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Operational Overview and Controls Guide

Two or Three Pump IronHeart Lite with Variable Frequency Drives

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I. PUMP SEQUENCING

The controller continuously monitors the pressure of the system with the system pressure transmitter and the suction pressure with a suction pressure transmitter. In automatic operation, the controller will signal the appropriate pump(s) to start or stop based upon the sequencing described herein. It should be noted that all pumps follow the same speed control signal produced by the controller. Upon starting, the pumps will slowly ramp up to the appropriate speed. Once this startup sequence is complete, the pumps will always run at whatever speed is required to maintain the set point pressure. All pumps are protected by minimum run timers to prevent unnecessary cycling. Whenever a lag pump stops, a momentary drop in system pressure may occur, resulting in the remaining pump(s) to speed up temporarily to compensate. The pumps will stop in the reverse order from which they started.

Please note that many of the set points described below are adjustable through the human machine interface (HMI). This is described in greater detail in both the Appendix 1 - Set Points section of this manual and the HMI manual.

A. Restart Sequencing

Anytime the system is reset from a complete alarm shutdown or after power is restored, pump sequencing is modified to help prevent water hammer. The lead pump will start on low system pressure as normal. However, there is a 10-second interval before each lag pump may start.

B. Lead Pump Sequencing

The lead pump will stop during very low demand conditions. This will happen after the lead pump minimum run time has expired, system pressure is maintained within 2 psig of the set point, the lag pump is off, and the VFD speed can be reduced without system pressure dropping for the duration of the adjustable lead stop delay.

If there is a HydroCumulator on the system, the operator can enable a charge feature through the HMI that will store up to an additional 10 psig (depending on the pump) in the tank before shutting down.

The lead pump will start when system pressure drops several pounds below the desired system pressure (system pressure set point - pressure sequencing deadband).

C. Lag Pump Sequencing

If the capacity of the lead pump is exceeded, the lag pump will start after an adjustable time delay. Similar to the lead pump, the lag pump(s) will start on low system pressure, but also require the VFD speed to meet or exceed the lag on speed. This helps ensure the running pump(s) are at or near capacity before starting another pump.

The lag pump(s) will stop after the minimum run timer has expired, system pressure is maintained, and its speed has reduced enough to ensure the lead pump can handle the flow

demand.

D. Sequence Alternation

The pumps will switch starting positions each time the lead pump either runs for 24 hours or has a non-alarm shutdown. If the lead pump is running at the time of alternation, it will continue to run for 10 seconds more with the new lead pump to help prevent water hammer.

II. SPEED CONTROL

For normal operation, the speed control should be set to automatic on the HMI. In automatic, this system will automatically adjust the VFD speed as required to maintain system pressure. The system pressure set point is set by the operator using the touch screen. As the pressure in the pipe decreases, the pump speed will increase until the pressure is returned to its set point value. If the pressure begins to rise above the set point, the pump speed will decrease until the set point is reached.

If the operator chooses or if the system pressure transmitter fails, the system will run in manual control at a fixed speed.

Minimum and maximum speed set points can also be set in the touch screen.

III. OPERATOR CONTROLS

A touch screen is provided for control of pump operation, display of system pressure, suction pressure, VFD speed, alarm status, and allow adjustment of certain parameters.

If an alarm should occur, an alarm horn will sound and an alarm message will be displayed on each screen of the HMI. The operator can review the alarm by looking at the alarm list. This is described further in the Human machine interface Manual.

A. Pump Selector Touch Keys

The pump selector touch keys are on the Main screen of the HMI.

"HAND" - Use for manual operation only - to start up, restart and reset, or test each pump. No pump should run in this position without supervision.

"OFF" - Pump will not run at all. Use during start up, restart and reset, or when a pump is down for service.

"AUTO" - Automatic position for each pump, which allows the controller to have full control over the pumps operation.

D. Alarm Silence/Reset Push Button

This button is on each of the alarm status screens of the HMI. Push once to silence the alarm horn, wait five seconds and push a second time to reset the system from alarm mode back to normal automatic operation. The system will not reset unless the original cause of the alarm(s) has been corrected or removed.

This button can also be used to defeat the minimum run time of the pumps and allow the lag pumps to turn off if they are not required to be running. This is a useful feature when testing or monitoring the system.

IV. ALARMS

Several of the alarms described below feature adjustable set points. These can be adjusted using the HMI. This is described in greater detail in both the Appendix 1 - Set Points section of this manual and the HMI manual. Please note that each of the alarms described below will be displayed on the HMI.

A. Low Suction Pressure Alarm

If the low suction pressure transmitter signals a loss of supply water pressure for 5 seconds (default), all pumps will be locked off. This alarm and the system will be disabled in the event of a suction pressure transmitter failure. This alarm requires manual resetting as described below.

B. Low System Pressure Alarm

If system pressure drops to or below the low system pressure set point for 30 seconds (default), this alarm will activate. System performance will not be affected by this alarm. It is used to alert the operator that a problem occurred. This alarm will be disabled in the event of a system pressure transmitter failure. The alarm requires manual resetting as described below.

C. High System Pressure Alarm

If system pressure rises above the high system pressure set point for 5 seconds (default), this alarm will activate and all pumps will be locked off until manually reset. This alarm will be disabled in the event of a system pressure transmitter failure. The alarm requires manual resetting as described below.

D. Pressure Transmitter Out of Range Alarms

The correct output range of the pressure transmitter(s) is 1 - 6 kHz. The pressure transmitter failed low alarm will activate if the controller receives an abnormally low signal for 2 seconds. The pressure transmitter failed high alarm will activate if the controller receives an abnormally high signal for 8 seconds. The system will run at the manual speed set point if the system pressure transmitter fails. If the suction pressure transmitter fails, the system will be disabled.

These alarms will automatically reset when the transmitter operates in its correct range.

E. Individual Drive Fault Alarms

If a fault occurs in the drive when it is being called to run, the VFD failure alarm will be activated. This alarm will stop the pump with the failed drive and start the next available pump if it is not currently running. The alarm requires manual resetting with the alarm silence / reset push button as described below.

F. Manually Resetting Alarms

Most of the alarms require manual resetting before returning to normal automatic operation. This ensures proper troubleshooting, problem solving, and a smooth return to normal automatic operation by the operator. Before resetting an alarm, the alarm horn must first be silenced by pressing the reset touch key on the HMI (on the alarm list screens). Five seconds after silencing the alarm horn, the system can be reset (provided the original reason for the alarm has been corrected).

V. PROTECTION DEVICES

A. Operator Safety

The enclosure features door-interlocking motor disconnecting devices (motor starter protectors, fused disconnect switches, or circuit breakers). These prevent the opening of the panel while the motors are running. To open the control panel, turn off each of the motor disconnecting devices. Please note, high voltage may still exist in the panel.

B. Motor Protection

Anytime a motor protection device trips, the cause of the problem should be determined before returning the motor to service. Each motor will be protected against overload and short circuit current by one of the following devices:

Motor Starter Protectors

If a MSP should trip due to over-current, the MSP handle will turn to an intermediate position between "ON" and "OFF". To reset the MSP, turn the handle to the "OFF" position and then back to "ON", similar to a tripped circuit breaker.

Fused Disconnect Switches

Dual-element fuses are provided for over-current protection.

Circuit Breakers

If a circuit breaker should trip due to over-current, the handle will turn to the "TRIP" position. To reset the circuit breaker, turn the handle to the "OFF" position and then back to "ON".

C. Control Circuit Protection

The control power transformer is sized according to the consumption of power of the controls. Circuit breakers that are sized according to N.E.C. requirements for transformers protect the primary and secondary circuits.

D. Pump Over-Temperature Protection

Each pump is fitted with a temperature purge valve. If the water in a pump becomes too hot (at low flow), the valve will open. The hot water is then dumped to drain, allowing cool water to enter the pump from the suction side. Once the pump is cool again, the temperature purge valve will close.

VI. PROGRAMMABLE CONTROLLER

The controller features both non-adjustable and adjustable timers. The adjustable timers can be changed using the HMI. Please refer to the Human machine interface Manual for instructions on how to do this. A listing of the set points for all timers is provided in Appendix 1 - Set Points.

A. Status LEDs

The status of the PC can be determined by observing the LEDs on the face of the PC. To do this, the control panel door must be opened and the control circuits must be energized. The function of each LED is described below.

POWER - This LED should be illuminated continuously if control power is on.

RUN - This LED should be illuminated during normal operation. If this LED is off, make sure the switch under the small door to the left of the HMI connection is in the RUN position.

ERROR - If this LED is flashing, then a program error is indicated. If it stays on continuously, a processor error is indicated. If turning power off and on cannot clear either of these errors, consult the factory.

IN / OUT - These individually numbered red LEDs turn on when their corresponding INput or OUTput point is on.

B. Program Changes

SyncroFlo will do all programming for the PC. Every phase of the program will have been tested with the entire machine at the factory. Final adjustments are made at start-up by factory trained personnel. If a program change is required, it will be made by SyncroFlo and transmitted to the field via a program loader or chip. SyncroFlo keeps a copy of the program at the factory so that any changes can be made and transmitted immediately.

C. Maintenance

The PC requires no routine maintenance. The program is stored on an EEPROM chip so that it will not be lost due to loss of power no matter how long the power is off.

A periodic check of the PC status lights will be sufficient to check for correct operation. The power and run status LEDs should always be on when control power is available. Testing all control functions to see if the PC performs as described can check the inputs and outputs. Remember that when an input or output contact is on, its status LED will be on.

D. Repairs

It is unlikely that a problem will develop with the PC itself. If a problem seems to be evident, call the factory for assistance. If it is determined that a problem does exist, a new unit can usually be shipped in 24 hours. Please note that if, for example, lightning struck the control panel and destroyed the PC, the pumps can still be run in the hand position while repairs are underway.

Appendix 1 - Set Points

A. Non-Adjustable Set Points

Reset Delay after Alarm Silence	5 sec.
Pressure Transmitter Failed Low Delay	2 sec.
Pressure Transmitter Failed High Delay	8 sec.
VFD Fault Delay	0 sec.
Lead Pump Start Delay	2 sec.

B. Adjustable Set Points

i. Time Delay Set Points

	<u>Default</u>	<u>Range</u>
Low System Press. Alarm Delay	30 sec.	1 - 999 sec.
High System Press. Alarm Delay	5 sec.	1 - 60 sec.
Low Suction Press. Alarm Delay	10 sec.	1 - 30 sec.
Lead Pump Minimum Run Time	30 sec.	30 - 600 sec.
Low Demand Lead Shutdown Delay	30 sec.	24 - 99 sec.
Lag Pump Start Time Delay	5 sec.	2 - 30 sec.
Lag Pump Minimum Run Time	30 sec.	30 - 600sec.
Lag Pump Stop Delay Delay	15 sec.	1 - 99 sec.

ii. Pressure Set Points

	<u>Default</u>	<u>Range</u>
System Pressure	(See Sys. Data Sheet)	0 - 999 psig
Pressure Sequencing Deadband	-5 psid below SP	-1 to -15 psid
Low System Pressure	Sys. Pr. - 10 psig	1 - 999 psig
High System Pressure	Sys. Pr. + 30 psig	1 - 999 psig
Low Suction Press. Alarm	5 psig	5 - 999 psig

iii. Speed Control

	<u>Default</u>	<u>Range</u>
VFD Minimum Speed	30 Hz	0 - 60 Hz
VFD Manual Speed	45 Hz	(Min - Max Spd.) Hz
VFD Maximum Speed	60 Hz	0 - 60 Hz
VFD Lag on Speed	50 Hz	0 - 60 Hz