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Station control

AutoSERIES of Thermo Scientific Flow Computers

Designed for greater control where you need it most.

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Contents

Revision History

Revision	Date
01	02-01-2023

1. Introduction

The Station Control (Table 57) function is a highly configurable system of PID controls, which can be utilized for control applications as simple as controlling a single valve to maintain a flow rate, to applications as complex as maintaining pressure with flow control, meter protection, and utilizing control of multiple valves for split range valve control.

The Station Control function is comprised of multiple simultaneous PID loops, which can be individually enabled and/or disabled to meet a customer's specific control needs. Setpoints may be local or remote. Transfer between control modes is "bumpless" so that the final system output from one PID to the next results in a smooth seamless movement of the valve from one setpoint to the next.

Tuning parameters for the control methods are similar as all the PIDs are typically controlling a single valve. Depending on application requirements, a user can configure the PID tuning parameters for one PID and copy/paste them to configure subsequent PID(s). This Copy/Paste functionality allows the PID tuning parameters to be linked so that changing one parameter changes all connected parameters at the same time. For example, copy the Proportional Gain and paste onto the Proportional Gain of the other control loops that user is using.

The Station Overview screen is a summary screen that shows which PID loop is currently in control, current output percentage, and other important parameters; to monitor and/or control the station as needed.
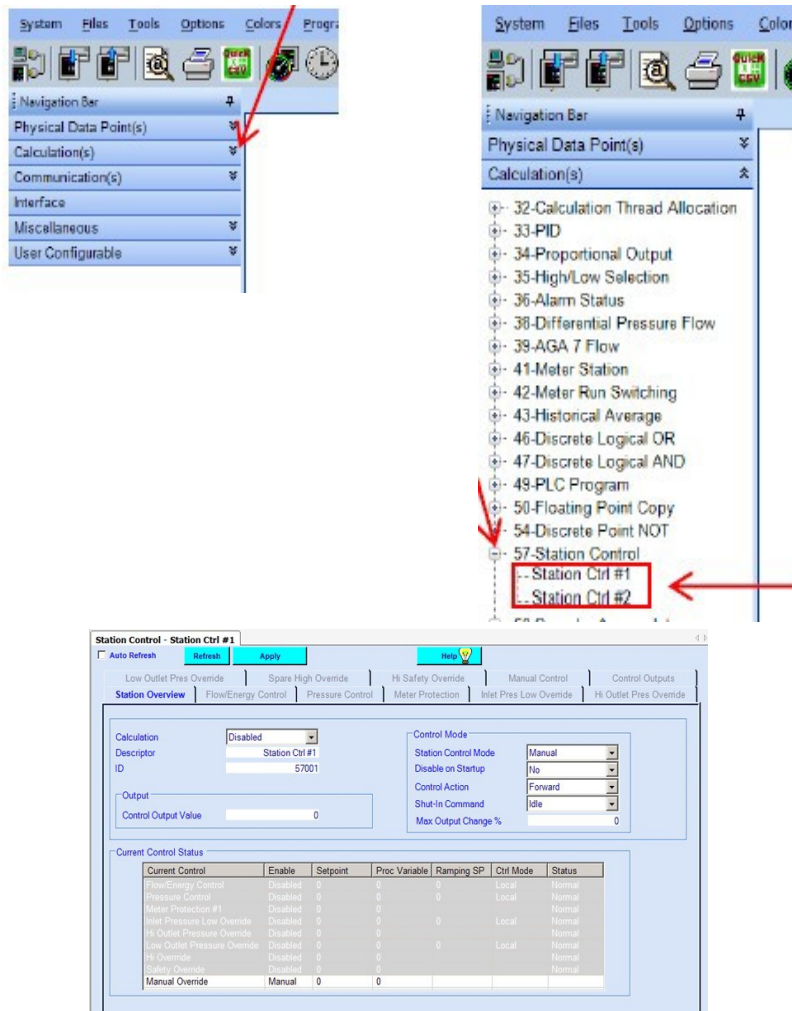

Figure 1. The Station Overview

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The **Control Outputs Tab** enables a user to configure up to four valves in either a split range or staged valve mode.
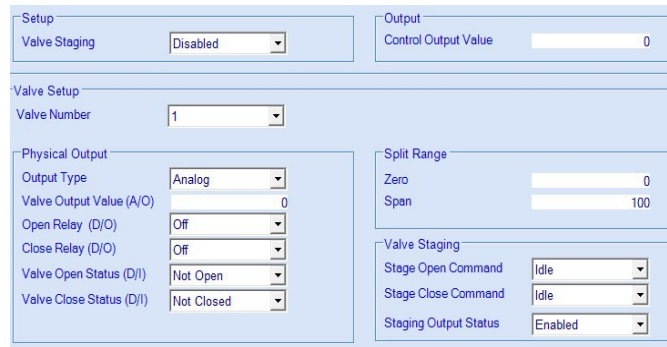

Figure 2. **Control Outputs Tab**

Features of Interest:

• Local or Remote setpoints. Remote setpoint can be two step (Load & Execute).

• Bumpless transfer between all control modes.

• Support for meter run staging (used with meter run switching function).

• Shut-in command to place station in manual mode and force valves closed.

• Supports both analog and digital stepper control of valves.

• Indication of which PID loop is currently in control.

• High/Low Select

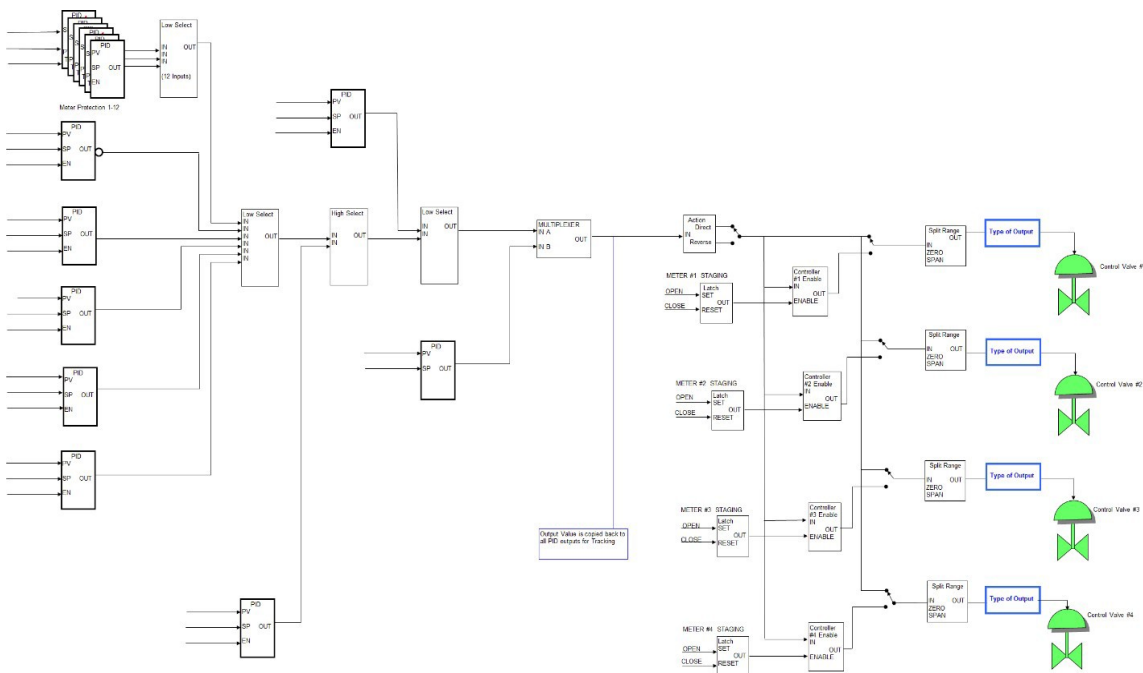Below is a diagram of the Station Control functionality in its entirety.

Figure 3. Station Control Functionality

Any PID that is disabled then that associated output goes to a Low Select will output a value of 100. Any PID that is disabled then that associated output goes to a High Select will output a value of 0. Two types of outputs are Analog or Digital with pulse width shaping (Jog control).

2. Logic Diagram Function Examples

For the following "typical" examples, the user will need to ensure that all undesired PID control loops have been disabled and only enable the PID loop(s) needed to obtain the desired control functionality.

The following examples show how features can be added incrementally by enabling or disabling PID control options in the Station Control function block. In these examples you will also see how we have implemented our High Select and Low Select functionality.

High Select: An "IF" statement that chooses the highest percent of all of the inputs and allows that percentage to propagate to the output.

Low Select: An "IF" statement that chooses the lowest percent of all of the inputs and allows that percentage to propagate to the output.

Note: Control modes are all operated independent of each other and not required to be configured sequentially.

Flow/Energy Control PID - Provides valve control in order to maintain a constant flow or energy rate by:

- Enabling the "Flow/Energy" PID, setting up the desired tuning parameters in the "Flow/Energy Control" tab.
- Connecting the proper output controls in the "Control Outputs" selection tab.
    - Reference PID Configuration Application Note.

Figure 4. Flow/Energy Control PID

Flow/Energy PID + Forward/Reverse Control Action - Allows user to have valve fully open at 100% or fully closed at 100% output.

- Selecting the "Control Action" mode to "Forward" or "Reverse" in the "Station Overview" tab.

Figure 5. Control Action

Pressure Control PID - Provides valve control to maintain a constant pressure by:

- Enabling the "Pressure Control" PID, setting up the desired tuning parameters in the "Pressure Control" tab.
- Connecting the proper output controls in the "Control Outputs" selection tab.

Figure 6. Pressure Control PID

Flow/Energy PID + Pressure Control (Override) PID – Provides flow control with a line pressure override:

- Enabling the "Flow/Energy Control" PID, setting up the desired tuning parameters in the "Flow/Energy Control" tab.

- Enabling the "Pressure Control" PID, setting up the desired tuning parameters in the "Pressure Control" tab.

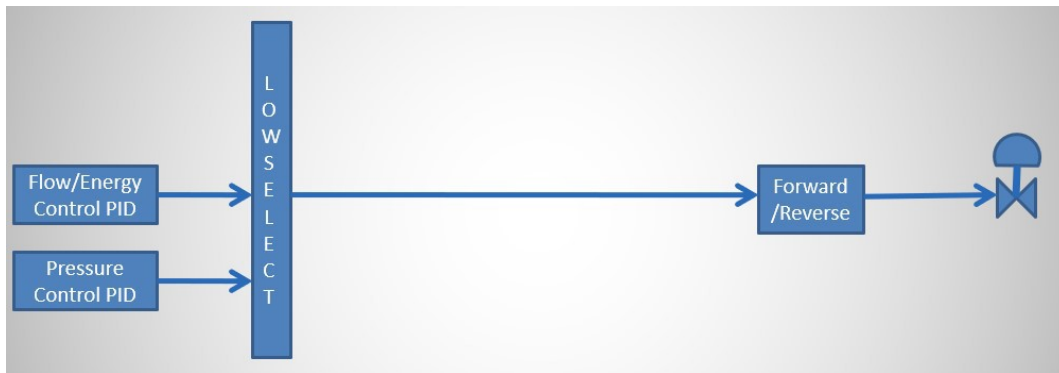- Connecting the proper output controls in the "Control Outputs" selection tab.

Figure 7. **Pressure Control (Override) PID**

Flow/Energy PID + Meter Protection PID(s) – Prevents over ranging of meters or transducers (Up to 12 Loops) is added by:

- Set the maximum "Number of Meters" that need to be monitored.

- Select each meter individually in "Meter Setup" and configure the desired parameters.

Note: "Low Select" is automatically used to choose between the Meter Protection and Flow/Energy control, whichever output is lowest.
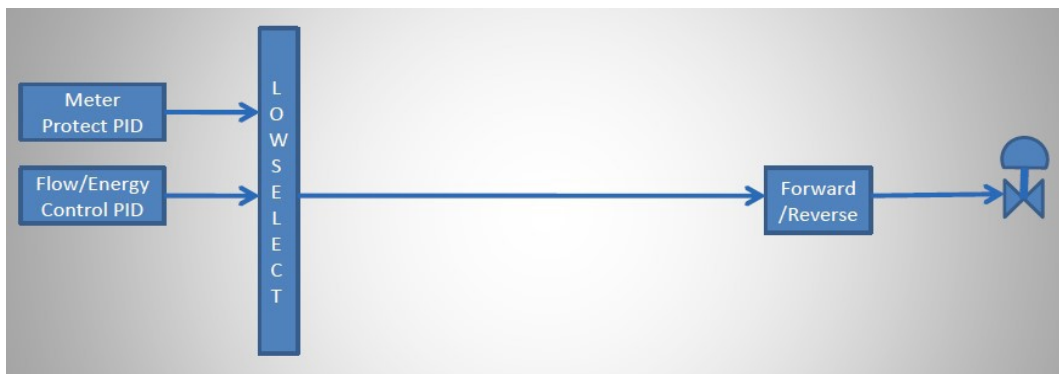

Figure 8. **Meter Protection PID(s)**

3. Sequential Station Control Functions

Flow/Energy + Meter Protec + Pressure Control + High Outlet Pressure + Low Inlet Pressure

Flow/Energy Control PID - Provides valve control to maintain a constant flow or energy rate by:

• Enabling the "Flow/Energy" PID, setting up the desired tuning parameters in the "Flow/Energy Control" tab.

• Connecting the proper output controls in the "Control Outputs" selection tab.

Figure 9. Flow/Energy Control PID

Flow/Energy PID + Meter Protection PID – Prevents over ranging of meters or transducers (Up to 12 Loops) is added by:

• Set the maximum "Number of Meters" that need to be monitored.

• Select each meter individually in "Meter Setup" and configure the desired parameters.

Note: "Low Select" is automatically used to choose between the Meter Protection and Flow/Energy control, whichever output is lowest.
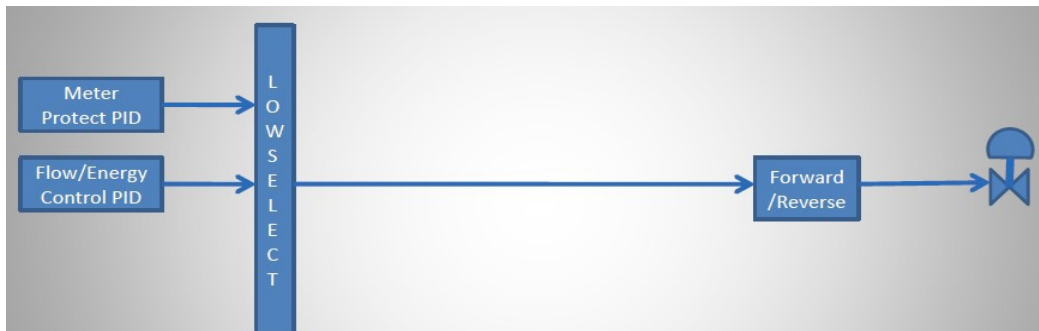

Figure 10. Meter Protection PID

Flow/Energy PID + Meter Protection PID + Pressure Control PID – Provides control to ensure that downstream pressure does not rise above the desired setpoint by:

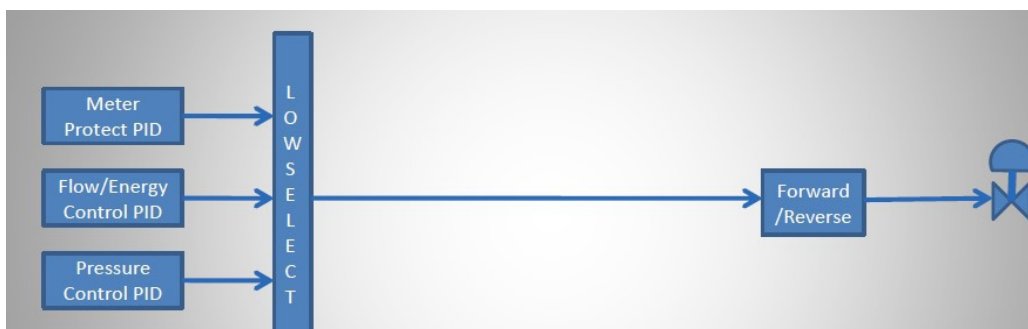• Enabling the "Pressure Control" PID, setting up the desired parameters in the "Pressure Control" selection tab.

Figure 11. Pressure Control PID

Flow/Energy PID + Meter Protection PID + Pressure Control PID + High Outlet Pressure Override PID – Prevents exceeding high outlet pressure setpoint by:

- Enabling the "High Output Pressure Override" PID, setting up the desired parameters in the "Hi Output Pres Override" selection tab.
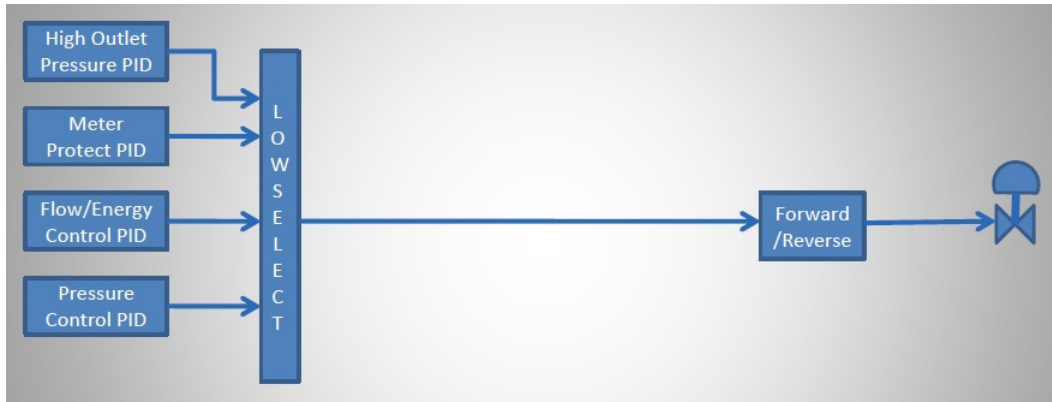
Figure 12. High Outlet Pressure Override PID

Flow/Energy PID + Meter Protection PID + Pressure Control PID + High Outlet Pressure Override PID + Low Inlet Pressure Override PID –Prevents inlet pressure from falling below setpoint by:

- Enabling the "Low Inlet Pressure Override" PID, setting up the desired parameters in the "Inlet Pres Low Override" selection tab.

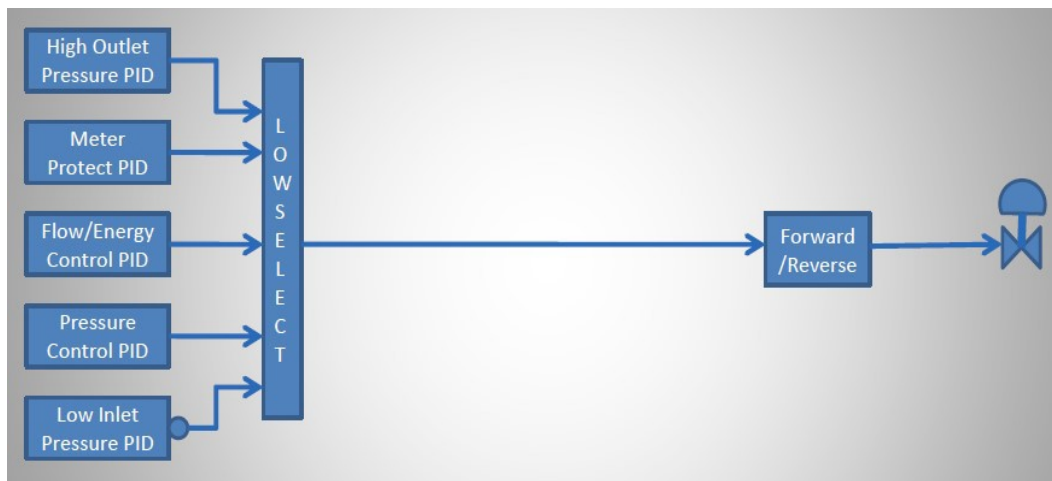**Note:** This PID loop is reverse acting by default.

Figure 13. Low Inlet Pressure Override PID

4. Low High Select Example

High Safety (MAOP – Maximum Allowable Operating Point) Override PID – Prevents downstream pressure from exceeding the maximum allowable operating pressure by:

• Enabling the "High Safety Override" PID, setting up the desired parameters in the "Hi Safety Override" selection tab.

The "Low Select" is automatically used to choose between the output of the High Select block and the High Safety Override PID, whichever output is lowest.
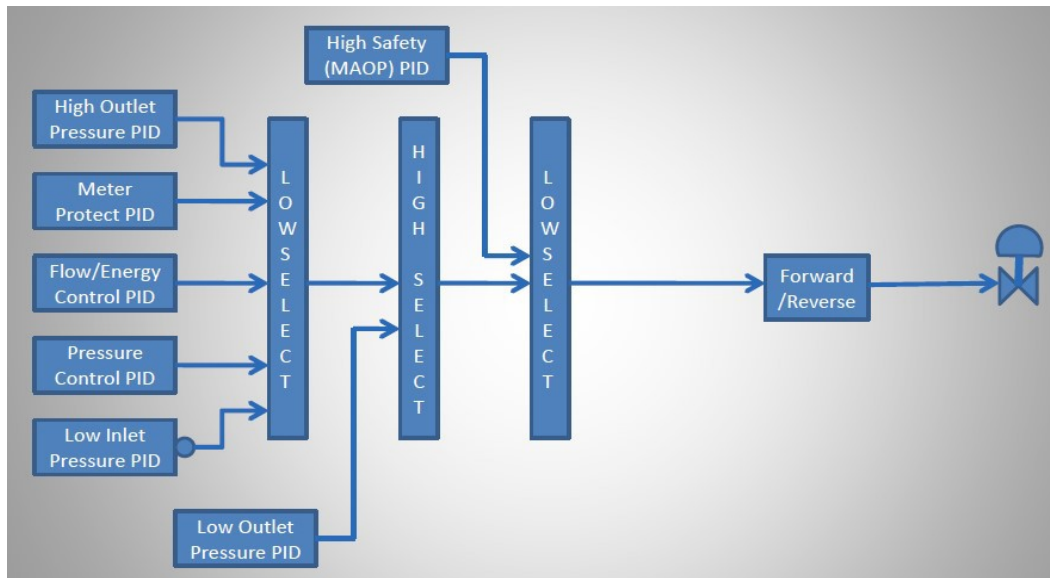

Figure 14. High Safety

5. Manual Override PID Example

Manual Override PID –Allows direct control of valve when in manual control mode.

• Enabling the "Manual Override" PID can be completed via the Station Overview tab and/or the "Manual Control" tab.

The Manual selection option will automatically switch out the final Low Select block and take control with its PID until the "Auto" option is selected in the "Station Control Mode" option. The "Station Control Mode" is the same parameter that is displayed in the "Station Overview" tab under the "Control Mode" block.
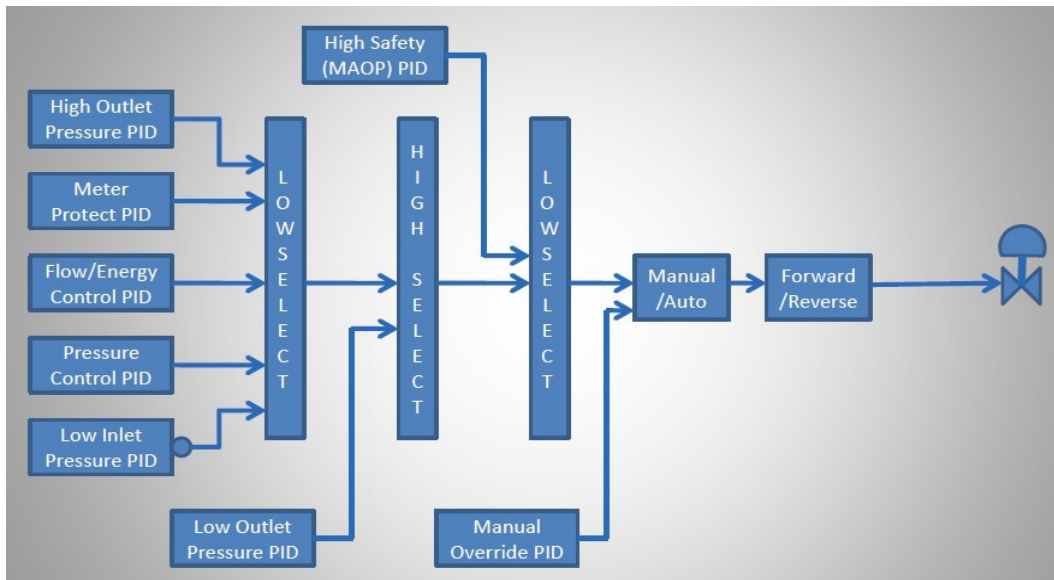

Figure 15. Manual Override PID

6. Split Range Valve Control Example

Split Range Valve Control –Allows multiple valves (up to 4) to be controlled in a sequential fashion by:

• Enabling the "Valve Staging" option in the "Control Outputs" tab.

• Selecting the desired valve number and setting Zero and Span values (described later).

• Paste the desired analog output to the "Valve Output Value (A/O)" or the proper DO/DI inputs and outputs to the "Open/Close Relay (D/O)" output selections and the "Valve Open/Close Status (D/I)" input selections if using "Jog Control".
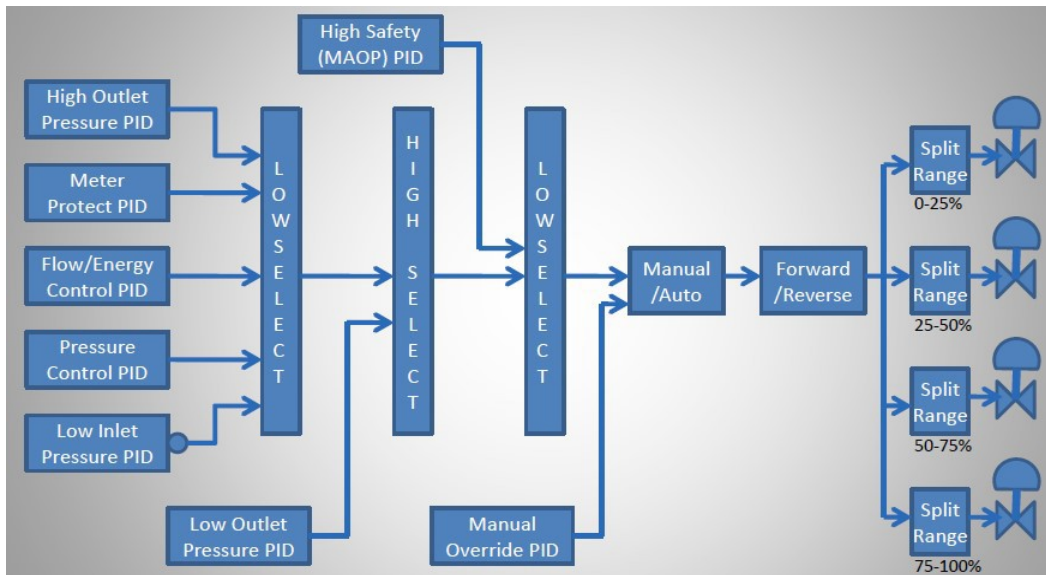

Figure 16. Split Range Valve Control

7. Autoconfig Station Control Overview

7.1 Station Overview Tab

The below example of the Station Overview page displays the status of the function and which PID loop is currently in control. In this case the Manual Override PID is Highlighted indicating that it is currently in control.
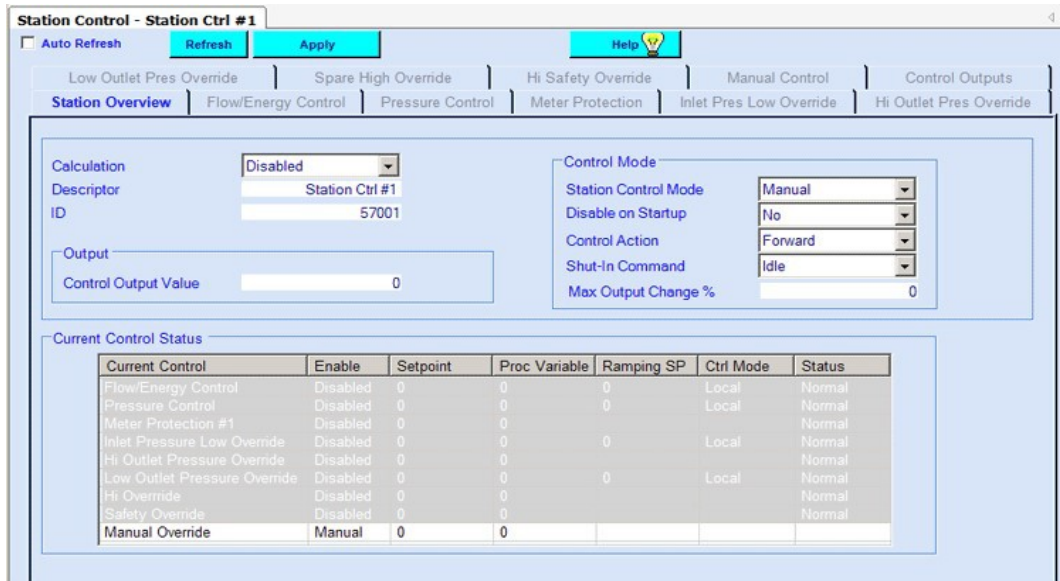

Figure 17. Station Overview

7.2 Parameter Definitions

• **Calculation**: Enable / Disable the Station Control function.

• **Descriptor**: Enter a description of this Station Control block.

• **ID**: The Station Control function ID.

• **Station Control Mode**: Select Auto if you want the instrument to control output based upon the processing of the enabled PID loops. Select Manual if you want to control the output manually using the Manual Override loop.

    • See Section below for Manual Control.

• **Disable on Download**: When a new configuration file is downloaded into the unit, the Station Control function, if enabled, will immediately begin controlling based on the setpoint, tuning parameters, etc. that were in effect at the time the configuration file was originally uploaded and saved. These values may not be applicable to current conditions. With this parameter set to Yes, the function will be set to disabled as part of the configuration file download process. This allows the operator to review the Station Control configuration parameters prior to enabling the control. Disable on Download must be enabled in the Offline mode prior to loading into physical unit.

• **Control Action**: Use this parameter to configure how the control output value should react to control the control valves correctly. Forward indicates that the output value should increase to open the valve (0% = valve fully closed, 100% = valve fully open). Reverse indicates that the output value should decrease to open the valve (100% = valve fully closed,

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0% = valve fully open). If the valves are controlled using a 4–20 mA output and the valve positioners are configured so that

the valve is fully open when a 20 mA signal is received, the control action should be set to Forward. If the valve positioners are configured so that the valve is closed when a 20 mA signal is received, the control action should be set to Reverse.

- **Shut-in Command**: If set to Shut-in, the Station Control mode is then set to Manual mode, and the manual loop setpoint is set to zero, causing the output to drive the valve(s) closed.

- **Max Output Change%**: This parameter limits the amount of change that can be applied to the control output value during one calculation cycle (1 second). This prevents large output changes in response to process upsets and allows the control loop to be tuned for tighter control response. Entering a value of 0.0 disables this feature. A non-zero value enables the feature and sets the output change limit. For example, if this parameter is set to 1.0% and the calculated output change for one calculation cycle is 2.5%, the actual change in the Control Output Value field will be limited to 1.0%.
  This parameter overrides all other calculated output values and acts as a failsafe to limit the speed of the function and valve control, eliminating possible valve "slamming".

- **Control Output Value** (Read Only Field): This is the calculated output of the Station Control function based upon the processing of the enabled control loop(s). This value is fed to the control outputs when split range or valve staging logic is applied.

Note: Do not map this "Control output value" to a physical output. Physical Analog Output should be connected to Valve Output Value (A/O) in the Control Outputs tab within the Physical Output block.

- **Current Control Status**: The Current Control Status data grid provides an overview of the current status of all control loops and indicates which control loop is actually in control. Enabled control loops are displayed in standard text while disabled loops are greyed out for clarity. An arrow is displayed that indicates which enabled loop is controlling the output. If a failure is detected on the input to an enabled loop, its status is displayed in red. The following items are included in the block for each control loop.

  - **Enable**: Indicates whether or not the control loop is enabled.

  - **Setpoint**: Shows the current operational setpoint value for the control loop and is based on user selection (local or remote).

  - **Process Variable**: Shows the current value of the process variable being controlled by the control loop.

  - **Ramping SP**: Shows the current value of the control loop's ramping setpoint. If setpoint ramping is disabled for the control loop, this value will be the same as the operational setpoint.

  - **Control Mode**: Shows the current local / remote control status for control loops that support both local and remote setpoints.

  - **Status**: Shows the current status (Normal or Failed) of the control loop's process variable. The actual conditions that will cause a failed status (I/O Failed, Manual Override, High Alarm, etc.) are individually configurable for each control loop.

7.3 Parameters for Station Control PID Loops

The screen below is an example of a configured Flow/Energy Control loop for the Station Control function.

Figure 18. Flow/Energy Control Loops

Note: Below are descriptions of the parameters by block (Setup block, Tuning block, etc.). Unless otherwise specified, the parameters apply to all PID loops associated with the Station Control function (flow/energy control, pressure control, meter protection, inlet pressure low override, high outlet pressure override, low outlet pressure override, spare high override, high safety override, and manual control). Note that the parameter names listed may not be identical to those displayed on the screen. For example, the Setpoint parameter refers to the Operating Setpoint parameter for the flow/energy control loop and the Inlet Press Setpoint parameter for the inlet pressure low override loop.

Setup block (all control loops except meter protection)

- **Control Loop Enable / Disable**: Enable or disable the control loop for inclusion in the Station Control logic.

- **PV**: Displays the current value of the control loop's process variable (pressure, flow rate, etc.). This parameter must be connected to the actual process variable value. For example, if the control loop is being used for pressure control, copy the pressure input from the analog input table (Table #16) and paste it into this field.

- **Operating Setpoint**: For control loops that do not support local and remote setpoints, enter the setpoint in this field. For control loops that do support local and remote setpoints, this field displays the actual control loop operating setpoint in use as determined by the local/remote setpoint selection logic.

Note: Any setpoint value entered here will be overwritten by Local or Remote Setpoint.

- **Max PV**: Set this field to an estimate of the maximum PV value that is expected. For a pressure control loop, this could be set to the maximum span of the pressure transducer that is providing the pressure input. For a flow/energy control loop, this could be set to the estimated maximum rate that could be expected when the flow control valves are fully open.
  This value is an estimation and is used to calculate a normalized PID error term (roughly in the range -1 to +1) using the following equation:

(Setpoint – Process Variable)/Max PV

Tuning block (all control loops)

Note: Instruction on PID tuning techniques is outside the scope of this document. A single set of tuning parameters is applied to all meter protection control loops.

- **Proportional Term**: PID proportional value (also known as the gain)

- **Integral Term**: PID integral value

- **Derivative Term**: PID derivative value

Note: Lower values can be entered in the above fields to slow down movement and then increase gradually as you continue to tune valve.

- **Error Deadband**: Use this parameter to specify when the control loop should be considered to be on setpoint (no adjustments to the control output value will occur). If the difference between the setpoint and process variable value is less than or equal to the error deadband value, no change in the control loop's output value will be made. The purpose of this parameter is to prevent undue wear and tear on the control valve by preventing minute adjustments to the position when the process variable is "close enough" to the setpoint. For example, if controlling pressure with a setpoint of 500 and an error deadband of 10, no change will be made to the control output for that loop value if the pressure is between 490 and 510.

- **Control Output Value** (Read Only Field): This field displays the calculated output of the overall Station Control function based upon the processing of all the enabled control loops. It is displayed on all control loop screens. This is a calculated output and no entry is required.

Setpoints block (flow/energy control, pressure control, inlet pressure low override control, low outlet pressure override control loops only)

- Control Mode: Specify whether the local or remote setpoint is to be used. Generally, the remote setpoint is selected for remote setpoint download from a host system, while the local setpoint is used by the local technician. This option allows a local technician to place the loop in local control during maintenance.

- Local Setpoint: When the Control Mode parameter is set to Local, specify the local setpoint value in this field. When in local control mode, this value will be immediately copied to the Setpoint field of the Setup block.

- Remote Setpoint: When the Control Mode parameter is set to Remote, specify the remote setpoint value in this field. When in remote control mode, this value will be immediately copied to the Setpoint field of the Setup block if the Remote Setpoint Load is set to Not Required or after the Remote Setpoint Load is set to Load SP if Remote Setpoint Load is set to Required.

Note: A setpoint can be entered in to both Local and Remote fields but only active setpoint is determined by Control Mode (Local or Remote).

- Remote Setpoint Load: Use this field to load the remote setpoint value into the Setpoint field in the Setup block when Remote SP Load is set to "Required".

- Ramping Setpoint: The ramping setpoint is the actual setpoint value being used in the current PID loop. If the Setpoint Ramp Rate parameter is set to a non-zero value, the ramping setpoint will ramp to the value of the operating setpoint in the Setup block at the rate specified in the Setpoint Ramp Rate field (process variable EU/second). For example:

  - The setpoint and ramping setpoint are both currently at 0.0. The setpoint is changed to 500 and the setpoint ramp rate is set to 10.0. The ramping setpoint will ramp up to the new setpoint value in steps of 10/second (0, 10, 20, 30, 40, etc.) until it reaches 500. The ramping of the setpoint value allows the PID to be tuned with more responsiveness since the maximum rate of change of the setpoint is known. If the setpoint ramp rate is set to 0.0, then the ramping setpoint will have the same value as the operating setpoint in the Setup block.

- Setpoint Ramp Rate: Specify the desired rate of change of the ramping setpoint. A value of 0.0 disables setpoint ramping. A non-zero value enables setpoint ramping. See example above for Ramping Setpoint

- Minimum Setpoint: Specify the minimum allowable setpoint value that will be accepted (applies to both local and remote setpoints). If a setpoint (local or remote) is entered that is less than the minimum setpoint value, the setpoint will be set to the minimum value.

  - For example, if the minimum setpoint is set to 100 and the local setpoint is set to 50, the local setpoint will be set to 100 (the minimum) automatically. Setting the Minimum Setpoint parameter to –999999.0 disables this feature.

- Maximum Setpoint: Specify the maximum allowable setpoint value that will be accepted (applies to both local and remote setpoints). If a setpoint (remote or local) is entered that is greater than the maximum setpoint value, the

setpoint will be set

to the maximum value. For example, if the maximum setpoint is set to 1000 and the local setpoint is set to 1050, the local setpoint will be set to 1000 (the maximum) automatically. Setting the Maximum Setpoint parameter to 0.0 disables this feature.

- Setpoint Copy: Specify whether the selected setpoint (local or remote) should be copied to the non-selected setpoint. When enabled, both the local and remote setpoints will always be equal to the selected setpoint value. Since this forces the local and remote setpoints to be equal, changes to the control mode (local/remote) will not cause a "bump" in the control outputs. When disabled, no copy is performed and the local and remote setpoints can contain different values.

- Remote SP Load: Specify whether a two-step process (load the remote setpoint value and set the remote setpoint load discrete to Load SP) is required to load the remote setpoint value into the operating setpoint in the Setup block. This feature is designed to facilitate "read back before execution" functionality, meaning a remote operator will download the desired setpoint value, wait for read back to verify that the setpoint was successfully downloaded, and then issue a Remote Setpoint Load.

7.4 Failure Handling Block

This section provides the ability to select how the Station Control function should respond to a failure or alarm condition that affects the process variable of a PID loop.

- Failure Status (Read only field): Indicates the failure/alarm status of the current PID Loop. If any monitored condition (as specified by the Fail Mask) is detected, the Failure Status is set to Failed, and the Station Control output will be handled as specified by the failure mode.

Note: This is a status field and no user selection is required.

- Failure Mode: Select how the Station Control logic should respond to a failed process variable.

Note: If the PID loop's process variable is a meter run volume or energy rate, the rate's status will reflect an "OR'ing" of the statuses of the live inputs (DP, Pressure, Temperature) for the meter run. If the PID loop's process variable is a meter station volume or energy rate, then the rate's status will reflect an "OR'ing" of the live input statuses of the meter station's meter runs (DP, Pressure, Temperature for all meter runs).

- Actions to take in response to a failure are listed below.
    - Fail Fixed: The Control Output will be held at its current value.
    - Fail Open: The Control Output will increase its value to 100% to fully open the control valve.
    - Fail Closed: The Control Output will decrease its value to 0% to fully close the control valve.
    - Ignore: The failed PID loop will be ignored (as if disabled) and will not affect the Control Output value.
    - Latch Fixed: The Control Output will be held at its current value.
    - Latch Open: The Control Output will increase its value to 100% to fully open the control valve.
    - Latch Closed: The Control Output will decrease its value to 0% to fully close the control valve.
    - Latch ignore: The failed PID loop will be ignored (as if disabled) and will not affect the Control Output value.

Note: In the event of any the "Latch" Failure Modes, user intervention will be required to "un-latch" the failure.

- Fail Mask: Specify which conditions of the process variable are to be monitored for a failure condition. Any combination of conditions may be selected by checking the appropriate boxes.

- All these refer to the physical process variable.

Figure 19. Fail Mask

7.5 Control Outputs Tab

Use the **Control Outputs** tab to configure a maximum of four valves that will be controlled in a sequential fashion.

Figure 20. Control Outputs

Valve Staging: Enable or Disable the valve staging function.

When disabled, the Station Control function will use a single output to control a valve. If enabled, the Station Control function will use up to 4 separate control outputs in order to control up to 4 separate valves.

The concept of "Valve Staging" works in concert with the Meter Run Switching (Table #42) function. This feature allows the Station Control function to take in valve Open/Close statues of up to 4 meter runs and only control the outputs of the meter runs that currently have been opened by the Meter Run Switching function.

The concept of "Split Range" is that, instead of using one large and expensive valve to control a significant amount of gas, the piping configuration is split up into several smaller less expensive pipe and valve "runs" to control the gas flow. The idea is to open or close successive valves in sequence in order to provide the desired amount of gas. Ideally, all valves would start out closed. Then, as the overall desired percent output is calculated by the Station Control function, that total percentage output is divided up between the existing valves. The first valve opens and provides a certain amount of gas. Once the first valve has reached 100% and more gas is necessary, the second valve begins to open to provide additional gas volume. Again, once the second valve has reached 100% and additional gas is needed the third valve begins to open and so on. The opposite process occurs for any reduction in gas flow. As the higher valves close to 0% the previous valves begin to close in order to reduce the total gas delivered.

Note: An alternate, but less common, method of controlling multiple valves is to control all of the configured valves simultaneously. The same percent output is sent to all of the valves in order to provide the desired flow rate. All valves would be open or closed the same amount in order to achieve the desired flow rate. To achieve this the Zero and Span values for all valves would be set to 0% and 100% instead of the Zero and Span values being divided or "Split" across the output range (see Split Range below).

In practice, valves do not react exactly when a control signal is applied so the individual valve ranges will need to be overlapped a small amount so that the next valve starts to open before the previous valve is fully open or close after the previous valve has started to close. This way the individual valves output slightly "overlap" each other in order to provide for smoother gas control.

7.6 Valve Setup block

Use the parameters in this block to configure how the control output is to be sent to the individual control valve(s). The Station Control has the ability to control up to four individual valve control outputs (analog or digital) that can be configured for staged valve or split range output. The split range mode allows multiple valves to be opened in sequence, with overlap if desired.

- **Valve Number**: Select which of the four valves outputs is being configured. The Physical Output, Split Range, and Valve Sequencing parameters displayed will reflect the values assigned to the valve selected.

7.7 Physical Output Block

The parameters in this block specify the physical I/O connections required to control the currently selected value output.

- **Output Type**: Specify how the currently selected valve will be controlled. If set to Analog, the valve will be controlled via an analog output (4-20 mA) signal. If set to Digital, the valve will be controlled via two discrete outputs utilizing jog control. Note that jog control also requires valve full open and valve full closed discrete input statuses from the valve.

- **Valve Output Value (A/O)**: Applies when Output Type is set to Analog. Specifies the current value being output to the analog output (4-20 mA) for controlling the current valve. This value is in percent, where 0% = 4 mA and 100% = 20mA. Normally, this field will be connected via copy/paste to a physical analog output (Table #21).

- **Open Relay (D/O)**: Applies when Output Type is set to Digital. Specify the output used to "step" the current valve in the open direction. Normally, this field will be connected via copy/paste to a physical relay output (Table #22).

- **Close Relay (D/O)**: Applies when Output Type is set to Digital. Specify the output used to "step" the current valve in the closed direction. Normally, this field will be connected via copy/paste to a physical relay output (Table #22).

- **Valve Open Status (D/I)**: Applies when Output Type is set to Digital. Specify the input used to indicate that the current valve is fully open. Normally, this field will be connected via copy/paste to a physical discrete input (Table #19).

- **Valve Close Status (D/I)**: Applies when Output Type is set to Digital. Specify the input used to indicate that the current valve is fully closed. Normally, this field will be connected via copy/paste to a physical discrete input (Table #19).

7.8 Split Range Block

The Split Range function works with the Valve Staging option to provide up to 4 control outputs for the control of separate valves. The split range feature provides a means to sequence the opening of multiple valves by specifying how the Control Output value is to be sent to each individual valve by setting the Zero and Span values.

The following examples shows how the Control Output signal can be split-ranged using several valves.

Assume that when the control output value ramps up from 0% to 50%, we want the first valve to transition from fully closed to fully open. When the control output value ramps from 50% to 100%, we want the second valve to transition from fully closed to fully open. This can be accomplished by setting the Zero and Span values for the first valve to 0 and 50 respectively and the Zero and Span for the second valve to 50 and 100 respectively.

- **Zero**: Specify the control output percentage at which the current valve should begin to open.

- **Span**: Specify the control output percentage at which the current valve should be fully open (100% output).

7.9 Manual Control Tab

The Manual selection option will automatically switch out the final Low Select block and take control with its PID until the "Auto" option is selected in the "Station Control Mode" or Setup block of the Manual Control tab.
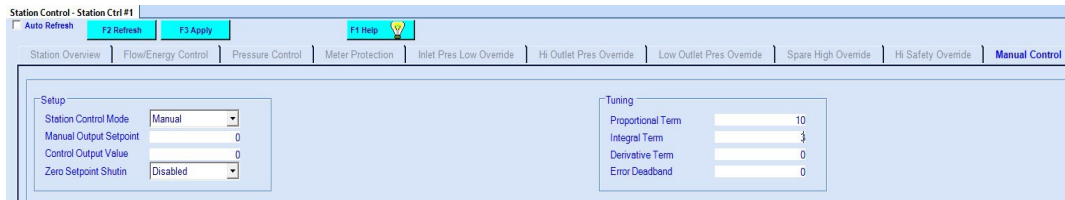

Figure 21. Station Control Mode

Definitions

- **Station Control Mode**: Allows user to control Manually or Automatically.

- **Manual Output Setpoint**: Setpoint to be entered here.

- **Control Output Value** (Read Only Field): This is the calculated output of the Station Control function based upon the processing of the enabled control loop(s). This value is fed to the control outputs when split range or valve staging logic is applied.

Note: Do not map this "Control output value" to a physical output. Physical Analog Output should be connected to Valve Output Value (A/O) in the Control Outputs tab within the Physical Output block.

- **Zero Setpoint Shutin**: If enabled, user would select specific enabled PID loop and apply a "zero" setpoint that would result in shutin of the station.

- **Tuning Note**: Technician will be required to enter proper tuning parameters.

  - Proportional Term: default=10

  - Integral Term: Default=3

  - Derivative Term: Default=0

  - Error Deadband: Default=0

7.10 Split Range Configuration Examples

2 Valve Split Range Example

Table 1. "Ideal" Example

Control Output	Valve #1 Output	Valve #2 Output
0%	0%	0%
10%	20%	0%
25%	50%	0%
50%	100%	0%
60%	100%	20%
75%	100%	50%
100%	100%	100%

Table 2. "Practical Overlapping" Example

Control Output	Valve #1 Output	Valve #2 Output
0%	0%	0%
10%	20%	0%
25%	50%	0%
50%	100%	5%
60%	100%	25%
75%	100%	55%
100%	100%	100%

Valve #1 Zero and Span Split Range Setup

Figure 22. Valve 1 Range Setup

Valve #2 Zero and Span Split Range Setup

Figure 23. Valve 2 Range Setup

3 Valve Split Range Example

Table 3. "Ideal" Example

Control Output	Valve #1 Output	Valve #2 Output	Valve #3 Output
0%	0%	0%	0%
16.6%	50%	0%	0%
33.3%	100%	0%	0%
50%	100%	50%	0%
66.6%	100%	100%	0%
83.3%	100%	100%	50%
100%	100%	100%	100%

Table 4. "Practical Overlapping" Example

Control Output	Valve #1 Output	Valve #2 Output	Valve #3 Output
0%	0%	0%	0%
16.6%	50%	0%	0%
33.3%	100%	5%	0%
50%	100%	55%	0%
66.6%	100%	100%	5%
83.3%	100%	100%	55%
100%	100%	100%	100%

Valve #1 Zero and Span Split Range Setup

Figure 24. Valve 1 Range Setup

Valve #2 Zero and Span Split Range Setup

Figure 25. Valve 2 Range Setup

Valve #3 Zero and Span Split Range Setup

Figure 26. Valve 3 Range Setup

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4 Valve Split Range Example

Table 5. "Ideal" Example

Control Output	Valve #1 Output	Valve #2 Output	Valve #3 Output	Valve #4 Output
0%	0%	0%	0%	0%
12.5%	50%	0%	0%	0%
25%	100%	0%	0%	0%
37.5%	100%	50%	0%	0%
50%	100%	100%	0%	0%
62.5%	100%	100%	50%	0%
75%	100%	100%	100%	0%
87.5%	100%	100%	100%	50%
100%	100%	100%	100%	100%

Table 6. "Practical Overlapping" Example

Control Output	Valve #1 Output	Valve #2 Output	Valve #3 Output	Valve #4 Output
0%	0%	0%	0%	0%
12.5%	50%	0%	0%	0%
25%	100%	5%	0%	0%
37.5%	100%	55%	0%	0%
50%	100%	100%	5%	0%
62.5%	100%	100%	55%	0%
75%	100%	100%	100%	5%
87.5%	100%	100%	100%	55%
100%	100%	100%	100%	100%

Valve #1 Zero and Span Split Range Setup

Figure 27. Valve 1 Range Setup

Valve #2 Zero and Span Split Range Setup

Figure 28. Valve 2 Range Setup

Valve #3 Zero and Span Split Range Setup

Figure 29. Valve 3 Range Setup

Valve #4 Zero and Span Split Range Setup

Figure 30. Valve 4 Range Setup

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