316 stainless steel. Manifold connection sizes shall be as follows:
 - 3 inch and smaller: Male NPT threaded
 - 4 inch ANSI Class 150 rotating flanges
- C. Pump Isolation valves shall be provided on the suction and discharge of each pump. Isolation valve sizes 2 inch and smaller shall be nickel plated brass full port ball valves. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy.
- D. A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the check valve shall not exceed 5 psi at the pump design capacity. Check valves 1-1/2" and smaller shall have a POM composite body and poppet, a stainless steel spring with EPDM or NBR seats. Check valves 2" and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.
- E. 80 gal hydropneumatic tank ASME rated, a connection of no smaller than 3/4" shall be provided on the discharge manifold.
- F. A pressure transducer shall be factory installed on the discharge manifold (or field installed as specified on plans). A factory installed pressure switch on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. 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 9-32 VDC.
- G. A bourdon tube pressure gauge, 2.5 inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts in a stainless steel case. Gauge accuracy shall be 2/1/2 %. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.
- H. The base frame shall be constructed of corrosion resistant 304 stainless steel. Rubber vibration dampers shall be fitted between each pumps and baseframe to minimize vibration.

2.8 TESTING

- A. The entire pump station shall be factory tested for functionality. Functionality testing shall include the following parameters: Dry Run Protection, Minimum Pressure and Maximum Pressure alarms (where applicable), Setpoint Operation, and Motor Rotation.
- B. The system shall undergo a factory hydrostatic test at the end of the production cycle. The system shall be filled with water and pressurized to 1.5 times the nameplate maximum pressure. Systems with 150# flange connections shall be tested at 350 psig, and systems with 300# flange connections shall be tested at 450 psig. The pressure shall be maintained for a minimum of 15 minutes with no leakage (slight leakage around pump(s) mechanical seal is acceptable) prior to shipment.

2.8 WARRANTY

- A. 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.