ITT

Flowtronex

Instruction Manual

19-001-200

Rev 0110

SILENT STORM

VFD Pumping System

Installation, Operation, Maintenance

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE.

NOTE: This product is not intended for use in potable water applications

Engineered for life

Acknowledgements

TABLE OF CONTENTS

NOTE: The information contained in this book is intended to assist operating personnel by providing information about the characteristics of the purchased equipment.

It does not relieve the user of their responsibility of using accepted engineering practices in the installation, operation, and maintenance of this equipment.

For additional questions, contact:

ITT FLOWTRONEX

(800) 786-7480 x1

www.flowtronex.net/

service@flowtronex.com

WARRANTY INFORMATION

Company warrants title to the product(s) and, except as noted below with respect to items not of Company's Manufacturer, also warrants the product(s) on date on shipment to Purchaser, to be of the kind and quality described herein, and free of defects in workmanship and material.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MECHANTABILITY AND FITNESS, AND CONSTITUTES THE ONLY WARRANTY OF COMPANY WITH RESPECT TO THE PRODUCT(S).

If within one year from date of initial operation, but nor more than eighteen months from date of shipment by Company of any item of product(s), Purchaser discovers that such item was not as warranted above and promptly notifies Company in writing thereof, Company shall remedy such non-conformance by, at Company affected part of the product(s). Purchaser shall assume all responsibility and expense for removal, reinstallation, and freight in connection with the foregoing remedies. The same obligations and conditions shall extend to replacement parts furnished by Company hereunder. Company shall have the right of disposal of parts replaced by it.

ANY SEPARATELY LISTED ITEM OF THE PRODUCT(S) WHICH IS NOT MANUFACTURED BY THE COMPANY IS NOT WARRANTED BY COMPANY and shall be covered only the express warrant, if any, of the manufacturer thereof.

THIS STATES PURCHASER'S EXCLUSIVE REMEDY AGAINST COMPANY AND ITS SUPPLIERS RELATING TO THE PRODUCT(S), WHETHER IN CONTRACT OR IN TORT OR UNDER ANY OTHER LEGAL THEORY, AND WHETHER ARISING OUT OF WARRANTIES, REPRESENTATIONS, INSTRUCTIONS, INSTALLATIONS OR DEFECTS FROM ANY CAUSE. Company and its suppliers shall have no obligation as to any product which has been improperly stored and handled, or which has not been operated or maintained according to instructions in Company or supplier furnished manuals.

SAFETY

Read all safety information prior to installation of the Silent Storm Pumping System.

SAFETY INSTRUCTIONS

SAFETY INSTRUCTION

This is a SAFETY ALERT SYMBOL. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury, death!

FAILURE TO FOLLOW THE INSTRUCTIONS MAY RESULT IN A SAFETY HAZARD.

DANGER

Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation, which if not avoided, may result in minor or moderate injury.

CAUTION

Used without the safety alert symbol indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

All operating instructions must be read, understood, and followed by the operating personnel. Flowtronex accepts no liability for damages or operating disorder which are the result of non compliance with the operating instructions.

When the Pumping System components reach the end of life the components should be disposed of or recycled in accordance with local laws.

SAFETY REMINDERS

1. This manual is intended to assist in the installation, operation, and repair of the system and must be kept with the system.
2. Installation and maintenance MUST be performed by properly trained and qualified personnel.
3. Review all instructions and warnings prior to performing any work on the system.
4. Any safety decals MUST be left on the controller and pump.
5. The system MUST be disconnected from the main power supply before attempting any operation or maintenance on the electrical or mechanical part of the system. Failure to disconnect electrical power before attempting any operation or maintenance can result in electrical shock, burns, or death.

ADDITIONAL SAFETY INFORMATION

This pump has been designed for safe and reliable operation. A pump is a pressure-containing device with rotating parts that could be hazardous.

Operators and maintenance personnel must realize this and follow necessary safety measures. Proper safety procedures must be followed. ITT Flowtronex shall not be liable for damage or delays caused by a failure to observe the instructions in this manual.

Safety Apparel:

- Wear insulated work gloves when handling hot bearings or using bearing heater.
- Wear heavy work gloves when handling parts with sharp edges, especially impellers.
- Wear safety glasses (with side shields) for eye protection, especially in machine shop areas.
- Wear steel-toed shoes for foot protection when handling parts, heavy tools, etc.
- Wear other personal protective equipment to protect against hazardous/toxic fluids.

Coupling Guards:

- Never operate a pump without a coupling guard properly installed.
- Never force piping to make a connection with a pump.
- Use only fasteners of the proper size and material.
- Ensure there are no missing fasteners.
- Beware of corroded or loose fasteners.

Operation:

- Do not operate below minimum rated flow, or with suction/discharge valves closed.
- Do not open vent or drain valves, or remove plugs while system is pressurized.

Maintenance Safety:

- Always lock out power.
- Ensure power is isolated from system and pressure is relieved before disassembling pump, removing plugs, or disconnecting piping.
- Use proper lifting and supporting equipment to prevent serious injury.
- Observe proper decontamination procedures.
- Know and follow company safety regulations.
- Never apply heat to remove impeller.
- Observe all cautions and warnings highlighted in pump instruction manual.

GENERAL DESCRIPTION

PRODUCT DESCRIPTION

A Flowtronex Silent Storm Variable Speed Pumping System is custom built to the requirements provided by the purchaser. The Silent Storm pumping system is a modular variable speed system designed to maintain a constant discharge pressure while providing a variable flow rate to match the water demand of the system. The system minimizes power consumption by combining a variable speed lead pump with constant speed lag pumps. The Silent Storm utilizes a microprocessor-based controller to efficiently manage pump operation to match a wide range of pressure boosting applications.

Silent Storm Variable Speed Pumping Systems are self-contained, pre-assembled and factory-tested pumping plants. Silent Storm utilizes state of the art technology, yet employs a simplistic and straightforward design that makes installation, operation, and maintenance an easy task, even for the most inexperienced of operators.

This manual serves as a guide to understanding the features of Silent Storm Pumping Systems and provides a quick and clear reference for answers to most questions pertaining to its service. Every attempt has been made to explain all facets of system operation and maintenance. However, should you have specific questions not addressed in this manual, you are encouraged to contact your nearest Flowtronex Authorized FlowNet representative, or the factory (800-786-7480 Ext. 3).

OPERATIONAL LIMITS

See pumping system nameplate information for pumping system flow capacity, pressure, full load current and electrical ratings.

Unless special provisions have been made for your pumping systems, the system pressure rating is as follows:

Pump system type	Max discharge pressure
End suction centrifugal	**175 psi**
Vertical turbine	**200 psi**

NAMEPLATE INFORMATION

The system nameplate gives identification and rating information as identified in the figure below.

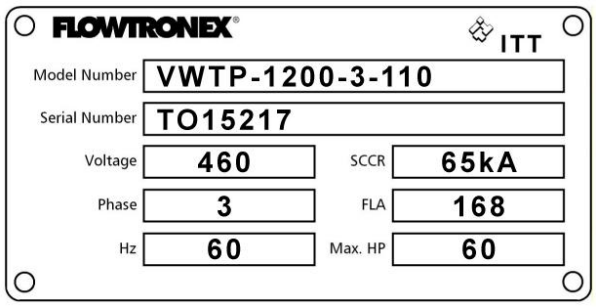

Figure 1: Sample Nameplate

Field	Explanation
Voltage	**Required input voltage**
SCCR	**Short circuit current rating**
Phase	**Number of motor phases**
FLA	**Full load amps**
Hz	**Required frequency (hertz)**
Max. HP	**Maximum horsepower**

Permanent records for this system are referenced by the serial number. Include the serial number with all correspondence and spare parts orders.

STATION NUMBERING

Example: V W T P - 900 - 3 - 120

1. Control Type:

   V = VFD

2. Water Source Type:

   W = Wet Well

   V = Vessel

   C = Can

   F = Flooded

   L = Lift

   B = Boost

   D = Deep Well

S = Submerged Sled pump assembly

M = Floating pump assembly

3. Pump Type:

   C = Horizontal

   S = Submersible

   T = Vertical Turbine

   M = Multi-stage Horizontal (ex. Goulds SSV)

   E = Submersible Trash Pump (ex. Ebara)

4. System Type:

   P = Pump Station

   T = Transfer

   X = Control Package

5. System Gallons per Minute: If a multi-zone system, show all zones with a slash (/) between each. If it is a control package, show the total number of pumps to be controlled.
6. Quantity of Pumps: Include pressure maintenance pump and current pumps - do not include future pumps in model number.
7. System Pounds per Square Inch: If multi-zone system, show all zones with a slash (/) between each zone. Design must assume that all zones run at the same time. Describe in no-uncertain terms the performance of each zone. If the station has spacing for future pumps, always create a model number showing the current conditions service. Make notes in your documentation describing the "current" versus "future" conditions of service. On boosted systems, model number should reflect the differential pressure with notes describing the incoming pressure.

HANDLING

Qualified personnel should unload and handle the unit. Prevent damage due to dropping or jolting when moving the unit. Thoroughly inspect the unit for damage upon receipt. Immediately notify the carrier of transportation damage. Ensure that sensing lines are free of crimps and kinks.

The unit is top heavy due to the position of the equipment. Do not use component eyebolts to lift the pump station.

WARNING: Falling Objects Hazard

Eyebolts, if provided, are designed to lift only the components to which they are attached.

Failure to follow these instructions could result in serious personal injury, death, and/or property damage.

STORAGE

During periods of storage, the unit should be covered to prevent corrosion and contamination from dirt. Store the unit in a clean, dry location to prevent condensation and freezing. After storage, check that it is dry before applying power. Specific component storage instructions must be followed in accordance with the respective equipment manufacturer's recommendations.

CAUTION: Extreme Temperature Hazard

Extreme temperatures are to be avoided. (Below 32ºF and above 110ºF.)

Failure to follow these instructions could result in serious property damage and/or moderate personal injury.

FIELD CONNECTION DIAGRAMS

Actual equipment manufacturers/models installed are system specific. Refer to specific manufacturers' Installation, Operation & Maintenance Manuals for details unique to each component. The pump instruction manual is supplied with the system (if applicable).

Review the wiring diagrams and dimensional drawings prior to unit installation and operation.

NOTE: Electrical supply must match the control panel nameplate specification. Incorrect voltage can cause fire, damaging electrical components and void the warranty.

NOTE: Electrical supply must be installed by a qualified electrician in accordance with all applicable codes, ordinances, and good practice.

GROUND CONNECTIONS

A grounding terminal is provided for a dedicated ground wire connection. All provisions of the National Electrical Code and local codes must be followed.

WARNING: Electrical Shock Hazard

Conduit grounds are not adequate. A separate ground wire must be attached to the ground lug provided in the enclosure to avoid potential safety hazards.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

INSTALLATION

LOCATION

Locate the pumping system in a clean, well ventilated, and properly drained location. It is recommended that the location selected facilitates ease of inspection, maintenance, and service. Outside installation requires protection from freezing.

WARNING: Falling Objects Hazard - Heavy Load, May Drop If Not Lifted Properly.

Do not lift the entire unit by component eyebolts. Eyebolts on components are used for factory assembly only and are not intended to lift the complete package.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

FOUNDATION

With proper installation and a suitable foundation, this unit is built to supply years of service. Establish a base of concrete weighing a minimum of 2-1/2 times the weight of the unit. (Check the shipping tickets or the pumping system drawing for unit weight.) Tie the concrete pad in with the finished floor. Use the appropriate anchor bolts to secure the pumping system to the foundation.

Pump packages with electrical conduit below surface may require corrosion protection approved for this condition.

WARNING: Electrical Shock Hazard

Electrical conduit installed below the surface may require a corrosion resistant protective coating to prevent conduit corrosion and electrical shock.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

Place the unit on its concrete foundation, supporting it with steel wedges or shims. These wedges or shims should be put on both sides of each anchor-bolt and midway between the bolts, to provide a means of leveling the base.

After the pumping system has been leveled, install the correct number of anchor bolts and tighten to secure the system.

PUMP INSTALLATION

In most cases, if the pumps have an overall length of less than twenty (20) feet, they are shipped assembled. Only the motor, head shaft, strainer basket, and discharge connection are shipped separately. The following instructions describe installation for assembled pump stations.

Prior to Installation

1. Measure each pump and document on the set/start report.
2. Confirm wet well probe measurements. Measure the distance from the bottom of the wet well to the top of the skid to ensure that pumps were ordered with the correct length. Preferred length is 12 inches above the bottom of the wet well.
3. Tighten all bolts and couplings on the pump before proceeding.
4. Install each pump according to the last digit on the pump identification tag.

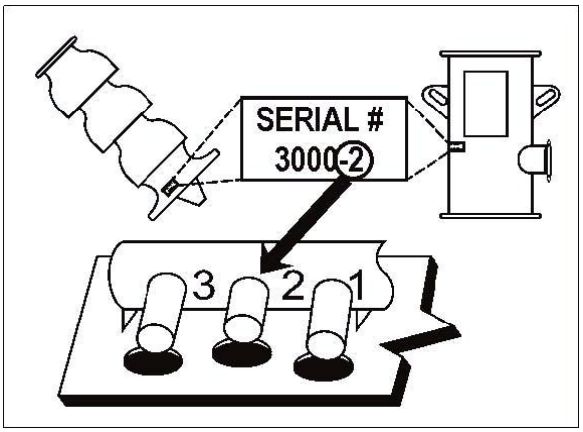

Figure 2: Location of Serial Number and Skid Position

Installing Assembled Pump Station

1. To set pump, use a crane or other adequate lifting device and a cable sling of adequate length. Attach the cable to the lifting lugs (lifting eyes) on either side of the pump.

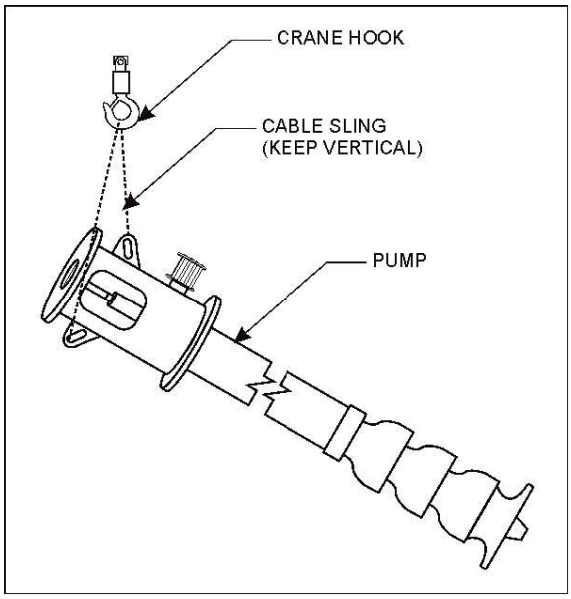

Figure 3: Lifting Pump

2. After the cable-sling is attached to the lifting lugs (lifting eyes) on the pump head, raise the pump to a vertical position. While in this position, install the strainer basket with bolts and clips. Position the pump over its access hole on the skid.

WARNING: Falling Objects Hazard

DO NOT work under heavy suspended object unless there is positive support and safeguards should a hoist or sling fail.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

3. Very slowly, lower the pump through its access, keeping one hand on the pump to detect any bumping by the pump against the edge of its hole or the wall of the wet well. When the pump is properly installed, it should not touch the side of the wet well. Premature bearing failure or destruction of the bowl assembly can result from improper installation.

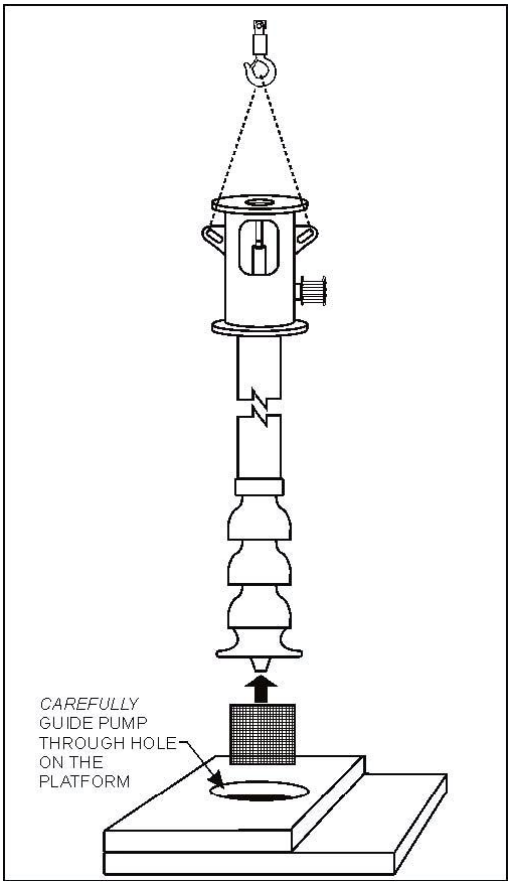

Figure 4: Position Head Over Access Hole on Skid

WARNING: Equipment Damage Hazard

Be prepared to stop lowering the pump IMMEDIATELY if any bump is felt.

It is possible that the pump bowl could catch on the edge of the skid and become unhooked from the cable or other lifting device. Possible serious bodily injury or damage to the pump could result.

Verify and ensure that the safety latch on the hook works properly.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

4. Push the pump slightly off-center when it is being lowered in the wet well to avoid hitting the manifold discharge pipe.
5. Stop lowering the pump when the base of the head is approximately 1/8 to 1/4 inch above the platform.

6. Line up the spool with the pump isolation valve on the manifold-discharge pipe and set the pump on the skid. Start threading the base bolts on the pump head. Slide the Victaulic clamp gasket so that the clamp rides in the gloves on both the isolation valve and the spool. Tighten the Victaulic clamp. Tighten the base bolts.
7. If the pumps are shipped unassembled, refer to the Gould Pumps, Model VIT Installation, Operation, & Maintenance Instructions.
8. Install the vertical hollow shaft motor to the top of the pump's disconnected head. Refer to the Gould Pumps, Model VIT Installation, Operation, & Maintenance Instructions.

WARNING: Falling Objects Hazard

DO NOT work under heavy suspended object unless there is positive support and safeguards should a hoist or sling fail.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

CAUTION: Motor Rotation Hazard

DO NOT install motor shaft, Gib key, or adjusting nut until motor rotation has been verified.

Failure to follow these instructions indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

STATION OPERATION

This section covers the sequence of operation for your station including: Door Switch Operation, Automatic Operation, and System Safeties.

DOOR SWITCH OPERATION

System Control Switch

Allows operator to select how the station operates:

OFF Regardless of individual switch position, pumps do not operate.

AUTO Places the system in

automatic mode.

MANUAL Places the pumps in manual mode. The operator must start and stop the individual pumps using each pump's switch.

Individual Pump Switches

Allows operator to select which pumps operate:

NOTE: Pumps have an OFF/ON switch or a MANUAL/OFF/AUTO switch.

MANUAL These switches start the individual pumps. However, the system MANUAL/OFF/AUTO switch must be placed in the MANUAL position before the individual pump is turned ON. Otherwise, each switch must be cycled OFF, then ON to "arm" the pump for operation.

OFF Selected pump does not operate, regardless of any other switch position.

AUTO Selected pump operates in Automatic Mode provided there is not an individual pump overload trip.

ON Selected pump will operate immediately if the system switch is set to MANUAL, and there are no faults. In AUTO, the pump will come on if there is a demand for it, and the PLC calls for it.

VFD / Bypass Switch

Enables or disables the VFD:

VFD This switch position enables VFD operation in either automatic or manual mode depending on the position of the system switch. VFD is the normal position of the switch.

BYPASS This switch position, places the pump station in either "Automatic VFD Bypass" or "Manual VFD Bypass" mode of operation depending on the position of the MANUAL/OFF/AUTO switch. In this mode, the pumps will start "across the line."

This mode is intended for use only when the VFD is not functional. Turn all pump switches to OFF before placing the system in BYPASS mode.

VFD Selector Switch (Optional On Some Stations) – PUMP 1 / PUMP 2 / PUMP 3

This switch determines which pump runs on the VFD when switch is in the MANUAL mode. However, if this switch is not present, the first pump with VFD capability runs as the VFD pump.

When the switch is in AUTO, the pump selected to run on the VFD has the lowest accumulated run time. Only one pump at a time can run on the VFD (also known as an inverter). Once a pump is running on the inverter, this switch is disabled. If another pump is selected when the inverter is in use, the newly selected pump does not run.

Low Discharge/Differential Pressure Switch

This switch allows the operator to enable or disable either the "Low Discharge Pressure" shut-down circuit, or the filter differential pressure circuit. Only one circuit can be overridden at one time, therefore a three-way switch is used.

LDP OVERRIDE This position prevents a low-discharge pressure fault from shutting down the pump station. Use the LPD OVERRIDE position during the initial pipe filling and when restarting the system from a de-pressurized condition in MANUAL or AUTO mode.

ACTIVE PRESSURE OVERRIDE This activates both the "low discharge pressure" and "filter differential pressure" protection systems. Normally, the pump station should be left in this position during

automatic operation to prevent overloading the pump motors and avoid damaging erosion in the event of a major pipe break.

DIFFERENTIAL PRESSURE OVERRIDE This switch position allows overriding the filter differential pressure switch. This override should be used only temporarily, and is not intended for prolonged operation.

Wye Strainer or Filter Switch

If present on the station, this switch controls the operation of the Wye strainer or filter solenoid.

OFF Prevents the Wye strainer or filter from flushing.

MANUAL The Wye strainer or filter flushes continuously, regardless of other switch settings. The MANUAL position may be used for de-pressurization for maintenance, or when attempting to clean a seriously dirty screen.

AUTO In this position, the Wye strainer or filter flushes for 10 to 15 seconds, 60 seconds after the main VSP, or the first XL (across-the-line) pump, starts. Afterwards, flushing occurs for 10 to 15 seconds after each hour of continuous pump operation. This is the normal position for the switch.

Lake Screen Switch

If present on the station, this switch controls the operation of the solenoid valve, which operates the self-rotating lake inlet screen.

OFF Prevents the Lake Screen from working.

MANUAL Energizes the solenoid continuously regardless of the status of the station. This can be used to de-pressurize the system, or to verify operation of the screen during maintenance.

AUTO Causes the Lake Screen solenoid to open after the main VSP has been operating at least one minute, the minimum flow requirement is met, and the speed test is not trying to stop the VSP. This is the normal position of this switch.

Well Pump Switch

If present on the station, this switch allows the operator to control the operation of a well pump. In most cases, the operation of this pump is completely independent of the operation of the pump station. However, the system is configurable so that the well pump does not run during the lockout period.

OFF Prevents the well pump from running.

MANUAL The well pump runs continuously until the switch is turned OFF.

AUTO The well pump starts and stops based on a separate level switch.

Reset Push Button

This button allows the operator to clear (Reset) any faults within the system once the cause of the fault has been cleared. It is also used for the lamp test.

RESETTING FAULTS Faults must be reset by the reset button, unless the fault automatically resets as described in the System Safeties section. Pressing the reset button clears all fault counters. These counters prevent certain faults from automatically resetting indefinitely. If the fault lamp does not go out after resetting, the cause of the fault is still present and must be resolved before normal operation can continue.

LAMP TEST Pressing this button for five seconds causes all lamps on the front panel to illuminate. Replace any lamps that do not illuminate. For safety reasons, the lamp test needs to be performed on a regular basis.

AUTOMATIC OPERATION

Overview

The primary benefit of Variable Speed Pumping (VSP) Systems is to ensure surge-free starts and stops while maintaining a constant down-stream line pressure with no mechanical pressure-regulating valve. This minimizes pipeline failures due to surges and, not incidentally, reduces the utility bill for the station.

Automatic operation is selected by the system control switch. In automatic operation, all pump activity is determined by the PLC. The position of the individual pump switch lets the PLC know whether or not it is available to run. In most cases, all pump switches are in the ON position. When a pump or a motor is removed from the system, turn the pump switch OFF, and the PLC will not try to run that pump.

The PLC brings one pump on at a time in order to satisfy the start criteria (usually setpoint pressure). Some stations are designed to start and stop the pumps based on remote start signals, level probe signals, or other criteria. The standard start and stop sequence is as follows:

Pressure below setpoint to start Combo 1	5 PSI
Delay time to start Combo 1	0 SEC
Pressure above setpoint to stop Combo 1	5 PSI
Delay time to stop Combo 1	5 SEC
Pressure below setpoint to start Combo 2	10 PSI
Delay time to start Combo 2	0 SEC
Pressure above setpoint to stop Combo 2+	30 PSI
Delay time to stop Combo 2+	90 SEC
Pressure below setpoint to start Combo 3+	5 PSI
Delay time to start Combo 3+	10 SEC

NOTE: The criteria for Combo 4 and above are the same as Combo 3.

The "pressure above setpoint to stop" and "delay time to stop" parameters only apply to Combo 1. The values of 30 PSI and 90 seconds were intentionally selected since they are out of range and will never be used.

There are three (3) main types of auto operation – line fill, system charging, and normal operation.

Line Fill Mode

Line Fill Mode is used when downstream pressure is significantly below setpoint, such as during the initial startup, or when leaks in the lines are repaired. Operation is as follows (performed in order):

System control switch: OFF

All Individual Pump switches: ON

Override/Active switch: LDP Override (Low Discharge Pressure fault disabled)

VFD Bypass switch: VFD

System control switch: AUTO

As soon as the system control switch is turned to the AUTO position, the VSP (Variable Speed Pump) with the lowest run time starts at a reduced speed. When the VSP starts, the startup ramp in the program lowers the setpoint to 2 PSI above the actual downstream pressure. The VFD adjusts the speed of the VSP to reach the desired setpoint. The setpoint ramps up at the rate of 1 PSI every 4 seconds until the normal setpoint is reached.

This feature prevents the VSP from coming up to full speed too quickly, and prevents the lag pump(s) from starting prematurely. This ramp-up feature allows the system to develop a controlled and smooth start up from a completely de-pressurized condition, minimizing pipe breakage from water hammer. Once the pressure above setpoint value is reached, the VSP shuts down. The pump switches can be left in ON and the system control switch left in AUTO. The Override/Active switch should be returned to the ACTIVE position. The station is now in system "charging" mode.

System Charging Mode

If there are no heads open, and the pressure is within the defined range of operation, pressure may slowly drop due to system

leakage, or other small demands. A PM pump is provided to address this issue. Most stations, but not all, include a PM pump. Door switches are set as follows (from end of line fill mode):

System control switch: AUTO

All Individual Pumps switches: ON

Override/Active switch: ACTIVE (Low Discharge Pressure and differential pressure faults enabled)

VFD Bypass switch: VFD

NOTE: As downstream pressure drops to more than 5 PSI below setpoint, the PM pump starts up. It runs until the system pressure builds up to 5 PSI above setpoint, and then shuts off.

Two issues can come into play here. One is cycle time. This refers to the number of times an hour that the PM pump starts and stops (one cycle). If the amount of cycles is excessive, either the system leaks have to be repaired, or the start/stop parameters need to be tuned (normally by dropping the pressure below setpoint to start, or increasing the pressure above setpoint to stop). Must-run times can cause the opposite problem. The PLC determines the must-run time for each pump. If this value is set too high, the PM pump reaches its "pressure above setpoint" and stops before the must-run time setting indicates. This can lead to an over-pressurization situation. Address this problem by lowering the must-run time.

WARNING: Excessive Run Time Hazard

Excessive must-run times, stop times, or stop pressure setting can cause system over-pressurization, pipe damage, and potentially cause personal injury. Consult your service technician or the factory if you are unsure about any settings.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

Normal Operation

Normal Operation occurs when heads are turned on, or a demand for water exists. Door switches are set as follows (from end of line fill mode):

System control switch: AUTO

Pump 1 switch: ON

Pump 2 switch: ON

Pump 3 switch: ON

PM Pump switch: ON

Override/Active switch: ACTIVE (Low Discharge Pressure and differential pressure faults enabled)

VFD Bypass switch: VFD

When the pressure drops 5 PSI below setpoint, the PM pump starts and continues to run until the pressure is 5 PSI above the setpoint. When this pressure is reached, the PM pump turns OFF. If the pressure continues to drop to 10 PSI below setpoint, the VSP starts. Five seconds later, the PM pump turns OFF. This is the operation sequence for Combo 1.

When the VSP starts, the startup ramp in the program lowers the setpoint to 2 PSI above the actual line pressure. The VFD adjusts the speed of the VSP to maintain the discharge or downstream pressure at the setpoint. The setpoint ramps up at the rate of 1 PSI every 4 seconds until the normal setpoint is reached. As the setpoint rises, so does the speed of the VSP. This feature prevents the VSP from coming up to full speed too quickly and prevents the lag pump(s) from starting prematurely. This ramp-up feature allows the system to develop a controlled and smooth startup from a completely de-pressurized condition, minimizing pipe breakage from water hammer. This is the operation sequence for Combo 2.

If the VFD reaches full speed driving the main VSP and the discharge pressure is more than 10 PSI below the setpoint, the demand for water is greater than the capacity of the VSP. An XL (across-the-line) pump starts as the lag pump. This operation sequence occurs during Combo 3.

When an XL pump starts, and the VFD is driving another pump, the inverter (VFD) speed immediately ramps down to the inverter “speed when lag pump starts” setting. This permits the XL pump to start with very little pressure surge, or related water hammer. Once the lag pump is at full speed, the VSP ramps back up to try and maintain setpoint pressure.

If the demand for water is still greater than the capacity of these two pumps, then Combo 4 starts. As occurred in the previous Combo, the inverter (VFD) speed immediately ramps down to the “speed when lag pump starts” setting. The second lag pump starts up and goes to full speed, and the VSP ramps back up to try and maintain setpoint pressure.

This sequence of events repeats for all available Combos.

When the flow decreases, the VFD (inverter) slows down to maintain a constant discharge pressure. Eventually as the speed decreases, a setpoint is reached where the VSP is not pumping any water. The XL pump(s) are supplying all the water required. If the flow continues to decrease, the discharge pressure increases above the setpoint. Slowing the VFD (inverter) does not reduce the pressure because the VSP is not currently pumping any water. Once the pressure reaches 1 or 2 PSI above the setpoint pressure, the Overpressure Accumulator starts counting. Once the count reaches 750, the last XL pump is stopped. If the pressure is well above the setpoint, or increasing rapidly, the pump can stop quickly; in 1 to 2 seconds. If the pressure remains 1 or 2 PSI above setpoint, the pump turns OFF in approximately 20 seconds. When an XL pump stops, the inverter (VFD) speed immediately ramps up to the “speed when lag pump stops” setting. This prevents the system pressure from dropping excessively due to the XL pump shutting off.

Once an XL pump has been stopped, the VSP waits for the time entered in the "delay time to start" before the XL pump is permitted by the program to restart. This feature minimizes pump cycling and pressure surges. The generic value for Combo 3 and up is 10 seconds. If the conditions for starting an XL pump are met after this waiting period, normally 10 seconds, the pump is restarted.

If the flow continues to decrease, each XL pump is stopped in the manner described above, until only the VSP is running. Stopping the last VSP is accomplished by using "Speed Test," which uses a stop method different from stopping an XL pump. Because the inverter speed keeps lowering as the flow decreases, the discharge pressure would never get above the setpoint. In this situation, the VSP would "idle," pump no water, and would never turn off. To shut down the VSP, the system initiates the "Speed Test" whenever the flow is below a predetermined value for 15 seconds. The program then lowers the setpoint by 5 PSI. If the VFD speed falls below a predetermined value and the pressure remains above the reduced setpoint for 15 seconds, the VSP turns OFF, and the setpoint returns to normal. Speed Test returns the station to "System Charging" mode until a new demand for water is created.

Manual VFD Operation

Overview

Manual operation is selected by the system control switch. In manual operation, all pump activity is controlled by the individual pump switches. In the case of multiple pumps available for VFD operation, the VFD select switch determines which pump(s) run in VFD mode. However, some stations do not come equipped with a VFD select switch. In that case, the first pump that is started is always the VFD pump. The speed of the VFD pump is controlled by the speed potentiometer (speed pot). All other pumps run in XL mode (at full speed). The Override/Active switch enables or disables the low-discharge pressure fault.

NOTE: Manual operation is rarely used. However, it does allow for operation of individual pumps for testing purposes.

Sequence of Operation (performed in order)

System control switch: OFF

All Individual Pump switches: OFF

Override/Active switch: LDP Override (Low Discharge Pressure fault disabled). If initial system pressure is high enough, place in Active.

VFD Bypass switch: VFD

VFD Select switch: Pump 1

Speed Potentiometer: Turned 100% counter-clockwise (0 speed)

System control switch: MANUAL

Pump 1 switch: ON

Speed Potentiometer: Turn clockwise to increase speed of pump 1

Pump 2 switch: ON (if required)

Speed Potentiometer: Adjust speed as required to maintain set point pressure.

Pump 3 switch: ON (if required)

Speed Potentiometer: Adjust speed as required to maintain set point pressure.

NOTE: When done, turn OFF all pump switches and place system control switch in OFF. Return Override/Active switch to ACTIVE. If the station can be run in Automatic mode, return the system switch to AUTO and turn ON all pump switches.

VFD Bypass Operation, Manual mode

Overview

This is an abnormal operating mode and would only be used when the VFD (inverter) is not operable but there is a need to irrigate. If the PLC is operable, and PRV (Pressure Reducing Valve) is in the system and functioning, we strongly recommend using Automatic VFD Bypass Mode.

WARNING: Manual VFD Bypass Hazard

This mode of operation should be used as a last resort if there is no DSR, or it is not functioning correctly. Constant operator attendance is recommended when this mode is used. The water demand must be calculated to match the individual pump output as closely as possible. Failure to do so will cause a serious over-pressure condition.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

System Operation (performed in order)

System control switch: OFF

All Individual Pump switches: OFF

Override/Active switch: LDP Override (Low Discharge Pressure fault disabled). If initial system pressure is high enough, place in ACTIVE.

VFD Bypass switch: BYPASS

VFD Select switch: Pump 1

Speed Potentiometer: N/A

System control switch: MANUAL

Pump 1 switch: ON

Allow system pressure to stabilize before turning on additional pumps.

Pump 2 switch: ON (if required)

Pump 3 switch: ON (if required)

NOTE: When done, turn OFF all pump switches and place system control switch in OFF. Return Override/Active switch to ACTIVE.

VFD Bypass Operation, Auto mode

Overview

VFD Bypass mode is an EMERGENCY ONLY mode used when the VFD is inoperative. Monitor station operation closely when in bypass mode due to limited pressure control available. Your station must be equipped with a PRV (Pressure Reducing Valve) in order to run VFD Bypass Mode automatically. This valve now assumes the pressure regulating function that was performed by the VFD in normal operation. Ensure that the PRV is adjusted to maintain your downstream pressure at no more than 12 PSI above setpoint pressure. Verify that the PRV is operating correctly before leaving the station unattended. Check station regularly to ensure continued proper operation. If your station is not equipped with a PRV, do not operate in automatic VFD bypass mode.

WARNING: VFD Bypass Switch Hazard

This mode of operation should be used as a last resort if there is no DSR, or it is not functioning correctly. Constant operator attendance is recommended when this mode is used. The water demand must be calculated to match the individual pump output as closely as possible. Failure to do so will cause a serious over-pressure condition.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

VFD Bypass mode is selected by the VFD / Bypass switch. The system control switch MUST be turned to the OFF position before selecting VFD bypass mode. Operation is similar to normal automatic operation but the start / stop sequences differ greatly. The registers below regulate this.

NOTE: These are generic values and might differ from your station.

Pressure below setpoint to start Combo 1	5 PSI
Delay time to start Combo 1	0 SEC
Pressure above setpoint to stop Combo 1	5 PSI
Delay time to stop Combo 1	5 SEC
Pressure below setpoint to start Combo 2	12 PSI
Delay time to start Combo 2	3 SEC
Pressure above setpoint to stop Combo 2	1 PSI
Delay time to stop Combo 2	60 SEC
Pressure below setpoint to start Combo 3	15 PSI
Delay time to start Combo 3	10 SEC
Pressure above setpoint to stop Combo 3	1 PSI
Delay time to stop Combo 3	30 SEC
Flow setpoint to stop Combo 1	0 GPM
Flow setpoint to stop Combo 2	20 GPM
Flow setpoint to stop Combo 3	80% *
Flow setpoint to stop Combo 4	80% **

80% of the previous combo's maximum output. * If one main pump puts out 500 gpm, you would enter 400 gpm here. ** If two main pumps put out 1000 gpm, you would enter 800 gpm here.

Other significant differences between VFD Bypass and Automatic VFD Operation are as follows:

1. The overpressure accumulator is not used in VFD bypass mode.
2. Flow will dominate stopping main pumps due to low Combo stop pressure settings. The PM pump will continue to operate similarly to VFD mode.
3. VFD Fault and Maximum RPM signals are ignored.
4. Pump starts are caused by pressure drop as in VFD mode, but due to operational differences, the settings are modified from those used in VFD mode.

Sequence of Operation (performed in order)

System control switch: OFF

All Individual Pump switches: ON

Override/Active switch: LDP Override (Low Discharge Pressure fault disabled). If initial system pressure is high enough, place in Active.

VFD Bypass switch: Bypass

VFD Select switch: N/A

Speed Potentiometer: N/A

System control switch: AUTO

When done, place system control switch in OFF. Return Override/Active switch to ACTIVE.

The PM pump continues to charge the system as in Automatic operation. Start and stop sequence is based on pressure.

Once a demand for water exists, the PLC starts the main pump with the lowest run time as an XL (across- the-line) pump, based on the “pressure below setpoint." If the flow capacity of the main pump exceeds the demand for water, pressure increases until the PRV opens and discharges the excess flow back into the water source. As demand for water increases, the PRV closes. If the PRV is completely closed, and the “pressure below setpoint" drops low enough, the PLC brings on the next Combo as required (all in XL mode). The lead pump remains at full speed while the next pump also comes up to full speed. If the cumulative flow capacity of the main pumps in operation exceeds the demand for water, the PRV opens and discharges the excess flow back into the water source. This process is repeated for all available Combos.

Combo shutdown based on flow is made possible by the way flow is read. The location of the flow meter measures only the flow that is actually being used. The flow out of the PRV discharge that is returned into the water source does not count as "measured flow." The result is as demand for water decreases, pressure continues to rise. The PRV opens as required to maintain pressure. As more flow is going out the PRV discharge, less flow is actually being used. When the flow reading drops below the “flow setpoint to stop” value, the pumps shut down in the reverse order that they started. Based on the demand for water, this process continues until all main pumps have shut down, and the station returns to "System Charging" mode.

PLC Bypass Operation

Overview

This is an abnormal operating mode and would be used if the PLC was not operable and there is need to irrigate.

WARNING: PLC Bypass Hazard

This mode of operation should be used as a last resort if there is no DSR, or it is not functioning correctly. Constant operator attendance is recommended when this mode is used. The water demand must be calculated to match the individual pump output as closely as possible. Failure to do so will cause a serious over-pressure condition. The high pressure discharge safety does not function in PLC bypass, and damage to your piping could occur. The only safeties that function in PLC bypass are low discharge pressure and phase fault.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

System Operation (performed in order)

System control switch: OFF

All Individual Pump switches: OFF

Override: LDP Override (Low Discharge Pressure fault disabled). If initial system pressure is high enough, place in Active

VFD Bypass switch: NA

VFD Select switch: NA

Speed Potentiometer: N/A

PLC Bypass switch: BYPASS

System control switch: MANUAL

Pump 1 switch: ON

Allow system pressure to stabilize before turning on additional pumps.

Pump 2 switch: ON (if required)

Pump 3 switch: ON (if required)

NOTE: When done, turn OFF all pump switches and place system control switch in OFF. Return Override/Active switch to ACTIVE.

SYSTEM SAFETIES

Overview

The program in the PLC protects the system by shutting down in either of the “Auto” or “Manual” Modes of operation if it detects any of the following problems:

Alarm or Fault	Automatic Restart?
Low Discharge Pressure	No Automatic Restart
High Discharge Pressure	Automatic Restart
Low Inlet Pressure (Optional)	Automatic Restart
Loss of Prime (Optional)	Automatic Restart
Low Level (Optional)	Automatic Restart
Station Phase Pressure (Optional)	No Automatic Restart
Individual Pump Faults	No Automatic Restart
VFD Fault	Automatic Restart

Table 1: Automatic Restart After Alarm or Fault

Automatic Mode of Operation

"High Discharge Pressure," “Station Phase Failure," "Low Inlet Pressure," "Low Level," "Loss of Prime," and "VFD Fault" allow the system to restart automatically when the fault clears in the automatic mode of operation. The PLC allows three (3) automatic restarts (which can be caused by any combination of these faults) in a one-hour period. At the fourth occurrence in a one-hour period, the station shuts down (hard fault). "Low Discharge Pressure" and "Individual Pump Faults," do not allow the system to restart automatically when the fault clears. These faults must be cleared and manually reset before station operation can resume. Individual pump faults require turning the pertinent individual pump switch to the OFF position, and then back ON (called, re-arming). In some instances, an individual pump can trip an alarm without shutting down the entire system, provided another pump is available to operate.

Manual Mode of Operation

All faults are cleared by pressing the Reset button, or by re-arming individual pump faults.

Low Discharge Pressure

The pressure transducer located in your station discharge line communicates the downstream pressure to the PLC. The PLC monitors downstream pressure to determine if the pressure is below the allowable range.

The standard PLC program defines low-discharge pressure as being 25 PSI below setpoint pressure. There is a time delay of 300 seconds (five minutes) before the station faults that is designed to give the system time to build pressure beyond this point. The values might vary on your station.

Based on the values above, if the discharge pressure remains 25 PSI below the setpoint for longer than five minutes, all pumps are shut down. The red station fault light on the control panel door comes on, and the display indicates that a "Low Discharge Pressure fault" has occurred.

This fault does not automatically reset. To clear the fault, press the Reset button. The station runs for another five minutes before determining whether the low discharge pressure condition still exists.

NOTE: If you are attempting to run in automatic line fill mode, place the Override/Active switch in OVERRIDE. Return switch to the ACTIVE position once the pressure is high enough to do so.

If the pump station is simply unable to keep up with the demand, shut the station down, and determine the nature of the problem. Consult the Troubleshooting section of this manual for assistance.

High Discharge Pressure

As with the "Low Discharge Pressure" fault, the PLC monitors downstream pressure to determine if the pressure is out of range, or above the allowable limit.

The standard PLC program defines high-discharge pressure as being 15 PSI above setpoint pressure. There is a time delay of 60 seconds, or one minute, before the station faults that is designed to give the system time to adjust the pressure to below this point. These values might vary on your station.

Based on the values above, if the discharge pressure remains 15 PSI above the setpoint for longer than one minute, the station shuts

down. Once the high pressure condition clears, the station automatically resets, and automatic operation resumes. The PLC allows three (3) automatic restarts in a one-hour period. At the fourth occurrence in a one-hour period, the station shuts down (hard fault). The red station fault light on the control panel door comes on, and the display indicates an "Alarm Shutdown Alert." Go to "Alarms," and the display should show that a "High Discharge Pressure fault" has occurred.

NOTE: At this point, shut the station down, and determine what the problem is. Consult the Troubleshooting section of this manual for assistance.

To clear the fault, press the Reset button.

Low Inlet Pressure

This optional safety is usually used on flooded-suction booster pump applications.

Normally, a pressure switch monitors the inlet pressure on the "suction" side of the pump. This switch is located in a box on the lower left side of the control cabinet. The switch is used in conjunction with a relay to inform the PLC that it is unsafe to run. Setting the low inlet pressure condition is accomplished by physically adjusting the pressure switch. There is a 20 second time delay in the PLC.

Once the inlet pressure drops below the switch pressure setting, all pumps shut down after a 20 second delay. Once the low inlet pressure condition clears, the station automatically resets and automatic operation resumes. The PLC allows three (3) automatic restarts in a one-hour period. At the fourth occurrence in a one-hour period, the station shuts down (hard fault). The red station fault light on the control panel door comes on, and the display indicates an "Alarm Shutdown Alert." Go to "Alarms," and the display should show that a "Low Inlet Pressure fault" has occurred.

WARNING: Low Inlet Pressure – Station Shutdown Hazard

At this point, shut the station down, and determine what the problem is. Consult the Troubleshooting section of this manual for assistance.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

There are two dials on the pressure switch. The one on the top is the correct adjustment. Turn clockwise to increase the pressure setpoint, counter-clockwise to decrease.

CAUTION: Delta Pressure Setting Hazard

Do not adjust the bottom dial. This is a delta pressure setting, and is not used. This dial must be adjusted fully counter-clockwise (0 position). If you are having trouble with your pressure switch, always verify that this dial is in the 0 (fully counter-clockwise position) before adjusting the top dial.

Failure to follow these instructions indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

WARNING: Minimum Pressure Setting Hazard

The pressure setting is based on the minimum pressure that the pump can safely operate. Do not lower the pressure switch setting without consulting the factory**.**

Failure to follow these instructions could result in serious personal injury, death, or property damage.

Loss of Prime

This optional safety is usually used on end-suction centrifugal pump applications.

A level probe is placed in the suction piping at a predetermined level. This probe works in conjunction with a relay to inform the PLC that it is unsafe to run. Fault usually signifies a malfunctioning foot valve.

After a second or two, all pumps shut down. If the loss of prime condition clears, the station automatically resets, and automatic operation resumes. The PLC allows three (3) automatic restarts in a one-hour period. At the fourth occurrence in a one-hour period, the station shuts down (hard fault). The red station fault light on the control panel door comes on, and the display indicates an "Alarm Shutdown Alert." Go to "Alarms" and the display should show that a "Loss of Prime fault" has occurred.

NOTE: At this point, shut the station down, and determine what the problem is. Consult the Troubleshooting section of this manual for assistance.

To clear the fault, press the Reset button.

WARNING: Equipment Damage Hazard

Do not attempt to bypass this safety, as pump damage will occur.

Failure to follow these instructions could result in property damage and/or moderate personal injury.

Low Level Fault

This safety is used in Vertical Turbine pump applications to signal when the wet well level is too low to permit safe operation of the pumps. Used in conjunction with a relay, three (3) level probes are placed in the wet well. From bottom to top, these are the "reference" (ground) probe, the "low" probe, and the "reset" probe. If the wet well level drops below the "low" probe, the relay sends a signal to the PLC telling it to shut down pump operation. The fault cannot be cleared until the reset probe is under water.

After a five (5) second time delay, all pumps shut down. Once the low level condition clears, the station automatically resets and automatic operation resumes. The PLC allows three (3) automatic restarts in a one-hour period. At the fourth occurrence in a one-hour period, the station shuts down (hard fault). The red station fault light on the control panel door comes on, and the display indicates an "Alarm Shutdown Alert." Go to "Alarms," and the display should show that a "Low Level fault" has occurred.

NOTE: At this point, shut the station down, and determine what the problem is. Consult the Troubleshooting section of this manual for assistance.

To clear the fault, press the Reset button.

Phase Failure

This safety utilizes a phase monitor to analyze incoming voltage and determines whether all voltage parameters are acceptable and the phase sequence is correct.

The LED on the phase monitor is lit if there is no fault. If there is a problem, the LED is off.

After approximately one (1) second, all pumps are shut down. Once the phase failure condition clears, the station automatically resets, and automatic operation resumes. The PLC allows three (3) automatic restarts in a one-hour period. At the fourth occurrence in a one-hour period, the station shuts down (hard fault). The red station fault light on the control panel door comes on, and the display indicates an "Alarm Shutdown Alert." Go to "Alarms," and the display should show that a "Phase Failure fault" has occurred.

NOTE: At this point, shut the station down, and determine what the problem is. Consult the Troubleshooting section of this manual for assistance.

WARNING: Electrical Shock Hazard

As this is an electrical problem, adhere to all safety procedures during troubleshooting. To clear the fault, press the reset button.

Failure to follow these instructions could result in property damage and/or moderate personal injury.

INDIVIDUAL PUMP FAULTS

There are three faults that are considered Individual Pump Faults. These are overload protection, high pump temperature (optional), and individual pump phase fault (optional).

Overload Protection

Overload Protection is standard on all pump stations. The overload is a safety device that shuts the motor down when amperage exceeds the setpoint of the device.

If the motor amperage exceeds the overload setpoint that pump shuts. In some instances, an individual pump can trip without shutting down the entire system if another pump is available to operate. If so, the PLC will automatically bring the available pump on line. The green light above the pump switch flashes for the pump that was shut down. Go to "Alarms," and the display should show that an "Individual Pump fault" has occurred. The PLC does not differentiate between the different individual pump faults.

WARNING: Overload Hazard

The overloads are located inside the control panel. All safety procedures must be adhered to during the any adjustment or resetting process.

Failure to follow these instructions could result in property damage and/or moderate personal injury.

Resetting the overload is accomplished by pushing in the blue Differential Overloads button on the right front face of the device, and rotating it approximately an eighth of a turn clockwise.

Adjustment of the overload setpoint is performed using the blue dial on the left front face of the device.

Once the overload has been reset, individual pump faults require turning the individual pump switch to the OFF position, and then back ON (re-arming).

High Pump Temperature (Optional)

High pump temperature utilizes a temperature probe inserted into the pump discharge piping. The probe trips when the water temperature reaches 120°F, and then immediately shuts down the pump. The green light above the pump switch flashes, indicating which pump has shut down. Go to "Alarms," and the display should show that an "Individual Pump fault" has occurred.

The temperature probe automatically resets at 105°F. At that time, the pump can be re-armed, and pump operation can continue.

NOTE: If the pump continues to shut down for this issue, shut the station down and determine what the problem is. Consult the Troubleshooting section of this manual for assistance.

VFD Fault

The VFD sends a fault signal (120 VAC) directly to the PLC. The display shows, "Inverter Fault." This is normally a VFD fault. To determine the nature of the problem, you must use the VFD keypad display and review the fault/alarm history. This procedure is outlined in the VFD section of this manual. A list of all inverter fault/alarm codes is found in your VFD manual.

In some instances, the display shows, "Inverter Relay Fault." In this case the PLC failed to get a VFD run signal back from the drive. This could be a problem external to the VFD. Consult the Troubleshooting section of this manual for more details.

After a two (2) second time delay, the VFD pump shuts down. The lag pump(s) continues to run. The PLC allows three (3) automatic restarts in a one-hour period. At the fourth occurrence in a one-hour period, the station shuts down (hard fault). The red station fault light on the control panel door comes on, and the display indicates an "Alarm Shutdown Alert." Go to "Alarms," and the display should show either an "Inverter fault" or an "Inverter Relay fault" has occurred. The fault does not have to be cleared in order to allow auto restart.

Once you have determined what the VFD (inverter) fault is, and have cleared it, press the station Reset button to clear the alarm shutdown status.

MAINTENANCE

REGULAR MAINTENANCE = INVESTMENT

Maintenance is an investment that will pay dividends in the form of improved reliability and durability. Site maintenance checks are a matter of day to day, week to week care that is important to the proper operation of the pumping equipment. Periodic equipment checks will ensure that the recommended lubricants, fluids and service parts are available and planned for. Flowtronex recommends Preventative Maintenance be performed quarterly.

DANGER: Personal Injury Hazard

Performing maintenance work on your pump station can be dangerous. You face the risk of electrical shock or related injuries, and must be trained in the danger of electricity. If you have any doubt, have a qualified technician do the work. Contact the factory for the closest authorized FlowNet service office to you.

Failure to follow these instructions will result in death or serious injury.

REGULAR MONTHLY MAINTENANCE INTERVALS

1. Heat exchanger:
    a. Verify that the flow through the heat exchanger is a solid streamline out of the exhaust line into the wet well. Too little flow reduces cooling capacity.
2. Control panel:
    a. Using the operator interface, verify that all the buttons operate properly. Also review the station operation, fault history, and data log for station operation.
    b. Verify that all surge devices are visually sound. Check the surge device for the station (mounted on the back of the control panel). Black soot on or around the device indicates that it has taken a surge and needs to be replaced.
3. Motor lubrication:
    a. If your motor has an oil bath thrust bearing, you need to ensure that it is filled to the recommended fill line on the sight glass (that is, filled to the minimum line).
    b. If it is a grease filled bearing, ensure that grease is not all over the inside of the motor and down in the bottom of the motor. This could be a sign of over-filling. Refer to the motor manufacturer's lubrication instructions.
4. Pumps - vertical turbine:
    a. Verify that the area surrounding the pump shaft has no silt built up around the head. If there is silt build up, fix it immediately.

CAUTION: Equipment Damage Hazard

Silt buildup is a sign of problems with the wet well and/or intake screen.

Failure to follow these instructions indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

5. Pumps - horizontal:
    a. For a horizontal pump, verify that the mechanical seal is not leaking between the pump and the motor.
6. Exercise the DSR using the following procedure. With system switch and all pump switches in the off position, close the pump station discharge isolation valve. Place the system switch in manual and start a VFD pump. Slowly ramp up the VFD speed. The DSR should open and relieve system pressure when it exceeds set point pressure by approximately 12-15 psi. Adjust DSR as required to meet this requirement. Repeat test at least once to ensure repeatability.
7. Sound and visual checks of whole station:
    a. Just listen. Do you hear any odd sounds rubbing or grinding or maybe

even electrical arcing or that something is in a bind? This can indicate a serious problem.

b. There is going to be some harmonic vibration with the pumps and motor. We are looking for excessive vibration or noise. Can you see a bend in the pump shaft? Do the motor and shaft shake violently? This needs servicing immediately. Do not operate pump if vibration is excessive.

c. Confirm that the building cooling and ventilation systems are operating and clear of all obstructions. Maximum operating range for equipment is 40°C (104°F). Verify that water, grease, oil, hardware, etc. are not leaking or loose on the pump station.

8. Verify that the area surrounding the pump shaft at the pump head has some leakage when the pump is operational.

    a. The correct leakage rate is approximately one drop per second. If the leakage exceeds two drops per second, the packing gears need to be adjusted.

WARNING: Rotating Shaft Hazard

Packing adjustment should be performed by properly trained and qualified personnel.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

9. Station skid:

    a. Visually inspect for leaks in the station piping, valves, and other components.

    b. Visually inspect the piping and skid for any stress cracks in the welds.

    c. Visually inspect the station for loose or damaged paint or areas of rust.

DANGER: Personal Injury Hazard

Pump station maintenance must be performed by properly trained and qualified personnel. Hazards exist for electrocution, shock, rotating components, and pressurized components.

Failure to follow these instructions will result in death or serious injury.

WINTERIZING PUMP STATIONS

CAUTION: Equipment Damage Hazard

Your pumping system must be properly winterized before storage. Failure to winterize the system could result in damage to the pipes, valves, pumps, or other components.

Failure to follow these instructions indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

Generalized Instructions for All Pump Stations

1. Turn all enclosure switches to the OFF position.
2. Open (turn off) all electrical disconnects to the pump station.

DANGER: Personal Injury Hazard

The pumping system must be disconnected from the main power supply before attempting any operation or maintenance on the electrical or mechanical parts of the system.

Failure to follow these instructions will result in death or serious injury.

3. Close all the station discharge isolation valves.
4. Close the pump station inlet isolation valves.
5. Close all auxiliary equipment isolation valves (if applicable).
6. Remove all connections from the heat exchanger inlet and discharge. Force water from the heat exchanger core with compressed air.

WARNING: Pump Pressure Hazard

Pumping system must be isolated from the system and pressure released before disassembly of any piping, valves, or pumps.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

CAUTION: Compressed Air Hazard

Proceed with caution when working with compressed air.

Failure to follow these instructions could result in serious personal injury, death, and/or property damage.

7. Connect hose to hose bib on the pump station. The bib is usually found under the discharge manifold for the pumps, or at the end of the hydro-pneumatic tank.
8. Slowly, open the hose bib ball valve on the pump station. Slowly, open all ball valves on the pump station. Wait until pump station pressure reads 0 PSI before closing the hose bib ball valve.

Vertical Stations

1. Carefully, remove plugs from the pump heads, including the submersible pressure maintenance pump. (See also Appendix A and Appendix B.)

WARNING: Pump Pressure Hazard

Pumping system must be isolated from the system and pressure released before disassembly of any piping, valves, or pumps.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

2. Carefully remove all tubing from the relief valve and/or the control valve, and drain both valves.
3. Carefully remove all tubing from pressure switches and transducers. Make certain that the station piping is completely drained.
4. Drain all valve pilots, including the sensing chamber and all pressure switches.
5. Loosen valve bonnet bolts, loosen the bonnet, and drain the valve bonnet of water.
6. Re-tighten the relief or the control valve bonnets.
7. Fill bonnets with a good-quality, non-toxic (such as, RV [Recreation Vehicle]) antifreeze.

Horizontal Stations

1. Slowly, bleed pressure from the inlet manifold using the ball valve or the hose bib on the isolation ball valve on the pressure gauge. Carefully, remove plug from the inlet manifold and drain.
   NOTE: Do this only if an inlet isolation valve is installed and closed.

WARNING: Pump Pressure Hazard

Pumping system must be isolated from the system and pressure released before disassembly of any piping, valves, or pumps.

Failure to follow these instructions could result in serious personal injury, death, or property damage.

2. If there is not an inlet isolation valve then and you cannot drain the inlet line, close all pump inlet isolation valves.
3. Remove the lowest plug on the pump volute or open the pit cock valve to drain all pumps completely.
4. Carefully, drain all filters and their components, including the flush lines.

Spring Restart of Pumping Station

Prior to restarting the pump station in the spring:

1. Make certain that all tubing is replaced; all connections are tightened; and check that all the drain valves are closed.
2. Open all operating valves and verify that the bonnet is tight.
3. Check that the drain plugs are installed in pumps and piping.

NOTE: Contact ITT Flowtronex PSI, if you have further questions on winterizing your pump station.

TROUBLESHOOTING

1. If a troubleshooting step needs to be performed by a qualified person, it is labeled "**To be performed by a qualified person only.**"
2. Steps that can be performed by unqualified persons are not labeled.
3. Qualified persons are those who have been trained in avoiding the electrical hazards of working on or near exposed energized parts. Only qualified persons may open the electrical enclosure.
4. Unqualified persons are those with little or no such training.

LOW DISCHARGE PRESSURE FAULT

Cause	Cure
Flow rate greater than station capacity or unable to pressurize the system in refill mode (too many sprinklers on).	Adjust the irrigation demand as required.
	Verify the pressure setpoint. Has this value been changed from the original design? If the setpoint has been increased, the available flow will be lower. Check the pump curve to verify the pump performance.
A large break in the irrigation piping.	Repair the piping.
Low system pressure setting is too high.	Verify n70:0 is set to 300 seconds.
System pressure transducer sensing line is valved off or clogged.	Check the ball valve position, and/or blow out line.
System pressure transducer failure.	Replace the pressure transducer (FlowNet).
All pumps not running.	One of main pump switches in OFF position.
	Consult the motor troubleshooting section if the motor won't start (see Motor Won't Start).
Main pump discharge isolation valve is closed.	Open the valve.
Pump discharge check valve leaks.	Check for foreign objects holding the valve open. Replace the check valve if it is damaged.
DSR is partially or fully open.	The pilot valve is set too low. Adjust as necessary.
	The needle valve on speed control is screwed in (closed) too far. Adjust as necessary.
	There is air inside the relief valve cover. Bleed air off the valve top.
	The ball valve(s) at the inlet and/or cover tapping(s) are closed. Open the valves.
	The optional strainer at the relief valve inlet tapping is clogged. Disassemble and clean.
	There is an obstruction under the relief valve or pilot valve seat. Disassemble and clean.
	There is a leak in the relief valve diaphragm. Replace the diaphragm.
	Bad relief valve or pilot valve seat. Rebuild or replace valve.
Low suction pressure or supply water restriction.	Call the city if the city water pressure is lower than the normal or published value. Check the supply piping for obstruction.

HIGH DISCHARGE PRESSURE FAULT

Cause	Cure
High system pressure setting too low.	Press F1, F8, F11 and verify n70:0 is set to 60 seconds.
System pressure transducer reading high.	Compare display readout to the pressure gauge. Calibrate if possible, and replace transducer if necessary (FlowNet).
Isolation valve for DSR or main discharge is closed.	Open the valve.
DSR will not open fully.	The pilot valve is set too low. Adjust as necessary, 15 PSI over set pressure.
	The needle valve on the DSR is too far open; adjust as necessary.
	The ball valve(s) at the inlet and/or cover tapping(s) closed. Open the valves.
	The indicating stem is bent and/or sticking.
Irrigation demand is reducing too quickly.	Reprogram irrigation to stage down in steps.

LOW LEVEL FAULT

Cause	Cure
Clogged or shut off supply pipe.	Check the supply pipe for restrictions or closed valve.
Clogged inlet screen.	Check and clean the inlet screen.
Problem with level probes.	Inspect probes for correct insertion depth.
	Look for dirty or corroded probes.
	To be performed by a qualified person only. Look for broken probes, probe holder, or wires.
	To be performed by a qualified person only. Check for loose or incorrect probe wiring.
	To be performed by a qualified person only. Verify ground continuity between the station and wet well.
Level relay failure (inside control panel).	**To be performed by a qualified person only.** Check relay for proper operation. Replace as required.

LOW INLET PRESSURE FAULT

Cause	Cure
Normally used on flooded suction horizontal or canned turbine stations	
Inlet pressure switch is set too high.	**To be performed by a qualified person only.** Check the pressure switch setting. (Located on lower left side of outside of enclosure.)
Pressure sensing line to pressure switch is clogged or valved off.	Ensure the valve is open, and blow out line if necessary.
Pressure is actually low – static.	If the city supplied water, check with them.
	If the water is supplied by a tank, check the tank level,

	and verify that the supply valve is open.
	If equipped with a suction manifold strainer, clean as required.
	Ensure the supply piping not clogged or restricted.
Pressure is actually low – dynamic.	Ensure that the flow rate is less than the supply capacity.

LOSS OF PRIME FAULT

Cause	Cure
Normally used on end-suction centrifugal pumps	
System has lost prime or air is trapped in system.	Check the system for prime lead in the foot valve or suction line.
Probe is dirty, corroded, or failed.	Clean or replace the probe as required.
Loss of prime relay failed.	**To be performed by a qualified person only.** Check the relay for proper operation. Replace as required.

PHASE FAULT

Cause	Cure
Previous power failure.	Press the station reset. If the problem is gone, the fault will reset.
Incoming line voltage less than 90% of rated station voltage.	Consult the power company.
Phase monitor voltage set too high.	**To be performed by a qualified person only.** Example – monitor set at 480 V, try 460 V.
One or more dead legs on a 3-phase power line.	**To be performed by a qualified person only.** Check all input fuses.
	Call the power company.
A reversal, shift, or imbalance of the line phases.	Normally occurs after the power company has worked on or replaced the transformer. Call the power company.
Phase monitor failure.	**To be performed by a qualified person only.** If the LEDs on the phase monitor are on, there is no fault. If the LEDs are off, and all voltage and phase conditions are good, the phase monitor needs to be replaced.

VFD FAULT

Cause	Cure
Look at VFD keypad to determine specific fault and consult the VFD manual. ***Codes identified below are some of the more common ABB 550 codes. Consult your specific VFD manual for other drive applications.***	
Fault code 3 – dev overtemp (drive heatsink is overheated).	**To be performed by a qualified person only.** The VFD fan won't come on. If there is no power, check circuit breaker. Check for no continuity across transorb

	(located at wire terminal strip). If the power is good, replace the fan.
	There is no water flow through heat exchanger. Make sure both ball valves are open.
	Water is leaking at the heat exchanger. Repair or replace the coil.
Fault code 2 – DC overvolt (intermediate circuit DC voltage is excessive).	**To be performed by a qualified person only.** Check the input voltage (AC) to the drive. If high, contact the power company.
Fault code 6 – DC undervolt (intermediate circuit DC voltage is insufficient).	**To be performed by a qualified person only.** Check the input voltage (AC) to the drive. If low, contact the power company.
Fault code 7 – AI1 loss (analog 1 input value is less than minimum value).	This can be a nuisance fault. Set parameter 3001 = 0 not sel.
Fault code 9 – motor overtemp (motor too hot, estimated value).	This can be a nuisance fault. Set parameter 3006 = 1050, and 3007 = 115.
Fault code 22 – supply phase (ripple voltage in the DC link is too high).	**To be performed by a qualified person only.** Check the input fuses to the VFD. Review the phase failure section above.

MOTOR WON'T START

Cause	**Cure**
Individual pump switch light is flashing.	**To be performed by a qualified person only.** The overload for that motor is tripped. Reset, adjust, or replace as required.
	Does the station have a high pump temperature option? Check if the water temperature is greater than 120°F. If it is, the pump is cavitating. If less than 120°F, the probe or relay is bad.
	To be performed by a qualified person only. Does the station have the individual pump phase fault option? See if the phase or voltage to motor is good. Check the motor fuses. Replace that pump's phase monitor as required.
Motor won't start, but the individual pump switch light is off.	If in VFD mode, will motor run XL? If yes, refer to the VFD troubleshooting section. If no, proceed to next step.
	To be performed by a qualified person only. Check the input power to the starter. Ensure correct power on all phases.
	To be performed by a qualified person only. Verify power on all lines to motor.
	To be performed by a qualified person only. Make sure motor terminal connections are not loose or broken.
Motor won't start, but the individual pump switch light is green.	**To be performed by a qualified person only.** Is pump jammed? Disconnect motor from pump, and try to run motor.

GLOSSARY OF TERMS

AC — Alternating Current. The voltage, and therefore current, constantly oscillates positive and negative. For North America, the line frequency is 60 Hz. Some other areas of the world use 50 Hz.

Across-the-line (XL) — Applying 100% of line voltage to a motor during startup and run. A simple large relay with a contact for each power phase (for 3 phase) is used to control the motor OFF/ON.

Analog — A signal that varies in some respect (voltage, current, frequency) in order to convey the value of some real world information (i.e. pressure, flow, temperature etc). A control system can take action based on the value of such a signal. Internally, the signal will be converted to some number based on the value of the signal.

Automatic lake screen — (ALS) A screen on the intake flume of the pump station, between the irrigation pond and the wet well, which is designed to be self cleaning by using a jet of clean water spraying from the inside-out during use.

Booster — A pump designed to increase the pressure of a pressurized irrigation line. This is usually used to move pressurized water from a lower to higher elevation area of the golf course.

Calibration — The act of or specific values used to scale the output of a measurement device to read real-world values.

Canned turbine — See vertical turbine.

Chemical injection — The process of adding chemicals to irrigation water to fertilize or medicate turfgrass.

Combo — A capacity level representing a predefined group of pumps on a station. Normally Combos are defined as follows:

Combo 1 — Normally the PM pump.

Combo 2 — Lead pump. Normally the VSP.

Combo 3 — Lead pump and first lag pump.

Combo 4 — Lead pump and two lag pumps.

Control valve — A valve designed to automatically open/close in order to maintain a specific setpoint pressure, flow, or level.

Control variable — A value that a control system monitors in order to perform some useful function.

Conventional — Refers to fixed-speed pump systems using a pressure reducing valve for pressure control.

CPU — Central processing unit. The part of the PLC that stores and allows manipulation of the program, in conjunction with an EEPROM chip.

Cycle time — The number of times an hour that a pump (PM or main pump) cycles on and off.

Cycling — This condition occurs when conditions require a pump to start if no pump is running, but require a pump to stop if a pump is running. This is excessive starting and stopping of one or more pumps and can be damaging to the

	equipment if allowed to continue.
DC	Direct Current. Such as a battery. The voltage is stable, and does not oscillate (at least intentionally).
Digital	A simple ON/OFF condition. For example, the presence or lack of a 120VAC signal on a wire is a digital condition.
DSR	Downstream Relief Valve is used to limit the maximum allowable downstream pressure.
Equal HP pumps	Also referred to as interchangeable pumps. Defines which pumps are available to start based on lowest run time. VSPs and XL pumps are defined in the PLC program. An XL pump can be an equal HP pump, but it will not start as a lead pump, because the lead pump will always be a VSP.
Filter	A device used downstream of the pumps to clean the water being pumped into the irrigation. These devices are typically self-cleaning, but require hardware/software to self-clean.
Fixed speed	Pumps run at a fixed RPM, defined by the motor windings and the frequency of the line voltage (50/60 Hz).
Flooded suction	A type of system where the pumps (usually centrifugal) are fed by a pond or other body of water at very low pressure (atmosphere, or just a few feet of water column). Pumps for these systems must be carefully selected for low NPSHR (Net Positive Suction Head Requirements) or cavitation and pump damage can occur. Low inlet pressure safety is an excellent choice for these systems.
Foot valve	A device used primarily on horizontal lift applications to maintain pump prime.
Frequency	(Hz) The number of oscillations per second of any system. Typically used to refer to electrical systems, such as AC power line frequency, or variable speed drive output frequency. This frequency defines the speed of an AC motor.
GPM	Gallons per minute. Units of flow for US use.
HSS	High speed switching. Starting pumps with a VFD to reduce inrush current and provide pressure control, but able to switch over to fixed speed so that the VFD is able to start another pump.
Input	A way for a control system to detect real-world occurrences. These can be digital or analog.
Inverter	Another term for Variable Frequency Drive (VFD). Actually, more correctly applied to the output circuitry of the drive, which converts DC voltage to AC voltage.
Lag pump	A pump used later in the pump sequence to support increasing irrigation demand requirements. The term lag simply refers to the fact that it does not start first.
Lake fill	(LLC) A circuit designed to keep a pond or lake at or above some minimum level of water.
Lead groups	Proprietary term used to describe the register(s) that defines which pumps on a station are interchangeable in their pressure/flow characteristics.
Lead pump	The pump in a lead group which is chosen by the controller to start first. This is usually determined by finding the pump in the lead group with the lowest

run-time.

Lift This refers to how high water must be "lifted" to reach the pump suction. Lift stations have even harsher NPSHR than Flooded Suction systems. Loss of prime safety is an excellent choice for these systems. Auto-re-prime systems are available to help maintain a full suction line (CRD reprime, vacuum pumps).

Lock-out A system which limits the pump systems available pumps and or limits the speed of a variable speed pump during user-defined time of day or day of week.

Low level probe A device that "shorts" out when removed from water. This removes the signal from the PLC and tells it that the pump is not safe to run due to a low water level condition.

Main pumps The pumps which are relied on for supplying the irrigation at mid-high flow rates.

Must-run time The amount of time (in seconds) that the pump must run.

OTIS Operator Terminal Information System. Accesses PLC data, and displays it. Also allows access to settable registers that you need to program.

Output A way for a control system to generate real world actions. An output can be a 120VAC signal to turn on a pump, or a varying 4-20 mA signal to control the speed of a VFD. Many types of output are available.

Overload A condition in which pumps are allowed to produce more flow rate than the motor that drives them is designed for. Also refers to a device in the control panel, which detects this situation and stops the pump in order to protect it.

Over-pressure accumulator A counter that is used to determine the lag pump shut down sequence.

Overshoot Indicates that the control variable has exceeded the setpoint value while the controller was trying to correct it.

Phase monitor A device that analyzes incoming voltage and determines whether all voltage parameters are acceptable and the phase sequence is correct.

PLC Programmable Logic Controller. A very robust/rugged computer designed for equipment control in harsh environments.

PM pump Pressure Maintenance Pump. Handles very light flow rates and leaks to prevent the main pumps from cycling.

Pressure switch This is a normally open or normally closed switch that changes output state when the pressure exceeds the setpoint of the switch.

Pressure transducer A device that converts actual pressure to a 4-20 mA signal that is input into the PLC which converts it back to an actual pressure reading.

PSI Pounds per square inch. Units of pressure for US use.

Re-arming This refers to turning the pertinent individual pump switch to the OFF position, and then back on to clear an individual pump fault.

Register A memory location in a PLC. These can be used as configuration and

storage or temporary storage during mathematical calculations.

Relay This is a normally open or normally closed device that changes output state when it is energized or de-energized, and sends or removes a 120VAC signal to the PLC.

SCADA Supervisory Control And Data Acquisition.

Sequential alternation One of several methods of selecting which pump to use first. This method simply picks #1 the first time, #2 the next and so on. Once all pumps have been selected as "lead" once, the method starts over at #1.

Setpoint The desired situation for a control variable. If the user wanted the irrigation system to operate at 120 PSI, that would be the setpoint for the controller.

SO_2 Pump Similar to a water feature pump in operation, but used to pump water through a SO_2 burner to reduce the PH of the local irrigation water supply.

Submersible A type of pump, some similar to a vertical turbine, others are of a different configuration, but in all cases the motor and pump are close-coupled and actually located in the wet-well, sump or bore hole. In fact, most of these pumps must be covered with water to operate without overheating. The motors used on these pumps are typically less efficient than those used on vertical turbine or centrifugal pumps. Submersible pumps require more water over the pump suction than do turbines; therefore the low water level safety must be carefully set high enough to protect these pumps.

Speed test The method used to shut down a VSP during normal automatic operation.

Temperature switch This is a normally open or normally closed switch that changes output state when the temperature exceeds the setpoint of the switch.

Timed alternation One of several methods of selecting which main pump to use first. This method determines which pump to start first, second, etc by picking the pump with the least run time.

Transfer pump A pump designed to move water from one reservoir to another.

Units Gives context to numbers in the PLC. Units describe what the number is about, such as PSI, GPM.

VFD Variable frequency drive. This allows a pump to run at variable speeds.

VSP Variable speed pump. Refers to a pump being controlled by the variable frequency drive. In the case of pump systems, variable speed gives the controller the ability to change the output of the station by changing the speed of one or more pumps.

Vertical turbine A type of pump which has the motor at the top, and the pump hanging on a column of pipe into a wet-well or “bore hole.” These pumps are very efficient and come in a wide range of horsepower/flow/pressure combinations. These pumps are generally not capable of high lift on the suction side. These pumps can be installed in a container, called a “Can”, which allows the pump to be used in-line as a booster. Low Level safety is used on Vertical Turbine sets, can turbines require low inlet pressure, or loss of prime safeties.

Water feature pump These pumps (of any type) are typically used to pump water through a piping system separate from the irrigation in order to operate man-made creeks, waterfalls, fountains etc. These pumps are usually run strictly by timers or interface relays (See also, lock-out).

APPENDIX A — FINAL CHECK LIST

£ Is the base unit properly leveled and secured?
£ Are all lubrication points properly lubricated?
£ Is the shut-off valve on to the pump suction open?
£ Is the shut-off valve on the discharge line open?
£ Is the piping properly supported so as to prevent strains on the unit?
£ Is the distribution system purged of debris and air? Is the system filled?

CAUTION: Stuffing Box Damage

Do not run pumps dry. Fill and vent the pump volute prior to operation.

Failure to follow these instructions indicates a potentially hazardous situation, which, if not avoided, may result in property damage.

£ Are the pump and driver shafts properly aligned?

Warning: Rotating Shafts

This pumping system must be disconnected from the main power supply before check or performing alignment.

Failure to follow these instructions could result in serious personal injury, death, and/or property damage.

£ Is the pump rotation correct?
£ Is there adequate ventilation and air circulation?
£ Have all piping connections been made? Have all flanged joints been checked for tightness?

APPENDIX B — ELECTRICAL WIRING AND CONTROL SETTINGS FINAL CHECKLIST

£ Does the feeder line voltage correspond to the unit voltage?

Check the unit nameplate or motor terminal connection.

WARNING: Electrical Shock Hazard

Inspect all electrical connections prior to powering the unit. Wiring connections must be made by a qualified electrician in accordance with all applicable codes, ordinances, and good practices.

Failure to follow these instructions could result in serious personal injury, death, and/or property damage.

£ Are the feeder wires correctly sized for the load?

£ Is the unit properly grounded?

WARNING: Conduit grounds are not adequate

A separate ground wire must be attached to the ground lug provided in the enclosure to avoid potential safety hazards.

Failure to follow these instructions could result in serious personal injury, death, and/or property damage.

£ Have all the power terminals in the control panel been check for tightness?

This is imperative since stranded wires tend to “flow” and become loose after initial installation.

ITT Flowtronex
Phone: (800) 786-7480 x1
service@flowtronex.com
www.flowtronex.net