

SEQUENCE OF OPERATION

IPS Controller 5000

General Information

The IPS Controller 5000 can be configured for a variety of process variable inputs including DP, Temperature, or Flow, and output signals. The details of the IPS Controller hardware configuration are detailed on the "IPS Controller 5000" project Submittal Sheet (file No. 90.52). Output signals are to the Variable Frequency Drives (VFD), any by-pass, and optionally to the Building Management System (BMS). The following summarizes the range of input/output variables possible for each of the IPS Controller 5000 variants:

Possible Input/output (I/O) variables*:

1. 1 analogue input per zone DP/T/Flow transmitter 4-20 mA
2. 1 analogue input for DP or Flow transmitter 4-20 mA for pump run-out protection
3. 1 digital input per DP switch (1 DP switch per pump)
4. 1 digital input for remote connection for start/stop
5. 1 digital input per pump for fault signal
6. 1 digital input per VFD for fault signal
7. 1 digital input for alarm silencer
8. 1 analogue output per VFD for speed signal
9. 1 digital output per pump for status
10. 1 digital output for pump/motor/VFD alarm
11. 1 digital output for DP transmitter alarm
12. 1 digital output for general system alarm
13. 1 digital output per VFD automatic bypass

- IPS CONTROLLER 5001 (with up to 4 pumps in parallel and 5 zones)
- IPS CONTROLLER 5002 (with up to 4 pumps in parallel and 8 zones)
- IPS CONTROLLER 5003 (with up to 4 pumps in parallel and 11 zones)

Optional Controller I/O*:

1. BMS communications serial port
2. VFD automatic bypass: In the event of a system failure due to VFD fault, the PLC shall automatically start the pump across the line. An alarm shall be displayed on the operator's interface indicating VFD failure. In case there is an overload trip on that pump across the line, automatically alternate to start the stand-by pump on VFD mode
3. 11 zone DP, Temperature, or Flow transmitters max (IPS CONTROLLER 5003)

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Processor Generic Logical Features:

1. Monitor single zone DP, Temperature, or Flow transmitter (up to 11 transmitters as an option remotely installed by contractor)
2. Compare each value to its set-point. The zone that has deviated the most from its set-point shall be set as the controlling zone (see detailed specifications for multi-zone control)
3. PID control algorithm for pump speed control in PLC
4. Independent PID control loop for each remote signal
5. Stage secondary pumps upon increase of system demands to yield max operating efficiency
6. Automatically disable any zone DP/T/Flow signals that are not within limits and alert the operator of a possible transmitter failure
7. Motor speed would be switched to manual at speed set by the operator if all transmitters failed
8. Manual VFD bypass
9. Manual and automatic alternation of secondary pumps based on hours of operation (1 week alternation)
10. Alarms shall include transmitters failure, pump/motor/drive failure, and general system failure
11. Run-out protection on variable speed pumps (requires optional DP or Flow sensor)
12. Password protection on operator interface

Example of Active Zone Selection (Multi-zone) Logic (DP sensor):

The multi-zone controller will select a "control signal" from one of up to eleven (11) signals (signal is the differential pressure, e.g. 40 KPa). Each signal is compared to its set point to calculate the "error from set point" (e.g. The set point might be 30 KPa, giving $40-30 = +10$ KPa error from set point).

No zone shall have a –ve error. The eleven “errors from set-point” would be compared to determine which error would be used to determine the input to the speed control algorithm. The following logic would be used to select the zone signal error:

- i. The controller will look constantly at all 11 error signals. If all errors are –ve then the zone with the highest negative error will be the controlling signal
- ii. If all 11 errors are +ve then the controlling signal shall be the zone with the smallest positive error
- iii. At the end of every 60 seconds the controller will switch to the active zone that has deviated the most from its set-point

Generic Process Sequence of Operation:

1. The pumps, when in the REMOTE mode, shall be started by receiving a signal from the customer’s contact or BMS
2. For remote start of the pumps the H-O-A switch should be in the Auto position
3. The pumps shall not start manually if controller is on REMOTE mode
4. When in the LOCAL mode the pumps can also be started using the virtual H-O-A switch in the Hand or Auto position
5. In stand-by configuration the control panel shall be capable of alternating the lead and lag pumps manually, and automatically based on hours of operation
6. DP switches across pumps to prove differential pressure developed by pump (pump delivering flow)
7. The IPS Controller 5000 controller shall automatically start lag pump and its VFD upon failure of lead pump, an alarm will be displayed showing pump/drive fault
8. Lag pump shall run for a minimum of 15 minutes (adjustable) once started
9. Upon failure of both drives the controller will send a system failure alarm and either pump can be started manually across the line (constant speed)
10. Pump operation can be switched manually to bypass the drive using the VFD-OFF-Bypass switch of each pump
11. The transmitter signal shall be analogue 4-20 mA to the controller
12. Each zone shall have its own field adjustable DP/T/Flow set-point in the controller
13. Each zone DP/T/Flow transmitter shall have its own field adjustable differential pressure range in the controller
14. The controller shall analyze the signals and select the zone that has deviated the most from its set point to be the controlling signal to the VFD
15. When the controlling zone set-point has been satisfied the VFD shall maintain the speed it is running at. If the controlling zone becomes less loaded the controller shall reduce the pump speed to conserve energy while satisfying all remote zone DP/T/Flow set-points
16. IPS Controller 5000 shall stage on lag pump and start a timed sequence of events once DP/T/Flow set-point cannot be met by lead pump
17. The controller will maintain pump minimum speed of 30% (adjustable)
18. VFD automatic bypass as an option (**if selected**): In the event of a system failure due to VFD fault, the PLC shall automatically start the pump across the line. In the event that the controlling zone is not satisfied with one pump across the line the second pump will be started DOL
19. An alarm shall be displayed on the operator’s interface indicating VFD failure
20. In case there is an overload trip on that pump across the line, automatically alternate to start the stand-by pump on VFD mode
21. Automatically disable any zone DP/T/Flow signals that are not within limits and alert the operator of a possible transmitter failure. Should a zone DP sensor fail the minimum speed will be increased to 80% FS (adjustable)
22. The controller shall scan and analyze the remaining transmitters if available
23. Motor speed shall be switched to manual at speed set by the operator if all transmitters failed
24. IPS Controller 5000 shall have run out protection of the pumps
25. IPS Controller 5000 controller shall be capable of receiving up to eleven (11) analogue signals from zone DP/T/Flow transmitters
26. The IPS Controller 5000 controller shall be capable of controlling up to four (4) variable speed secondary pump