

SECTION 4 PUMP STATION

4.01 GENERAL

- A. The prefabricated pump station shall have a minimum capacity and discharge pressure at skid edge as described in the drawings and technical specifications. The overall pump length shall extend to within twelve inches of the bottom of the wet well. The main irrigation pumps shall operate at no more than 1800 RPM
- B. 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.
- C. Construction shall include a fabricated steel plate and skid assembly to support all components during shipping and to serve as the installation mounting base.
- D. The discharge manifolds from the pump station shall terminate at or near the pump station skid edge and be provided by the pump station manufacturer.
- E. All products, components and assemblies specified herein shall also be listed as or approved equal. All substitutions shall be submitted to the Owner for review and comment prior to submitting a bid.

4.02 MANUFACTURER REQUIREMENTS

- A. The pump station shall be manufactured by **Watertronics, Inc.**, Hartland, Wisconsin **or approved equal**. The following information must be furnished by the contractor or manufacturer's representative within 10 days before bid date, to the Consultant/Engineer for consideration as an equal brand.
- B. A complete specification and submittal of all major components for the proposed pump station with individual pump performance verification.
- C. A detailed pumping station proposal drawing complete with component location, sizes and dimensions specific to the installation and matching the specifications herein.
- D. A complete electrical schematic for all high and low voltage circuits showing breaker/ fuse sizing, wire numbering and color.
- E. Pump station manufacturer's U.L. file number for the electrical controls and pump station.
 - a. A copy of the manufacturer's certificate of insurance in excess of \$1,000,000.
 - b. 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 than two technicians on call seven days a week. Verify with Names, Addresses, and Phone Numbers.
 - c. 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. 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. Verify with Names, Addresses, and Phone Numbers.

4.03 U.L LISTED CONTROL PANEL, LOGIC AND SENSORS

- A. 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.
- B. All external operating devices shall be dust and weatherproof. 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.

- C. A closed type cooling system shall be included to cool the enclosure and reject heat from the VFD. **Open type cooling systems allowing outside ambient air to enter the panel are not acceptable.** No water line connections shall be permitted inside of the control enclosure.
- D. VFD status and internal parameters must be viewable without the opening of the enclosure door.
- E. The control panel shall be designed, built, tested and U.L. listed by the pump station manufacturer.

4.04 MAIN DISCONNECT

- A. A three-pole, main station disconnect shall be contained within the NEMA 4 control enclosure. 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.

4.05 MOTOR COMBINATION STARTERS- BREAKER

- A. Each motor shall be protected by a MSP combination starter and breaker. Device will be UL 508 Type F. Motor starter protector and contactor are electrically and mechanically linked by means of a link module and adapter plate. All starters are suitable for use in group installation applications according to NEC-430-53(c).

4.06 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.

4.07 PREMIUM LIGHTNING ARRESTER, SURGE PROTECTION ON 480V, 120, 24V CIRCUITS

- A. Surge suppressor shall meet or exceed the following criteria: Minimum single impulse current rating: 80,000 amperes per phase. Duty cycle testing: 2,500 200KA 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.
- B. Incoming power: 200 kA transient. Control circuit 120v: 25kA transient. Analog circuit 24v: 20 kA transient.

4.08 SECONDARY CONTROL CIRCUIT BREAKERS

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

4.09 MAIN PANEL POWER AND MOTOR PHASE MONITOR

- A. 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.

4.10 CORROSION INHIBITING MODULES

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

4.11 CONTROL LOGIC

- A. 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 RS232 and RS485 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. The PLC will have a high speed counter, clock and calendar function with year, month, day, hour, minute, and day of week

4.12-a PRESSURE REGULATION - VARIABLE FREQUENCY DRIVE (VFD)

- A. Pump station shall be equipped with a single VFD for multiple pumps of the same horsepower motors. Any pumps varying in size shall be controlled by a dedicated VFD.
- B. The variable frequency drive shall be IGBT based with selectable carrier frequency up to 15 KHZ. The VFD shall include terminals for incoming power, motor output power and control terminals.
- C. The VFD shall generate a sine-coded, variable voltage/ frequency, three phase output for optimum speed control. The VFD shall incorporate power loss ride-through for a minimum of 2 seconds. VFD protective features shall include current limit, auto restart, short circuit protection, electronic motor overload protection and ground fault protection. The VFD shall have a push button programming display for easy access to operation parameters. The VFD shall be protected on the primary side a breaker of the appropriate amperage. Overload capacity: 120% rated output current for one minute. Voltage Fluctuation: +10%, -15%. Sine wave, PWM, with full range, and automatic torque boost. Frequency Control Range: 0.5 to 500Hz. Frequency Accuracy: Digital, 0.01Hz, Analog, .1%. Motor overload protection, Instantaneous over current of 180% of rated output current. Over voltage at 820VDC if 460V input. Under voltage: user adjustable. Momentary Power Loss: up to 2 second ride through. Electronic Ground Fault. LED capacitor charge indicator. Input Phase loss alarm. Ambient temperature range of 0 to 50 degrees C. Humidity of 95% non-condensing.

4.12-b OPERATOR DEFINED AUTOMATIC PRESSURE REGULATION BASED ON VARIABLE FLOW

- A. The operator shall be capable of changing the regulated downstream pressure 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.

4.13 LEAD PUMP SELECTION

- A. 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.

4.14 ALARMS

- A. 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. High discharge pressure cutout. Pressure remains 11 PSI above regulate set point for set time delay.
 - 3. Phase/ voltage cutout. High or low voltage, loss of phase, or phase reversal.

4. Low intake water level cutout. Wet well or pond level remains below set point for set time delay.
5. Starter fail cutout. Output to starter is not met with corresponding running input for set time delay. Indicates overload, phase imbalance or control fuse.
6. VFD fault and VFD bypass status.
7. Optional Alarms for Custom Sensors as Defined in the Technical Specifications

4.15 OPERATOR INTERFACE

- A. Operator interface shall be a full color STN 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 STN color display type with no less than 240 x 320 pixel resolution, with viewing area measuring not less than 10" diagonal. User memory for storing critical pump operation data shall not be less than required for up to 1 year of data.
- B. The operator interface shall allow remote control operation of all pumping stations from any operator interface or computer/tablet/phone wirelessly.
- C. 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.

4.16 REMOTE MONITORING SOFTWARE FOR PERSONAL COMPUTER: SHORT HAUL MODEM STYLE

- A. Pump station monitoring software, will be fully compatible with Windows XP, Vista, 7, and 8 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 2.4 Ghz to the pump station over direct wire, cellular modem, radio modem, short haul modem, or over fiber cable. The software shall also be capable of communicating over the Internet and Intranets 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.
- B. The pump station manufacturer shall supply all required communication hardware except; computer and computer accessories including all necessary direct burial cable.
- C. The remote monitoring software shall require a PC based computer with minimum requirements: Quad 4 Processor, Windows 7 OS, 4 GB RAM, 500 GB of free hard drive space, Intel HD graphics card.
- D. 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 resettable.
 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. User event log
 31. An Alarm Paging window to configure up to three, (3), different pagers to be called for sending of a digital, coded alarm message
 32. Input window for initialization string to configure the phone modem and computer before connection to pager. Includes serial port identifier locator
 33. 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
 34. 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
 35. 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 Remote Monitoring Software 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.
 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 serial port connection
 39. Settable connection setting including: Data Bits, Parity, and Stop Bits
 40. Performance setting allowing adjustments if necessary for different computer speeds and connection types
 41. Connection diagnostics for troubleshooting any communications problems
 42. A print button allowing the user to print setup configurations
 43. Ability to allow the user in one click to cascade or tile all open windows
 44. All screen items will have a help window available to the user
 45. A full pump station owners manual in digital form including graphic images of all touch screens
 46. 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 Remote Monitoring Software. 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.
 47. Time of use lockout (ability to set up to three unique lockout periods per day of irrigation pumps, water feature pump, lake fill, and fertigation injection pumps)
 48. Email report notification: Email report can be sent to a specified time each day and or at time of alarm.
 49. Audible alarm indication: Upon an active pump station alarm a banner to be displayed on the computer screen along with an audible alarm noise
 50. Ability to setup fertigation chemical tank diameter and display tank level in gallons
 51. Ability to modify the chemical to station flow ratio without having to manually adjust injection pump
 52. CUSTOM ALARMS and INFORMATION as defined in the TECHNICAL SPECIFICATIONS
- E. 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.
- F. Remote Monitoring Software, 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.

4.17 PRESSURE TRANSDUCER

- A. 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.

4.18 MAGNETIC FLOW SENSOR

- A. 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 electromagnetic 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.

- B. The flow tube shall be an ANSI B16.5 class 150 flanged for sizes less than 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.
- C. The signal converter shall be a NEMA 4 rated, and shall house the microprocessor-based electronics required for magnet excitation and flow measurement.
- D. 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.

4.19 SKID WIRING

- A. 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.
- B. 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.

4.20 JUNCTION BOXES

- A. 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 exterior of the main controls enclosure to allow user connection.

4.21 VERTICAL TURBINE IRRIGATION PUMPS

- A. Bowl assembly including suction case, intermediate bowls and discharge bowls shall be of Class 30 cast iron. The impellers shall be of **stainless steel or bronz**, statically balanced. Impellers shall be adjusted vertically by means of an adjusting nut located at the top of the driver. The pump shaft shall be supported by bearings above and below each impeller. The size of each shaft shall be appropriate to transmit the horsepower required by the pump.
- B. Each turbine pump inlet strainer shall be corrosive resistant basket type with an area not less than four times the pump suction bell inlet area.
- C. The discharge column pipe shall be A53 Grade B sch 40 steel and furnished in interchangeable 10' sections with threaded couplings. The line shafts shall be ground and polished 416 stainless steel, and shall be coupled with steel couplings, have left hand threads, which tighten during operation. Drop-in type shaft centering spiders shall be provided at each column coupling at maximum 10' spacing. The section of shaft passing through the stuffing box shall be stainless steel having a chromium content of not less than 12%.

4.22 DISCHARGE HEAD IRRIGATION PUMPS

- A. Each pump shall be supplied with a DUCTILE IRON discharge head having a flanged discharge opening. The top diameter of the discharge head shall match the motor base to distribute the load uniformly. The minimum operating pressure of each discharge head shall be no less than 30% higher than the maximum output pressure of the pump. The DUCTILE IRON discharge head will have a tensile strength of 65,000 PSI.

4.23 COLUMN PIPE

- A. Column pipe should be A53, Grade B schedule 40 material, in inter-changeable sections not more than 10 feet in length. Pump line shaft shall be AISI 416 SS. The size of the shaft shall be no less than determined by ANSI specification B58.1, Section 4.2, Table 4. Bearing retainers shall be bronze with rubber bearings.

4.24 SUBMERSIBLE PRESSURE MAINTENANCE PUMP

- A. 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 submersible type, constructed of stainless steel. The pressure maintenance pump shall perform as specified by the Technical Specifications.

4.25 MAIN IRRIGATION PUMP MOTOR

- A. Each pump driving motor shall be squirrel cage induction vertical hollow-shaft type. The connection to the pump shaft shall be bolted-down type couplings in the motor. The temperature rise of the motor shall be to NEMA standard MG-1-12. **Motors to be Inverter Duty, High Efficient** with Class F installation. A thrust bearing of ample capacity to carry the weight of all rotating parts plus the hydraulic thrust of the pump shall be incorporated into the motor. The bearings shall be B10 rating with average life no less than five years continuous operation. The motor shall be of proper size to drive the pump at any point on the operation curve without exceeding the percent of the motor horsepower nameplate rating as called out in the Technical Specifications.

4.26 VHS MOTOR WINDING CONDENSATE HEATER

- A. Each VHS 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.

4.27 PRESSURE MAINTENANCE PUMP MOTOR

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

4.28 SKID CONSTRUCTION

- A. 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 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 structural channel iron to support pumps, manifolds, control enclosures and periphery. The skid shall be drilled and tapped for mounting of pumps, manifolds, tanks, relief valves and other equipment. All tolerances shall be sufficient to 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 pump station skid shall cover the wet well completely, without the need for a separate wet well cover plate. The pump station skid shall incorporate an integral wet well access hatch measuring not less than 16 inches by 24 inches. The access hatch door shall be both hinged and removable. For safety purposes, the wet well hatch access handle shall not protrude above the skid surface. The skid shall be powder coated per enclosed specification on both top and bottom.

4.29 FABRICATED PIPING

- A. All fabricated piping shall conform to ASTM specifications A53 for Grade B welded or seamless pipe. Discharge piping shall be standard wall steel. 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.

4.30 DRAINS

- A. 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:
 - a. Drain for each pump discharge check valve
 - b. Drain in discharge manifold upstream of station discharge isolation valve.
 - c. A wash down 3/4" brass hose bib on the discharge manifold, upstream of the main station isolation valve.

4.31 PUMP CHECK VALVES

- A. Pump check valves shall be bolted directly to the pump discharge heads and sized per the technical data sheet. They shall be of the silent operating type that begins 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.

4.32 ISOLATION VALVE

- A. 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.

4.33 PRESSURE RELIEF VALVE

- A. 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.

4.44 SYSTEM AIR RELEASE ALL VT PUMPS

- A. Individual pump column air shall be purged prior to entering the pump station discharge manifold. An air release assembly shall be located on each pump discharge head, upstream of the pump check valve. Separation reservoirs or tanks with air/ water balance controls shall not be accepted.

4.45 PRESSURE GAUGE

- A. A pressure gauge shall be located on each zone's 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.

4.46 INSIDE PANEL LIGHTING PACKAGE (STANDARD)

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

4.47 POWER ZONE

- A. 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 and quantity as called out in the technical data sheets.

4.48 OPTICAL ISOLATOR

- A. 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.

4.49 FERTIGATION RUN RELAY - N/A

4.50 LAKE LEVEL CONTROLS

- A. 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. Lake level wire terminal connections will be located in a J-box on the control panel exterior.
- B. Logic and Relay for remote pump start and city water fill valve, selectable in color touchscreen operator interface. Single or dual level activation is user selectable.

4.51 SELF CLEANING INTAKE SCREEN

- A. The inlet screen is a Clemons CW 1700 with 12 mesh with sealed bearings.

4.52 DISCHARGE DROP PIPE

- A. The pump station manufacturer shall supply the discharge drop pipe as detailed within the drawing package. Discharge Drop Pipe shall be powder coated inside and out.

4.53 CONSTRUCTION

- A. 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 zinc or cadmium plated for corrosion resistance.

4.54 POWDER COATING

- A. The completed pump station including piping, valves, pipe supports, pump supports and skid shall be powder coated on all sides, inside and out.

4.55 TESTING

- A. 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.

4.56 ON-SITE PUMP STATION OFF LOADING & SETTING

- A. 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 or owner**. Pump station shall be delivered onto the golf course on flat bed truck no longer than 26'.

4.57 ON-SITE PUMP STATION START UP

- A. Technical start up shall be furnished by the pump station manufacturer or a qualified, Watertronics certified 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 operational cycle when possible.
- d. Customer training and presentation of owners manual.

4.58 WARRANTY

- A. 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.

4.59 SITE PREPARATION DRAWINGS

- A. 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.

4.60 OPERATION AND MAINTENANCE MANUAL

- A. 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.