Hydro MPC-S Guide Specification

Part I – GENERAL

1.1 WORK INCLUDED

A. Constant 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 CONSTANT SPEED PACKAGED PUMPING SYSTEM

A. Furnish and install a pre-fabricated and tested constant speed packaged pumping system to maintain water delivery pressure.

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 NSF61 / NSF372 Listed for drinking water and low lead requirements.

2.2 PUMPS

A. All pumps shall be ANSI NSF 61 / NSF372 Listed for drinking water and low lead requirements.

B. The pumps shall be of the in-line vertical multi-stage design.

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. Small Vertical In-Line Multi-Stage Pumps (Nominal flow from 3 to 125 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.

2. The suction/discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.

3. Pump Construction.

a. Suction/discharge base, pump head, motor stool:	Cast iron (Class 30)
b. Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
c. Shaft	316 or 431 Stainless Steel
d. Impeller wear rings:	304 Stainless Steel
e. Shaft journals and chamber bearings:	Silicon Carbide
f. O-rings:	EPDM

Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18).

Optional materials for the suction/discharge base and pump head shall be cast 316 stainless steel (ASTM CF-8M) resulting in all wetted parts of stainless steel.

4. The shaft seal shall be a balanced o-ring cartridge type with the following features:

a. Collar, Drivers, Spring:	316 Stainless Steel
b. Shaft Sleeve, Gland Plate:	316 Stainless Steel
c. Stationary Ring:	Silicon Carbide
d. Rotating Ring:	Silicon Carbide
e. O-rings:	EPDM

The Silicon Carbide shall be imbedded with graphite.

5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

E. Large In-line Vertical Multi-Stage Pumps (Nominal flows from 130 to 500 gallons per minute) shall have the following features:

1. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.

2. The suction/discharge base shall have ANSI Class 125 or Class 250 flange connections in a slip ring (rotating flange) design as indicated in the drawings or pump schedule.

3. Pump Construction.

a. Suction/discharge base, pump head	Ductile Iron (ASTM 65-45-12)
b. Shaft couplings, flange rings:	Ductile Iron (ASTM 65-45-12)
b. Shaft	431 Stainless Steel
c. Motor Stool	Cast Iron (ASTM Class 30)
d. Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
e. Impeller wear rings:	304 Stainless Steel
f. Intermediate Bearing Journals:	Tungsten Carbide
g. Intermediate Chamber Bearings:	Leadless Tin Bronze
h. Chamber Bushings:	Graphite Filled PTFE
I. O-rings:	EPDM

4. The shaft seal shall be a single balanced metal bellows cartridge with the following construction:

a. Bellows:	904L Stainless Steel
b. Shaft Sleeve, Gland Plate, Drive Collar:	316 Stainless Steel

c. Stationary Ring: Carbon
d. Rotating Ring: Tungsten Carbide
e. O-rings: EPDM

5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

2.3 MOTORS

A. Motors are to be provided with the following basic features:

1. Motors shall be designed for continuous duty operation, NEMA design B with a 1.15 S.F.

2. Totally Enclosed Fan Cooled Motors are to be furnished with minimum class F insulation. Open Drip Proof Motors are to be furnished with minimum class B insulation.

3. Nameplate shall have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.

4. Open Drip Proof (ODP) motors shall have drip covers.

5. Motors over 50 lbs shall having lifting provisions.

6. Motors shall have a NEMA C-Flange for vertical mounting.

7. 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.

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 user interface shall have a color display with a minimum screen size of 3-1/2” x 4-5/8” for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.

C. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.

D. The controller shall have the ability to be connected to a battery to maintain power on controller during periods of loss of supply power.

E. The controller shall have built in data logging capability. Logged vales shall be graphically displayed on the controller and able to be exported to computer via standard connection. A minimum of 3600 samples per logged value with the following parameters available for logging:

- Speed of pumps
- Inlet pressure
- Discharge pressure
- Controlling parameter (process value)

F. 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)
- Most recent existing alarm (if any)
- System status with current operating mode
- Status of each pump with current operating mode and rotational speed as a percentage (%)

G. The controller shall have as a minimum the following hardware inputs and outputs:

- Three analog inputs (4-20mA or 0-10VDC)
- Three digital inputs
- Two digital outputs
- Ethernet connection
- Field Service connection to PC for advanced programming and data logging

H. Pump system programming (field adjustable) 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)

I. The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).

J. The controller shall have advanced water shortage protection. When analog sensors (level or pressure) are used for water shortage protection, there shall be two indication levels. One level is for warning indication only (indication that the water level/pressure is getting lower than expected levels) and the other level is for complete system shut-down (water or level is so low that pump damage can occur). System restart after shut-down shall be manual or automatic (user selectable).

K. The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence. The set-point influence function enables the user to adjust the control parameter (typically pressure) by measuring an additional parameter. (Example: Lower the system pressure set-point based on a flow measurement to compensate for lower friction losses at lower flow rates).

L. 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.

M. The controller shall be able to adjust the ramp time of a change in set point on both an increase or decrease change in set point.

N. The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:

High System Pressure	Low system pressure
Low suction pressure (warning and alarm)	Individual pump failure
VFD trip/failure	Loss of sensor signal (4-20 mA)

Loss of remote set-point signal (4-20mA) System power loss

O. 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, but not be limited to:

Pump Run Lights
System Fault Light
Emergency/Normal Operation Switches
Service Disconnect Switches (accessible from side of panel)
Surge Arrestor
100kA SCCR panel rating

P. The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).

Q. The controller shall have a pump "Test Run" feature such that pumps are switched on during periods of inactivity (system is switched to the "off" position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of two to three (3-4) seconds every 24 hours, 48 hours or once per week and at specific time of day (user selectable).

R. The controller shall be capable of changing the number of pumps available to operate or have the ability limit the maximum power consumption by activation of a digital input for purposes of limited generator supplied power.

S. The actual pump performance curves (5^{th} order polynomial) shall be loaded (software) into the pump system controller or be able to input manually into controller based on three points on pump curve of pumps controlled.

T. The controller shall have the ability to compensate for pipe friction loss by decreasing pressure set-point at lower flow-rates and increasing pressure set-point at higher flow-rates without the requirement of a flow meter.

U. 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.

V. The controller shall have a built in Ethernet connection allowing controller to connected to network and access of controller via web browser and internet any where around the world where internet communication is available.

W. The controller shall have a programmable Service Contact Field that can be populated with service contact information including: contact name, address, phone number(s) and website.

2.5 SEQUENCE OF OPERATION

a. The system controller shall operate from two to six equal capacity pumps to maintain a discharge pressure (system set-point) range. 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. When a flow demand is detected (drop in system pressure) a pump shall be switched on. If the discharge pressure is above the system set-point pressure and below the stop pressure, that pump shall remain in operation. If the system pressure continues to fall below the system set-point, an additional pump shall be started. If the actual system pressure is above the system set-point and below the stop pressure, all pumps in operation shall continue to run. When the system pressure rises above the stop pressure (decreasing flow), the system controller shall switch a pump off. Additional pumps shall be switched off if the system pressure is above the stop pressure.

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. If a no flow shut-down is required (periods of zero demand) a bladder type diaphragm tank shall be installed. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When zero flow is detected by the system controller, the remaining pump(s) shall be switched off. When the system pressure falls to 50% of ON/OFF band below the system set-point (flow begins after shut-down), a pump shall be switched on, increasing speed to maintain the system set-point pressure.

d. 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. The time of the pump change-over shall be field adjustable.

e. The system controller shall be able to control a pressure maintenance pump, (jockey pump), in the system. The set point of the pressure maintenance pump shall be able to be any value above or below the pump system's set point. The pressure maintenance pump shall be able to be staged on as back-up pump when capacity of pump system is exceeded.

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 through 8 inch:	ANSI Class 150 rotating flanges
10 inch and larger:	ANSI Class 150 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. For systems that require a diaphragm tank, a connection of no smaller than ¾" 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). Systems with positive inlet gauge pressure shall have a factory installed pressure transducer 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. Systems with a flooded suction inlet or suction lift configuration shall have a factory installed water shortage protection device on the suction manifold.

I. 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.

J. Depending on the system size and configuration, the control panel shall be mounted in one of the following ways:

On a 304 stainless steel fabricated control cabinet stand attached to the system skid.
On a 304 stainless steel fabricated skid, separate from the main system skid
On its own base (floor mounted with plinth)

2.8 TESTING

A. The tester used for testing the pump system shall be constructed and calibrated according to the requirements of hydraulic test standard ISO 9906.

B. The entire pump station shall as a minimum be factory tested for functionality and documented results of functionality test supplied with pump station.

Functionality testing shall include the following parameters:

1. Complete System Hydrostatic Test – 1.5 times the nameplate maximum pressure
2. No-Flow Detection Shutoff Test
3. Water Shortage Test
4. Two-Point Setpoint Performance Test.

C. Water used for testing shall be treated with three different filtration systems to ensure only clean water is used for testing pump station.

1. 25 micron mechanical filter – removes solid parts from water
2. Activated carbon filter – keeps water clear and eliminates odor
3. Ultraviolet light system – kills all bacteria growth

D. Optional performance testing shall include: (Select one)

1. 10-Point Verified Performance Test
2. Witnessed Verified Performance Test

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.