WATERTRONICS®
ELECTRONICALLY CONTROLLED PUMPING SYSTEMS

Specification

Horizontal Centrifugal Fixed Speed (EBV) Prefabricated Pump Station

Project Name: ?
Project Location: ?,
Pumping System Model No. HC-**HP/HP/HP-Flow-Boost**
Total Design Criteria: Quantity of Pumps: ?
Design Flow: ? GPM @ ? PSI Station Discharge

10/22/05
SCOPE OF WORK

It is the intention of this specification to describe an automatic, prefabricated pump station for irrigation purposes. Design, fabrication, testing and service shall be the sole responsibility of the pump station manufacturer. The pump station shall provide water to the irrigation system while simultaneously maintaining a constant discharge pressure by using a prefabricated pump station with an Electronic Butterfly Valve on each main pump for pressure regulation, under varying flow conditions up to the maximum specified capacity.

SECTION 1: GENERAL

1.1 The prefabricated pump station shall have a minimum capacity and discharge pressure at skid edge as described in the technical specifications. The pumps shall operate at no more than 3600 RPM.

1.2 The station shall be completely wired, piped, hydraulically, electrically, and flow tested to full station capacity at factory prior to shipment to job site. Documentation of dynamic test shall be verified by owner prior to pump station shipment upon request.

1.3 Construction shall include a fabricated steel plate and skid assembly to support all components during shipping and to serve as the installation mounting base.

1.4 The discharge manifold from the pump station shall terminate at or near the pump station skid edge and be provided by the pump station manufacturer.

The station shall be by **WATERTRONICS** conforming to the following specifications. WATERTRONICS, INC. 525 Industrial Drive, P.O. Box 530, Hartland, Wisconsin 53029-0530, 262-367-5000 PH, 262-367-5551 FAX.

SECTION 2: MANUFACTURER REQUIREMENTS

2.1 Manufacturer

The pump station shall be manufactured by **Watertronics, Inc.,** Hartland, Wisconsin. The following information must be furnished by the contractor or manufacturers representative:

a. A complete specification and submittal of all major components for the proposed pump station with individual pump performance verification.

b. A detailed pumping station proposal drawing complete with component location, sizes and dimensions specific to the installation.

c. A complete electrical schematic for all high and low voltage circuits showing breaker/ fuse sizing, wire numbering and color.

d. Pump station manufacturers U.L. file number for the electrical controls and pump station.

e. A copy of the manufacturers certificate of insurance.

f. Product support technicians shall be capable of accessing all information pertaining to the pumping equipment, e.g. electrical schematics, pump curves, program data, bill of materials, etc. The manufacturer shall have no less then two technicians on call seven days a week.

g. The pump station manufacturer shall provide factory authorized or factory direct service personnel for the set, start-up, preventative maintenance and general service of the pump system. A factory authorized or factory direct service technician must be located within one-hundred (100) mile radius of the project site. The pump systems technician must have a minimum of 5 years experience. The pump station manufacturer shall provide technical phone support twenty-four hours a day seven days a week.

SECTION 3: U.L. LISTED CONTROL PANEL, LOGIC AND SENSORS

3.1 General U.L. File Number E142155

The pumping station electrical controls shall be mounted in a self-containing NEMA 4 enclosure fabricated from not less than 12 gauge steel. Door gasket seals shall be neoprene sponge, sufficient to protect interior components from weather and dust. The electrical panel doors shall be constructed from 12 gauge steel with integral latches.

All external operating devices shall be dust and weather proof. All internal components of the enclosure shall be mounted on a removable back panel. Mounting screws for components shall not be tapped into the enclosure wall. No pressure gauges, pressure switches, water activated devices, or water lines of any sort shall be installed in any electrical control panel.

The control panel shall be designed, built, tested and U.L. listed by the pump station manufacturer.

3.2 Main Service Disconnect

A three-pole, main station disconnect shall be contained within the NEMA 4 control enclosure. An externally mounted service disconnect shall not be acceptable. Disconnect shall be non-fused and isolate all power to the control enclosure. The disconnect shall have an operating handle mounted in the enclosure door, mechanically interlocked to prevent entry while disconnect is in ON position.

3.3 Motor Fuses, Starters And Overloads

Each starter shall be protected on each power leg by a time delay fuse of the appropriate amperage. Motor starter coils shall be 120 volt operated. Overload relays shall be electronic type, ambient compensating and differential tripping type. Bi-metallic or melting alloy type overloads shall not be permitted. The overload shall protect each power leg and shall be set to the motor full-load current rating. Further protection shall include sensitivity to current imbalance and single phase conditions.

3.3a Solid State Soft Starter (Optional; must be called for in the Technical Specification)

The pump station manufacturer shall provide electronic soft starts on all motors as called out in the technical data sheets. The starter logic function shall be "Soft Start" with a selectable kickstart. The acceleration ramp time is DIP switch selectable from 2 to 30 seconds. The initial torque shall be adjustable via a digital switch with 10 settings from 5 % to 90 % of locked rotor torque. The current is held at 150% of full load for a time. The following protections shall be provided in the "starting" and "running" modes: Start fault, Line fault, Temperature fault, and Stalled motor. When these conditions are detected, the soft start will not operate or will shutdown if it is operating.

3.4 Control Transformer

A control transformer shall provide 120 volt power to the pump station controls. The control transformer shall be protected on primary and secondary sides with appropriately sized fuses. No load other than the pump controls shall be supplied by the control transformer.

3.5 Premium Lightning Arrester

Surge suppressor shall meet or exceed the following criteria: Minimum single impulse current rating: 80,000 amperes per phase. Duty cycle testing: 2,500 10KA impulses with less than 10% drift. Response time: <5ns. Suppressors shall consist of solid-state components and operate bi-directionally. Minimum continuous operating voltage of the suppressor shall be greater than 110% of the nominal system voltage.

3.6 Secondary Control Circuit Fuses

Single-pole secondary distribution fuses with appropriate ratings shall supply power to each pump starter coil circuit, the control system and to other circuits as specified.

3.7 Main Panel Power And Motor Phase Monitor

The incoming power and each motor shall be protected by a phase loss/low voltage system dropout relay to de-energize the pump station control circuit or motor contactor if either a phase failure, phase reversal or low voltage condition occurs. If after attempted automatic re-starts the phase failure/low voltage alarm condition remains, the alarm must be manually reset. Individual motor overloads will also act as phase monitors for each motor.

3.8 Corrosion Inhibiting Modules

Corrosion inhibiting modules shall be installed in all electrical enclosures in accordance with the manufacture's recommendations.

3.9 Control Logic

The pump sequence controller shall be an industrial grade PLC with diagnostic LEDs for monitoring of discrete inputs and outputs. Not less than two additional analog inputs and outputs shall be standard for monitoring and control purposes. The PLC shall contain two communication ports for monitoring and programming purposes. The PLC shall contain an EEPROM, battery backed RAM and non volatile memory for storage of critical configuration data.

3.9a Electronic Butterfly Valve Pressure Regulation On Main Pumps

The pump station discharge pressure shall be regulated to provide surge-free constant pressure as programmed via the control panel operator interface. Discharge pressure shall be regulated by an Electronic Butterfly Valve, consisting of the following:

a. Gradual entry of water from the EBV pump into the discharge manifold to allow for complete purging of pump column air and elimination of surges.

b. Maintain programmed downstream pressure regardless of discharge flow.

c. Up to six, user adjustable PID control settings to ensure accurate pressure regulation at all flows, programmed pressure, or connected pump combination.

d. Adjustable pressure ramp-up and ramp-down to assure surge free pressure regulation.

e. After a drop in pressure, gradually increase system pressure over a user adjustable period of time to eliminate surging.

f. Rate of change of pressure control to anticipate and eliminate rapid pressure changes caused by changing system demand.

Adjustment of regulated downstream pressure shall be accomplished though the control panel operator interface. Hydraulic type, pilot controlled pressure reducing valves shall not be accepted. Individual pressure regulating valves shall be butterfly type with electric motor gear actuation. The maximum allowable pressure drop across the butterfly valve at full pump capacity shall not exceed one PSI. The Butterfly Valve shall be rated for not less than 285 PSI.

3.9b Automatic Pressure Regulation Based On Variable Flow

The pump station controls shall be capable of changing the regulated downstream pressure while in operation, based on discharge flow or discrete input as called out by the technical specifications. The pump station controls shall also be capable of up to six, user adjustable pressure regulation set points based on discharge flow or one additional set point based on a discrete input. In addition to adjustment of downstream pressure, the controls shall be capable of up six pressure regulation algorithms to insure accurate pressure regulation regardless of regulated pressure, discharge flow or connected pump combination.

3.9c Lead Pump Selection

Lead selection of equal horsepower pumps shall be accomplished by total accumulated pump running time. Unless manually overridden, the pump with the lowest accumulated running time shall be the next pump started in the sequence. Alternating logic for selection of lead pump shall not be accepted.

3.9d Alarms

Controls shall shut down the pump station in the event of the following alarm conditions. The controls shall attempt to restart the system after alarm shutdown or loss of power to minimize loss of irrigation. After a user adjustable number of attempts to re-pressurize the system, the controls will go into hard shut down and remain there until manually reset.

1. Low discharge pressure cutout. Pressure remains 20 PSI below regulate set point for set time delay.

2. Low inlet pressure shutdown or loss of prime shutdown.

3. High discharge pressure cutout. Pressure remains 11 PSI above regulate set point for set time delay.

4. Phase/ voltage cutout. High or low voltage, loss of phase or phase reversal.

5. High pump volute temperature cutout. Pump temperature stays above 120 degrees F. for a set time delay.

6. Starter fail cutout. Output to starter is not met with corresponding running input for set time delay. Indicates overload, phase imbalance or control fuse.

3.9e Operator Interface

Mounted in the enclosure door shall be an operator interface for logical display of all pump station functions. The operator interface shall be NEMA 4 rated for mounting in the control enclosure door. The operator interface shall be touch sensitive with intuitive on-screen user instruction for ease of operator use. The use of buttons or keys or off-screen user instructions shall not be permitted. The operator interface shall be LCD type with no less than 240 x 320 pixel resolution, with viewing area measuring not less than 5" diagonal. User memory for storing critical pump operation data shall not be less than 1 MB.

The operator interface shall allow the user to view and modify all pertinent operation parameters. The operator interface shall incorporate password protection for modification of critical pump station parameters. The operator interface capabilities shall include but are not limited to the following:

a. Display of pressure in PSI, flow in GPM and total gallons pumped in thousands of gallons.

b. Separate display for total gallons pumped with operator reset capability and time stamping.

c. Pump control and running status.

d. Individual pump total elapsed run time display.

e. Alarm status with time stamping and display of pump station conditions at shutdown.

f. Number of attempts remaining to re-pressurize the system before hard shutdown after interruption of service with reset capability.

g. Status of optional auxiliary equipment such as strainer flushing or pond fill pumps with momentary-on override capability.

h. Override for automatic pump alternation.

i. Adjustment of automatic/ manual pressure regulation set points.

j. Pressure set points, flow set points, electronic flow limiting threshold and pressure regulation tuning for the EBV.

3.9e Operator Interface (Optional; must be called for in the Technical Specification)

Operator interface shall be a full color TFT active matrix LCD display unit mounted in the enclosure door. Operator interface shall be used for logical display of all pump station functions. The operator interface shall be NEMA 4 rated. The operator interface shall be touch sensitive with intuitive on-screen user instruction for ease of operator use. The use of buttons or keys or off-screen user instructions shall not be permitted. The operator interface shall be LCD color display type with no less than 240 x 320 pixel resolution, with viewing area measuring not less than 5.7" diagonal. User memory for storing critical pump operation data shall not be less than required for up to 1 year of data.

The operator interface shall allow the user to view and modify all pertinent operation parameters. The operator interface shall incorporate password protection for modification of critical pump station parameters. The operator interface capabilities shall include but are not limited to the following:

a Overview screen showing pump system configuration. Screen shall show if each individual pump is enable or disabled, the number of hours on each pump, station full flow and pressure design criteria

b. System screen with information on current regulation pressure, setpoint, regulation pressure, System status, restarts remaining, VFD reference speed, pressure regulation method (VFD or EBV modes) and adjust settings button. Adjust settings button will allow changing parameters etc after entering password.

c. Settings menu to allow changes to pressure regulation settings, pipe saver mode, VFD manual mode, analog calibration, flow calibration, program or register settings.

d. Flow screen will display pressure in PSI, flow in GPM and total gallons pumped in thousands of gallons. Separate display for total gallons pumped since last reset.

e. Alarm status with time stamping, display of pump station conditions at shutdown and restart. Alarms will be displayed in red when activated and a separate listing will be displayed in green when the alarm is reset. Alarms will be logged to a compact flash disk allowing the service technician to upload data to a spreadsheet type program.

f. Full control of and capability of monitoring, adjusting and viewing any options present such as water level, inlet strainer, wye strainer, filtration, chemical injection, or liquid tank levels. Adjustment of automatic/manual pressure regulation set points.

g. Graphing capability for up to 1 full year detailing flow rate and pressure. Graphing function shall give option to graph and plot a point every minute. The graph function will be selectable by day, month and year as well as the time of desired graph. All data will be logged to a compact flash disk allowing the service technician to upload data to a spreadsheet type program.

3.9f Watervision Remote Monitoring Software For Personal Computer (Optional; must be called for in the Technical Specification)

Pump station monitoring software (Watervision), will be fully compatible with Windows 95, 98, Me, 2000, and NT 4.0 for workstations. Software will include full graphical representation of the pump station and its features. The software will be capable of communicating at rates up to 19200 baud to the pump station over direct wire, dial-up telephone modem, cellular modem, radio modem, short haul modem, or over fiber cable. The software shall also be capable of communicating over the Internet and Intranets including dial-up networking to the computer connected to the pump station. One software package and installation procedure shall cover all above connection types. All connections and setting shall be field configurable. The remote monitoring software independent of connection type shall be capable of changing all operating parameters of the pump station. A single copy or multiple copies of the software can be loaded on a single computer to communicate to up to 256 different pump locations. A single site license will be supplied for each pump station location.

A. The pump station manufacturer shall supply all required communication hardware except; computer and computer accessories including phone modem, all necessary direct burial cable.

The remote monitoring software shall require a PC based computer with minimum requirements: Pentium^{7} 233MHz, 32MB RAM, 30MB of free hard drive space, VGA graphics card, one free serial port without IRQ sharing, mouse or trackball, 9600 baud phone modem if communications to the pump station require.(Above equipment by end user).

B. The remote monitoring software shall feature full data sharing interaction between leading irrigation manufacturers software using PumpLink.

C. The software supplied by the pump station manufacturer will include all of the following features as standard:

1. Graphical overview of system operations including Pump Status, Flow, Pressures and Regulate Set Points
2. Operational status of pumps; Enabled/Disabled, Running/Not Running, Position of Hand/Off/Auto switch
3. Total number of hours of each pumps operation since first activation
4. Individual time of day lockout for each pump
5. Display of maximum GPM designed for each pump
6. Individual pump/motor alarm status.
7. View system Pressure and Flow in both digital and bar graph form
8. View of Final Regulate pressure set point and Current Regulate system pressure status

9. View location for any current alarms with help screens for each. Alarms are: low pressure, high pressure, phase loss, low/high voltage, low water level, (if desired), individual motor overload with I.D., PLC low battery, VFD alarm, (if equipped), Pressurization Alarm, Final shutdown alarm
10. Alarm reset button, with digital read out of re-starts remaining before final shutdown
11. System status: System O.K. or System Pressurizing
12. Seven, (7) different pressure regulation points based on seven different user definable GPM flow regions
13. Set single pressure set point value. (Desired system pressure set point regardless of flow)
14. Ability to toggle between Single Set Point or Flow Based Pressure Set Points
15. Pump station historic total gallons pumped. Not user re-settable.
16. Pump station total gallons pumped since last time user pushed reset button
17. View and make individual adjustments for wet well inlet self-flushing filter, or discharge filter: A. Duration of flush. B. Frequency of flush. C. Flush enabled or disabled. D. Differential PSI. E. Manual Flush F. Flushing On/Off indicator
18. Pressure set point for flush activation, (if so equipped).
19. View and adjust wet well level and the activation level in inches for the remote fill pump or valve.
20. Password protected entry window to alter PLC registers for trained personnel
21. Window to log the pump stations Highest Pressure, Lowest Pressure, Highest Flow, Lowest Flow, with Month, Day, Year, Time of event since last reset of Running Log.
22. Total number of starts for each pump
23. Time and Date log for last station or individual motor alarm
24. Pump station lifetime historic event log tagged for date and time for Pressure Changes, Flow Changes, Pumps On/Off, Alarms, and Customizable events like inlet and discharge filter flush count. Logs 300,000 events or approximately one season=s data
25. Ability to search data by date and download to a disc.
26. Ability to show a data chart in spread sheet form of all collected data with controls for the user to navigate to data by date
27. Ability to chart full graphical trending scalable for any time span from minutes to years to view pressure, flow, and pumps running as standard. The graph is customizable by the user to graph and record any of the 3755 PLC data registers
28. Full print abilities for all charts
29. All data will be collected by event to capture critical data point without filling memory limitations
30. An Alarm Paging window to configure up to three, (3), different pagers to be called for sending of a digital, coded alarm message
31. Input window for initialization string to configure the phone modem and computer before connection to pager. Includes serial port identifier locator
32. Each pager phone number has a window for entering pager commands. Test button to test set up and send a test call to the pager selected
33. Modes of communication for connecting to the pump system include: Direct Wire, Short Haul Modem, Radio Modem- *Spread Spectrum, UHF, and VHF*, Fiber Optic Cable, Dial-up Phone Modem, and Cell Phone Modem
34. Each installed software package can be setup to be a network server or client. The package connected to the pump system will be a sever allowing up to 5 remote clients to attach to it. Thus allowing any form of PC running Watervision to connect to the server using TCP/IP via an Intranet or over the Internet. Because the same software is loaded, the user interface will be identical at home as in the office, only the means of connection will vary.
35. When using a dial-up type connection an Auto Dial feature is available. User configured, allowing the user to be connected on particular days and times
36. Area to set the initialization sting guaranteeing compatibility with nearly every modem
37. Area to set the phone number of the remote site
38. Settable node address allowing connections to 245 different pump sites
39. Settable serial port connection
40. Settable data rate up to 19200 baud
41. Settable connection setting including: Data Bits, Parity, and Stop Bits
42. Performance setting allowing adjustments if necessary for different computer speeds and connection types
43. Connection diagnostics for troubleshooting any communications problems

44. PumpLink Sharing allowing the user to setup up to 16 different data viewers out of all 2056 pump station analog and 1699 digital data points.
45. The data and the user given description is then also available in the PumpLink. OCX utility for use by any irrigation equipment company=s software.
46. A print button allowing the user to print setup configurations
47. Ability to allow the user in one click to cascade or tile all open windows
48. All screen items will have a help window available to the user
49. A full pump station owners manual in digital form including graphic images of all touch screens
50. A database software utility (Maintenance Manager) will be supplied allowing the user to manage and record all service aspects of the pump station. The utility automatically retrieves information such as pump hours and total gallons from Watervision. The database shall be fully customizable allowing the user to also log and schedule any other service work completed on ground maintenance equipment or facilities.

D. Installation of the pump station software shall be seamless to the user via an easy to use configuration program that shall be started by simply inserting the media into the users computer drive and following installation instructions.

Watervision, PumpLink, and Maintenance Manager are registered trademarks of Watertronics Inc. Microsoft, Windows, and Windows NT are registered trademarks of the Microsoft Corporation. Other brands and product names are trademarks of their respective holder.

3.9g Pressure Transducer

A solid state pressure transducer shall provide a noise free, linear output proportional to discharge pressure. Transducer shall be solid-state, strain gauge type with integral voltage regulation and output accuracy not less than 0.25%. Transducer shall be constructed of stainless steel and rated for the pump station discharge pressure called out in the technical specifications.

3.9h Flow Sensor

A flow sensor shall be installed providing the pump station flow rate and total flow through the operator interface device (OID) as specified in section (3.11). The flow sensor shall be a six bladed design which provides a low impedance signal proportional to the flow. The accuracy shall be plus/minus 2% of actual flow rate between flow velocities of 1-30 ft./sec. A flow meter run shall be included with a minimum of 5 pipe diameters straight run upstream and 2.5 pipe diameters downstream for proper meter accuracy. Flow sensor model must have internal noise filtering feature. Flow sensor wire must be encased in 1½" liquid tight conduit from sensor to enclosure. Meter run shall be sized as shown in technical data sheet.

3.9i Magnetic Flow Sensor (Optional; must be called for in the Technical Specification)

The pump station shall have a flow sensor installed, which shall be utilized to control and display the pump station flow rate and to display total gallons pumps through the touch screen operator interface device mounted on the control panel door. The flow meter shall be electro magnetic design comprising of two major components, a primary head and a signal converter. The flow meter signal converter shall produce two separate signals, pulse and 4-20ma, in linear proportion to flow rate. Flow meter shall read flows from 0-40 fps, with a worst-case inaccuracy of +/-0.5% of reading with +/- 0.2% repeatability. Flow meter shall be sized so that maximum system flow lies between 16 and 24 fps through the meter. The primary meter head shall incorporate a straight-thru flow design with no moving parts or pressure loss, low maintenance and high accuracy. Meter shall be installed according to manufacturers recommendations.

The flow tube shall be an ANSI B16.5 class 150 flanged for sizes less then 24". Wetted liner shall be hard rubber. Liner shall extend beyond the ends of the flow tube and over the flanged faces. The electrodes shall be Hastelloy.

The signal converter shall be a NEMA 4 rated, and shall house the microprocessor-based electronics required for magnet excitation and flow measurement.

The meter shall be calibrated during the pump station full run performance testing while at the factory prior to shipment. The magnetic flow sensor on the pump station shall be calibrated against a master meter. The manufacturer's test and calibration equipment shall be certified and shall be re-certified every three years.

SECTION 4: SKID ELECTRICAL

4.1 Skid Wiring

Skid wiring shall conform to National Electrical Code Standards. All wiring from control panels to motors shall be in metal reinforced, water tight, flexible conduit with copper conductors rated not less than 600 volts and of proper size to carry the full load amperage of the motors without exceeding 70% capacity of the conductor. Flexible conduit runs shall not exceed six feet in length. A grounding cable sized to National Electrical Code requirements shall be included in the flexible conduit. There shall be no splices between the motor starters and the motor connection boxes.

Wiring to flow sensors, and pressure transducer shall be multi-conductor shielded cable suitable for Class II low voltage controls. Wiring to motor operated valves,(option available for VFD stations), shall be in flexible conduit with TFFN #18 gauge copper conductors rated not less than 600 volts.

4.2 Junction Boxes

All off skid devices requiring control interface shall be terminated in a junction box. This junction box shall be located at the skid edge nearest the installation point of the off skid device. Fertigation and monitoring systems shall be terminated in a NEMA 4 junction box located on the bottom left side of the main controls enclosure to allow end user connection.

SECTION 5: PUMP ASSEMBLIES

5.1 Horizontal Centrifugal Irrigation Pump

Pumps shall be electric motor driven, horizontal centrifugal with mechanical shaft seal, volute case and impeller.

The shaft seal shall be a self-adjusting mechanical type to prevent leakage and eliminate the need for drain piping. The volute case shall be precision machined from gray cast iron and engineered to modern hydraulic standards. It shall be possible to rotate the discharge connection to any of four positions. A heavy cast iron bracket shall maintain alignment between the motor and volute cast.

The impeller shall be an enclosed type and balanced to provide smooth operation. The impeller is to be keyed to the shaft and locked with a special cap screw and washer. The motor shaft is to be manufactured from high grade steel and of reduced length to increase shaft rigidity, extend bearing life, and reduce the overall length of the pump and motor assembly. The pump shaft shall be protected with a replaceable stainless steel sleeve. The pump motor and impeller shall be removable from the back of volute case for service without disturbing the plumbing.

5.2 Vertical Centrifugal Pressure Maintenance Pump

For the purpose of maintaining system pressure during non-irrigation periods, a pressure maintenance pump shall be incorporated in the system. Pressure maintenance pump shall be vertical type,

constructed of stainless steel. The pressure maintenance pump shall perform as specified by the Technical Specifications.

SECTION 6: MOTORS

6.1 Main Irrigation Pump Motor

Each pump motor shall be a squirrel cage induction horizontal solid shaft type. The pump impeller shall be direct mounted and keyed to the motor shaft with a stainless steel protective sleeve. The temperature rise of the motor shall be to NEMA Standard MG-1-12.42 for class B or Class F insulation.

Radial and thrust bearings of ample capacity to accommodate the hydraulic thrust of the pump shall be incorporated into the motor. The motor shall be of proper size to drive the pump at any point on it's operation curve without exceeding the percent of motor horsepower nameplate rating.

6.2 Main Motor Winding Condensate Heater

Each pump motor will be supplied with a 120 volt space heater in the motor windings to prevent condensation during non-use times. The heaters will be deactivated while the motors are running.

6.3 Pressure Maintenance Pump Motor

The system pressure maintenance pump shall be equipped with a 3600 RPM, high efficiency motor. The pressure maintenance pump shall perform as specified by the Technical Specifications.

SECTION 7: SKID, PIPING, VALVES, GAUGES, & MECHANICAL EQUIPMENT

7.1 Skid Construction

Pump station skid shall be formed from a single sheet of 3/8" steel, continuous welded and smooth ground at all corners resulting in a seamless, one piece structure 6 3/8" tall with rounded edges and corners. Two 3" holes shall be located at each corner of the skid, on the side wall, for the purpose of lifting the pump station. The skid shall be strategically reinforced underneath with 6" structural channel iron to support pumps, manifold control enclosure and periphery. Flat steel, diamond or checker plate welded over structural steel shall not be permitted. The finished skid height shall be 6-3/8". The skid shall be drilled and tapped for mounting of pumps, manifolds, tanks, relief valves and other equipment. All tolerances shall permit direct bolting of pump station components to skid. No slotted holes shall be permitted in the pump station skid and no nuts or bolt heads shall be permitted on the under side of the skid. The skid shall be primed and painted per enclosed specifications on both top and bottom.

7.2 Fabricated Piping

All fabricated piping shall conform to ASTM specifications A53 for Grade B welded or seamless pipe. Discharge piping 8" and above shall be a minimum of Schedule 10. Discharge piping 6" and smaller shall be Schedule 40. All welded flanges shall be forged steel slip-on or weld neck type. All welded fittings shall be seamless, conforming to ASTM Specification A234, with pressure rating not less than 150 PSI.

7.3 Drains

Drains are to be provided from any possible low point in the system and are to be equipped with 3/8 A or 1/4" brass valves. Drains shall include, but are not limited to, the following:

- Drain for each pump discharge check valve

- Drain in discharge manifold upstream of station discharge isolation valve.

- A wash down 3/4" brass hose bib on the discharge manifold, upstream of the main station isolation valve.

7.4 Pump Check Valve

Pump check valves shall be located on the discharge of the pump and sized per the technical data sheet. They shall be of the silent operating type that begin to close as forward velocity diminishes and be fully closed at zero velocity preventing flow reversal. Valve bodies shall be cast from ASTM-126C cast-iron or better and shall be free from blow holes, sand holes, and other impurities. The valve design shall incorporate a center guided, spring loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe diameter. Internals shall be machined bronze disc, seat, and stem guide. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 2.5 PSI.. Valves 4" and smaller to be pressure rated for 250 PSI, 6" to 10" to be pressure rated to 150 PSI. Valves 12" and larger check valves to be globe style with 150 PSI rating, iron bodied with bronze trim.

Comment [FRC1]: Our standard is bronze on bronze, which has worked well for us. Your comments please. (

7.5 Isolation Valve

Each Pump shall be isolated by means of a butterfly valve after the check valve and before the discharge manifold. The discharge manifold shall also have an isolation valve at the skid edge. Isolation valves shall be butterfly type with ten position lever for valves 4" and smaller or gear operators for valves 5" and larger, rated for 200 PSI WOG working pressure. Trim shall include stainless steel stem, bronze or nickel coated iron streamlined disk with full faced resilient seat design to eliminate need for flange gaskets.

7.6 Pressure Relief Valve

A pressure relief valve shall be installed on the discharge piping downstream of the pressure regulating valves. The valve shall be sized to bypass sufficient water back to the water source to avoid the discharge pressure from exceeding the maximum programmed pressure set point by more than 10 PSI.

7.7 Pressure Gauge

A pressure gauge shall be located on the discharge manifold for the purpose of measuring regulated, downstream pressure. Pressure gauge shall be 304 stainless steel case and bezel construction. Gauge shall be 4" diameter, liquid filled. Pressure sensing connection shall be 1/4" NPT lower gauge connection.

SECTION 8: ADDITIONAL SKID MOUNTED AND CONTROL INTEGRATED EQUIPMENT

8.1 Power line conditioner (Optional; must be called for in the Technical Specification)

The pump station manufacturer shall supply a 120 volt, single phase regulated power conditioner pre-wired inside a separate **NEMA 4** ventilated enclosure mounted on the pump station rated for the KVA and breakers as called out on the technical data sheets. The input voltage range will be +10%/-20% of input nominal voltage. The output voltage regulation will be + or - 3% for an input line variation of +10%/-20%. The harmonic distortion shall not be less than 3% total RMS content at full load. The input/output surge suppression module shall easily attenuate and absorb repeated 6,000 volt or larger spikes without damage while protecting the load. The power conditioner shall distribute its power to a circuit breaker distribution panel to allow the end user a connection point to the conditioned power.

8.2 Power Zone (Optional; must be called for in the Technical Specification)

The pump station manufacturer shall provide an auxiliary power supply pre-wired and mounted on the skid. It should be capable of delivering 120 volt OR 220 Volt single phase power, with KVA and breaker ratings as called out in the technical data sheets.

8.3 Inside Panel Lighting Package (Standard)

The pump station manufacturer shall provide within their control panel, fluorescent internal lighting that is switch activated. The light fixture should be mounted on the top of the enclosure and should be capable of illuminating the entire inside of the enclosure.

8.4 Optical Isolator (Optional; must be called for in the Technical Specification)

The pump station manufacturer shall provide optical isolation to isolate the PLC and computer system from sensor circuits, which may have a different ground reference. The optical isolator shall isolate the signal generated by the flow sensor from system input circuitry. The optical isolator wire terminal connection will be located in a J-box on the control panel exterior.

8.5 Fertigation Run Relay (Optional; must be called for in the Technical Specification)

The pump station manufacturer shall provide a run relay, which shall provide a start/stop signal for customer supplied fertigation pump. The run relay shall allow the fertigation pump to run only after 100 GPM station flow rate. The station GPM setting to activate or de-activate the fertigation pump shall be field adjustable through the operator interface. The run relay will be mounted in a J-box on the control panel exterior.

8.6 Lake Level Controls (Optional; must be called for in the Technical Specification)

The irrigation reservoir shall be continuously monitored by an electronic pressure transducer which will send a 4-20ma signal to the PLC. The reservoir level will be read on the Touchscreen operator interface and displayed in inches. The user shall be able to control the remote signal activation level by making the desired adjustments on the screen. When low (set point) level has been maintained for the pre-set period of time, a 120 VAC signal shall be sent to a dry contact relay in the pump station panel to activate the start signal for a fill pump or valve. Upon a rise in the reservoir level the signal will stop and the relay will drop out to stop the filling operation.

8.8 Auto-flush Wye Strainer (Optional; must be called for in the Technical Specification)

The pump station manufacturer shall provide an automatic flushing wye strainer mounted and wired on skid. The wye strainer basket shall be piloted in both body and cover and fabricated from 24 gauge stainless steel with perforations as shown in the technical specifications. The body of the strainer shall be cast iron with flanged connections. Pressure drop through the strainer shall be not more than 1.75 PSI at full station capacity. The strainer shall be automatically flushed after a specific pump station run duration period. This timer is adjustable through the computer operator interface device (OID) as called out for in these specifications. An Manual “on” switch shall be mounted on the Touchscreen operator interface. Provided as an integral part of the strainer package shall be a normally closed solenoid operated valve. The PLC shall initiate the flushing cycle by opening the 2" solenoid valve for set time. The flushing duration shall be an adjustable timer through the computer interface device. A 2" ball valve shall be supplied to isolate the solenoid valve. The wye strainer size shall be specified in the technical data sheet. The flush line shall be piped to skid edge. Others to supply flush line back to supply pond.

8.9 Filtration System (Optional; must be called for in the Technical Specification)

The pump station shall be equipped with a filtration system to assure a clean water supply to the irrigation system. The filtration shall consist of individual barrels containing removable filter elements. The number of barrels, the specific filter model number and filter screen micron rating shall be called out in the

technical specification. Each removable filter element shall consist of a course screen in series with a fine screen. The fine screen shall be flushed periodically to remove accumulated debris.

Flushing initiation shall be a timed interval, user adjustable, and a pressure drop across the screen, also user adjustable. Flushing control shall be governed by the pump station PLC. Separate flushing controls shall not be accepted.

Flushing action shall be initiated by an electronically actuated butterfly valve. The Electric Butterfly Valve (EBV) is impervious to dirty water vs. a hydraulic diaphragm valve susceptible to damage due to the filtered particles being flushed. Using a hydraulic diaphragm valve as the filter flush valve is **not acceptable.** To assure tolerance to dirty water, electric butterfly valve shall open/close at a programmed rate to eliminate excessive pressure drop or pressure spike.

Operation: Water shall flow into the **316 stainless steel** filter body and through the 316 stainless steel filtering screen from the inside out allowing blocked contaminates to accumulate on the inside surface of the filtering screen. Differential pressure across the filtering screen shall be continuously monitored as the filter cake builds on the inside of the filtering screen. The differential pressure across screen shall be monitored using a pressure transducer upstream and downstream of the filter assembly. Using a differential pressure switch is **not acceptable**. The pump station control logic shall have the capability of graphically tracking the pressure across the filter for troubleshooting purpose locally at the pump station through the touch screen operator interface device and through the remote monitoring and control software. When the differential pressure reaches an adjustable threshold (recommended at 7 psi) a flush cycle shall be initiated by the opening of the electric butterfly valve. The opening of the flush valve drops the pressure inside the drive chamber allowing flow to reverse through the suction scanner nozzles. The suction scanner nozzles transfer this reduced pressure at the nozzle location onto the inside of the filtering screen surface. This reduced pressure on the inside of the filtering screen creates a reversed flow through the filtering screen, pulling the containments off the screen, back through the suction scanner nozzles and out the flush valve. Once the nozzles have traversed and cleaned the entire screen surface, the flush valve shall close stopping the flush cycle.

The drive mechanism of the filter shall **not** consist of electric motor, or limit switches to return the drive mechanism to its start position. The drive mechanism shall allow the suction scanner nozzles to traverse across the screen and return to their start position, and if required, to continue this cycle indefinitely without interrupting the flush flow. A hydraulic motor directly attached to the suction scanner shall drive the suction scanner.

The filter screen element shall be **316 stainless steel** with micron opening size called out for in the technical specification. The filter housing and cover shall be manufactured from **316 stainless steel** and shall be manufactured to ASME standards but not stamped unless called for in the technical specification.

8.10 Pump Station Enclosure (Optional; must be called for in the Technical Specification)

The pump station shall be totally enclosed by a modular type enclosure.

The pump station-mounting base shall act as the base of the enclosure. Side panels and posts shall be secured to the mounting base.

The pump station enclosure shall consist of the following:

Side panels, two sets of double doors and pitched roof panels formed from 14-gauge steel.
Corner posts, center posts and header beams formed from 12-gauge steel.

Corner posts shall be attached to the pump station skid by no fewer than four 3/8” thread forming bolts. Center posts shall be attached to the pump skid by no fewer than two 3/8” thread forming bolts. A header beam shall run from corner post to corner post on all sides of the enclosure. The header beam shall be attached to corner posts and center posts with ¼” bolts.

Each side panel shall have either a corner or center post on each side. Corner and center posts hold side panels in place from behind. Header beams hold side panels in place at the top and front. At least two ¼" thread forming bolts hold side panels to the pump skid at the bottom.

All panels shall be formed at each edge to give structural rigidity.

a. The entire roof shall be removable without disturbing the remainder of the building. The roof panels shall sit on top of and bolt to the header beams. Bolts shall be spaced no farther than 20" apart around the lower flange of each roof panel. Removal of these bolts shall be the only obstacle to removing the entire roof. One eyehook shall be welded to each roof panel. When two roof panels are joined together the mated pair is easily removed with a lifting strap and a boom. Removing the roof panels allows full access to pumps and motors from above.

b. One incandescent light fixture shall be mounted at least 54" above the floor. The fixture will be suitable for wet locations and a cage will protect the light bulb. The switch will also be suitable for wet locations and be mounted at the edge of the door giving access to the control cabinet. All wire will be protected inside ½" sealtite flexible conduit.

c. A fan shall be incorporated into one fixed side panel. The fan motor shaft shall be placed at least 48" above the top of the pump station skid. The fan shall have protective screening completely surrounding the blades and self-opening shutters on the outside of the panel. The fan shall be at least 18" in diameter and move at least 2800 cfm. The fan shall draw air from within the enclosure. A self-opening louvered panel shall be placed in a fixed side panel as far from the fan as possible. This louvered panel shall serve as air intake into the enclosure. An industrial thermostat will activate the fan.

d. Painting shall consist of a multi-step coating system including metal preparation, a rust prohibitive epoxy prime coat and a two part ultraviolet insensitive polyurethane finish having a total dry film thickness of not less than 5 mils. Each coat will be applied and baked for one half hour at 165 degrees F. All enclosure components including side panels, doors, roof panels, posts, headers, and mounting brackets shall be painted medium green.

SECTION 9: ADDITIONAL SHIP LOOSE INTEGRATED EQUIPMENT

9.1 Stainless Steel Lake Inlet Screen (Optional; must be called for in the Technical Specification)

An all stainless steel box screen will be provided as called for in the Technical Specification. The screen will be box style with stainless steel mesh on three sides. The top, bottom and outlet sides will be solid stainless sheet. For support of the screen, stainless steel legs will be attached to the bottom. The box screen will have a clamp on style fitting with stainless steel bolts and nuts to slide over the inlet pipe.

9.2 Inlet/Discharge Drop Pipe (Optional; must be called for in the Technical Specification)

The pump station manufacturer shall supply the inlet and discharge drop pipes, with vertical swivel connection, for connection to the irrigation main line. The pipe will be of Schedule 40 steel, painted to match the pump station and sized for depth and termination based on the irrigation contractors requirements or as shown on the bid documents.

9.3 Floating Suction Intake Assembly (Optional; must be called for in the Technical Specification)

High density extra high molecular weight polyethylene (HDPE) pipe suction piping of size shown in technical data sheet shall be supplied with foot valve. HDPE suction piping shall be shipped in sections and be complete with flanged ends and companion flanges for pumping system. Bolts, nuts and gaskets shall be supplied for assembly of suction piping. HDPE floats shall be supplied with mounting hardware. The foot valves shall be constructed of aluminum. They shall contain a rubber flapper which sets on a machined aluminum surface and provides a tight seal to minimize leakage. Ample space shall be provided for the flapper to fold back out of the liquid stream, keeping friction loss to a minimum.

9.4 Fertigation Injection System (Optional; must be called for in the Technical Specification)

Scope: Pump system manufacturer shall provide the following as part of the pumping system. These items shall be shipped loose and installed on site. If there are any discrepancies between this section and the main specifications, this section takes precedence

Fertigation Feed Injection System:

General Description: Pump station manufacturer shall provide a fertigation feed nutrient injection system capable of independently injecting as specified in the technical data sheet up to four separate liquid product(s).

Each injection pump shall to be controlled by a separate AC Variable Speed Drive. The pump(s) shall be mounted on separate fiberglass base(s). The electrical controls to be mounted inside the pump station control panel, and shall not be separate. The injection system software controls will be integrated as part of the program logic controller operating the irrigation pump station. The pump(s) shall not be mounted on the irrigation pump station skid unless otherwise specified. It shall be the responsibility of the irrigation pump station manufacturer for installing wire and conduit from the control panel to the motors, installation from injection pump discharge into the injection quill and start-up.

The pump station manufacturer shall provide a run relay, which shall provide a start/stop signal for a fertigation pump(s). The run relay shall allow the fertigation pump to run only when a main pump is operating and flow is in excess of 100 GPM. The GPM to activate or de-activate the fertigation pump shall be field adjustable through the operator interface. Run relay will be mounted in a J-box on the control panel exterior. Customer is responsible for installing the chemical supply tanks and the suction line to each injection pump unless otherwise noted in the specification. The fertigation nutrient injection system to be manufactured by Watertronics Hartland, Wisconsin Model EZ Feed.

The fertigation nutrient injection pump(s) shall have Teflon diaphragm with Alloy 20 contour plates and Alloy 20 wetted parts. Each pump capable of delivering product from 3 GPH up to 80 GPH at the station rated pressure. Pump(s) to be independently driven via AC Variable Speed Drive to accurately control injection rate. As part of the injection system the suction and discharge isolation valves shall be constructed of PVC, with PVC suction and discharge tubing.

The nutrient injection system shall automatically vary its flow output in proportion to irrigation flow. The irrigation pump station flow sensor will provide the input signal to provide accurate application. All calibration, setup, and operation functions shall be accomplished through pump station PLC controls and Touch Screen Operator Interface and include a run light, HOA switch and speed pot. In manual mode, the user can manually adjust pump speed.

A Clear PVC calibration tube shall be included on the injection pump suction to accurately calibrate the metering pump over a minimum 30-second test.

Controller Hardware Specifications:
Full battery backed memory for program storage, product configuration information and control parameters.
RS232 port available for MODBUS™ communication over modem, wireless or wired connections.
Real Time Clock/Calendar.

Hardware for monitoring of water flow meter rate.
Analog inputs available upon request for chemical tank level monitoring

Controller Functional Capabilities:
System shall be capable of injecting each product proportional to the irrigation pump station flow rate.
All injection programs and applicable parameters must be accessible through this interface.
Lock out mode to prevent unauthorized access of control parameters

Hoses and fittings per pump:
15 feet of ½" diameter discharge hose rated to 250 pounds working pressure
15 feet electrical conduit
15 feet motor cable
PVC check valve
PVC isolation valve
PVC injection quill
PVC suction and discharge plumbing at each head
Fiberglass mounting base

Installation /Start-up:
It is the responsibility of the customer to provide any necessary pad or containment for tanks prior to installer arrival.
It is the responsibility of the customer to provide the chemical supply tanks and connect from tanks to suction connection of each injection pump
Installation to include complete assembly and water testing of system & operator training

9.5 Chemical Storage Tanks (Optional; must be called for in the Technical Specification)

Scope: Pump system manufacturer shall provide the following as part of the pumping system. These items shall be shipped loose and installed on site. If there are any discrepancies between this section and the main specifications, this section takes precedence.

Installation /Start-up: It is the responsibility of the customer to provide any necessary pad or containment for tanks prior to installer arrival. It is the responsibility of the pump station manufacturer to provide the chemical storage supply tanks and connect from tanks to suction connection of each injection pump. Installation to include complete assembly and water testing of system & operator training.

The quantity and size of the chemical storage tanks to be provided by the pump station manufacturer will be called out either on the drawing or in the technical specifications.

500 gallon HDPE cone bottom tank with leg stand, 2" outlet with 2" suction isolation valve, 2" return line fitting, and 30' of 2" suction hose.

1050 gallon HDPE cone bottom tank with leg stand, 2" outlet with 2" suction isolation valve, 2" return line fitting, and 30' of 2" suction hose.

1600 gallon HDPE cone bottom tank with leg stand, 2" outlet with 2" suction isolation valve, 2" return line fitting, and 30' of 2" suction hose.

SECTION 10: CONSTRUCTION

Construction shall be of modular form utilizing a steel base structurally adequate to support pumps, piping, tanks, and electrical equipment as a single integral assembly. All nuts, bolts, washers, and fasteners shall be stainless steel, zinc or cadmium plated for corrosion resistance.

SECTION 11: PAINTING

Painting of the entire unit shall consist of a multi-step coating system including metal preparation, a rust prohibitive epoxy prime coat and a two part ultraviolet insensitive polyurethane finish having a total dry film thickness of not less than 5 mils. Each coat will be applied and baked for one half hour at 165 degrees F. All pump station components including skid, manifolds, isolation and relief valves, grooved clamps and supports shall be painted medium green. All electrical enclosures and accessory panels and tanks shall be appliance white.

SECTION 12: TESTING

The pump station manufacturer shall conduct and document a complete factory dynamic test of the pump station prior to shipment. Pump station shall be tested throughout the entire operating range at the net discharge pressure called for in the technical specifications. Individual pump pressure, flow, RPMs, volts, amps, KW and power factor shall be documented for verification by the consulting engineer or owners' representative prior to delivery upon request.

SECTION 13: ON-SITE PUMP STATION OFF LOADING & SETTING

Off-loading & setting of the pump station is the responsibility of the **contractor,** unless specifically called out elsewhere in the specification. **Crane** to off-load and set the pump station on the concrete slab is to be provided by contractor.

SECTION 14: ON-SITE PUMP STATION START UP

Technical start up shall be furnished by the pump station manufacturer or a qualified service agency. Location and mounting details shall be furnished by the pump station manufacturer. Electrical connection, by purchaser, shall consist of a single conduit from owners disconnect to the pump station main disconnect. Additional purchaser responsibility shall include confirming correct motor rotation and securing local inspection/approval.

Technical start up procedures by the pump station technician shall include the following:

a. Station start up and pressurization.

b. Pressure, flow and programming adjustments.

c. Monitoring of complete golf course irrigation cycle when possible.

d. Customer training and presentation of owners manual.

SECTION 15: WARRANTY

The manufacturer shall warrant the pumping station to be free of defects and product malfunctions for a period of one year from date of start up or fifteen months after shipment, whichever occurs first. Failures caused by, lighting strikes, power surges, vandalism, flooding, operator abuse, or acts of God are excluded from warranty coverage. All warranties implied or otherwise shall not exceed those warranties extended by major or sub-component suppliers.

SECTION 16: SITE PREPARATION DRAWINGS

Site preparation drawings shall be furnished by the manufacturer within two weeks after receipt of order. Drawings shall indicate pump station alignment, discharge piping size, and electrical services required from local contractor. The owner shall return one set of drawings marked approved or corrected within one week of receipt.

SECTION 17: OPERATION AND MAINTENANCE MANUAL

Operation and maintenance manuals shall be furnished at time of start up and initial training. Owner will also receive training specific to this station as specified.

End of Specification; HC Fixed EBV Written Spec-10-22-05