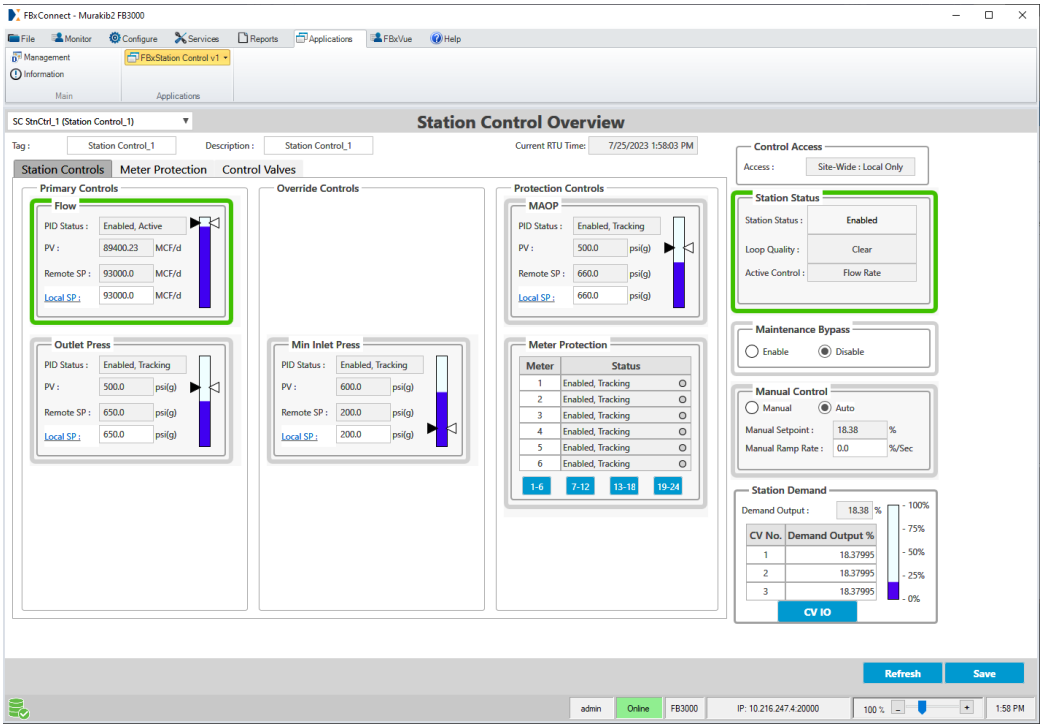
FBxStation Control™ Application User Manual



Energy and Transportation Solutions

EMERSON™

Application & Device Safety Considerations

- ## Reading these Instructions
  Before operating a device or application, read these instructions carefully and understand their safety implications. In some situations, improper use may result in damage or injury. Keep this manual in a convenient location for future reference. Note that these instructions may not cover all details or variations in equipment or cover every possible situation regarding installation, operation, or maintenance. Should problems arise that are not covered sufficiently in the text, immediately contact Energy and Transportation Solutions (ETS) Customer Support for further information.

- ## Protecting Operating Processes
  The failure of a device or application – for whatever reason – may leave an operating process without appropriate protection and could result in possible damage to property or injury to persons. To protect against this, review the need for additional backup equipment or provide alternate means of protection (such as alarm devices, output limiting, fail-safe valves, relief valves, emergency shutoffs, emergency switches, etc.). Contact ETS for additional information.

- ## Using Qualified Personnel
  Installation, configuration, and any subsequent modifications to a device or application should only be performed by qualified, suitably trained personnel information.

- ## System Training
  A well-trained workforce is critical to the success of your operation. Knowing how to correctly install, configure, program, calibrate, and troubleshoot your Emerson equipment provides your engineers and technicians with the skills and confidence to optimize your investment. ETS offers a variety of ways for your personnel to acquire essential system expertise. Our full-time professional instructors can conduct classroom training at several of our corporate offices, at your site, or even at your regional Emerson office. You can also receive the same quality training via our live, interactive Emerson Virtual Classroom and save on travel costs. For our complete schedule and further information, contact the ETS Training Department at 800-338-8158 or email us at *education@emerson.com*.

- ## Grounding Equipment
  Ground metal enclosures and exposed metal parts of electrical instruments in accordance with relevant safety standards. For the USA, refer to OSHA rules and regulations as specified in *Design Safety Standards for Electrical Systems*, 29 CFR, Part 1910, Subpart S, dated: May 16, 1981 (OSHA rulings are in agreement with the National Electrical Code). For international locations, refer to IEC 60364-4-41: PROTECTION AGAINST ELECTRIC SHOCK. You must also ground mechanical or pneumatic instruments that include electrically operated devices such as lights, switches, relays, alarms, or chart drives. The chassis (or earth ground) lug provides a safe connection point to a customer-designated ground location for ESD and transient voltage suppression. Do not use the chassis ground lug for signal, common, or return connections. **Do not connect the chassis ground lug directly to a lightning arrestor/lightning rod.** Do not run signal wiring in conduit or open trays with power wiring or near heavy electrical equipment. If shielded wiring is used, ground the shield of the signal wiring at any one point of the signal loop.

  Important: Complying with the codes and regulations of authorities having jurisdiction is essential to ensuring personnel safety. The guidelines and recommendations in this manual are intended to meet or exceed applicable codes and regulations. If differences occur between this manual and the codes and regulations of authorities having jurisdiction, those codes and regulations must take precedence.

- ## Protecting from Electrostatic Discharge (ESD)
  Any device contains sensitive electronic components which can be damaged by exposure to an ESD voltage. Depending on the magnitude and duration of the ESD, it can result in erratic operation or complete failure of the equipment. Ensure that you correctly care for and handle ESD-sensitive components.

- ## Ethernet Connectivity
  This automation device is intended to be used in an Ethernet network which **does not** have public access. The inclusion of this device in a publicly accessible Ethernet-based network is **not recommended**.

- ## Returning Equipment
  If you need to return any equipment to ETS, it is your responsibility to ensure that the equipment has been cleaned to safe levels, as defined and/or determined by applicable federal, state and/or local law regulations or codes. You also agree to indemnify ETS and hold ETS harmless from any liability or damage which ETS may incur or suffer due to your failure to ensure device cleanliness.

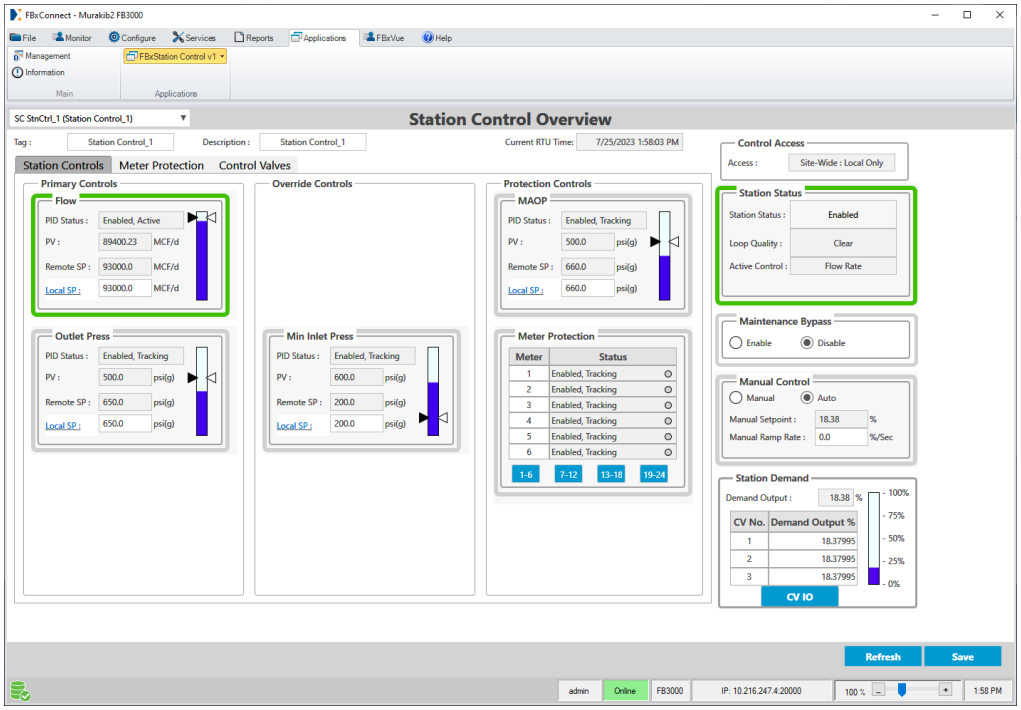
Contents

Chapter 1. Introduction

FBxStation Control™ is an application for the Emerson FB3000 RTU you can configure to control multiple natural gas meter runs associated with multiple stations. It operates in conjunction with the standard measurement application included in the FB3000 firmware.

While the FB3000 measurement application supports both natural gas and liquids metering, the FBxStation Control application was designed primarily for control of natural gas meters and stations.

Figure 1-1. Monitor Screen



1.1 Meters

A meter is a device which measures natural gas flow and pressure through a single pipeline or tube. This is referred to a meter run. In some cases, a physical meter can handle measurements for more than a single pipeline/tube (multiple meter runs) but for purposes of this application, the term meter refers to a single meter run.

1.2 Stations

A station is a grouping of one or more meters. The FBxStation Control application running in the FB3000 RTU supports up to 24 stations.

1.3 Station Control Functions

Station Control supports the following functions:

- **Station Regulation** – Through the Station Control Config tabs, you specify whether the station measures flow or energy, and what circumstances cause station valves to shut and what actions to take should an error condition arise. Screens also let you configure PID loops. You also use the Run Mapping tab to import your station and meter run mapping configuration directly from FBxConnect.
- **Run Staging** – On the Run Staging tabs, you identify the order in which meter runs (tubes) become active to achieve the desired flow and pressure.
- **Remote Control Valves** – These valves open and close in response to commands either from FBxStation Control or from a SCADA system to meet the demand for flow or pressure. You specify for FBxStation Control how the valves operate so it can monitor them and initiate open/close commands as needed.
- **Bi-Directional Flow Control (**Optional) – Most natural gas pipelines deliver gas in a single direction. Optionally, the same pipeline can be used to deliver gas in both directions – bi-directional flow, sometimes abbreviated as “bi-di”. FBxStation Control can manage bi-directional flow through the pipeline.

Chapter 2. Installation

2.1 Before You Begin

- You must install the FB3000 RTU on site and connect the field devices associated with meter runs to the I/O modules in the FB3000 RTU. You must ensure the RTU includes sufficient I/O capacity to support the number of stations and meter runs you want to control through FBxStation Control. For example, if you plan to use valve position feedback, ensure you have enough inputs to support that. See the ***Emerson FB3000 RTU Instruction Manual (D301851X012***) for information on mounting, wiring, and I/O configuration.
- You must install Field Tools/FBxConnect version 3.11 or newer on a laptop computer and establish communications with the FB3000 RTU through Field Tools, either by a serial or Ethernet connection. See the ***Field Tools Quick Start Guide (D301703X412)*** for information
- Your FB3000 RTU must be running firmware version 2.11 or newer. See the ***FBxConnect Configuration Software User Manual for the FB3000 (D301882X012)*** for information about installing a firmware upgrade.
- You must have configured I/O for your field devices in FBxConnect, and you must define your stations and meters in FBxConnect. See the ***FBxConnect Configuration Software User Manual for the FB3000 (D301882X012)*** for information on these topics.

Note: The Station Control application is designed to control natural gas meters. If your site(s) include a combination of natural gas and liquids metering, we recommended you configure Stations 1 -24 to handle the natural gas meters, and only configure Stations 25 and higher for liquids meters.

Note: The FBxStation Control application is a licensed program (SC04). You must license it prior to the installation.

Once you complete all of these items, you can install the FBxStation Control application.

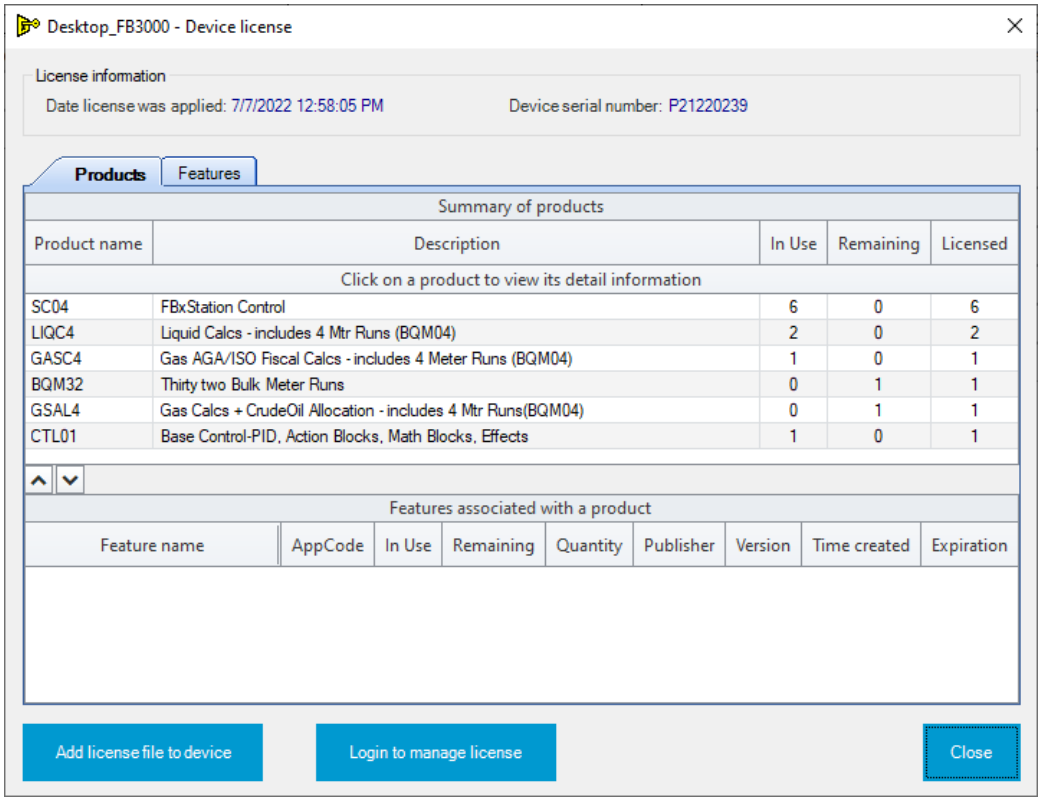
2.1.1 Licensing

You license the FBxStation Control application in FBxConnect. To see that screen, click **Services > Device License** and add the license file for Station Control you purchased to the device.

Important

If you add an additional FBxStation Control license, you must **stop** the FBxStation Control application and then **start** it, so it recognizes the newly licensed runs/stations. The FBxStation Control license agreement is available for download from Guardian.

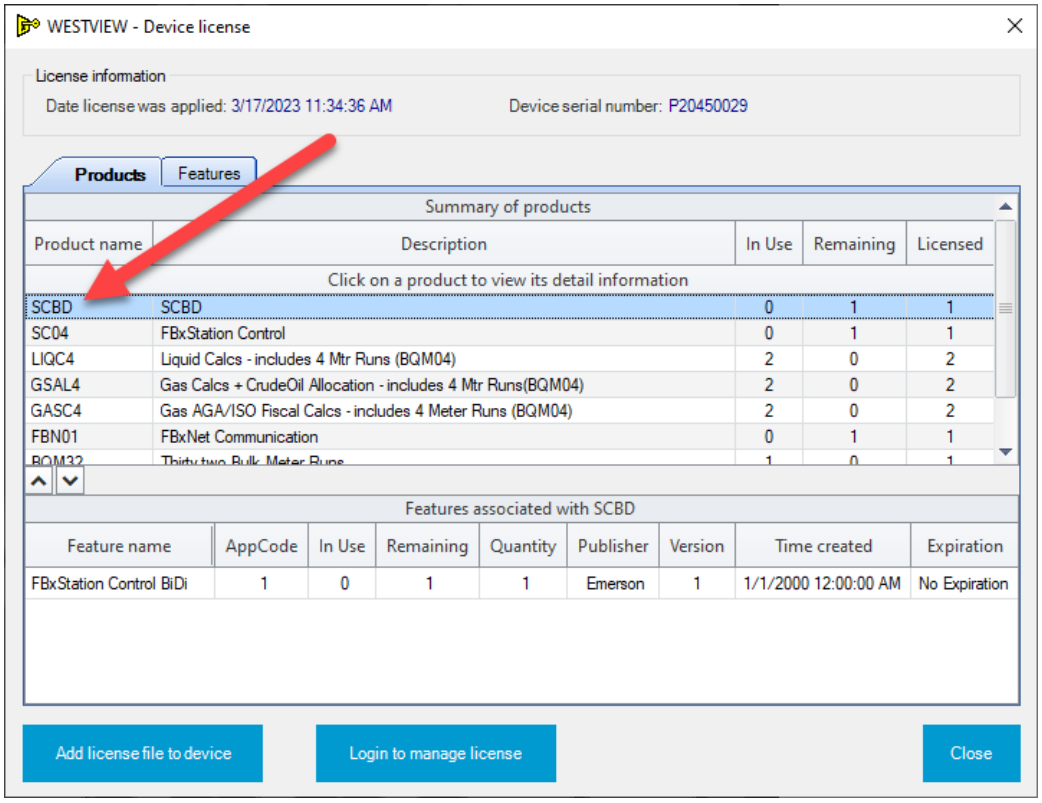
Figure 2-1. Licensing in FBxConnect



Bi-Directional Control License

If you plan to use bi-directional flow control, you must purchase the Station Control Bi-Directional control license (**SCBD**) in addition to any other licenses you have for the device.

Figure 2-2. SCBD License



2.2 Installing the Application

Important

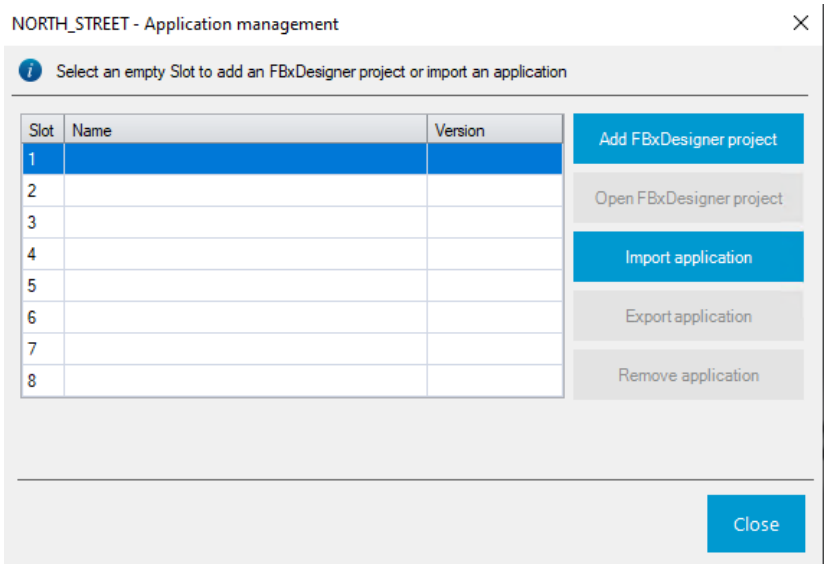
If your FB3000 already includes an earlier version of FBxStation Control, follow the steps in *Section 2.3* before installing the new version.

1. In FBxConnect, click **Applications > Management**.

Figure 2-3. Applications Management

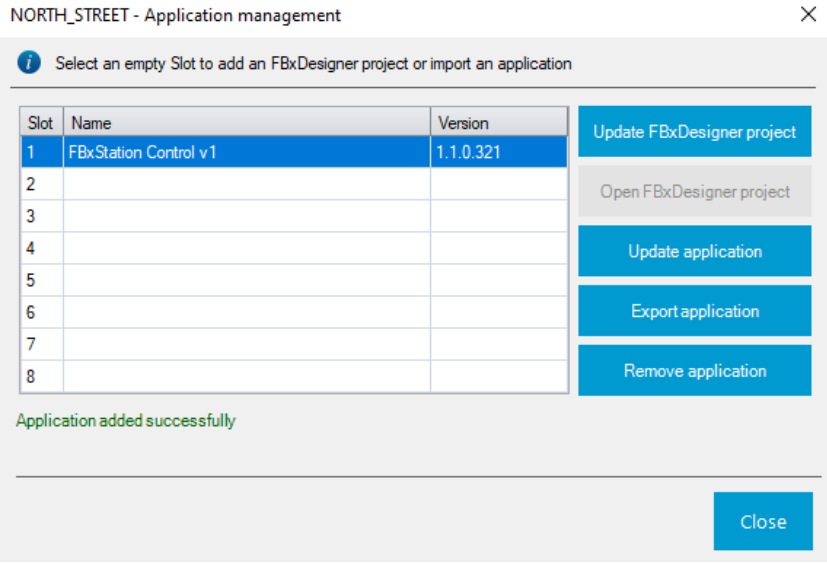
2. Click to select an empty slot (one that has no application) then click **Import application** and navigate to the FBxStation Control ZAP application file and select it.

Figure 2-4. Application Management dialog box



3. Click **Open**.
4. When FBxConnect reports ***Application added successfully*** click **Close**.

Figure 2-5. Application added successfully

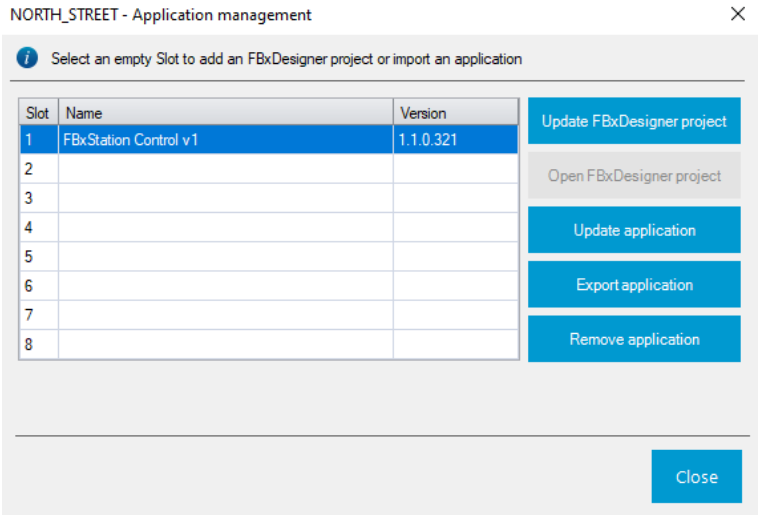


2.3 Updating an Existing Application

To update your application, it must have the same name as the existing application.

1. In FBxConnect, click **Applications > Management**.

Figure 2-6. Application Management



2. Click **Update application** and navigate to the new FBxStation Control ZAP application file (which includes the Configuration.XML file in it) and select it.
3. Click **Open** and wait until FBxConnect reports the update has completed successfully.

2.4 Configuration Overview

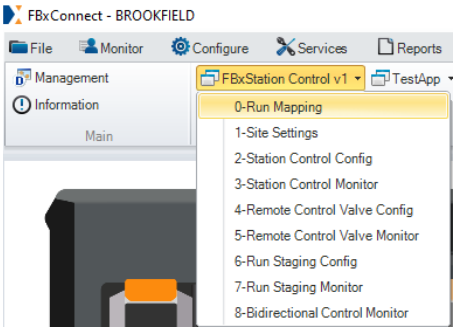
Follow these steps in order:

1. Launch Field Tools and create a connection to the FB3000 RTU to launch FBxConnect for online communication with the RTU.
2. In FBxConnect, configure the I/O necessary for station control. See the FBxConnect online help or the *FBxConnect Configuration Software User Manual (For FB3000) (D301882X012)* for details.
3. In FBxConnect define your stations and meters and assign the meters to particular stations. See the FBxConnect online help or the *FBxConnect Configuration Software User Manual (for FB3000) (D301882X012)* for details.
4. From the Application Management page in FBxConnect, install the FBxStation Control Application in the RTU.
5. Start the FBxStation Control application in FBxConnect.
6. Click **Run Mapping** and import the station/meter mapping from FBxConnect that you did in Step 3.
7. Configure Site Settings.
8. Select the station you want to configure.
9. Depending upon whether or not you plan to use Bi-directional flow, you must choose **one** of the following options:
    - Configure parameters on the Station Control Config General tab, and then Configure PIDs on the appropriate PID tabs (Primary PIDs, Protection PIDs, Override PIDs), then tune the loops from the PID tuning screens.
    - Configure bi-directional control parameters on the Station Control Config bi-directional tab.
10. Configure remote control valves.
11. Repeat steps 8 through 10 for additional stations.
12. Use the overview screens to monitor the operation of the loops.
13. Configure meter run staging (optional).

Chapter 3. Starting the Application

1. Click the **Applications** tab in FBxConnect.
2. Expand the Station Control menu and select **Run Mapping**.

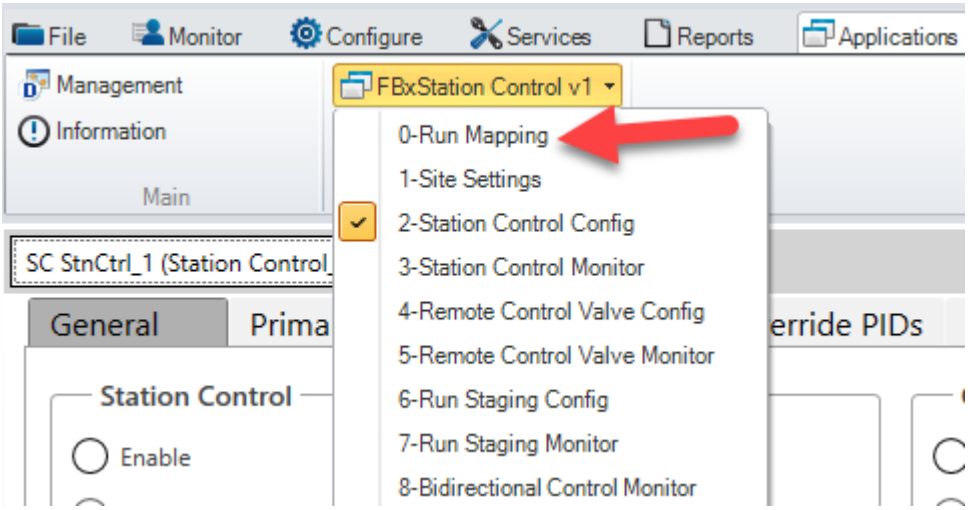
Figure 3-1. Calling up the Config Menu



3.1 Menu Navigation

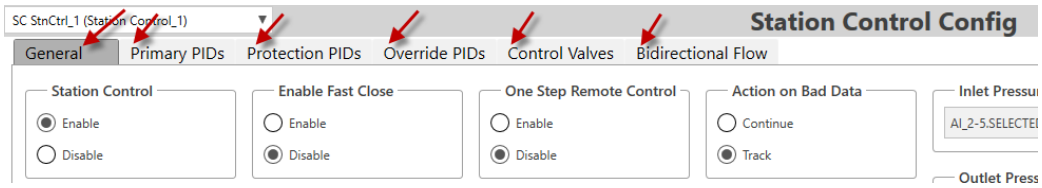
To reach the various screens in FBxStation Control, click the **Applications** tab in FBxConnect, then click the StationControl application name and select from the menu items shown.

Figure 3-2. Calling up Screens



Many screens have tabs or sub-tabs to organize the information related to a particular feature. Click on the tab name to open the tab.

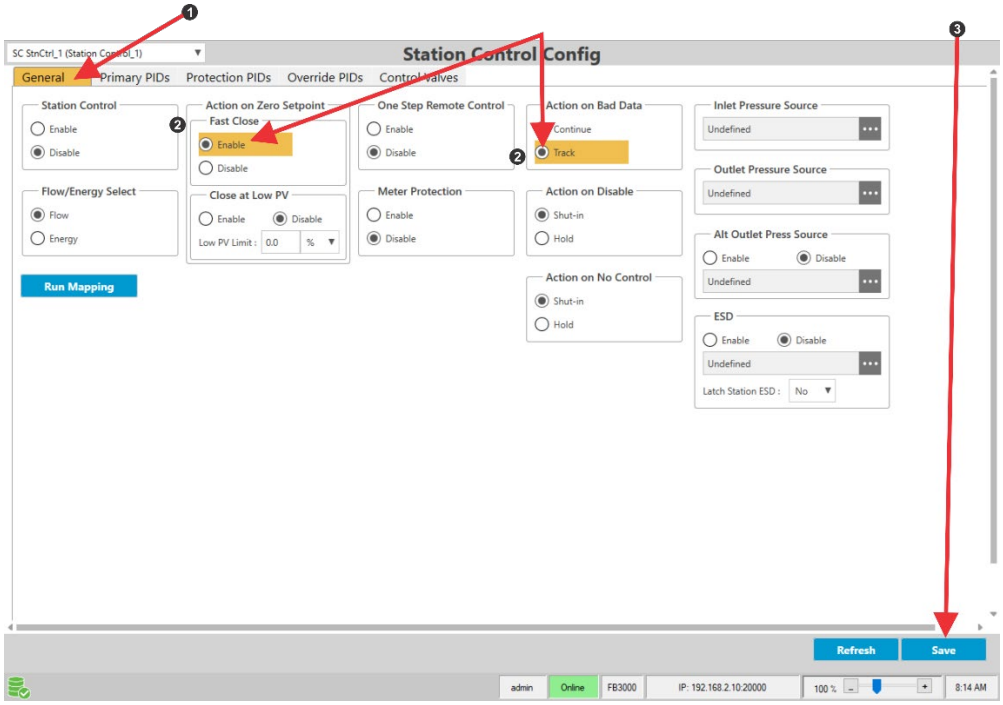
Figure 3-3. Selecting a Tab



3.2 Saving Changes

Before the edits you make in the FBxStation Control application can take effect, you must save them. When you make an edit, FBxStation Control highlights unsaved edits in a golden-brown color. Click **Save** before you move off that tab to save your edits.

Figure 3-4. Highlighting of unsaved changes



1 Tab highlighted to indicate un-saved changes.
2 Changes you made but have not saved are highlighted.
3 Click **Save** to save changes; then those fields are no longer highlighted.

Chapter 4. Run Mapping

Note

Before you attempt to configure any of the major functions in the FBxStation Control application, you must map meters to stations in FBxConnect software **first** from the Meter Setup and Station items on the Configure tab. This sets up the standard firmware functionality in the FB3000. Then you import that configuration into the FBxStation Control application as described in this section.

The FB3000 supports both natural gas and liquid meter types, while FBxStation Control was developed to control natural gas meters and stations only. You should determine the proper meter setup and station assignment in advance, particularly for installations where the FB3000 will be performing both natural gas and liquid metering. Although it is certainly possible to stagger natural gas and liquid metering stations, in order to simplify the configuration process and track station data and functions, we recommend you reserve a contiguous block of stations, starting with 1 and sized based on licensing and future requirements, for natural gas metering.

For example, if you have an installation that will initially incorporate a single SC04 license to control up to 4 meters and stations, but you plan future expansion to control 8 meters and stations, you can use the setup shown below:

- Station 1-4 (current)→ Natural Gas Metering (DP and Linear meter types)
- Station 5-8 (future)→ Natural Gas Metering (DP and Linear meter types)
- Station 9 & up→ Liquids Metering (Liquid Allocation meter types)

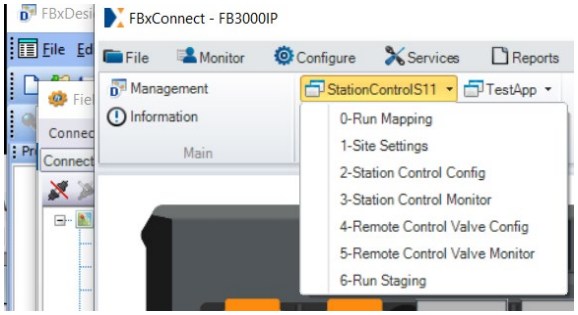
Once you complete your mapping in FBxConnect, you can import the mapping into FBxStation Control using the Station Control Run Mapping screen.

On any screen, you can update the data on the screen by clicking **Refresh** and save your edits by clicking **Save**.

You can reach the Station Control Run Mapping screen by either of two ways:

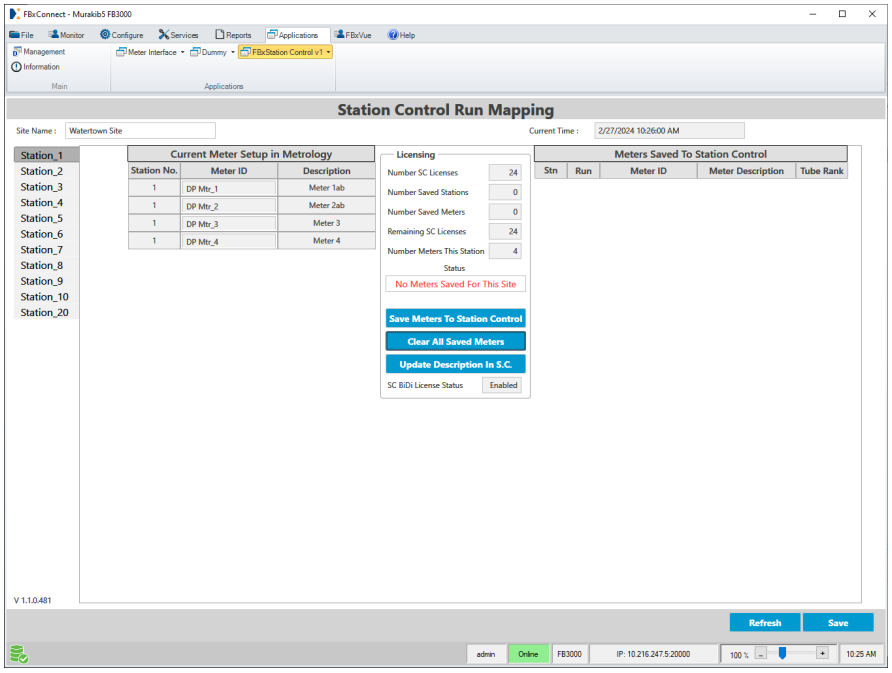
- Select **Run Mapping** from the Station Control application menu in FBxConnect.

Figure 4-1. Calling up the Run Mapping Screen



- Click the **Run Mapping** button on the Station Control Config General tab.

Figure 4-2. No Meter Runs Mapped Yet

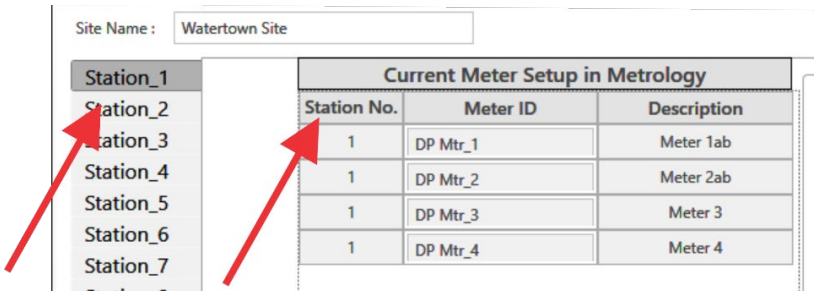


When you open the Run Mapping display it shows the meter setup configured for Station No. 1 measurement. If other stations have been configured, the screen shows additional tabs below the Station_1 tab. If no meters are shown for the selected station, it means the configuration was not completed in FBxConnect.

The Station Control Run Mapping screen shows your existing stations for the current **Site** and their meter runs. You need to bring each station's meter runs into FBxStation Control, and then (if using meter run staging) set a tube rank for each meter run.

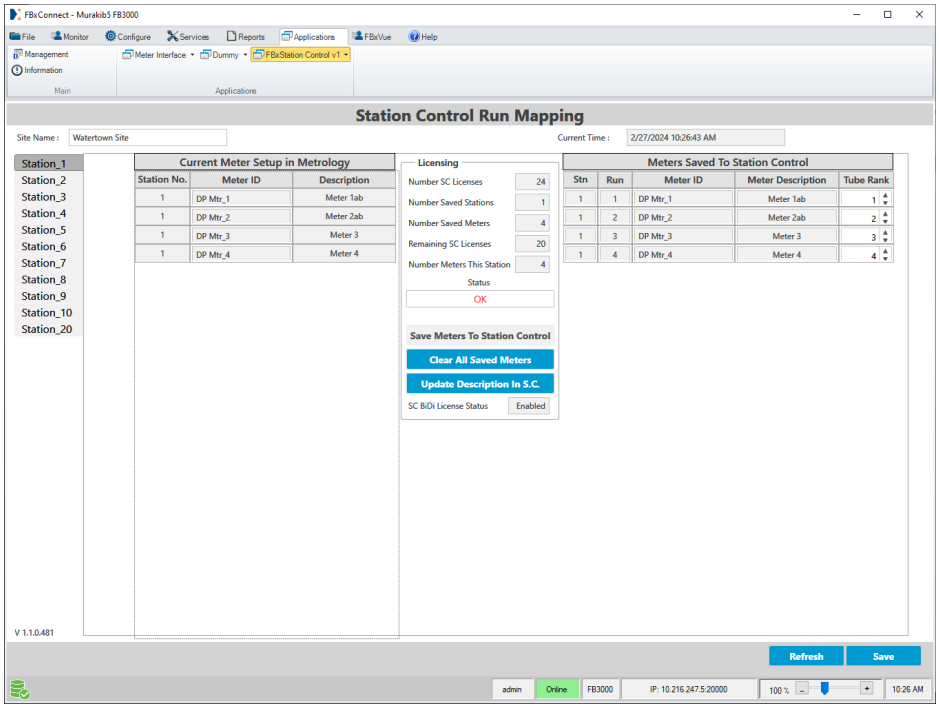
1. In the **Site Name** column on the left of the screen, click on a station name and FBxStation Control shows the current meter setup for that **Station** at right in the **Current Meter Setup in Metrology** column including the **Meter ID**, as well as an optional **Description**. The meters are listed in the order they were configured in measurement, with DP Meter types listed first. Descriptions (if shown) come directly from the device configuration.

Figure 4-3. Selecting the Station



2. Click **Save Meters To Station Control** to bring that station and its meters into the application. FBxStation Control copies the details to the **Saved To Station Control** column. This overwrites any previously saved details for this station.

Figure 4-4. Saving Meters into Station Control

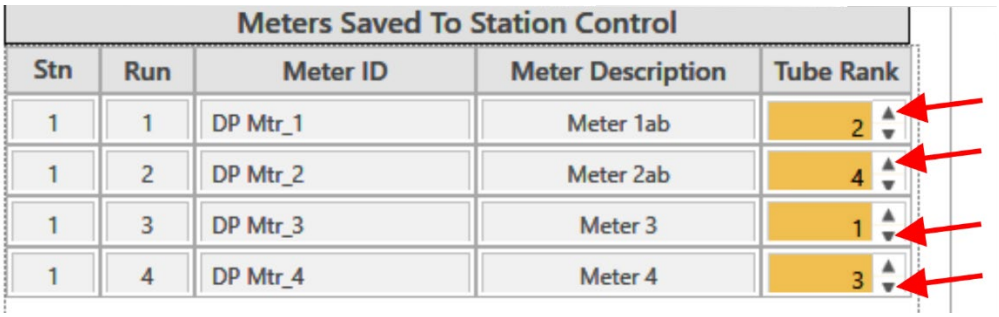


Note: If you realize you made a mistake and want to remove **all** the saved information, you can click **Clear All Saved Meters**.

3. If you plan to use meter run staging (tube staging) use the up and down arrow controls to assign a **Tube Rank.** Rank refers to order in which a run is opened or

closed, as flow varies through the station. The run ranked 1 will open first, to meet any demand for flow. The runs ranked 2 and higher will open as the flow through the station increases and more runs are required. In a given station, no meter run (tube) should have the same rank as another meter run (tube). If you do **not** plan to use meter run staging, you should leave the **Tube Rank** at the default value.

Figure 4-5. Setting the Tube Rank



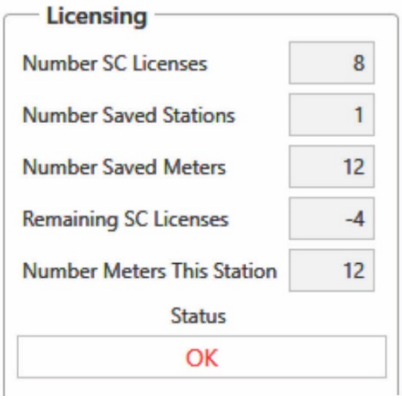
Meters Saved To Station Control

Stn	Run	Meter ID	Meter Description	Tube Rank
1	1	DP Mtr_1	Meter 1ab	2
1	2	DP Mtr_2	Meter 2ab	4
1	3	DP Mtr_3	Meter 3	1
1	4	DP Mtr_4	Meter 4	3

4. If you have made changes to the **Description** in FBxConnect metrology and want them reflected in Station Control, click **Update Description in S.C.**
5. The **SC BiDi License Status** shows **Enabled** if bi-directional control is licensed for these stations; or **Disabled** if bi-directional control is not licensed.
6. Repeat steps 1, 2, and 3 for each additional station. When you finish, click **Save** to save all your changes.

The center of the Station Control Run Mapping screen includes a Licensing box. As you copy station and meter run configurations into FBxStation Control, it maintains a count of the available licenses and monitors to see that your configuration does not exceed any licensing limits.

Figure 4-6. Licensing



Licensing

Number SC Licenses	8
Number Saved Stations	1
Number Saved Meters	12
Remaining SC Licenses	-4
Number Meters This Station	12

Status

OK

Number SC Licenses	The number of FBxStation Control licenses currently installed in this device.

Number Saved Stations	The number of different stations you have brought into FBxStation Control.
Number Saved Meters	The total number of meters across all stations under FBxStation Control.
Remaining SC Licenses	The number of unused FBxStation Control licenses remaining. A negative number means you have used up all your purchased licenses and are trying to use more than you have purchased.
Number Meters This Station	The number of meters for the currently selected station.
Status	Status messages include:

No Status	The status check operation has not executed or is pending.
No Meters Setup For This Station	Nothing has been configured in FBxConnect for the selected station.
No Meters Saved For This Station	The meter setup for the selected station has not been saved to Station Control.
Saved Meter Mismatch	The meter setup saved to Station Control for the selected station does not match the current meter setup in FBxConnect.
OK	The saved meter setup for the selected station matches the current meter setup in FBxConnect.

If Status indicates you have exceeded a limit, and you want to start over, click **Clear All Saved Meters**, and make different choices that do not exceed the licensing limits. You would also clear the meters if you modify the meter-station mapping in FBxConnect

Important

If you add an additional FBxStation Control license, you must **stop** the FBxStation Control application and then **start** it, so it recognizes the newly licensed runs/stations.

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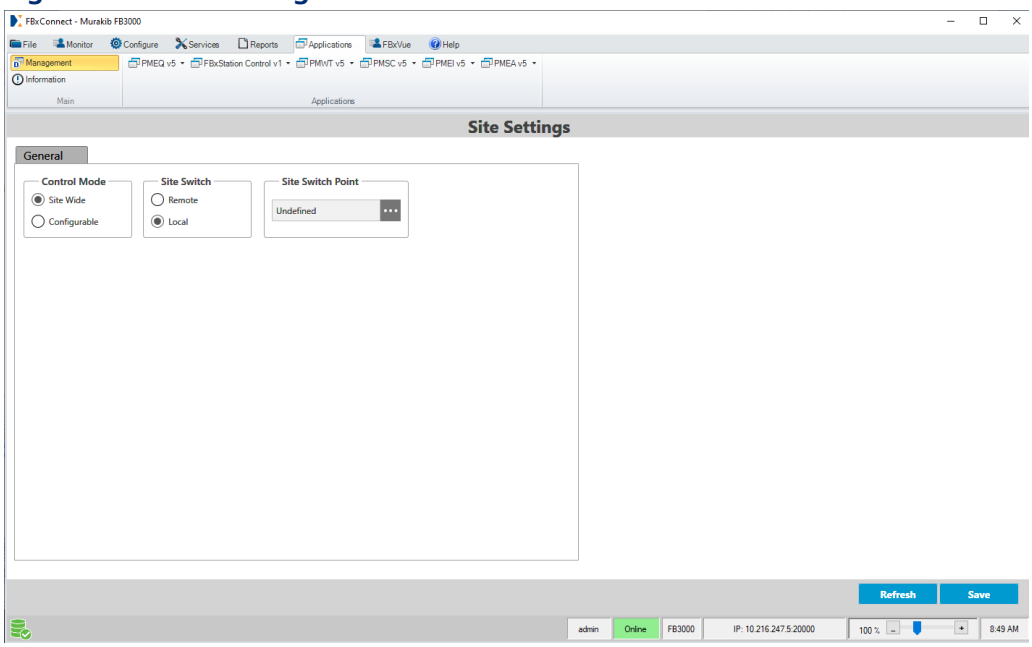
Chapter 5. Site Settings

FBxStation Control includes 24 switches you can associate with individual valves. These switches support a lockout of either local control (FBxConnect user) or remote (SCADA system) control of the valves.

To reach the Site Settings – General tab, select **Site Settings** from the Station Control application menu in FBxConnect.

Figure 5-1. Site Settings – General tab

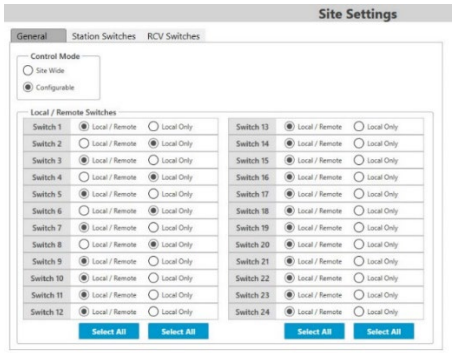


Under **Control Mode** if you choose **Site Wide**, all stations, valves, and switches support whatever access you choose under **Site Switch** - either **Remote** (SCADA system access) or **Local** (FBxConnect/FBxStation Control access). Click **Save** to save that choice.

You can use **Site Switch Point** to specify a database tag, the value of which will determine whether **Local** or **Remote** is active. If you configure the tag, the **Site Switch** box disappears. The database tag must be type BOOL; a state of FALSE chooses **Remote**; a state of TRUE chooses **Local**.

If you choose **Configurable**, the Site Switch field disappears, and a table of switches shows on the **General** tab, and FBxStation Control shows two new tabs (**Station Switches** and **RCV Switches**).

Figure 5-2. Configurable Mode – Choosing Local or Local/Remote



Choose **Local/Remote** if you want both local control (FBxConnect user) and remote control (SCADA system). This allows both someone making local changes in a Station Control screen, as well as a remote SCADA system to issue commands to an associated station or valve. If you want to set that for every switch in a column, choose **Select All**.

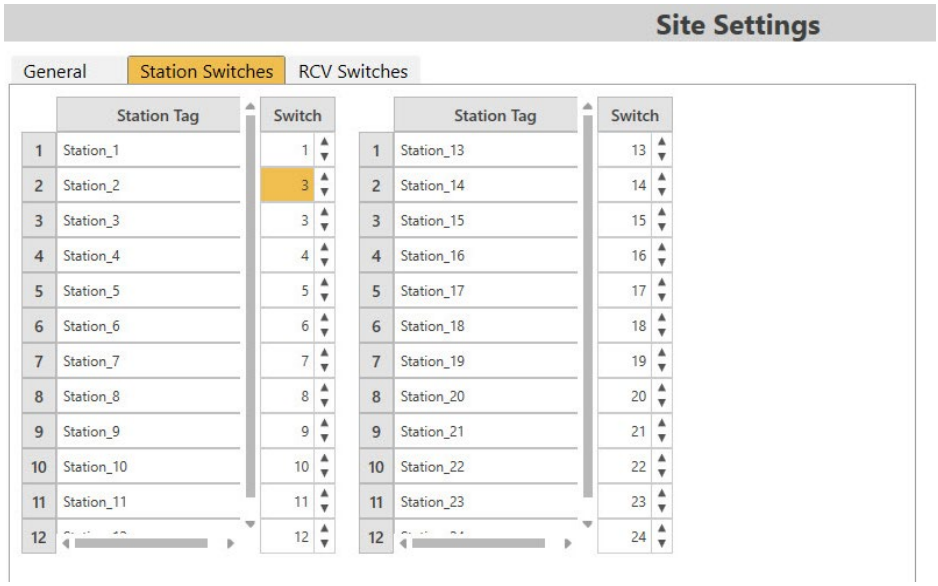
Choose **Local only** to allow someone making local changes in a Station Control screen to issue commands to an associated station or valve, but to lockout commands issued from a remote SCADA system. If you want to set that for every switch in a column, choose **Select All**.

On any screen, you can update the data on the tab by clicking **Refresh** and save your edits by clicking **Save**.

5.1 Site Settings – Station Switches Tab

By default, Station 1 is associated with Switch 1, Station 2 is associated with Switch 2, and so on. On the Station Switches tab, you can associate a station with any of the 24 switches. You can also associate the same switch with more than one station. You cannot, however, associate a station with more than one switch.

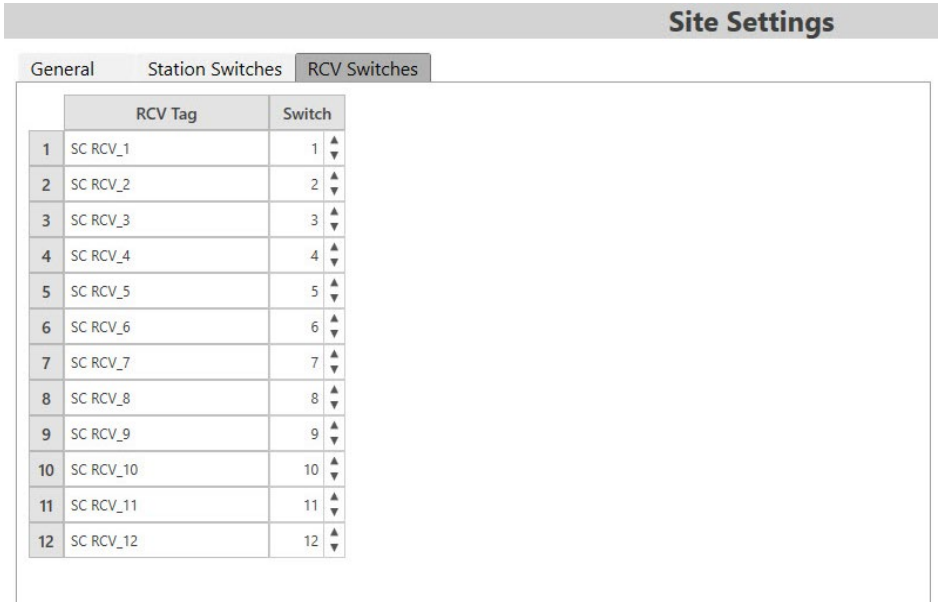
Figure 5-3. Station Switches Tab



5.2 Site Settings – RCV Switches Tab

By default, Station 1 is associated with Remote Control Valve (RCV) 1, Station 2 is associated with RCV 2, and so on. On the RCV Switches tab, you can associate a remote control valve with any of the 24 switches. You can also associate the same switch with more than one RCV. You cannot, however, associate an RCV with more than one switch.

Figure 5-4. RCV Switches Tab



Chapter 6. Station Control Config - General Tab

Go to Station Control Config and select the Station you want to configure from the listed instances:

Figure 6-1. Navigating to Station Control Config

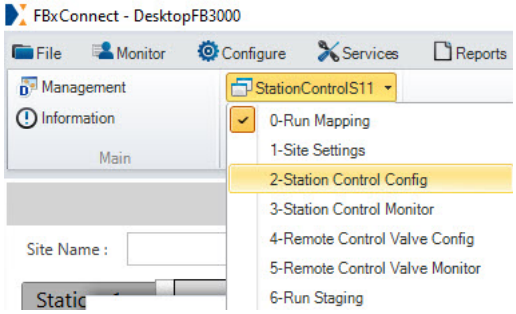
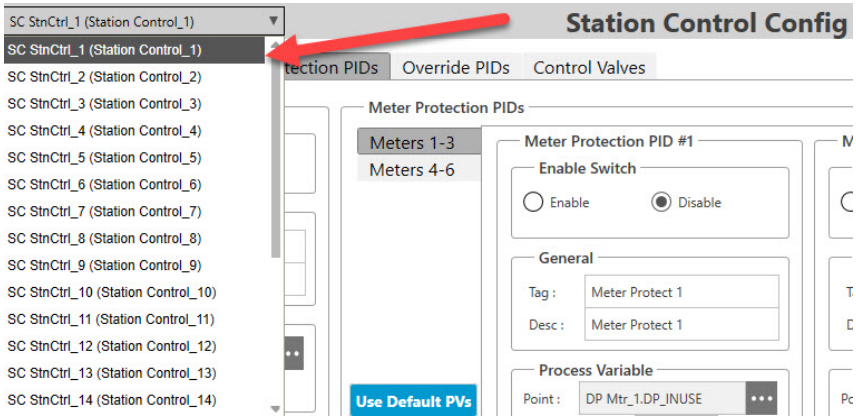
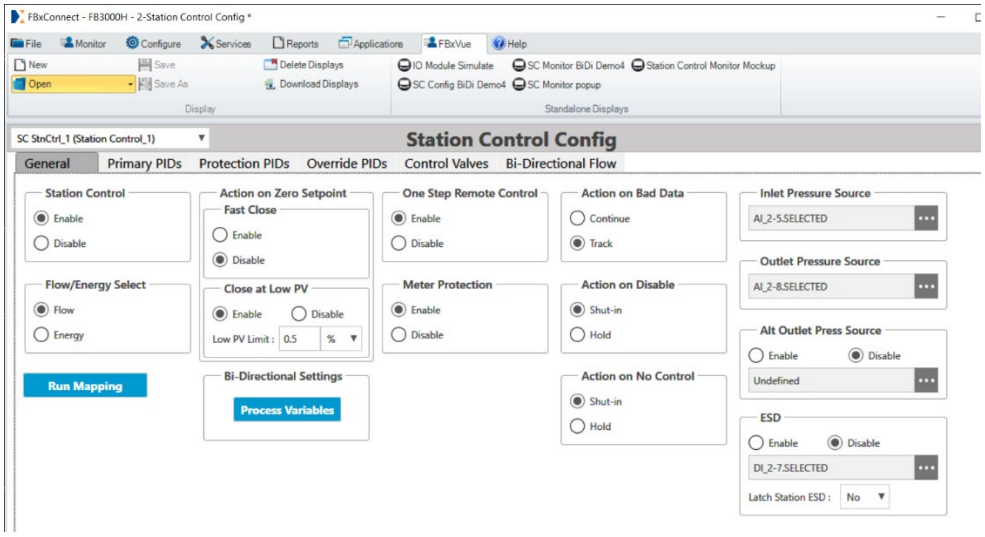


Figure 6-2. Selecting the Station



The General tab defines certain parameters that apply to the entire station.

Figure 6-3. Station Control Config tab



You can update the data on the tab by clicking **Refresh** and save your edits by clicking **Save**.

Station Control

Enable Click to activate the station control functions for this station.

Disable Click **Disable** to turn off the station control functions for this station. You should leave station control disabled until you have fully configured the Station Control application.

Flow/Energy Select

A station can control either flow or energy; they are mutually exclusive.

Flow Choose if this station runs a **Flow** control loop.

Energy Choose if this station runs an **Energy** control loop.

Action on Zero Setpoint

Note: Fast Close and Close at Low PV are mutually exclusive choices; you can only enable one of these at any given time.

Fast Close

Click **Enable** to allow this station to shut valves quickly (Fast Close) when the setpoint is 0%.

Click **Disable** to prevent Fast Close.

Close at Low PV

If you choose **Enable**, when the process variable for this station falls below a certain user-defined value or percentage, close valves. Valves close more gradually than with the Fast Close option.

Choose **Disable** to turn off the close at low PV option.

Low PV Limit

If **Close at Low PV** is enabled, select **"%"** to set a percentage, or "**UNITS**" to enter a value. Enter the percentage or value in the **Low PV Limit** field.

One Step Remote Control

Enable Valves operate by a single Execute signal.

Disable Valves operate in ARM and Execute mode. This means an ARM signal comes on for 5 seconds, and an Execute signal must turn on within that same 5 second period to actuate the valve; otherwise, both ARM and execute signals turn off.

Meter Protection

Enable Activate meter protection PIDs for out-of-range process values.

Disable De-activates meter protection PIDs.

Action on Bad Data

Continue When questionable data is detected on a PID control, FBxStation Control continues using the questionable data for that PID control.

Track When questionable data is detected, FBxStation Control disables the relevant loop.

Action on Disable

Specifies action to take when Station Control is disabled.

Shutin If Station Control is disabled, the station is shut in; all valves are closed.

Hold If Station Control is disabled, all valves are left in their current position.

Action on No Control

When all primary loops are disabled, or tracking is active because the Qbit is TRUE (questionable data), this specifies the action to take.

Shutin If all primary loops are disabled or tracking active, the station is shut in; all valves are closed.

Hold If all primary loops are disabled or tracking active, all valves are left in their current position.

Alt Outlet Pressure Source

Enable If you want to specify an alternate outlet pressure source to use if there is a problem with the standard outlet pressure source, select this and then click the point picker ··· to specify the parameter which represents the alternate outlet pressure source value.

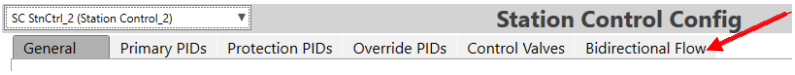
Disable There is no alternate outlet pressure source.

Run Mapping Click this button to map meter runs.

BiDi Mode This option is only shown for even-numbered stations.

Forward This is the default – no bi-directional flow.

Reverse This allows for bi-directional control for this pair of stations. Once you select this, FBxStation Control makes the Bi-Directional Flow tab visible.

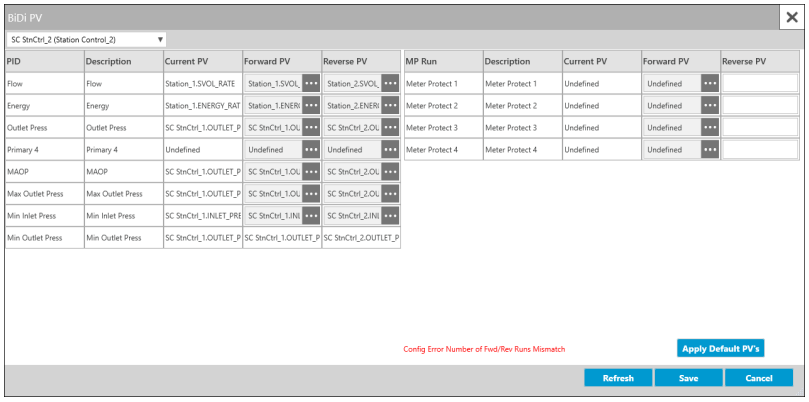


Bi-Directional Settings

Process Variables

When in bi-directional control mode, the point picker buttons on the PID loop pages are disabled. Click the Process Variables button to select the process variables used in bi-directional control.

Figure 6-4. BiDi PVs



PID Shows the name of the loop.

Description Shows a short description for the loop.

Current PV Shows the current process variable monitored by this loop.

Forward PV Click the point picker ··· to specify the process variable that applies for this loop when bi-directional control operates in the forward flow direction.

Reverse PV Click the point picker ··· to specify the process variable that applies for this loop when bi-directional control operates in the reverse flow direction.

MP Run Shows the name of the Meter Protection run.

Description Shows a short description of the meter protection run.

Current PV Shows the current process variable monitored by this meter protection run.

Forward PV Click the point picker ··· to specify the process variable that applies for this meter protection

	run when bi-directional control operates in the forward flow direction.
Reverse PV	Click the point picker ··· to specify the process variable that applies for this meter protection run when bi-directional control operates in the reverse flow direction.
Apply Default PVs	If you decide you want to restore the default process variables for the loops, instead of any pVs you picked with the point picker, click **Apply Default PVs.**

ESD

Enable	Emergency Shut Down (ESD) closes all valves for a station (called a “shut-in”) when FBxStation Control receives notification of an emergency condition.
Disable	Emergency Shut Down (ESD) function is disabled.
ESD Point	When enabled, Emergency Shut Down (ESD) closes all valves for a station when FBxStation Control receives notification of an emergency condition. Use the point picker ··· to specify the parameter which reports the emergency condition.
Latch Station ESD	When set to Yes – The station remains shut even when the ESD condition clears. You must manually reset the ESD condition using the Reset ESD button on the monitor screen to allow operation of the station to resume. When set to No – The station operation resumes when the ESD condition clears.
Inlet Pressure Source	Click the point picker ··· to specify the parameter which represents the inlet pressure source value.
Outlet Pressure Source	Click the point picker ··· to specify the parameter which represents the outlet pressure source value.

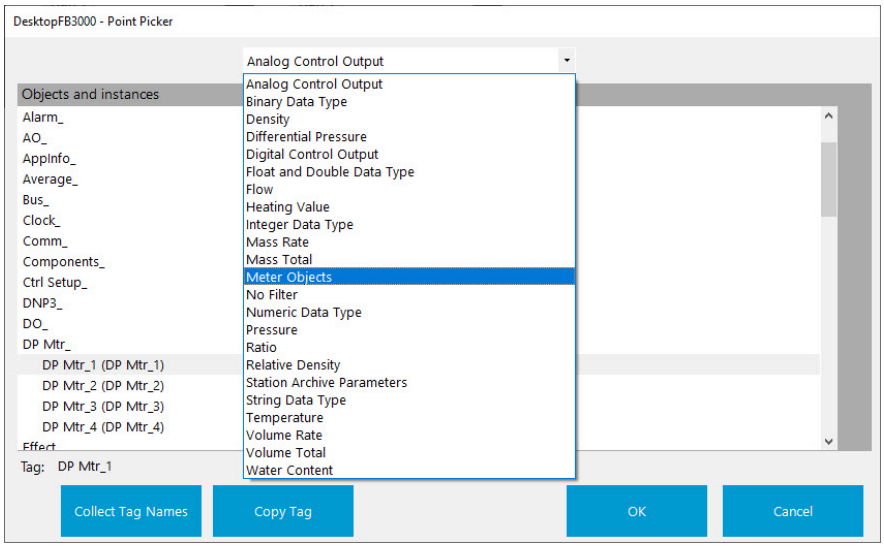
Note
When using bi-directional flow control, you must specify an inlet pressure source and outlet pressure source for both the forward and reverse stations.

6.1 Working with the Point Picker

FBxStation Control has the same point picker button available in FBxConnect. Many fields are already populated with default parameters. Unless you have a specific reason to use something other than default, you should accept the default. If there is no default specified, or you want to replace the default specified with something else, click the point picker ⋯.

In the Point Picker, use the filter menu to select the object or instance, for example, **Meter Objects**.

Figure 6-5. Selecting the Type of Objects in the Point Picker

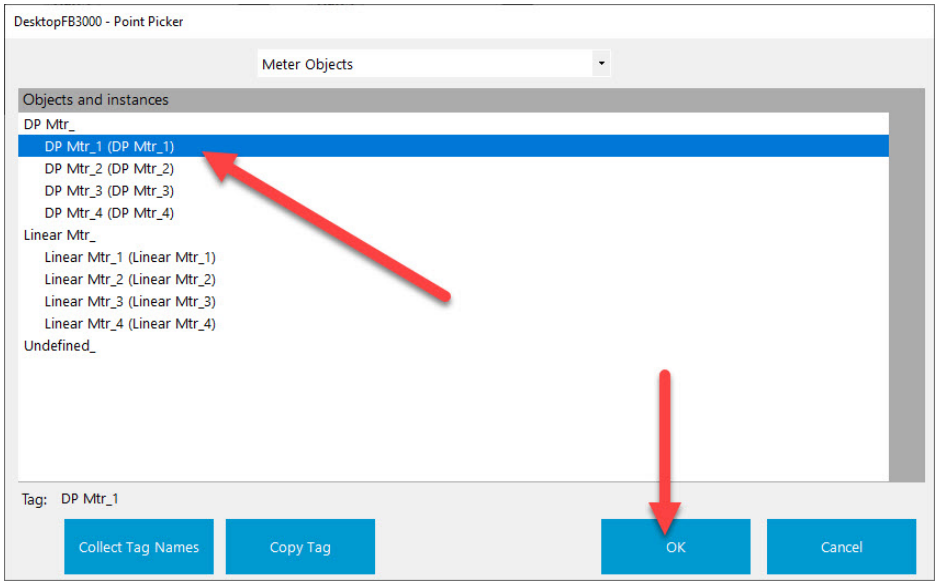


Now click the **Collect Tag Names** button.

The Point Picker searches for all the object's tag names and displays them in the Objects and Instances pane.

Select the name of the parameter you want for this field and click **OK**.

Figure 6-6. Selecting the Object



Chapter 7. Station Control Config - PID tabs

Proportional, Integral, and Derivative (PID) control loops compare the value of a process variable (PV) to a pre-defined setpoint (SP) which is the desired new value for that process variable. To reach that desired value, the control output of the PID, manipulates another variable called the variable (MV) to minimize the error – the difference between the PV value and SP value. For example, to increase a flow rate to its desired setpoint, a valve is opened a certain percentage thereby increasing the flow, until the desired setpoint is reached; in that example, the valve position is the MV and the flow rate is the PV.

FBxStation Control supports primary PIDs, Protection PIDs, and Override PIDs.

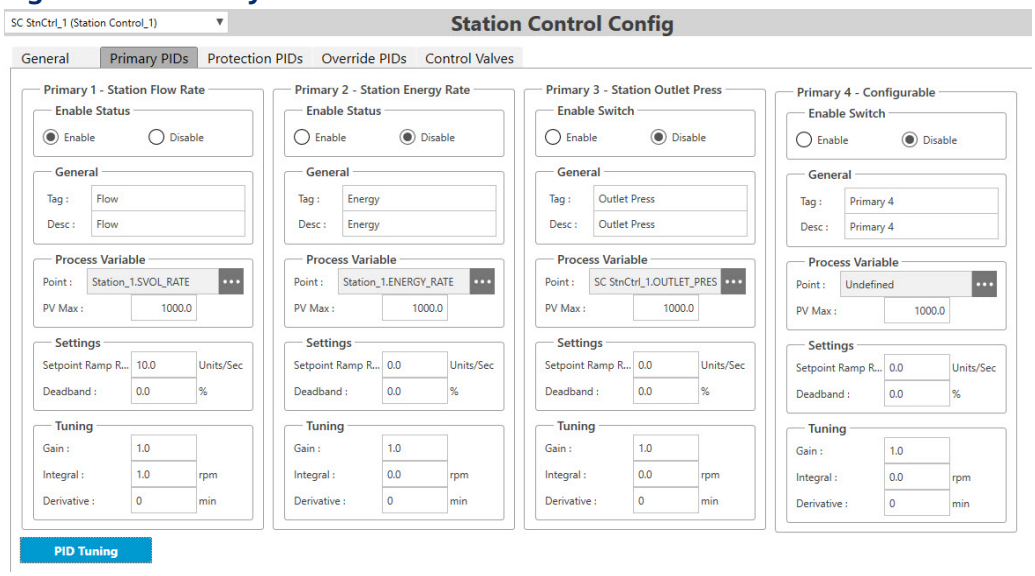
On any screen, you can update the data on the tab by clicking **Refresh** and save your edits by clicking **Save**.

7.1 Primary PIDs

There are four primary PIDs per station – three for specific process variables (station flow rate, station energy rate, and station outlet pressure) and the fourth you can configure for the process variable of your choice, it has no default PV. Click the **Primary PID**s tab in Station Config to configure these.

Note: Flow rate and energy rate are mutually exclusive; you can only choose one or the other for a particular station at a given time.

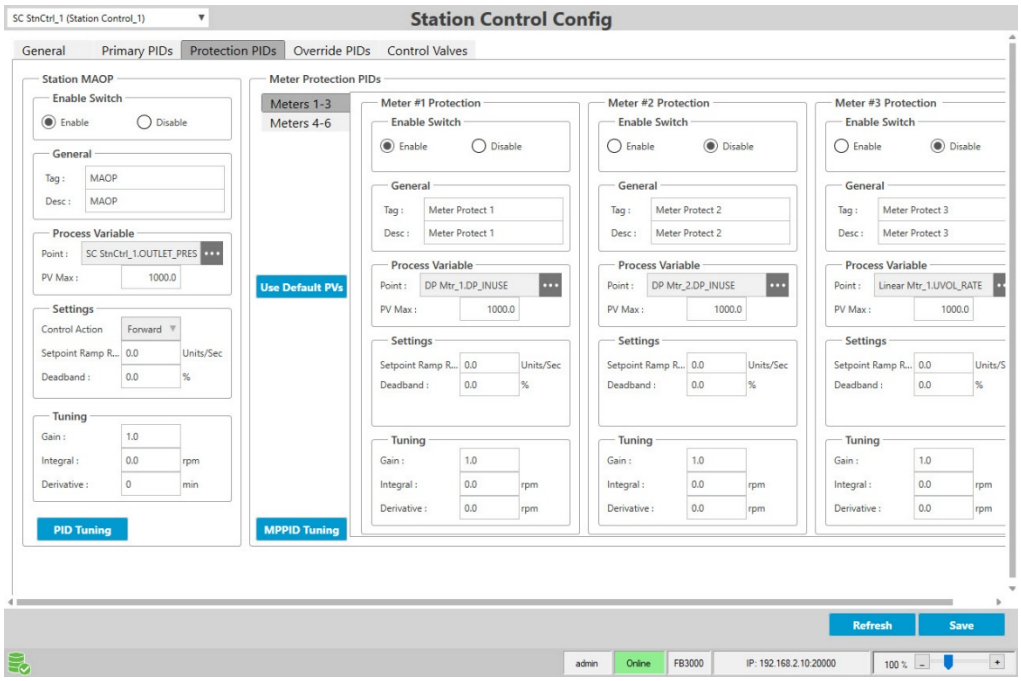
Figure 7-1. Primary PIDs tab



7.2 Protection PIDs

Protection PIDs only activate when the setpoint of the PV is exceeded. The Station MAOP PID has highest priority, then the protection PIDs. The primary PID resumes control when the process variable returns to the acceptable range (at or below the setpoint). Click the **Protection PIDs** tab in Station Control Config to configure these.

Figure 7-2. Protection PIDs tab

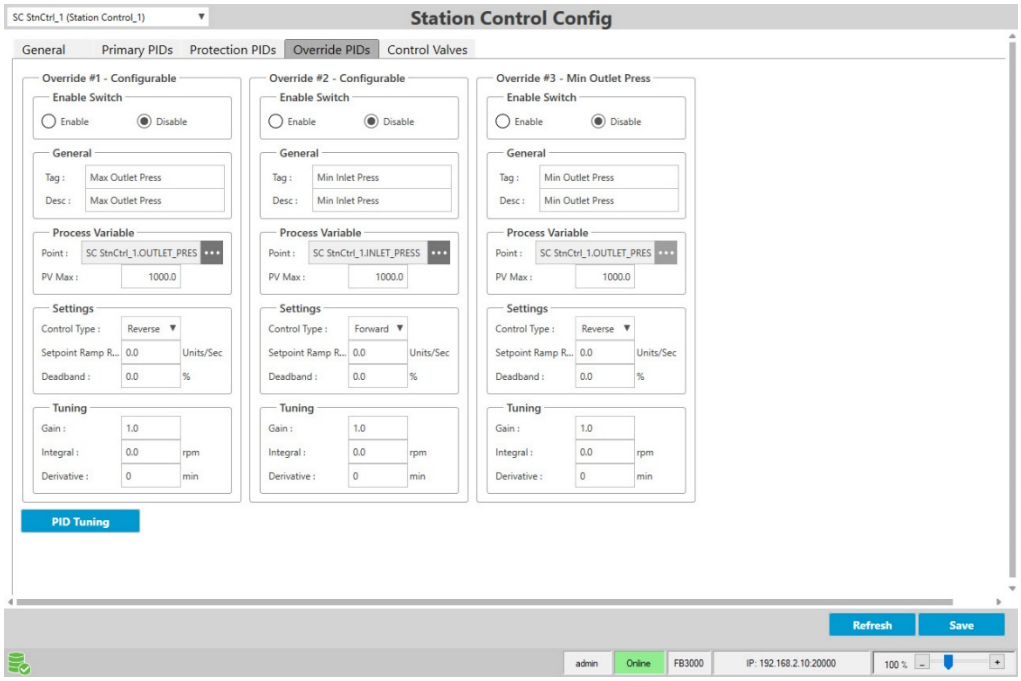


7.3 Override PIDs

Like meter protection PIDs, if the PV in a primary PID exceeds the setpoint, an override PID takes control until the PV comes back into normal operating range. Once back in normal operating range, the primary PID resumes control. Click the **Override PIDs** tab in Station Control Config to configure these.

Override 1 and 2 default to inlet and outlet pressure, respectively, but you can change them.

Figure 7-3. Override PIDs



7.4 PID Control Parameters

Unless otherwise noted, all these parameters apply to Primary PIDs, Protection PIDs, and Override PIDs.

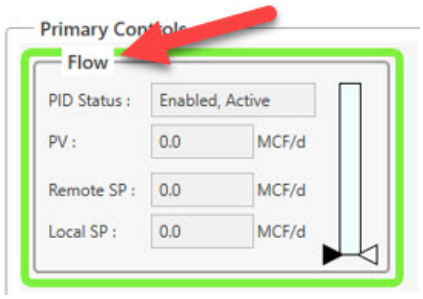
<u>Enable Status / Enable Switch</u>

Enable Click to activate this PID loop.

Disable Click to de-activate this PID loop.

<u>General</u>

Tag A name used on the monitor screen to identify the control box for the loop, such as “Flow” shown, below.



Desc A description for the loop also shown on the overview screen.

Process Variable

Point The AI point used as the process value for the PID. Click the point picker button ··· to select the AI point.

PV Max The maximum value for the process value.

Settings

Control Action (MAOP PID on Protection PIDs tab only)

Note: This setting is only available on specific PIDs such as MAOP and the Override PIDs 1, 2, and 3.

Important: Exercise care when selecting the proper control action. The choice of setting depends on the relationship of the selected process variable to the control action of the output device, typically a station valve. For example, if Override 1's default PV is Station Outlet Pressure and the loop will be limiting the outlet pressure to some maximum value, reverse control action is required to reduce the control output and close the station valve when PV exceeds setpoint (SP). If the control action is erroneously set to Forward, the control action causes the station valve to open further, resulting in increased outlet pressure.

Forward When the control action is set to Forward, the PID output increases when the assigned PV value exceeds setpoint (SP).

Reverse When set to Reverse, the output decreases when the PV value exceeds setpoint (SP).

Setpoint Ramp Rate The rate at which a change in setpoint should be applied to the loop.

Deadband A calculated loop output which does not vary by more than the percent specified here will not change the output.

Tuning

Gain The proportional gain which determines the amount of output change produced by a change of error.

Integral Integral establishes the reset rate in "repeats per minute" for the loop.

Derivative Derivative establishes a scale factor to determine how much the rate-of-change of the manipulated variable (MV, not error) affects the function block output. The numerical entry for this parameter represents the amount of rate correction in minutes.

Use Default PVs Click this button on the Protection PIDs tab if you want to use the default process variables FBxStation Control uses for protection PIDs. For orifice meters, the default is DP; for linear meters, the default is uncorrected flow rate. If you do **not** want to use the defaults, select the variables yourself using the point picker.

7.5 PID Tuning

Click **PID Tuning** or **MPPID Tuning** to bring up the tuning screen.

Figure 7-4. PID Tuning Screen

Enable Switch

Enable Click to activate this PID loop.

Disable Click to de-activate this PID loop.

General

Tag A name used on the overview screen to identify the control box for the loop.

Desc	A description shown on the control box for the loop.

Process Variable

Point	The AI point used as the process value for the PID. Click the point picker button ··· to select the AI point.
Max Value	The maximum value for the process value.

Settings

Direction	Set to either Low or High.
Setpoint Ramp Rate	The rate at which a change in setpoint should be applied to the loop.
Output Deadband	A calculated loop output which does not vary by more than the percent specified here will not change the output.

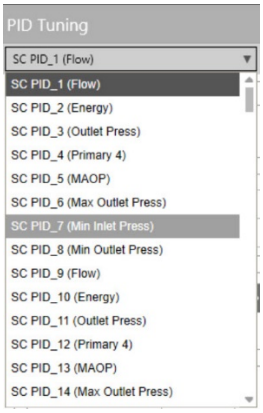
Tuning

Gain	The proportional gain which determines the amount of output change produced by a change of error.
Integral	Integral establishes the reset rate in “repeats per minute” for the loop.
Derivative	Derivative establishes a scale factor to determine how much the rate-of-change of the process variable (not error) affects the function block output. The numerical entry for this parameter represents the amount of rate correction in minutes.

7.5.1 Loop Tuning Procedure

This PID tuning procedure presents one possible approach. Consult books or online resources on PID tuning if necessary.

1.To begin, select the desired PID loop from the drop-down menu.



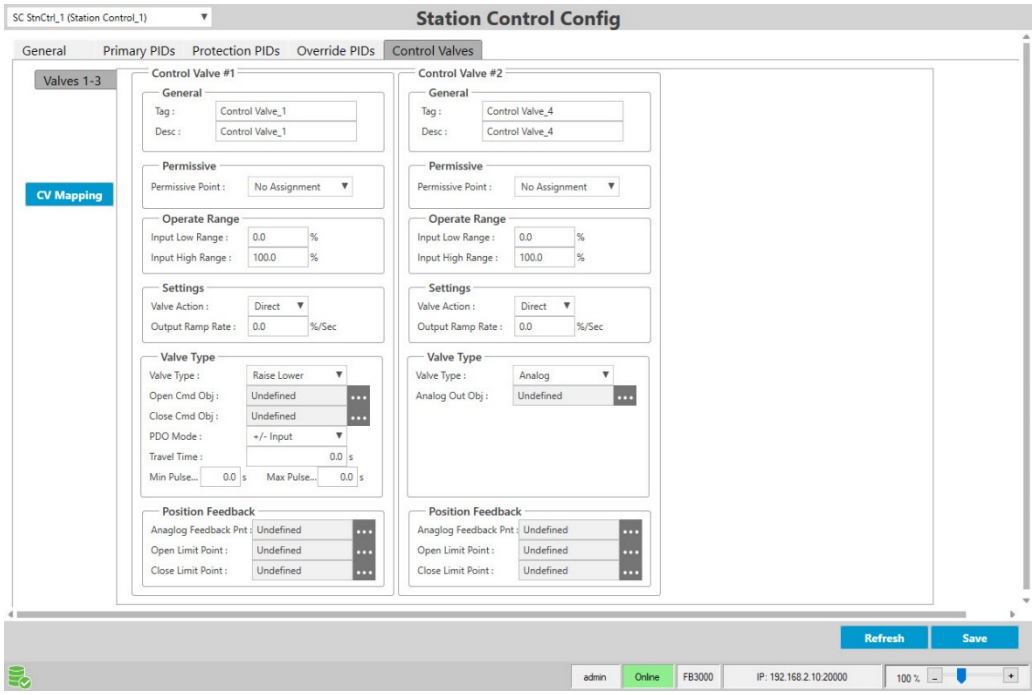
2. In the **Max Value** field, specify the maximum possible value that could ever be measured for the process variable in this loop. For example, this might be the span of the transmitter, or the maximum possible flow through this station.
3. Specify a **Setpoint Ramp Rate** in units/second to indicate how quickly a change in setpoint should be applied. If you leave at zero, changes are applied immediately – without any ramping.
4. Set initial values for **Gain, Integral,** and **Derivative**. One way to determine these is to use the Ziegler/Nichols method. Consult resources as needed.
5. Set **Output Deadband** to define a range above and below the output within which a fluctuation in the calculated output will not result in a change in the actual output.
6. Enable the loop.
7. While monitoring the trend window, make small incremental changes to the setpoint, and observe how it affects the PV. Adjust **Gain, Integral,** and **Derivative** as needed to achieve smooth, stable control.

Chapter 8. Station Control Config - Control Valves Tab

Click the **Control Valves** tab in Station Control Config to configure these, then select the valves you want to configure.

You can update the data on the tab by clicking **Refresh** and save your edits by clicking **Save**.

Figure 8-1. Station Config – Control Valves tab



General

Tag — A tag name used as a label for the box on the overview screen associated with the valve.

Desc — A description for the valve also appearing in the box on the overview screen.

Permissive

Permissive Point — Associate the control valve with a particular tube staging meter run. The valve only operates when that meter run is open.

Operate Range	Defines the normal operating range for the valve. If there are multiple valves associated with the station, you might choose to split the ranges so certain valves cover a certain range.
Input Low range	Defines the lowest percent open the valve should be to remain in the normal operating range. You can set the **Input Low Range** to a negative value so the valve operates over a shorter range.
Input High range	Defines the highest percent open the valve should be to remain in the normal operating range.
Settings	
Valve Action	Set to either Direct for direct action or Indirect for indirect action. Direct action increases the valve output as the input increases. Indirect action decreases the valve output as the input increases.
Output Ramp Rate	The rate at which a change in setpoint should be applied to the valve as a percentage of valve travel per second.
Valve Type	
Valve Type	Choose Analog if the valve has analog position feedback or Raise Lower if the valve is pulsed and receives feedback from opened and closed limit switches.
Analog Out Obj	Click the point picker button ••• to select the analog output point which controls the valve.
Position Feedback	
Analog Feedback Point	Click the point picker button ••• to specify the analog input which reports the current position of the valve.
Open Limit Point	Click the point picker button ••• to specify the bool which reports the current position of the valve is totally open.

Close Limit Point

Click the point picker button ••• to specify the bool input which reports the current position of the valve is totally closed.

CV Mapping

Click here to call up the Control Valve (CV) Mapping screen.

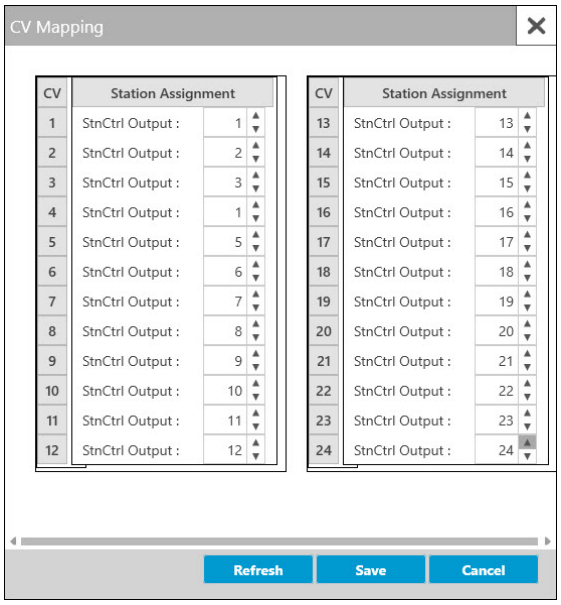
8.1 Control Valve Mapping

You can map a valve to any station, but the valve can only be mapped to one station at a time. You can also map multiple valves to one station which allows you to split the ranges at which valves operate.

To assign a valve to a station:

1. Choose the valve (based on its number in the CV column).
2. Type in the number of the station (or use the arrows to adjust the number).
3. If you want to assign additional valves to particular stations, repeat steps 1 and 2 for each valve.
4. Click **Save** to store the valve/station assignments.

Figure 8-2. Control Valve (CV) Mapping

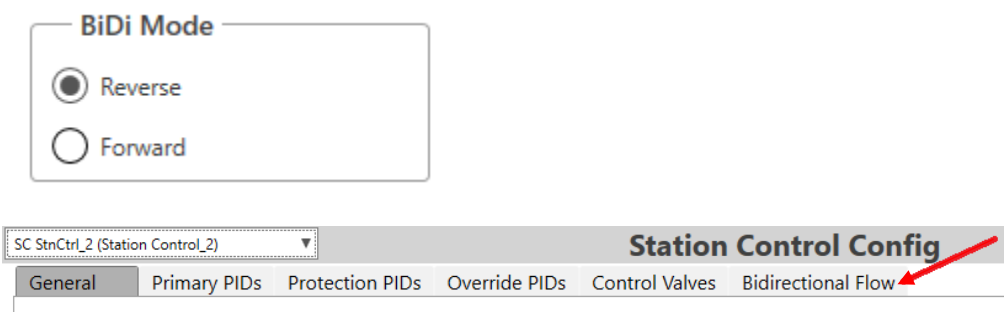


Chapter 9. Station Control Config – Bi-Directional Flow Tab

By default, flow through the pipeline travels in a single direction. Bi-directional flow allows the flow of gas through a single pipeline to change its direction from forward-to-reverse or reverse-to-forward. To use bi-directional flow, you must configure a pair of consecutively numbered stations for the same pipeline – the first (odd-numbered) station handles forward flow, the second (even-numbered) station handles reverse flow.

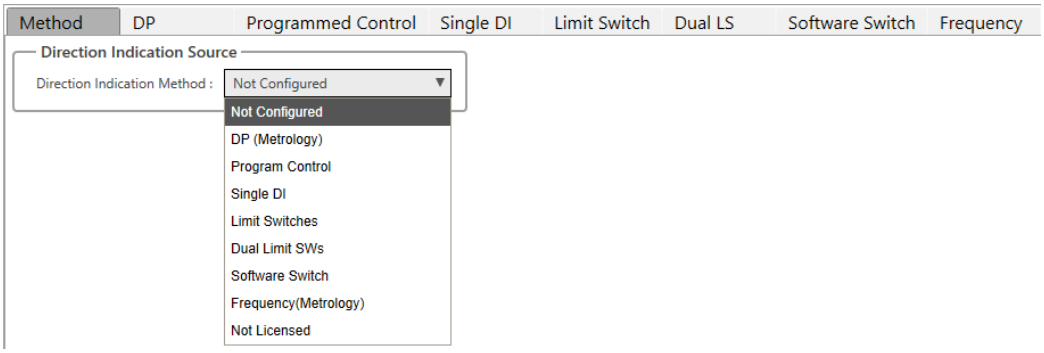
Station Control only displays the **Bi-directional Flow** tab if you select **Reverse** as the **BiDi Mode** on the **Station Control Config – General tab** for the second station (even-numbered station) in a pair of consecutively numbered stations.

Figure 9-1. Selecting the BiDi Mode on the General Tab



When configuring the even-numbered station, you must select the indication method for bi-directional control. **This choice determines what variable causes a direction change.**

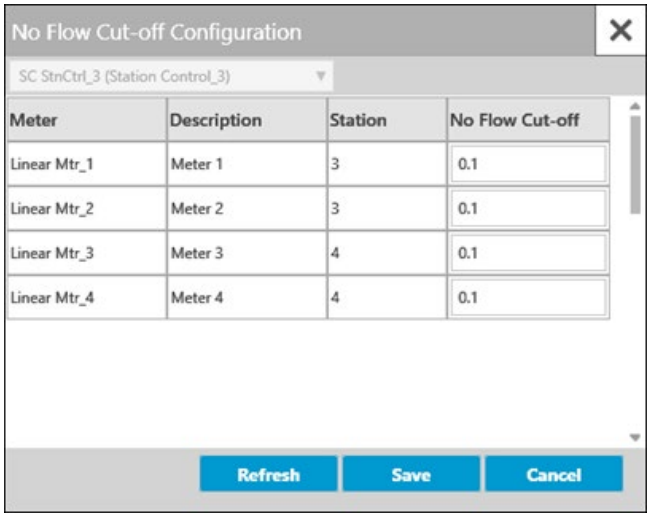
Figure 9-2. Choosing the Direction Indication Method



The Programmed Control, Single DI, Software Switch, Limit Switches, and Dual Limit Switches direction indication methods include a **Flow Cut-off Config** button Flow Cut-off Config which opens a pop-up screen in which you can specify a no flow cutoff

value for a meter. This overrides any cutoff specified in the DP/Linear meter setup in FBxConnect. Simply enter the value below which flow should be stopped in the **No Flow Cut-off** field and click **Save**.

Figure 9-3. No Flow Cut-off



Note

The no flow cut-off does not apply to the DP and frequency indication methods which use the cutoff specified in the DP/Linear meter setup in FBxConnect.

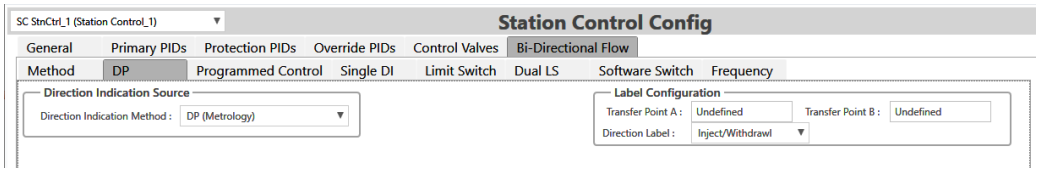
On any screen, you can update the data on the tab by clicking **Refresh** and save your edits by clicking **Save**.

The sections that follow cover the various indication methods.

9.1 DP (Metrology)

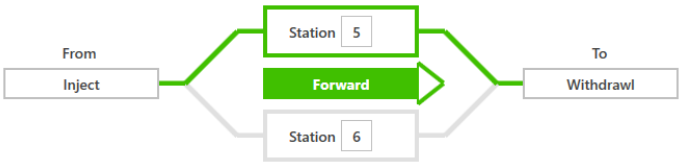
When you choose DP (differential pressure), the value of differential pressure, as determined by the standard firmware functionality in the RTU (standard metrology), determines whether flow direction for this station should be forward or reverse.

Figure 9-4. Bi-Directional Control - DP



Label Configuration

Figure 9-5. Transfer Point Labels

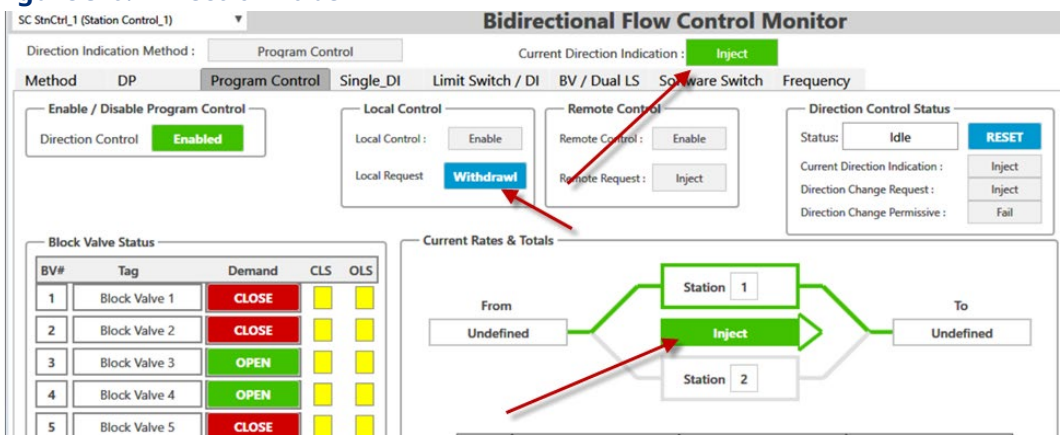


Transfer Point A Specify the text that appears in the Bi-Directional Monitor display on the **left** of the direction graphic in the Current Rate & Totals.

Transfer Point B Specify the text that appears in the Bi-Directional Monitor display on the **right** of the direction graphic in the Current Rate & Totals.

Direction Label Normally, the terms “Forward” and “Reverse” show the direction in various places on FBxStation Control displays. Optionally, you can use this drop-down to select alternate pairs to use instead of Forward/Reverse. Among the choices are “Inject/Withdrawl” and “Delivery/Receipt.”

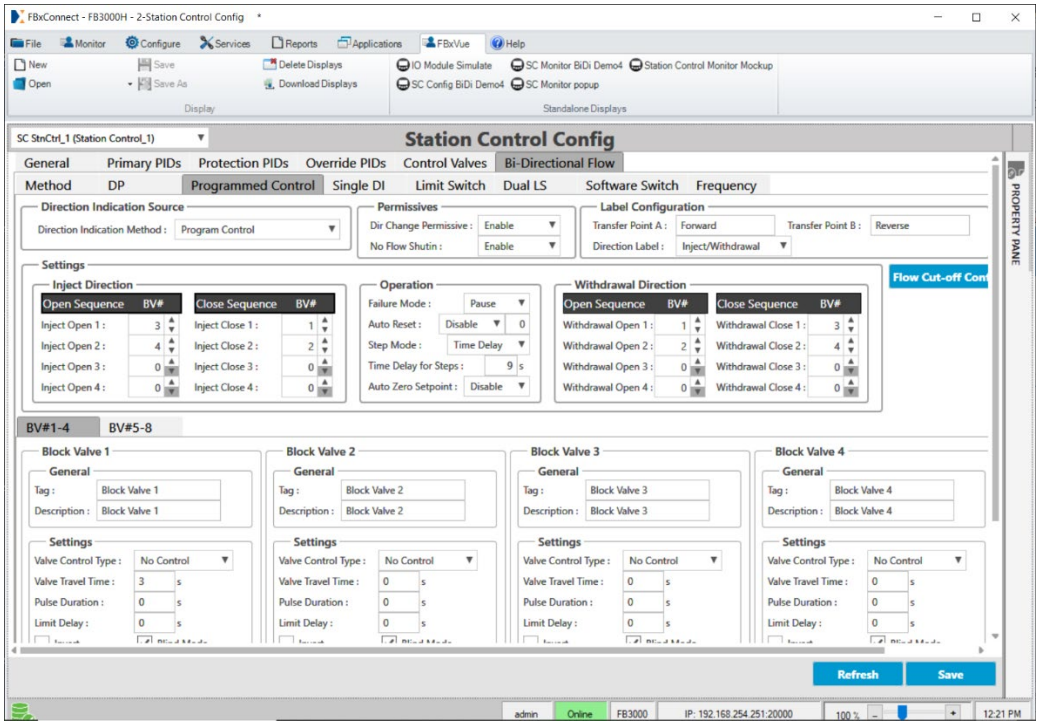
Figure 9-6. Direction Label



9.2 Programmed Control

When you choose **Programmed Control,** FBxStation Control manipulates up to 8 block valves in a predefined sequence to change the direction of flow for the station.

Figure 9-7. Bi-Directional Control – Programmed Control



Permissive

Either the **Fast Close** or **Close at Low PV** option has to be **Enabled** to use a permissive.

Dir Change Permissive

Choose either:

Enabled

FBxStation Control checks that conditions are valid for the chosen permissive before changing flow direction. Valid conditions are:

Permissive:	**Valid Condition:**
Fast Close	Zero setpoint entered for primary loop.
Close at Low PV	Zero setpoint entered for primary loop and the PV for the primary loop must be below the value configured for the **Close at Low PV** option.

Disabled

FBxStation Control can change direction without checking for valid conditions.

No Flow Shutin Choose either:

Enabled When enabled, if there is no flow for this station, FBxStation Control closes the bi-direction block valves for this station. Enabling **No Flow Shutin** also enables the **Close at Low PV** option if it or the **Fast Close** option are not enabled. **Close at Low PV** and **Fast Close** are configured on the Station Control Config – General tab.

Disabled A no flow indication does not trigger FBxControl to close bi-direction block valves for this station.

Label Configuration See *Section 9.1*.

Settings

Forward label **Direction**

Open Sequence BV# Choose the order in which specific block valves should be opened in sequence to establish forward flow for this station. Selecting **1** means block valve 1 (BV#1) opens at this step in the sequence; selecting **2** means block valve 2 (BV#2) opens at this step in the sequence, and so on.

Close Sequence BV# Choose the order in which specific block valves should be closed in sequence to establish forward flow for this station. Selecting **1** means block valve 1 (BV#1) closes at this step in the sequence; selecting **2** means block valve 2 (BV#2) closes at this step in the sequence, and so on.

Operation

Failure Mode Choose one of the following actions to occur during a failure of a valve to reach the demanded state within the specified travel time for the valve.

	Revert	FBxStation Control attempts to return to the previous state in the event of a failure. When commanding the station from the forward-to-reverse direction, if a failure occurs, FBxStation Control commands the valves go back to the **Forward** positions. When commanding the station from the reverse-to-forward direction, if a failure occurs, FBxStation Control commands the valves go back to the **Reverse** positions.
	ESD All	ESD (Emergency Shut Down) forces the station to shut-in (close all valves) in the event of a failure. When this happens, all valves close simultaneously.
	ESD Step	ESD Step forces the station to shut-in based on the **Step Mode**. If **Step Mode** is **Time Delay**, valves close one at a time in sequence based on the **Time Delay for Steps** value. If **Step Mode** is **Limit Switches**, valves close one at a time in sequence when the limit switch for the current valve reports closed, or the valve fails.
	Pause	FBxStation control halts the valve sequence to allow the failed valve indication to be rectified, and then resumes the sequence.
Auto Reset	Only available if the **Failure Mode** is **Pause**. When enabled, attempts to automatically reset an error, as if the reset button was clicked. Specify the maximum number of reset attempts FBxStation Control should make in the box next to the Enabled/Disable selection. If the maximum number of attempts is set to 0, there	

is no limit on the number of reset attempts, and reset attempts continue indefinitely.

Step Mode

There are two possible step modes:

Time Delay	In this mode, FBxConnect commands the next valve in sequence based on the **Time Delay for Steps** setting.
Limit Switches	In this mode, when the Opened or Closed limit switch for the active valve triggers, or if there is a valve failure, the application moves to operate the next valve in sequence.

Time Delay for Steps

Note: This field is not visible if Step Mode is set to Limit Switches.

Specify the amount of time, in seconds, between valve actions. If you set this to 0, FBxConnect commands the next valve in the sequence to operate immediately after the current valve command is done being issued. If it is necessary to wait until one valve is done operating before operating the next valve in the sequence, set **Time Delay for Steps** to a value that is greater than the travel time of the valve.

Auto-Zero Setpoint

When enabled, automatically sets the Station Control setpoint to zero to shut the station in to allow for a direction change. Enabling this also enables the **Dir Change Permissive** and **Close at Low PV** options. **Close at Low PV** is configured on the Station Control Config – General tab.

Reverse label **Direction**

Open Sequence BV# Choose the order in which specific block valves should be opened in sequence to establish reverse flow for this station. Selecting **1** means block valve 1 (BV#1) opens at this step in the sequence; selecting **2** means block valve 2 (BV#2) opens at this step in the sequence, and so on.

Close Sequence BV# Choose the order in which specific block valves should be closed in sequence to establish reverse flow for this station. Selecting **1** means block valve 1 (BV#1) closes at this step in the sequence; selecting **2** means block valve 2 (BV#2) closes at this step in the sequence, and so on.

BV# Click the tab for the group of four block valves you want to view.

Block Valve *n* Up to 8 block valves (BV) can be configured for each station.

General

Tag Optionally specify a name for the block valve here.

Description Optionally enter a description for the block valve here.

Settings

Valve Control Type Each block valve may be configured for one of three control types. The settings for each block valve may be made independently of the other block valves. The **Valve Control Type** selection may be one of the following:

No Control	FBxStation Control has no control of the valve.
Single Maintained Output	Choose this option when a single output energizes to change the position of the valve. When this is selected, only configure the Open

		Cmd Object 1, and optionally, the Open Cmd Object 2 items.
	Dual Maintained Outputs	Choose this option when there are two outputs, one to open the valve, and the other to close the valve, and these outputs should be maintained, even after the appropriate limit switch indicates that the valve is in the demanded position.
	Dual Pulsed Outputs	Choose this option when there are two outputs, one to open the valve, and the other to close the valve, and these outputs should pulse until the appropriate limit switch indicates that the valve is in the demanded position. Use **Limit Delay** to maintain a pulse for some time after the limit switch triggers.
Valve Travel Time	Specify the amount of time, in seconds, it takes the valve to fully travel from the open-to-close or close-to-open position.	
Pulse Duration	Specify the amount of time to pulse the output. This setting only applies when **Control Type** is **Dual Pulsed Outputs**.	
Limit Delay	Specify the amount of time, in seconds, to maintain the output pulse after an opened or closed limit is indicated. This setting only applies when **Control Type** is **Dual Pulsed Outputs**.	
Invert	If you check this box, it changes the output to its opposite state when it is transmitted to the valve. An output in the state **OFF** becomes **ON;** an output in the state **ON** becomes **OFF**.	
Blind Mode	Check this box if there is no limit switch feedback provided by the valve.	

I/O

Open Output Obj Click the point picker ••• to choose the open output variable used to command the valve to open.

Close Output Obj Click the point picker ••• to choose the close output variable used to command the valve to close.

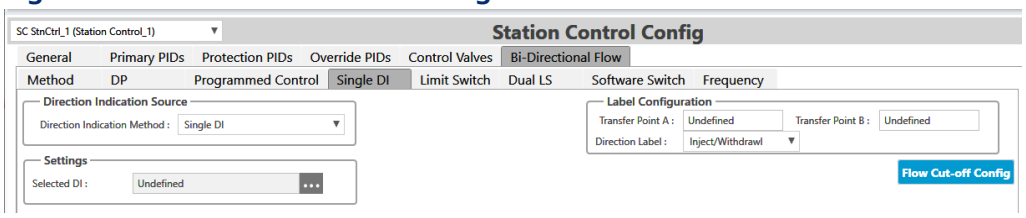
Open Limit SW Pnt Click the point picker ••• to choose the input which provides feedback that the valve is open.

Close Limit SW Pnt Click the point picker ••• to choose the input which provides feedback that the valve is closed.

9.3 Single DI

When you choose **Single DI,** FBxStation Control chooses flow direction for this station based on the state of a single digital input.

Figure 9-8. Bi-Directional Flow – Single DI



Settings

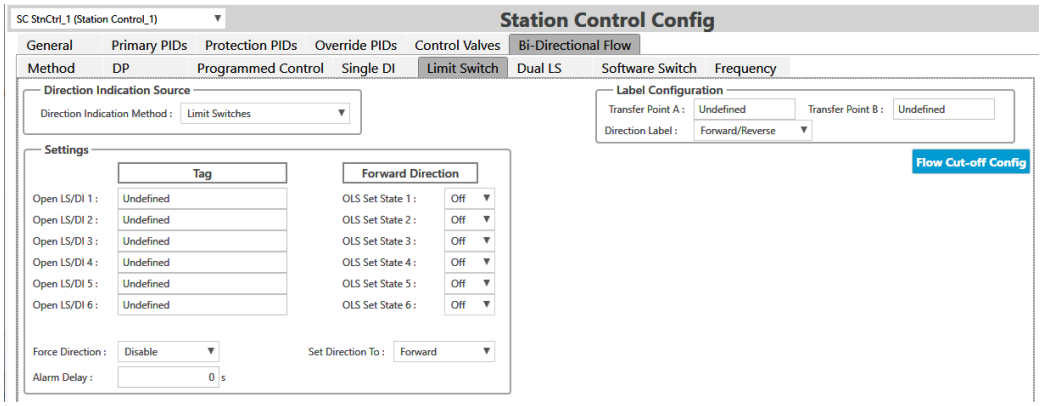
Selected DI Either use the default, or click the point picker ••• to choose the single digital input which determines the direction of flow for this station.

Label Configuration See *Section 9.1*.

9.4 Limit Switches

When you choose **Limit Switches**, you can configure up to six limit switches to specify the direction of flow for this station. This operates using a voting scheme. A direction change only occurs when a **majority** of the switches call for a change of direction.

Figure 9-9. Bi-Directional Control – Limit Switch



Settings

Open LS/DI *n*

Either use the default, or click the point picker ••• to choose a variable for this limit switch *n*.

OLS State Forward *n*

Select the state which indicates flow should be in the **forward** direction:

On If you choose this, it means that this limit switch should be in the **On** state when flow is in the forward direction.

Off If you choose this, it means that this limit switch should be in the **Off** state when flow is in the forward direction.

Force Direction

If enabled, no flow direction changes until the states of all limit switches agree. This is unlike a voting system. Until all limit switches agree, the direction remains at that chosen by **Set Direction To**.

Set Direction To

Determines the flow direction when the states of limit switches are not in agreement. Only operates when **Force Direction** is enabled.

Alarm Delay

If **Force Direction** is enabled and the states of all limits switches do not agree, this specifies a time (in seconds) after which an alarm is generated to indicate a discrepancy in the states of limit switches. Set to 0 to disable the alarm.

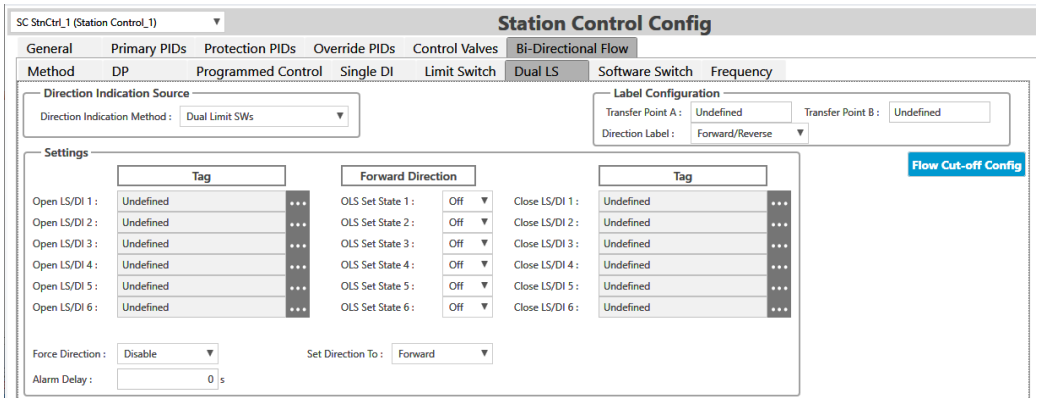
Label Configuration

See *Section 9.1*.

9.5 Dual Limit Switches

When you choose **Dual Limit Switches**, you can configure up to twelve limit switches to specify the direction of flow for this station; 6 open limit switches and 6 closed limit switches. This operates using a voting scheme. A direction change only occurs when a **majority** of the switches call for a change of direction.

Figure 9-10. Dual Limit Switches



Settings

Open LS/DI *n*

Either use the default, or click the point picker ••• to choose a variable for this limit switch *n*.

OLS State Forward *n*

Select the state which indicates flow should be in the **forward** direction:

On If you choose this, it means that this limit switch should be in the **On** state when flow is in the forward direction.

Off If you choose this, it means that this limit switch should be in the **Off** state when flow is in the forward direction.

Close LS/DI *n*

Either use the default, or click the point picker ••• to choose a variable for this limit switch *n*.

Force Direction

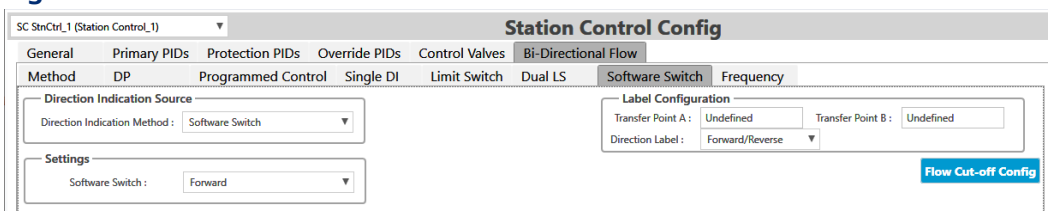
If enabled, no flow direction changes until the states of all limit switches agree. This is unlike a voting system. Until all limit switches agree, the direction remains at that chosen by **Set Direction To**.

Set Direction To	Determines the flow direction when the states of limit switches are not in agreement. Only operates when **Force Direction** is enabled.
Alarm Delay	If **Force Direction** is enabled and the states of all limits switches do not agree, this specifies a time (in seconds) after which an alarm is generated to indicate a discrepancy in the states of limit switches. Set to 0 to disable the alarm.
Label Configuration	See *Section 9.1*.

9.6 Software Switch

When you choose **Software Switch** the flow direction is determined by the state of a software switch. This is a variable either set locally, or by the SCADA system.

Figure 9-11. Bi-Directional Control – Software Switch



Settings

Software Switch If the state of the software switch is **Forward** (OFF) then flow through the station is in the forward direction.

If the state of the software switch is **Reverse** (ON), then flow through the station is in the reverse direction.

Label Configuration See *Section 9.1*.

9.7 Frequency (Metrology)

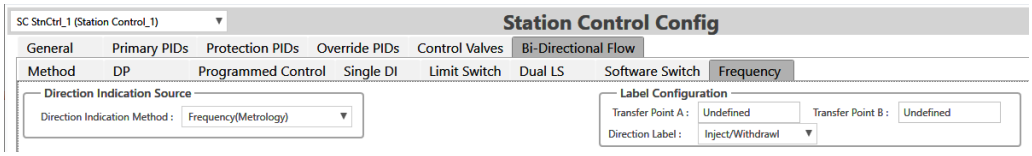
When you choose **Frequency Input**, the flow direction is determined by the value of the frequency provided by the standard firmware functionality in the FB3000 (standard metrology).

If the frequency on a forward run is above the cutoff, the direction is **Forward**.

If the frequency on a reverse run is above the cutoff, the direction is **Reverse**.

If there are multiple runs configured, and there is flow through more than one run, direction is determined by a voting scheme. Whatever the majority of the runs indicates determines the station direction. A tie results in unchanged results from the previous state.

Figure 9-12. Bi-Directional Control - Frequency



Label Configuration See *Section 9.1*.

9.8 Bi-Directional Flow Control Examples

The following examples show various scenarios for using bi-directional flow control:

9.8.1 Example 1: 2 Differential Pressure (DP) Meters With a Separate Transmitter for Forward and Reverse DP

Reminder

In FBxStation Control, forward flow stations are always odd-numbered and reverse flow stations are always even-numbered.

In this case, in FBxConnect, you would assign 2 DP meters to the forward station, and 2 DP meters to the reverse station. Each DP meter has its own I/O for DP. All DP meters share the same I/O for static pressure (SP) and flowing temperature (FT).

Figure 9-13. Assigning DP Meter 1 to Station 1 (Forward)

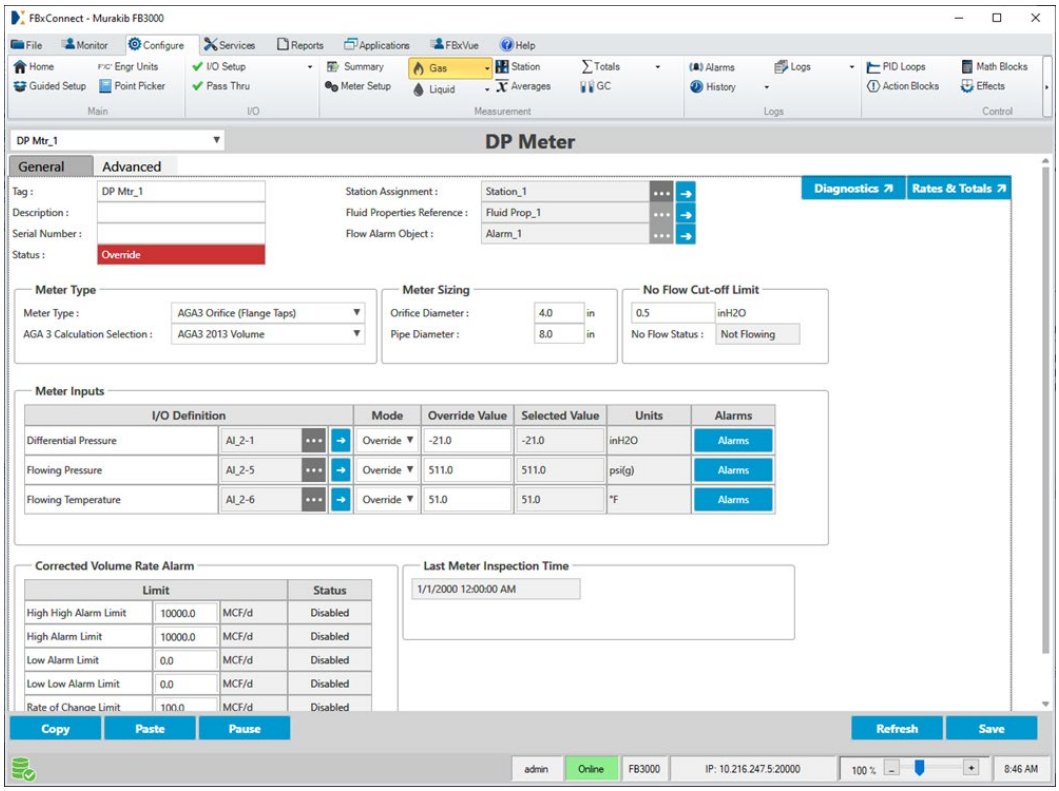


Figure 9-14. Assigning DP Meter 2 to Station 1 (Forward)

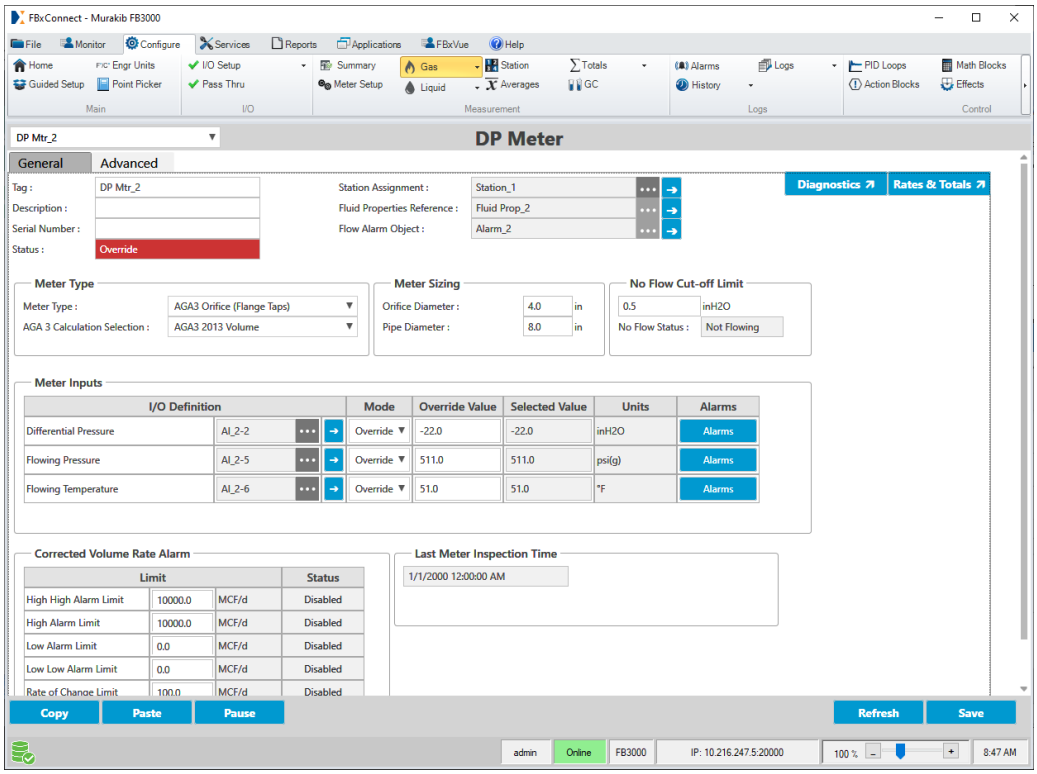


Figure 9-15. Assigning DP Meter 3 to Station 2 (Reverse)

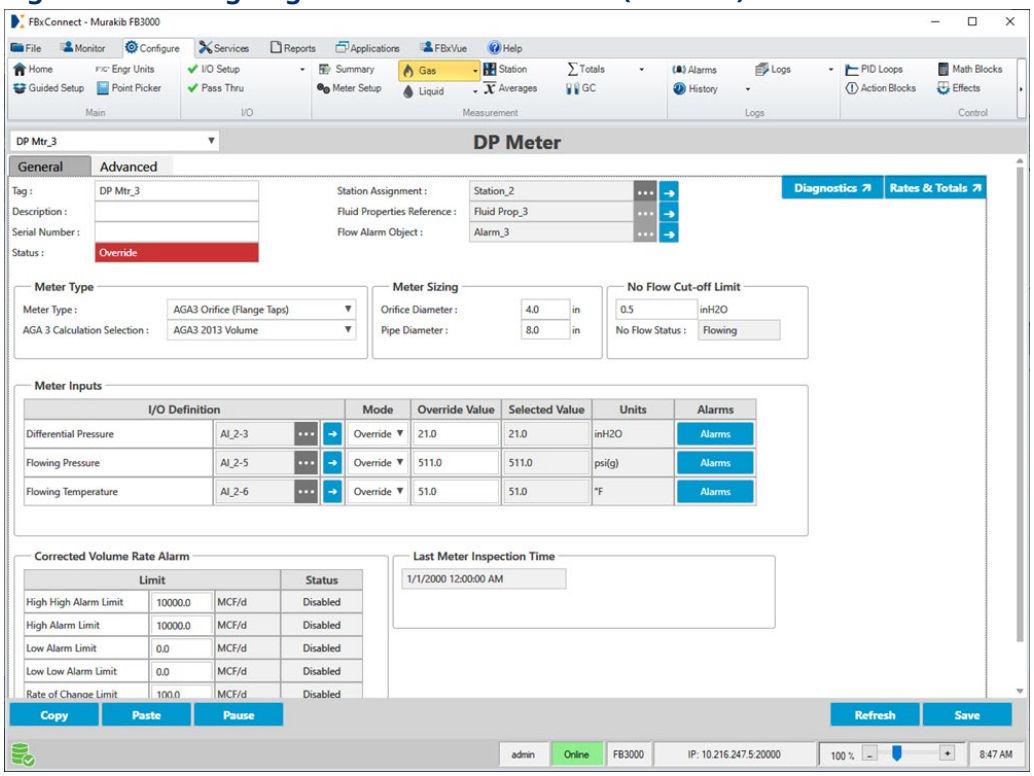
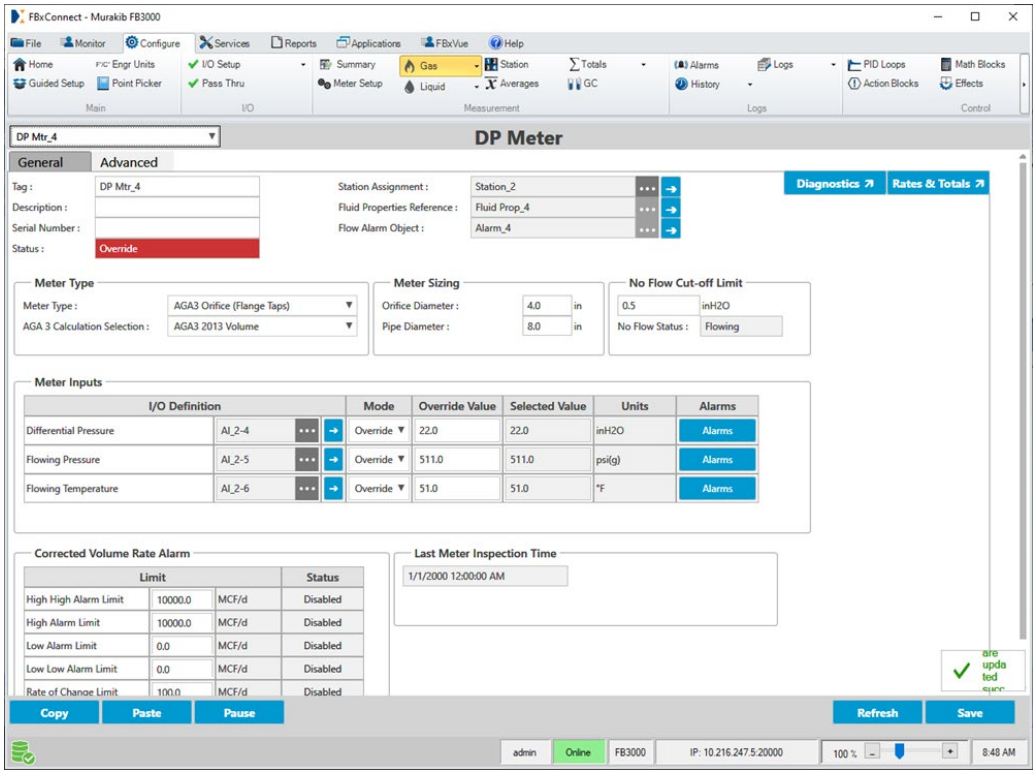


Figure 9-16. Assigning DP Meter 4 to Station 2 (Reverse)



The switch from forward flow to reverse flow occurs when the positive DP on DP Meters 1 and 2 switches to negative and the negative DP on DP meters 3 and 4 switches to positive.

On the monitor screen we see which DP meters are in use; if flow is below cut-off, it shows as 0.0 flow.

Figure 9-17. Station 1 Active (Forward Flow)

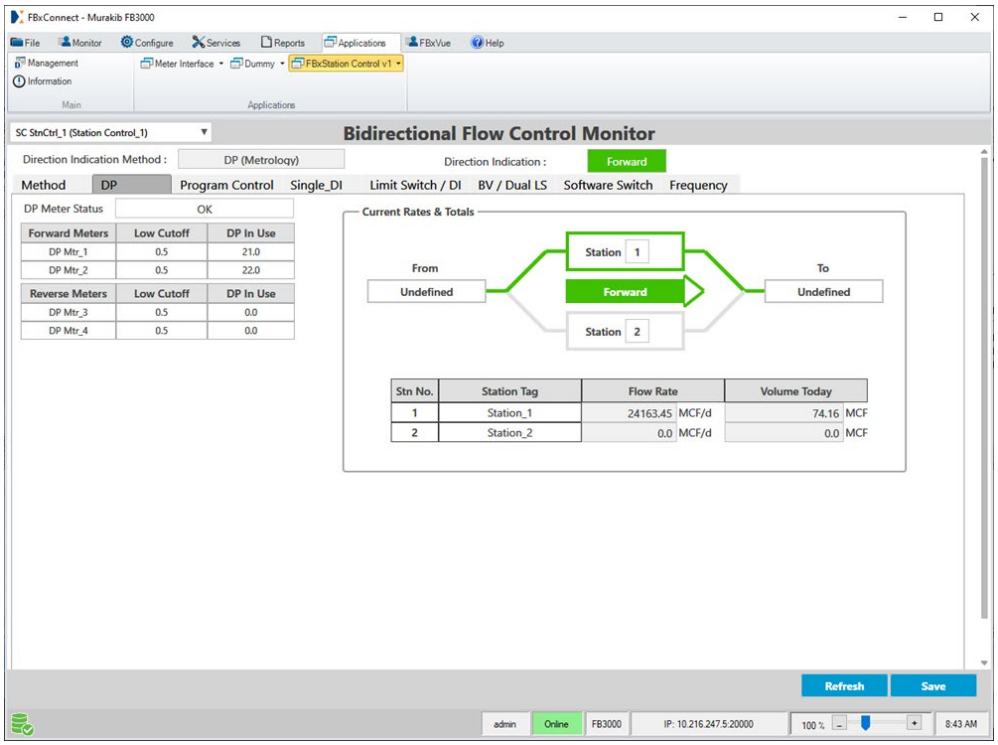
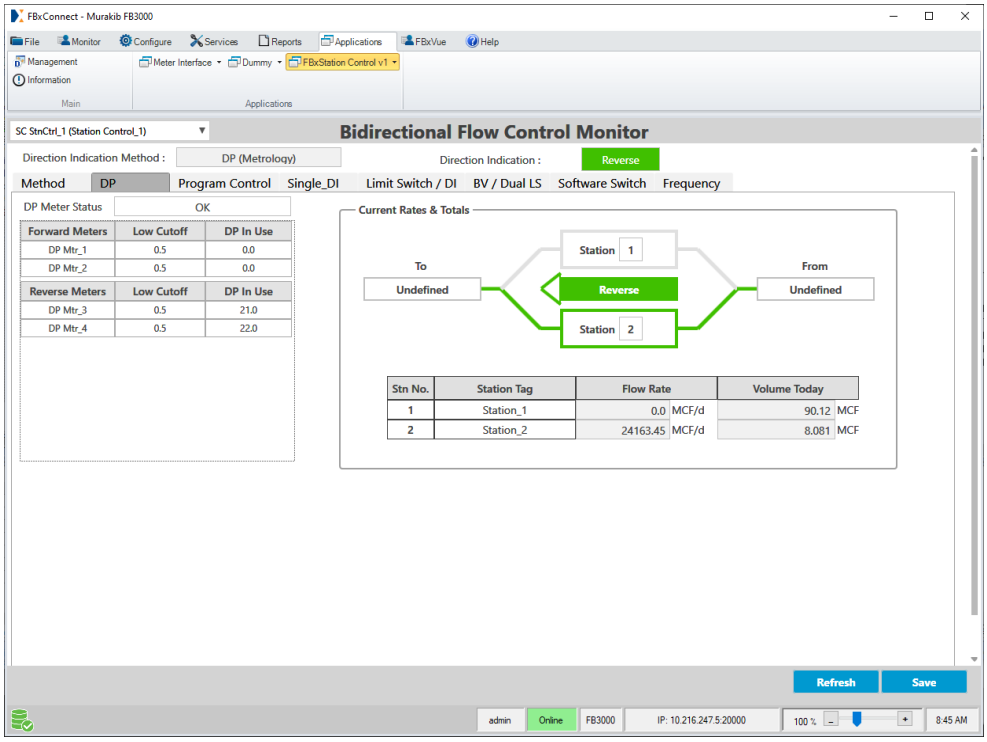


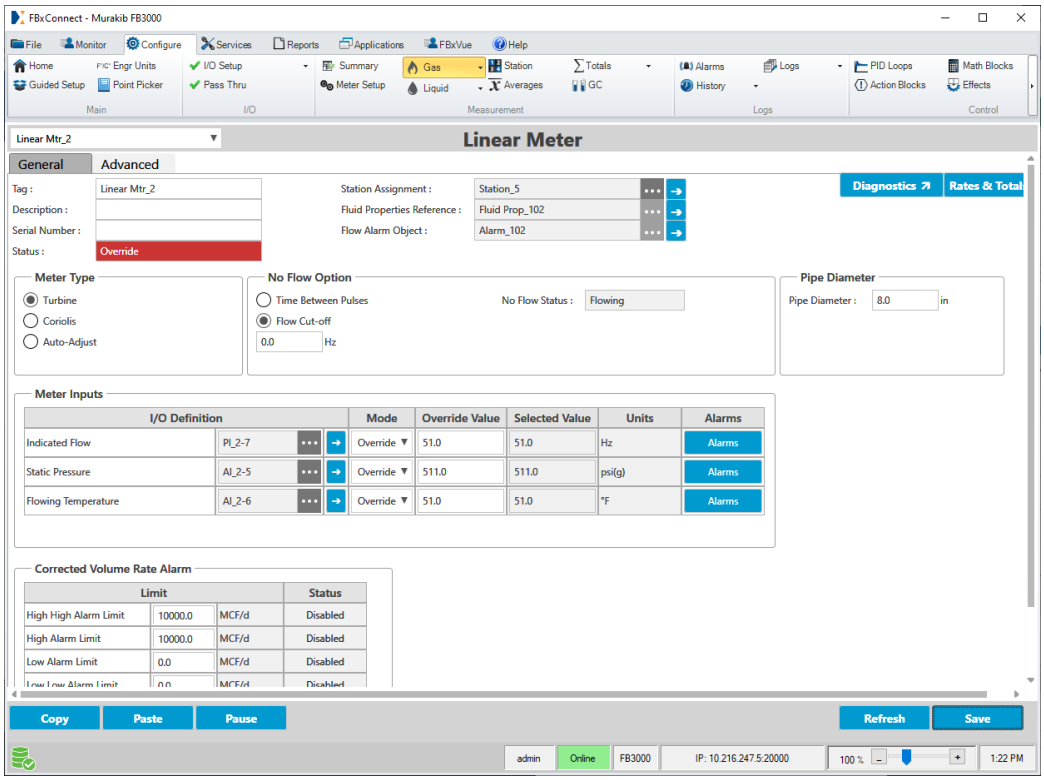
Figure 9-18. Station 2 Active (Reverse Flow)



9.8.2 Example 2: A Single Linear Turbine Meter with one Frequency Output for Forward/Reverse Flow using a Digital Input to Force a Direction Change

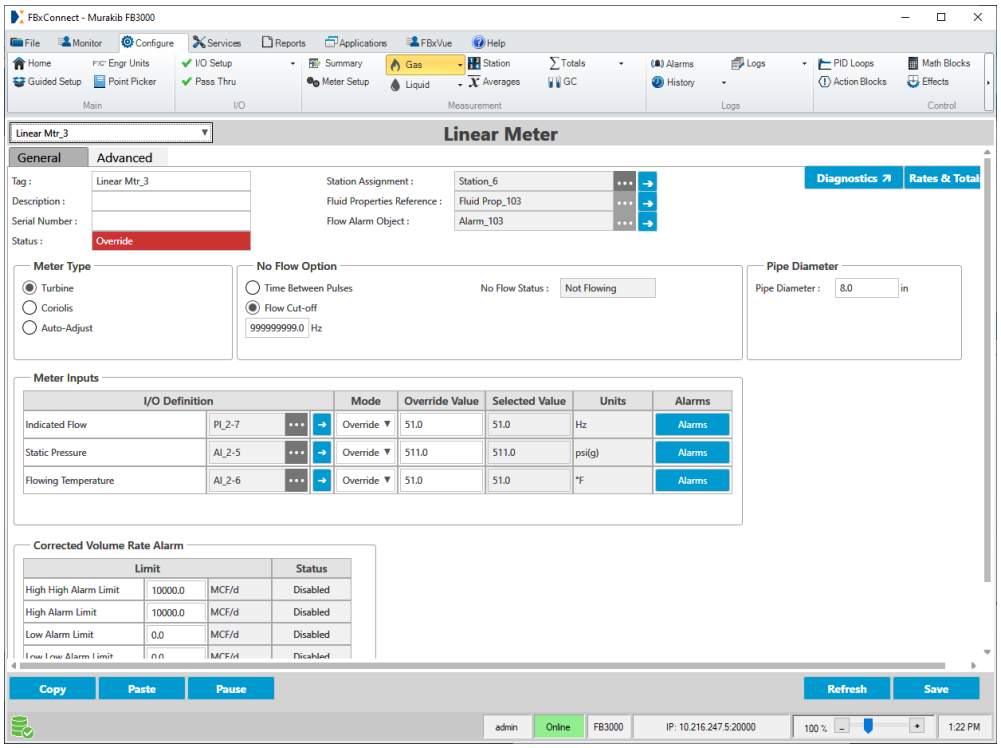
In FBxConnect, we assign Linear Meter 2 to Station 5.

Figure 9-19. Assigning Linear Meter 2 to Station 5



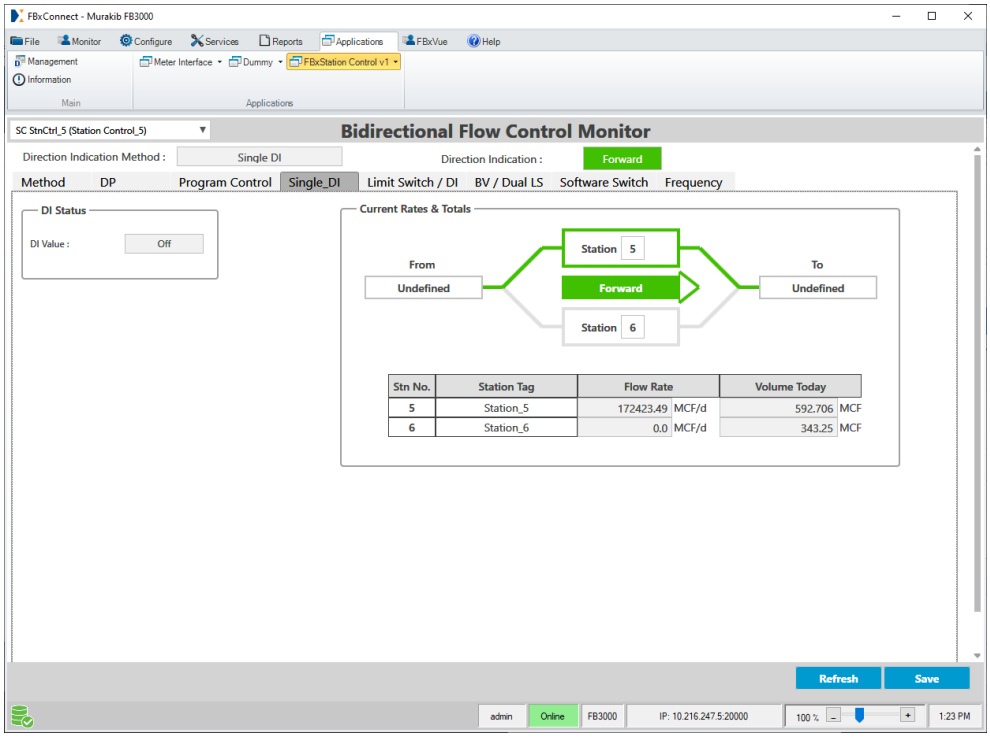
When measuring reverse flow, the physical meter we called Linear Meter 2 is called Linear Meter 3 and we assign it to Station 6 in FBxConnect. In either direction, it uses the same I/O points.

Figure 9-20. Assigning Linear Meter 3 to Station 6



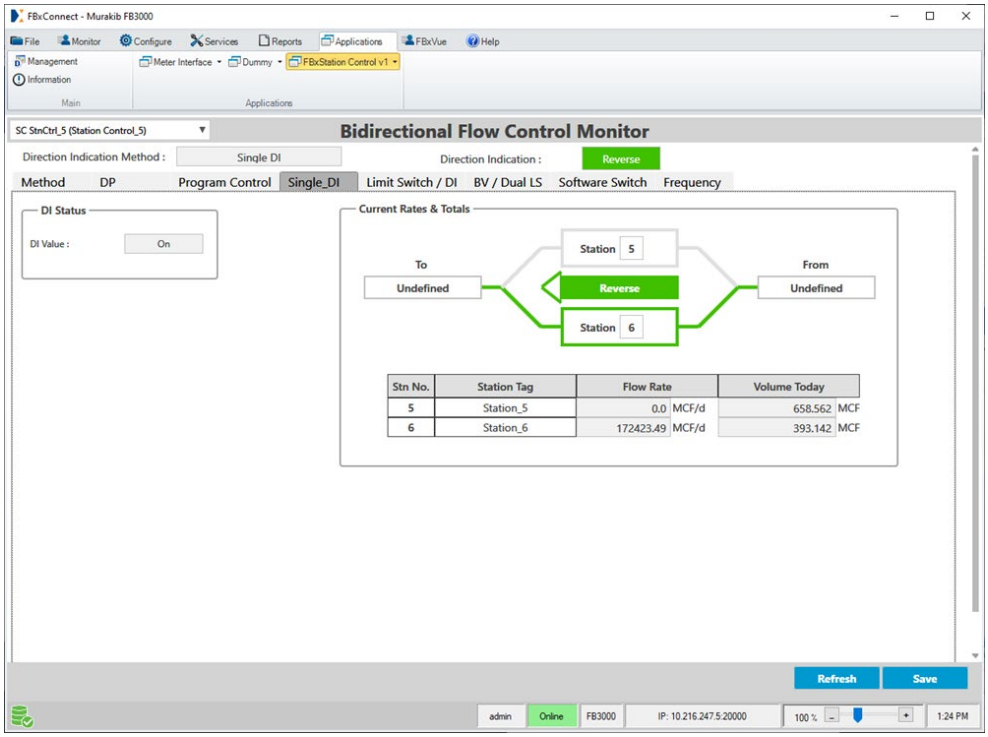
In the FBxStation Control Bidirectional Flow Control Monitor you can see meters shown while in forward flow. FBxStation Control writes to the cutoff parameter. The **DI Status** value (associated with the pulse output) is Off.

Figure 9-21. Station 5 Active (Forward)



When the **DI Status** value changes state to On, the cutoff parameters update and flow switches from forward to reverse.

Figure 9-22. Station 6 Active (Reverse)



9.8.3 Example 3: Two Linear Turbine Meters with One Frequency Output for Forward/Reverse Flow Using a Digital Input to Switch Direction

In FBxConnect, we assign Linear Meters 4 and 5 to Station 7.

Figure 9-23. Assigning Linear Meter 4 to Station 7 (Forward)

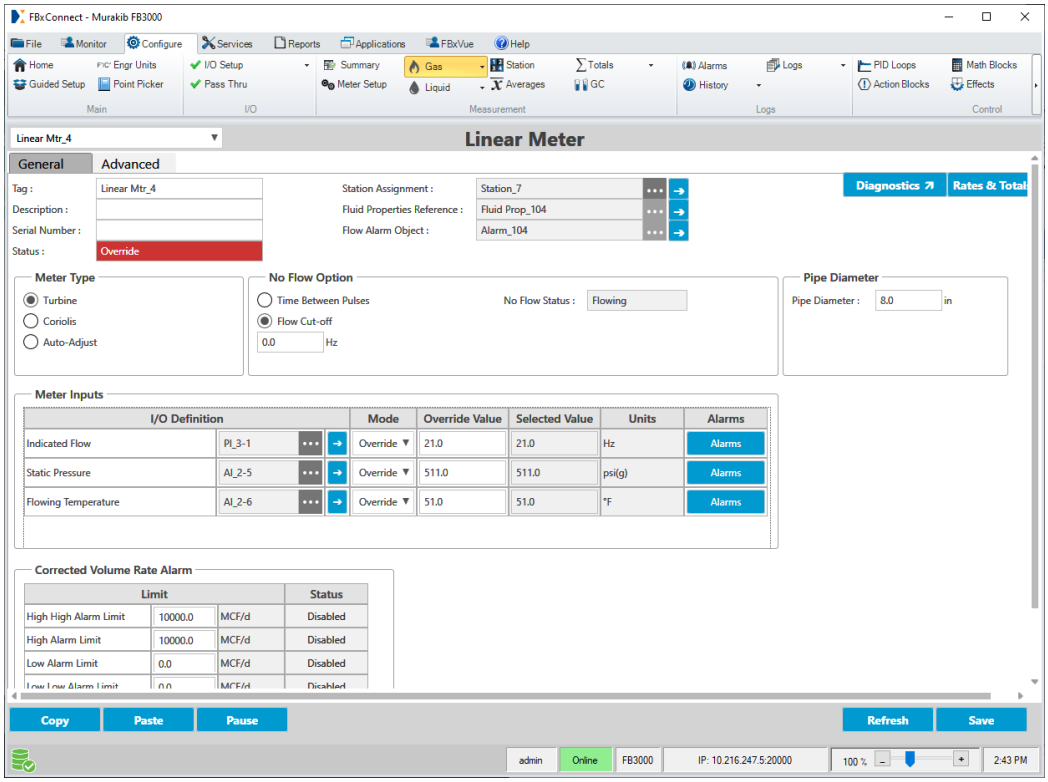
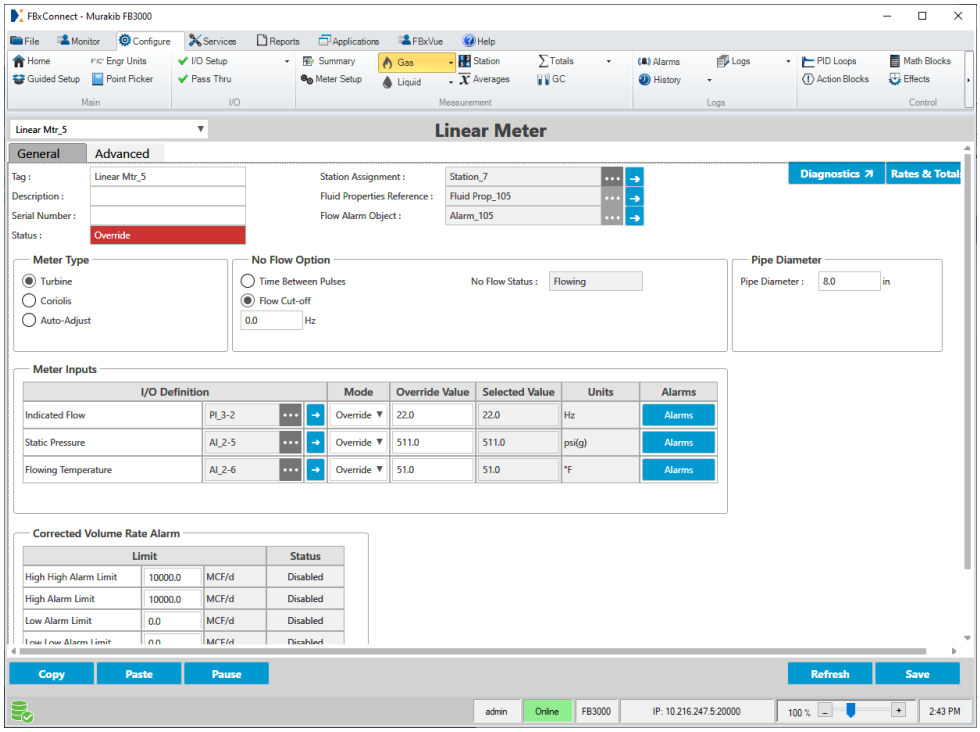


Figure 9-24. Assigning Linear Meter 5 to Station 7 (Forward)



When measuring reverse flow, Linear Meter 4 is called Linear Meter 6, and Linear Meter 5 is called Linear Meter 7. Both meters are assigned to Station 8 for reverse flow.

Figure 9-25. Assigning Linear Meter 6 to Station 8 (Reverse)

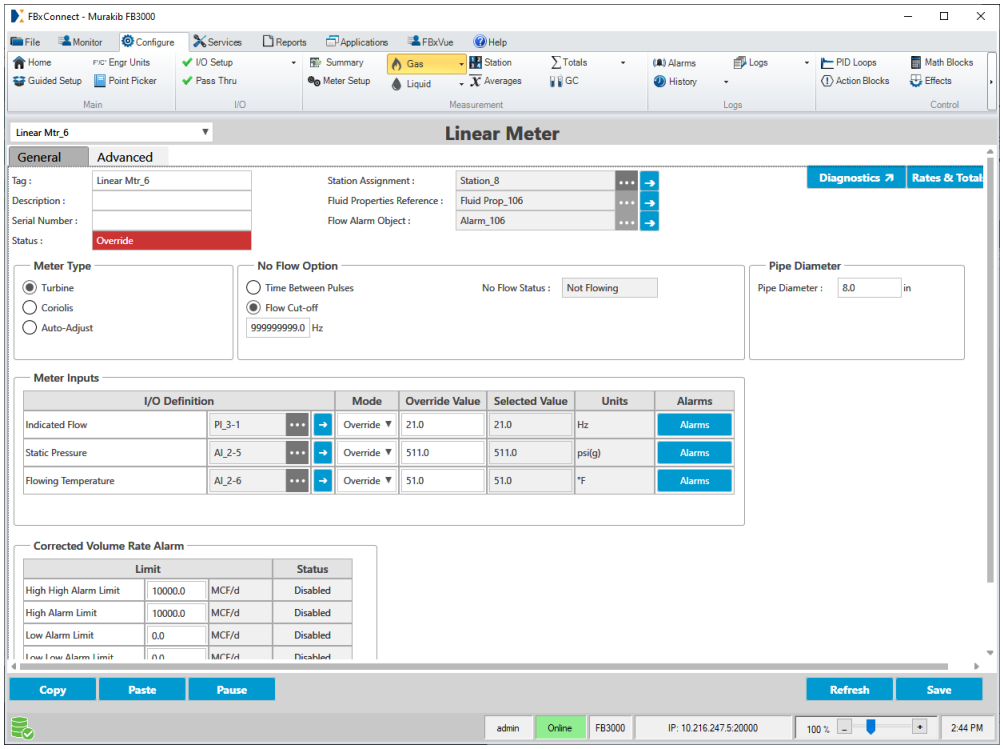
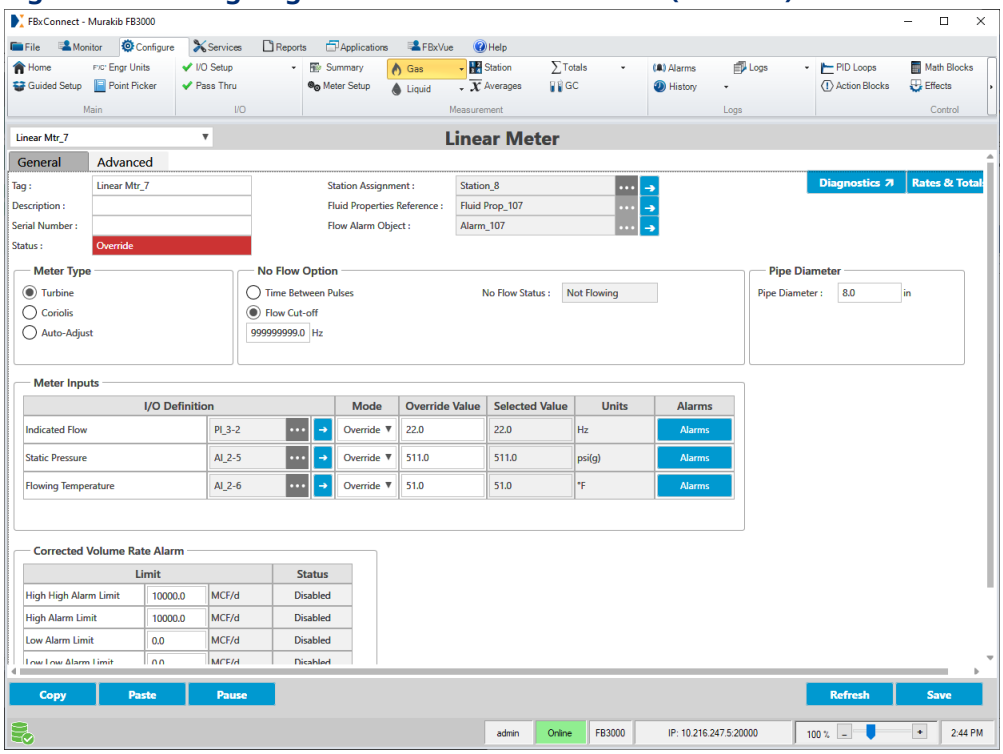
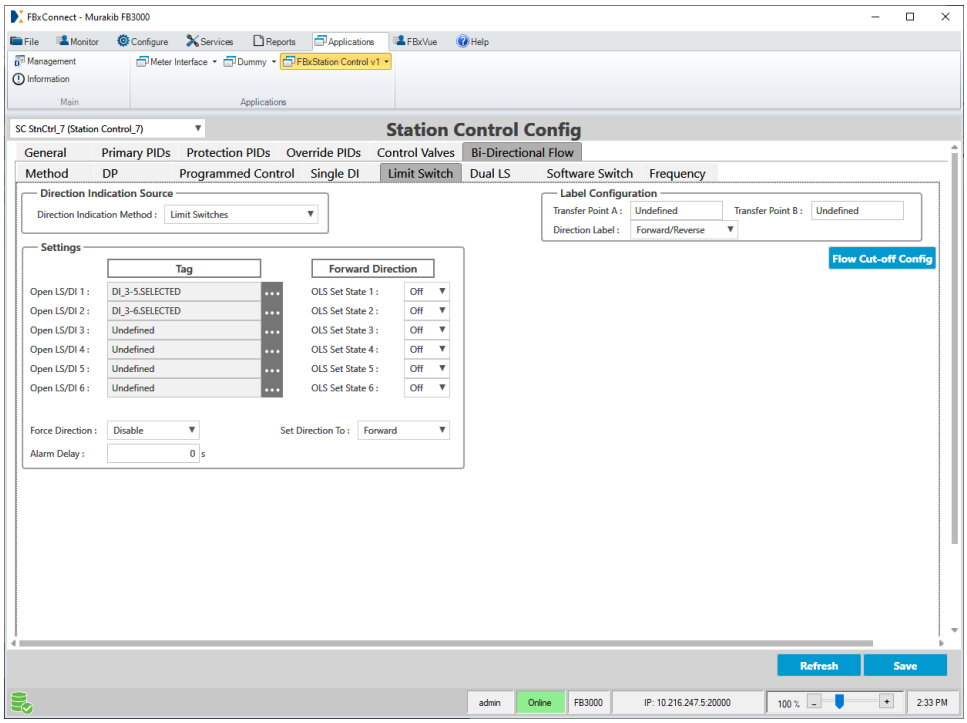


Figure 9-26. Assigning Linear Meter 7 to Station 8 (Reverse)



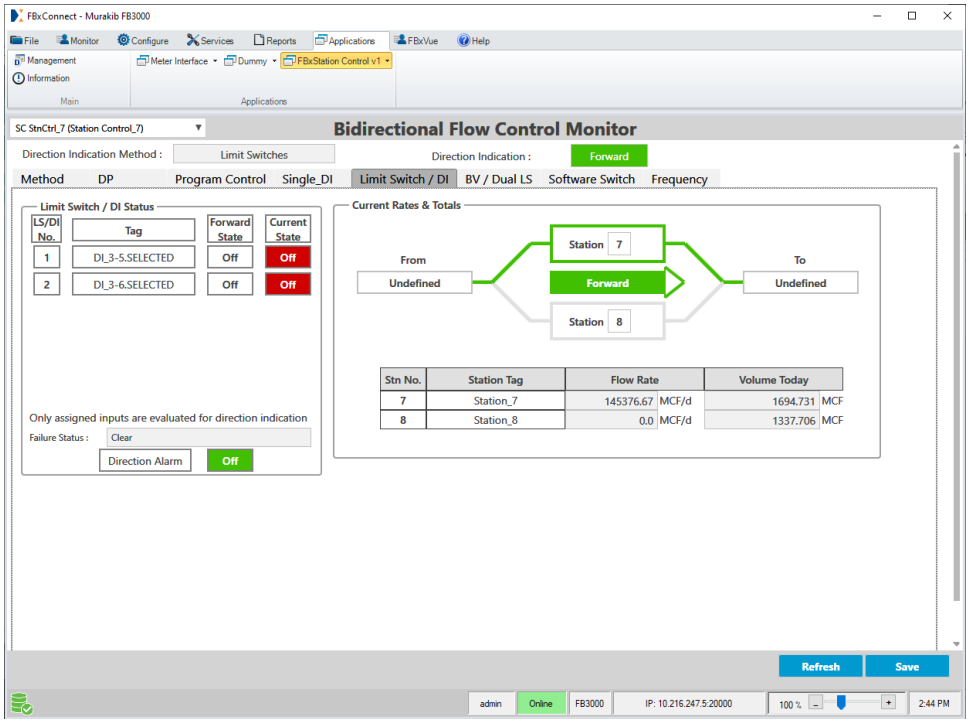
The limit switches used to select the direction are configured on the Limit Switch tab:

Figure 9-27. Configuring Limit Switches to Choose Direction



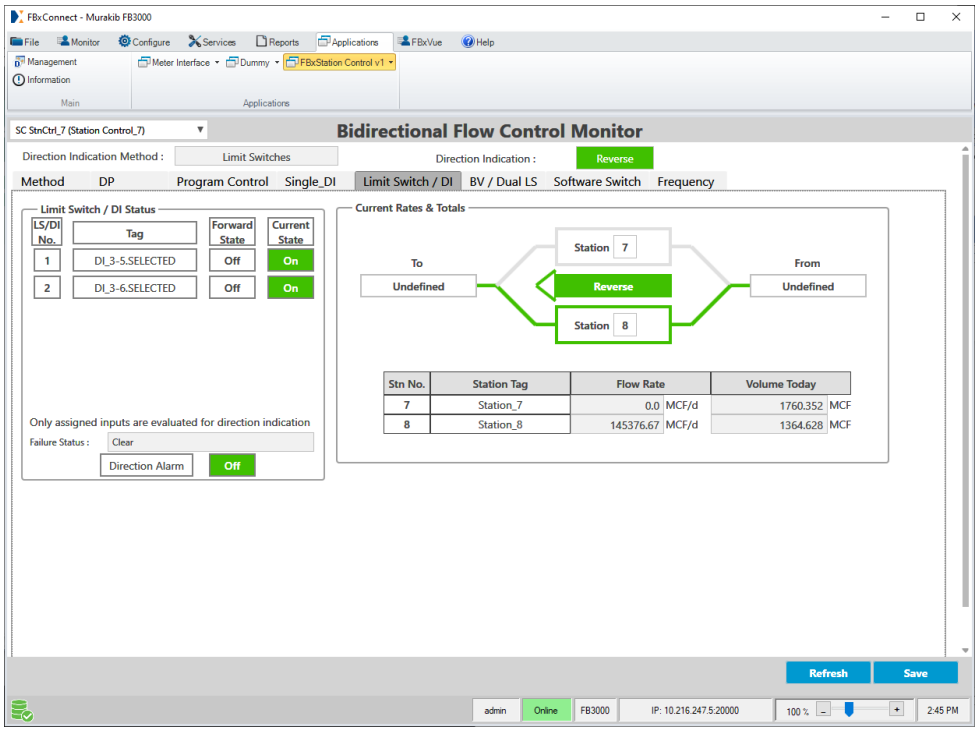
Meters shown while forward. Station Control is writing to the cutoff parameter.

Figure 9-28. Station 7 Active (Forward)



When the DI changes state the cutoff parameters are updated and flow switches to reverse.

Figure 9-29. Station 8 Active (Reverse)

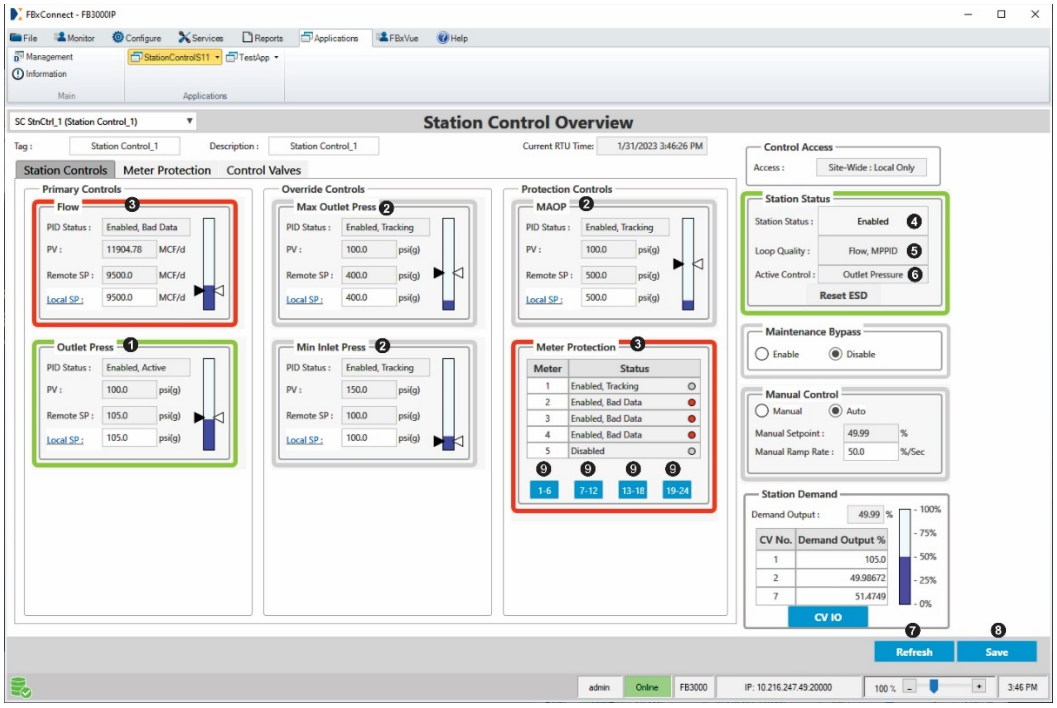


Chapter 10. Station Control Monitor

To reach Station Control Monitor, select **Station Control Monitor** from the Station Control application menu in FBxConnect.

Tabs on the Station Control Overview screen provide data on the current status of each enabled loop and control valve.

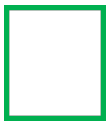
Figure 10-1. Station Control Overview



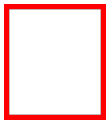
1 Loop in active control for this station. Highlighted in green.
2 Loops enabled, but not in active control.
3 Loops reporting errors. Highlighted in red.
4 Current status of the station.
5 Loop quality shows loop(s) reporting errors.
6 Shows the name of the loop in active control.
7 Click to update the data on the screen.
8 Click to save your entries.
9 Click the numerical range buttons to choose the meters you want to view onscreen.

The Station Controls and Meter Protection tabs display a control box for only those loops which you have enabled.

You can update the data on the screen by clicking **Refresh**.

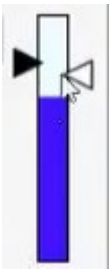


A control box outlined in green indicates the currently active PID loop. This is the loop that currently provides the lowest control output value to the valve(s).



A control box outlined in red indicates that either the data is out-of-range or one or more errors exist.

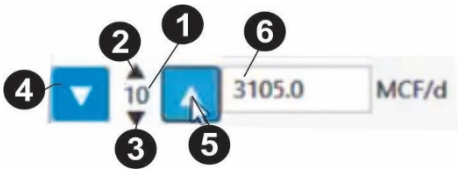
A control box outlined in gray is enabled but not controlling anything; it tracks the output.



The bar graph in a given control box shows the current value of the process variable in blue. The white triangular pointer shows the local setpoint; the black triangular pointer shows the remote setpoint. When you change either setpoint, the other setpoint tracks it.

PID Status	Shows the status of the loop.
PV	Shows the live value of the process variable controlled by this loop.
Remote SP	Shows the value of the remote entry for the setpoint. A remote entry would be from a SCADA system.
Local SP	Shows the value of the local entry for the setpoint. Local entry would be from an FBxConnect user, such as someone entering a setpoint in the FBxStation Control application.

You can enter the setpoint. Alternatively, you can click on Local SP to bring up controls to set a desired increment by which to increase/decrease the local setpoint, and then use the blue up and down arrows to adjust the setpoint.



Where:

1. Increment by which to change the setpoint.
2. Click up-arrow to increase the size of the increment.
3. Click down arrow to decrease the size of the increment.
4. Click to lower setpoint by given increment.
5. Click to raise sepoint by given increment.
6. Setpoint value.

Control Access

Access Shows whether the station is under local control (FBxConnect user) or remote control (SCADA system).

Station Status

Station Status Shows the current status of the station.

Loop Quality Shows any loop currently having errors.

Active Control Shows which loop is currently in control.

Reset ESD If shown as a button, indicates an emergency shut down for the station occurred and a latch is in effect. You must click this button to reset the latch and allow the station control to resume.

Maintenance Bypass

Enable	Only the primary outlet pressure loop operates; all others enter track mode (disabled), and cannot control the pressure loop.
Disable	Any control loop can operate.

Manual Control

Manual	When selected; you have manual control, and can enter a setpoint and ramp rate on this display to control the loop.
Auto	When selected; FBxStation Control automatically chooses which loop(s) control the station.
Setpoint	Enter the manual setpoint for the loop.
Manual Ramp Rate	The rate at which a change in setpoint should be applied to the valve as a percentage of valve travel per second.

Station Demand

Demand Output	Shows the demanded percentage change required for the loop.
CV Demand Output%	Shows the demanded percentage change for each valve.
CV IO	This button opens a read-only screen that shows the variables associated with this control valve.

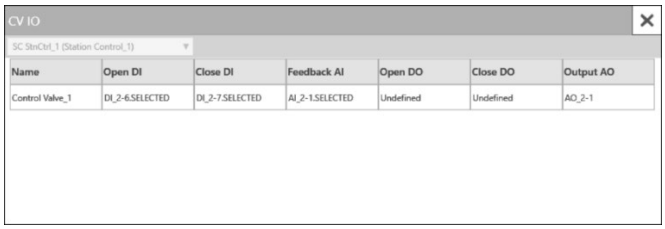
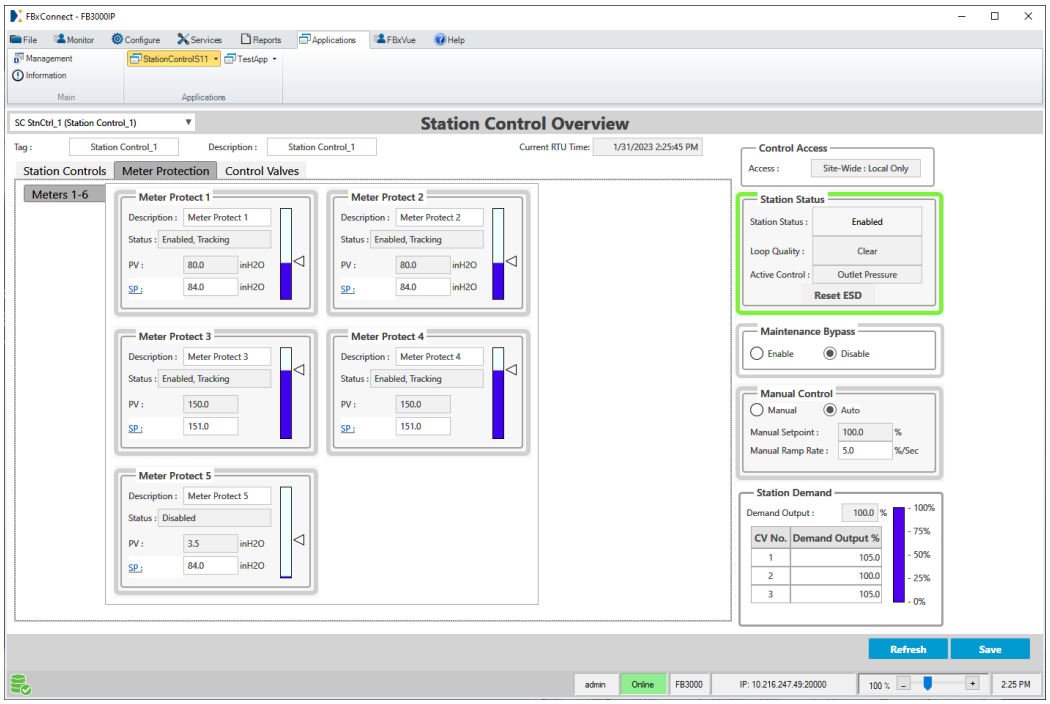


Figure 10-2. Station Control Overview – Meter Protection tab

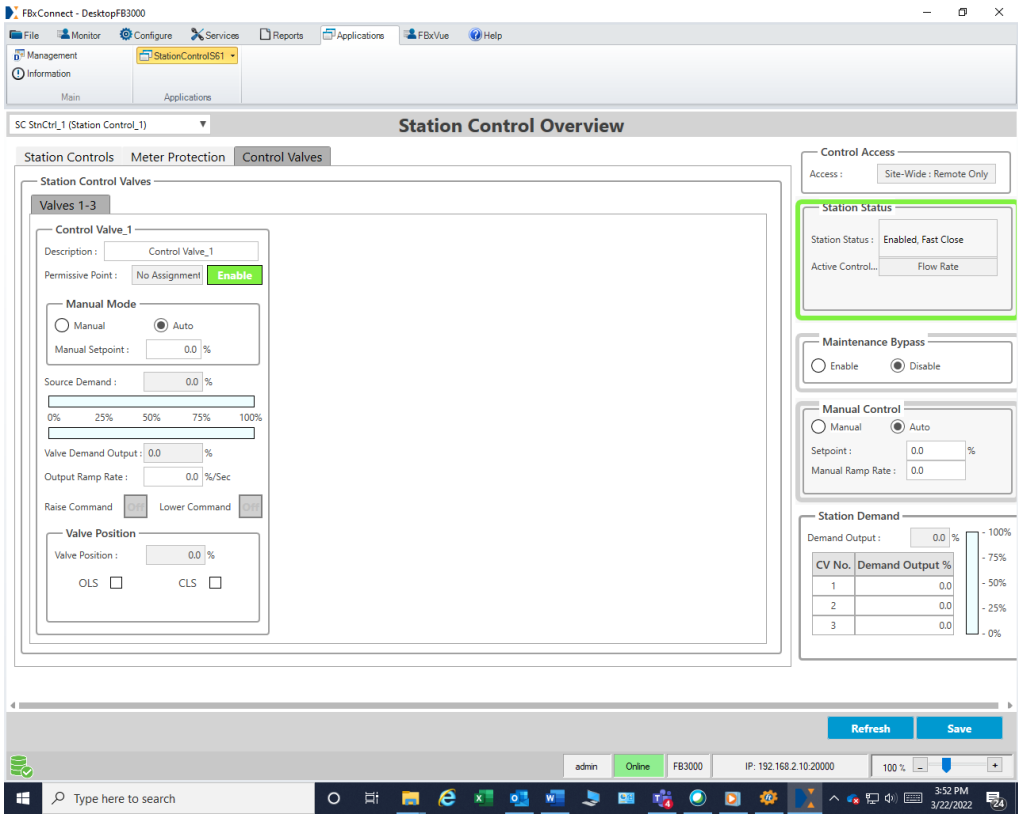


These fields, on the Meter Protection overview tab apply specifically to meter protection loops:

Description	A description of the loop.
Status	Reports the status of the loop, and whether it has errors.
PV	The process variable for the loop.
SP	The desired setpoint for the loop.

The Control Valves tab shows currently enabled control valves.

Figure 10-3. Station Control Overview – Control Valves Tab



Station Control Valves

Control Valve

Description — Enter descriptive text for the control valve.

Permissive Point — When enabled, you can assign this valve to a particular tube staged meter run. If the tube staged valve for that meter run is disabled; the control valve will not operate.

Manual Mode

Manual — When selected; you have manual control, and can enter a manual setpoint to control the valve in the FBxStation Control application.

Auto — When selected; FBxStation Control automatically changes the setpoint.

Manual Setpoint — Enter the manual setpoint for the loop.

Source Demand	Shows the desired demand output from the station control logic. Also shown as a horizontal bar graph.
Valve Demand Output	Shows the current % open position of the valve. Also shown as a horizontal bar graph.
Output Ramp Rate	The rate at which a change in setpoint should be applied to the valve as a percentage of valve travel per second.
Raise Command	Used for valves in raise/lower mode. When ON, pulses to open the valve are active.
Lower Command	When ON, pulses to close the valve are active.
Valve Position	
Valve Position	Show the current %open position of the valve.
OLS	Opened limit switch; green indicates the valve is fully opened.
CLS	Closed limit switch; green indicates fully closed.

Chapter 11. Remote Control Valve Config

Valves 1-4
Valves 5-8
Valves 9-12

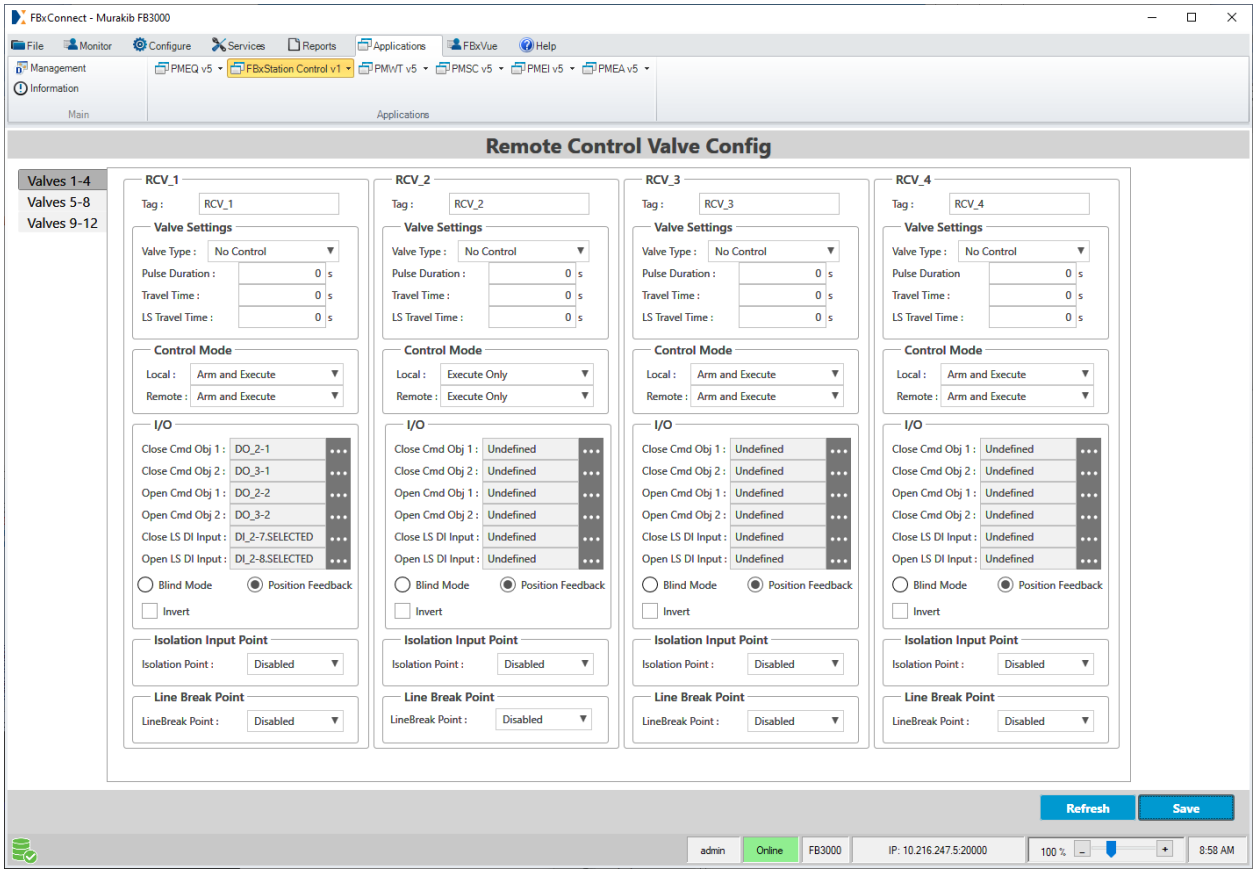
The Remote Control Valve Config page lets you configure the remote control valves.

To reach the Remote Control Valve Config screen, select **Remote Control Valve Config** from the Station Control application menu in FBxConnect.

The screen displays four valves at one time; select a group of four valves to configure from the column at left.

On any screen, you can update the data on the screen by clicking **Refresh** and save your edits by clicking **Save**.

Figure 11-1. Remote Control Valve Config Screen



RCV*n*	The remote control valve number.
Tag	A name used to identify the valve.

Valve Settings

Valve Type There are four types of valves:

No Control	Automatic control of the valve is disabled.
Single Maintained	Choose this option when a single output energizes to change the position of the valve. When this is selected, only configure the Open Cmd Object 1, and optionally, the Open Cmd Object 2 items.
Dual Maintained	Choose this option when there are two analog outputs, one to open the valve, and the other to close the valve. These outputs should be maintained, even after the appropriate limit switch indicates that the valve is in the demanded position.
Dual Pulsed	Choose this option when there are two digital outputs, one to open the valve, and the other to close the valve. These outputs should be pulsed until the appropriate limit switch indicates that the valve is in the demanded position. You can use the **Limit Delay** setting to maintain a pulse for some time after the valve position triggers the limit switch.

Pulse Duration The amount of time (in seconds) to pulse the output. This setting only applies when Valve Type is **Dual Pulsed**.

Travel Time Specifies the amount of time, in seconds, the valve should take to fully travel from the open-to-close or close-to open position. This entry may be changed from this screen.

LS Travel Time Specifies a delay to wait for the valve limit switch to change after a pulse to control the valve occurs.

Control Mode Valve control operates either in **Execute Only** mode or **Arm and Execute**.

In **Arm and Execute** when **Arm** is turned ON, Station Control starts a 10-second timer during which time the **Execute** must turn ON or it will not move the valve. If **Execute** is turned on after the 10-second timer expires, Station Control ignores it and no valve movement occurs.

	Use this mode for extra safety to force you to confirm you really want to move the valve. In **Execute Only** mode, Station Control starts to move the valve as soon as **Execute** is turned ON. There is no confirmation required.
Local	Select the control mode to use when the station is under local control (FBxConnect user such as Station Control).
Remote	Select the control mode to use when the station is under remote control (SCADA system).
Close Cmd Obj 1	Click the point picker button ··· to specify the digital output used to command the valve to close.
Close Cmd Obj 2	If the valve close command requires a second digital output in order to confirm that the valve should close, operate, click the point picker button ··· to specify the second digital output. Typically, this is a safety measure used with large valves.
Open Cmd Obj 1	Click the point picker button ··· to specify the digital output used to command the valve to open.
Open Cmd Obj 2	If the valve close command requires a second digital output in order to confirm that the valve should open, operate, click the point picker button ··· to specify the second digital output. Typically, this is a safety measure used for large valves.
Close LS DI Input	Click the point picker button ··· to specify the digital input that serves a closed limit switch to report the valve fully closed.
Open LS DI Input	Click the point picker button ··· to specify the digital input that serves an open limit switch to report the valve fully open.
Blind Mode	Select this to ignore limit switch status from the valve.
Position Feedback	Select this to use position feedback from the valve – such as limit switch status.
Invert	Select this to invert outputs. When selected, a valve open command is OFF and a valve close command is ON.

Isolation Input Point Used if you want to isolate the valves.

Isolation Point If the point specified becomes TRUE, the valve closes. If the point becomes FALSE, the valve opens.

When the point says **Disabled**, this does nothing.

When the point specifies a **Station**, Station Control checks if the station is in an emergency shut down (ESD) state. If it is, **Isolation Point** becomes TRUE and the valve shuts. This can also occur if bi-directional control for the station changes direction.

When the point specifies an external input **Ext Input**, and the external input becomes TRUE the valve shuts.

Line Break Point

A line break refers to the pipeline breaking open.

Linebreak Point If the point specified becomes TRUE, the valve closes. If the point becomes FALSE, the valve remains closed, and you must open it manually.

When the point says **Disabled**, this does nothing.

When the point specifies a **Station**, Station Control checks if the station is in an emergency shut down (ESD) state. If it is, **Linebreak Point** becomes TRUE and the valve shuts. This can also occur if bi-directional control for the station changes direction.

When the point specifies an external input **Ext Input**, and the external input becomes TRUE the valve shuts.

Chapter 12. Remote Control Valve Monitor

Valves 1-4
Valves 5-8
Valves 9-12

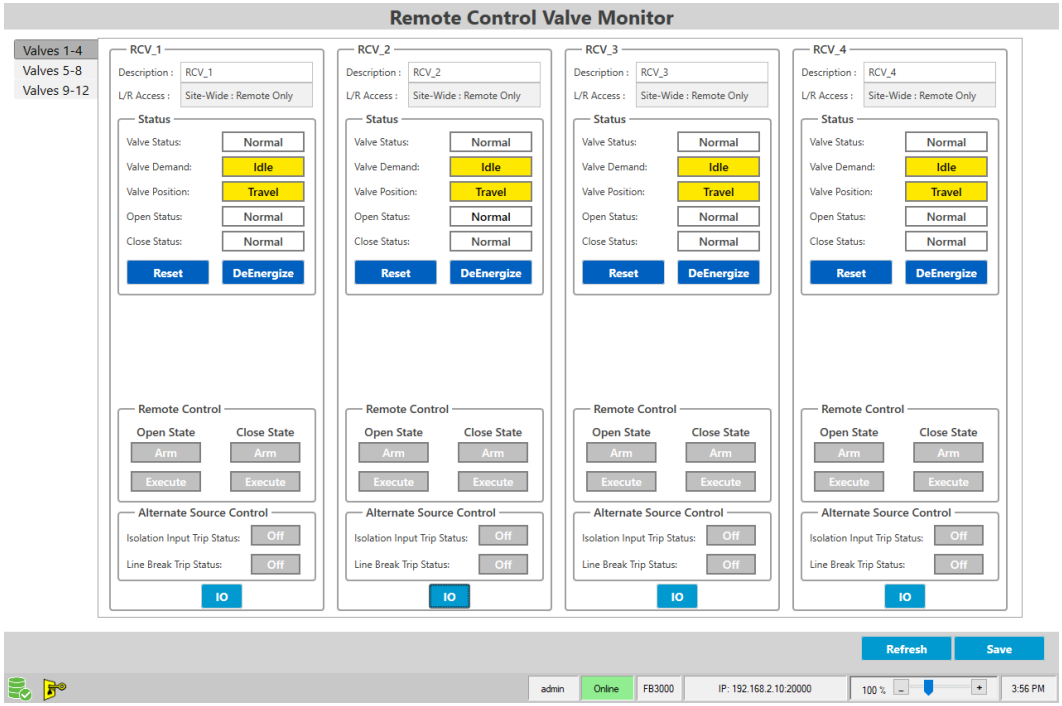
The Remote Control Valve Monitor page lets you see the current state of the remote control valve, and lets you issue commands to open or close the valves.

To reach the Remote Control Valve Monitor, select **Remote Control Valve Monitor** from the Station Control application menu in FBxConnect.

The screen displays four valves at one time; select a group of four valves to configure from the column at left.

You can update the data on the screen by clicking **Refresh**.

Figure 12-1. Remote Control Valve Monitor

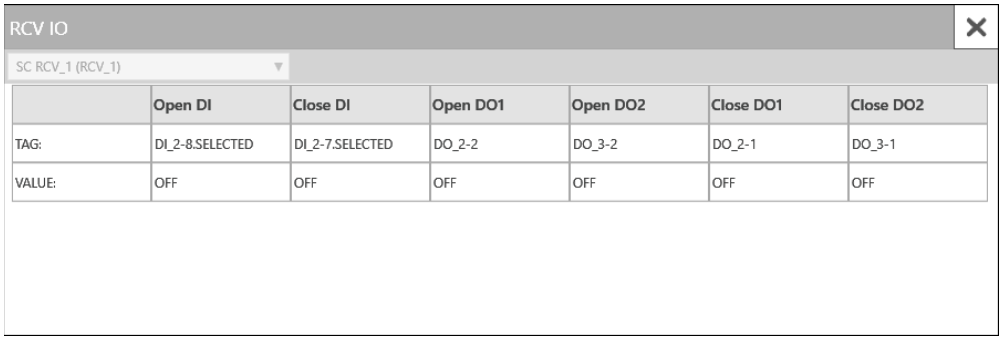


RCV*n*	The remote control valve number
Tag	Shows a description of the valve.
L/R Access	Shows whether the valve is configured for both local and remote control, or if it is configured for local control only.

Status	
Valve Status	The overall status of the valve.
Valve Demand	The requested position for the valve. Shows **Idle** if there is no pending open/close command.
Valve Position	The current position of the valve. Shows **Travel** if the valve is somewhere in-between opened and closed.
Open Status	The status of the open limit switch. Shows **Fail** if the valve limit switch is not open by the end of the valve travel time. Shows **Normal** if the limit switch indicates the valve is in the demanded position.
Close Status	The status of the closed limit switch. Shows **Fail** if the valve limit switch is not closed by the end of the valve travel time. Shows **Normal** if the limit switch indicates the valve is in the demanded position.
Reset	Clear all errors shown for the valve.
Deenergize	Turns off all outputs.
Local Control	
Open Valve	Shows buttons for local control of opening the valve.
Arm	Click to start a 10-second timer within which you must click **Execute** to open the valve. If you do not click **Execute** before expiration of the timer, the valve does not open. If shown grayed out, the valve is configured for Execute Only; no timer applies.
Execute	Click to open the valve.
Close Valve	Shows buttons for local control of closing the valve.
Arm	Click to start a 10-second timer within which you must click Execute to close the valve. If you do not click Execute before expiration of the timer, the valve does not close. If shown grayed out, the valve is configured for Execute Only; no timer applies.
Execute	Click to close the valve.
Remote Control	This section is only available if you set the Site Settings page to make this configurable, and if remote control is allowed.

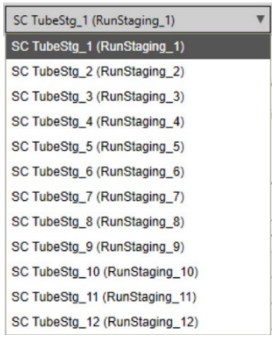
Open State	Shows status of remote control actions for opening the valve.
Arm	Shows if Arm timer has started.
Execute	Shows if Execute in progress.
Close State	Shows status of remote control actions for closing the valve.
Arm	Shows if Arm Timer has started.
Execute	Shows if Execute in progress.
Alternate Source Control	
Isolation Input Trip Status	Shows **On** if the isolation input is TRUE.
Line Break Trip Status	Shows **On** if the line break status is TRUE.
IO	This button brings up a read-only pop-up screen which shows the variable associated with the valve (**Tag**,) and the current status **Value** of the valve.

Figure 12-2. RCV IO Pop-up



	Open DI	Close DI	Open DO1	Open DO2	Close DO1	Close DO2
TAG:	DI_2-8.SELECTED	DI_2-7.SELECTED	DO_2-2	DO_3-2	DO_2-1	DO_3-1
VALUE:	OFF	OFF	OFF	OFF	OFF	OFF

Chapter 13. Run Staging Configuration



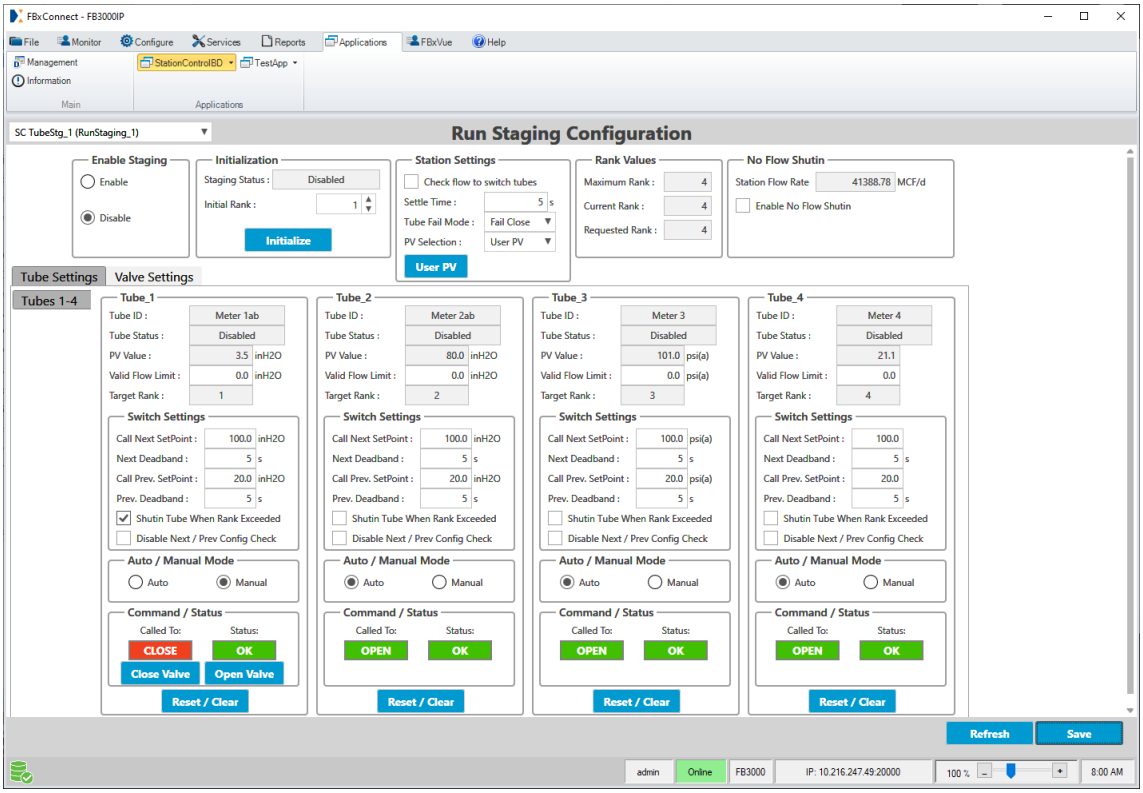
After you finish your selections on the Station Control Config and Run Mapping screens, and assign your switches to particular stations and valves, you can configure meter run staging. Meter run staging is sometimes referred to as run switching or tube switching.

To reach the Run Staging Configuration screen, select **Run Staging** from the FBxStation Control application menu in FBxConnect.

Run staging requires at least two meter runs for a station, and each run on a given station must have a different assigned rank.

On any screen, you can update the data on the screen by clicking **Refresh** and save your edits by clicking **Save**.

Figure 13-1. Run Staging Configuration



Enable Staging

Enable	Enables run staging for this station. **Note**: You must initialize run staging before you enable it.
Disable	Disables run staging for this station.

Initialization

Staging Status	Shows the status of the meter run staging process.
Initial Rank	This is the rank the station will demand when you click the **Initialize** button.
Initialize	Click this button to initialize run staging based on the initial rank setting.

Station Settings

Check flow to switch tubes	When selected, as each meter run is commanded to open, FBxStation Control compares the current flow rate for the meter run to the **Valid Flow Limit** set for that tube in the Tube Settings tab. If the flow rate does not exceed the Valid Flow Limit value, the meter run/tube is considered to have failed, and FBxStation Control (if in automatic mode) opens the next highest ranked tube.
Settle Time	When opening or closing a run, the flow rate through the runs may momentarily increase or decrease above or below the setpoints for opening or closing additional runs. **Settle Time** is a period of seconds during which no control actions will occur.
Tube Fail Mode	Select either **Fail Open** or **Fail Close**. It is important to understand the advantages and disadvantages of each mode. Tube Fail Mode only applies when FBxStation Control detects a Q-bit or measurement error, and only on the highest-ranking tube. FBxStation Control shuts any lower ranked tube which fails. Depending on the purpose of the station, a different fail mode may be appropriate. In cases where keeping gas flowing outweighs other concerns, you may want to choose **Fail Open**. A possible example of this is when the station feeds a power station or compressor station. In other cases, in which the delivery is not as critical, you may choose for safety concerns to let the tube shut. Ultimately, you must carefully consider the decision of whether to fail open or fail closed on a site-by-site basis.

PV Selection

Choose one of the following:

DP/Flowrate Uses differential pressure (DP) for an orifice meter and flow rate for a linear meter.

FR/Velocity Uses flow rate for an orifice meter and velocity for linear meters. When you choose this, a **Pipe Diameter** button becomes visible, and you can enter the pipe diameter.

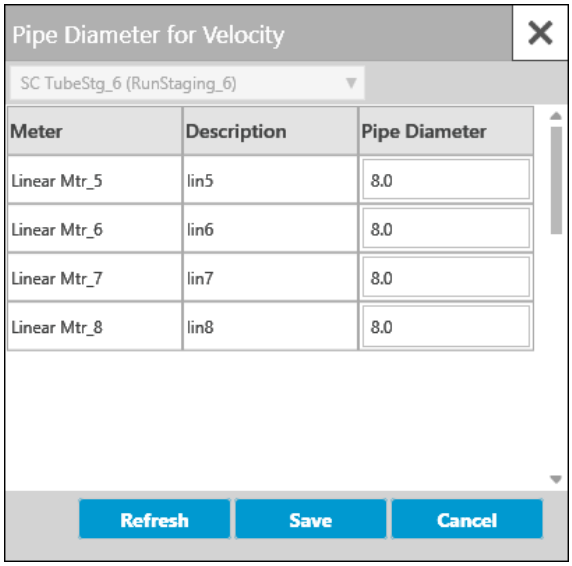
DP/Velocity Uses differential pressure (DP) for orifice meters and velocity for a linear meter. When you choose this, a **Pipe Diameter** button becomes visible, and you can enter the pipe diameter.

Flowrate Uses flow rate for both differential pressure (DP) meters and linear meters.

User PV When selected, a **User PV** button becomes visible which you can click to launch a pop-up display to specify the process variable (PV) to use for run staging/tube staging.

Pipe Diameter

This button is only visible when **PV Selection** is **FR/Velocity** or **DP/Velocity**. When you click **Pipe Diameter**, it opens the Pipe Diameter pop-up screen where you can specify the pipe diameter for the meters.



Enter the **Pipe Diameter** for your meter. You can click **Refresh** to update the screen. Click **Save** when you finish to save your entries and close the pop-up.

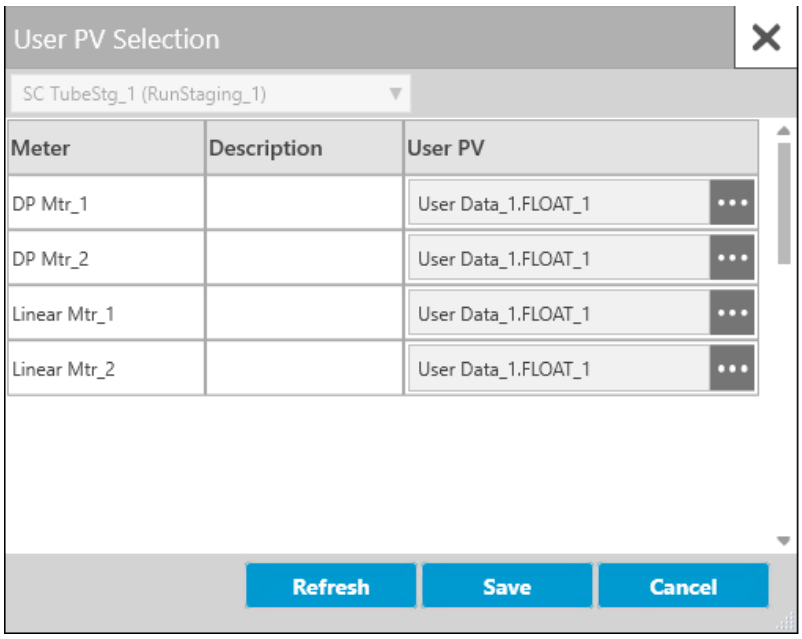
Note

The engineering units (EU) used for the pipe diameter are set at the station level in the standard measurement firmware.

User PV

User PV

This button is only visible when **PV Selection** is **User PV**. When you click **User PV**, it opens the User PV pop-up screen from which you can select the process variable to use for your tube staging. For each **Meter** shown, you can click the point-picker button ••• in the **User PV** field to select the process variable to use for tube staging for this meter. Click **Save** when you finish to save your selections and close the pop-up.



Rank Values

Rank refers to the order in which a run is opened or closed, as flow varies through the station. The run ranked 1 will open first, to meet any demand for flow. The runs ranked 2 and higher will open as the flow through the station increases and more runs are required.

You assign ranks on the Run Mapping screen.

Maximum Rank

The highest possible ranked meter run (tube) that can be opened for this station. This is equivalent to the number of runs assigned to the station, so if a station has 4 meter runs assigned to it, the maximum rank is 4.

Current Rank

The highest ranked tube (meter run) currently open.

Requested Rank This is the highest ranked tube (meter run) which should be opened to meet the current requested demand. Because the valves for a tube open sequentially by rank, the requested rank might not be the same as the current rank.

No Flow Shutin

Station Flow Rate The current flow rate for the selected station.

Enable No Flow Shutin If enabled, and the station flow rate is 0, all meter runs/tubes for this station are commanded to close.

13.1 Tube Settings tab

Tube *n*

Tube ID A name assigned to the tube.

Tube Status Reports the current status of the tube:

- **Config Fail** Invalid configuration for tube switching. This occurs when the run's low switch point is higher than the previous run's high switch point.
- **Disabled** Tube switching configuration and data are valid, but meter run staging is disabled.
- **Maint Mode** The corresponding meter run is in maintenance mode and meter run staging is disabled.
- **Normal** Tube switching configuration and data are valid, but meter run staging is disabled.
- **PV Fail** The process variable's questionable data bit (Q-Bit) is TRUE.
- **Q-Bit Fail** The flow rate calculated for the station is questionable.
- **Shutdown** The run is closed due to a shutdown command.

PV Value The current value for the process variable associated with the tube. Depending on the configuration, this could be DP, flow rate, or velocity.

Valid Flow Limit If the **Check Flow to Switch Tubes** feature is selected in the Station Settings section of the Run Staging Configuration

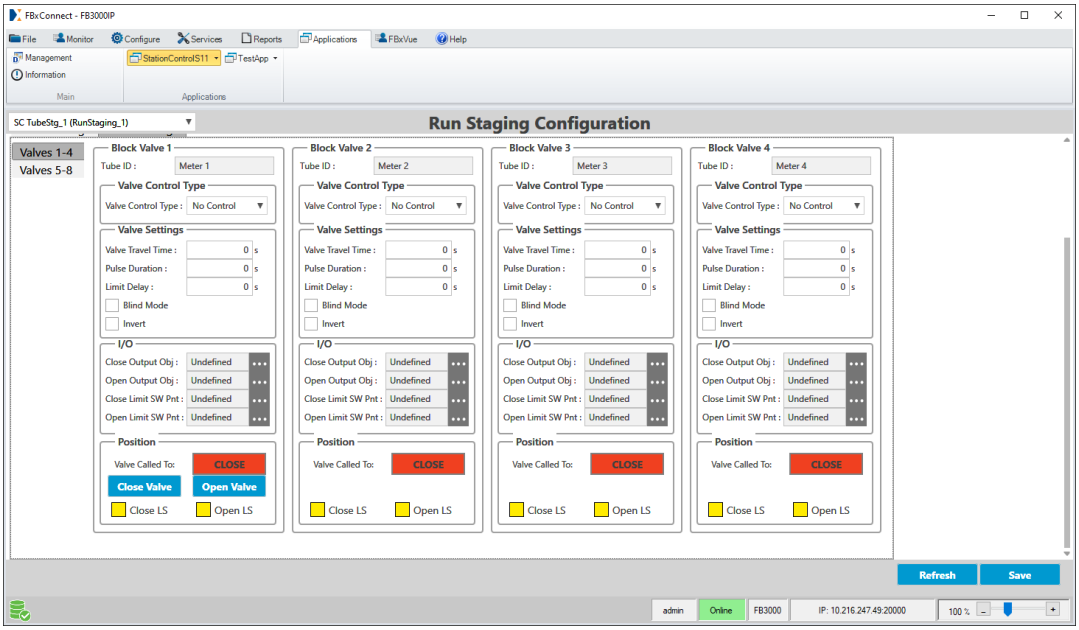
	screen, the process variable must exceed this limit for flow to be validated. In practical terms, when a run is requested to open, the actual rank will not be updated until the flow validation number is exceeded. If it fails to be exceeded prior to the end of the travel time, the run is marked as failed and the next higher-ranked run is requested.
Target Rank	The rank configured for this run. When the requested rank matches the target rank, the run of that target rank opens. When the run opens, the current rank should match the target rank.
Switch Settings	
Call Next Setpoint	The next setpoint is in the same units as the process variable and used to determine whether or not to increment the **Requested Rank** to thereby open an additional tube/meter run.
Next Deadband	The process variable must exceed the value of **Call Next Setpoint** for the number of seconds in **Next Deadband** before FBxStation Control changes the **Requested Rank**.
Call Prev. Setpoint	**Call Prev Setpoint** is in the same units as the process variable and used to determine whether or not to decrement the **Requested Rank**.
Prev. Deadband	The process variable must be less than the value of **Call Prev Setpoint** for the number of seconds in the **Prev DeadBand** field before FBxStation Control changes the **Requested Rank**.
Shutin Tube When Rank Exceeded	In automatic mode, if **Shutin Tube When Rank Exceeded** is selected, when the **Requested Rank** exceeds the rank for this tube, FBxStation Control shuts the tube.
Disable Next / Prev Config Check	Checks next and previous configuration settings. You disable this if you have a mixture of different types of tubes with different configurations.
Auto / Manual Mode	An individual tube may be put into **Auto** or **Manual** mode.
Auto	When in auto mode, the **Called To** setting is determined by the tube switching logic.
Manual	When in manual mode, you can change the **Called To** setting yourself from this page.

Command/Status

Called To	This is the command to the tube. When the tube is in Auto mode, tube switching logic determines how to set this command. When the tube is in Manual mode, you can set this command yourself on the Valve tab.
Status	Shows the status summary of the tube. Will show **Fail** for a Config Fail, PV Fail, or Q-Bit Fail.
Open Valve, Close Valve	When the tube is in Manual mode, you can click either of these buttons to send a command to the valve.
Reset / Clear	If an error occurs in the meter run staging sequence that causes a meter run (or runs) to improperly open or shut, you must reset the staging sequence as follows: 1. Determine the root cause of the error then correct the condition. Typical causes might include invalid DP or counts measurements, or incorrect settings for “next” or “previous. 2. Disable meter run staging. 3. Click **Reset/Clear**. 4. Re-initialize meter run staging. 5. Re-enable meter run staging.

13.2 Valve Settings Tab

Figure 13-2. Valve Settings Tab



Block Valve *n*

Tube ID A name assigned to the tube associated with this block valve.

Valve Control Type

Valve Control Type	**No Control**	Automatic control of the valve is disabled.
	Single Maintained	Choose this option when a single output energizes to change the position of the valve. When this is selected, only configure the Open Cmd Object 1, and optionally, the Open Cmd Object 2 items.
	Dual Maintained	Choose this option when there are two analog outputs, one to open the valve, and the other to close the valve. These outputs should be maintained, even after the appropriate limit switch indicates that the valve is in the demanded position.
	Dual Pulsed	Choose this option when there are two digital outputs, one to

open the valve, and the other to close the valve. These outputs should be pulsed until the appropriate limit switch indicates that the valve is in the demanded position. You can use the **Limit Delay** setting to maintain a pulse for some time after the valve position triggers the limit switch.

Valve Settings

Valve Travel Time Specifies the amount of time, in seconds, the valve should take to fully travel from the open-to-close or close-to-open position. This entry may be changed from this screen. We recommend you add a few seconds to the manufacturer's specified valve travel time to account for feedback from limit switches to confirm the valve's position.

Pulse Duration The amount of time (in seconds) to pulse the output. This setting only applies when Valve Control Type is **Dual Pulsed**.

Limit Delay The **Limit Delay** is the amount of time, in seconds, that the output pulse will be maintained after an opened or closed limit is indicated. This only applies for the **Valve Control Type** of **Dual Pulsed**.

Blind Mode When selected, FBxStation Control does not use limit switch feedback to determine whether to pulse the valve.

Invert This setting changes the operation of the digital output. When this box is checked:

An **OPEN** command sets the digital output assigned to the open command to OFF (or FALSE). If dual outputs are used, FBxStation Control sets the digital output assigned to the Close command to ON (or TRUE).

A **CLOSE** command sets the digital output assigned to the open command to ON (or TRUE). If dual outputs are used, FBxStation Control sets the digital output command" to OFF (or FALSE).

I/O

Close Output Obj Click the point picker button ··· to specify the digital output used to command the valve to close.

Open Output Obj Click the point picker button ··· to specify the digital output used to command the valve to open.

Close Limit SW Pnt

Click the point picker button ··· to specify the digital input that serves a closed limit switch to report the valve fully closed.

Open Limit SW Pnt

Click the point picker button ··· to specify the digital input that serves an open limit switch to report the valve fully opened.

Position

Valve Called To

This is the command to the valve. When the tube is in Auto mode, tube switching logic determines how to set this command.

Open Valve, Close Valve

When the tube is in Manual mode, you can click either of these buttons to send a command to the valve.

Close LS

Close limit switch status indicated by color:

- Gray - Close limit switch OFF
- Yellow - Valve traveling
- Red - Close limit switch ON – Valve is closed
- Error - Unknown state

Open LS

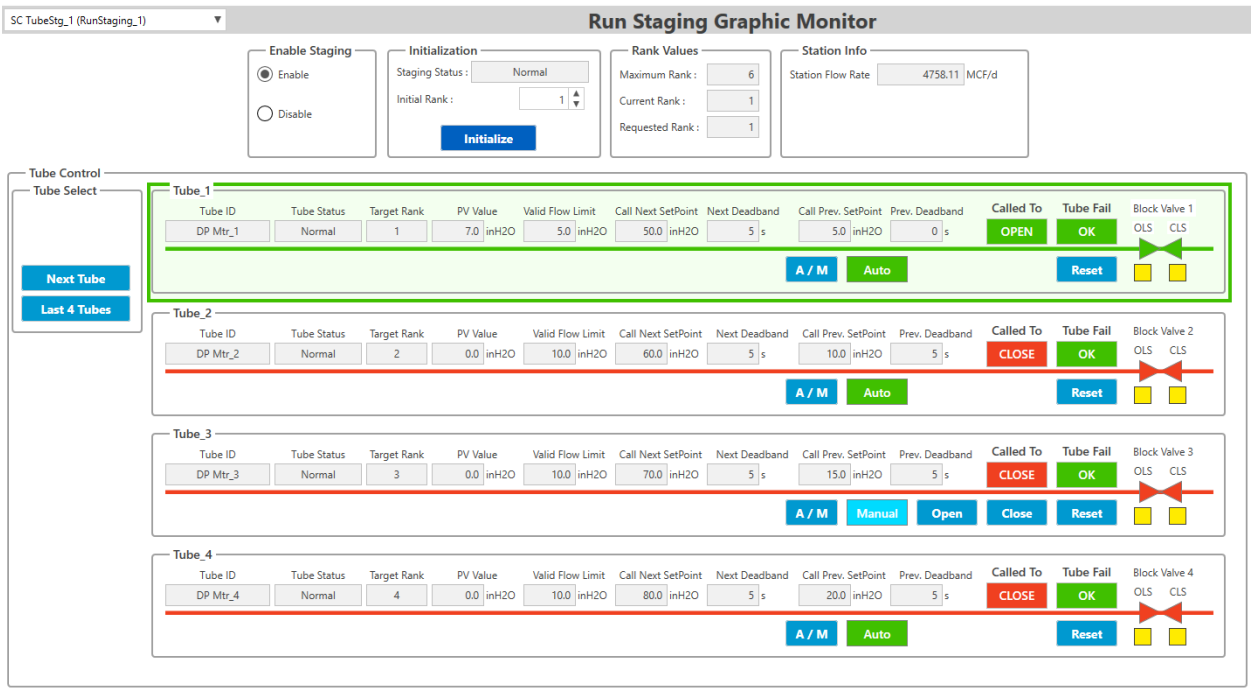
Open limit switch status indicated by color:

- Gray - Open limit switch OFF
- Yellow - Valve traveling
- Red - Open limit switch ON – Valve is opened
- Error - Unknown state

Chapter 14. Run Staging Monitor

To reach the Run Staging Monitor screen, select **Run Staging Monitor** from the Station Control application menu in FBxConnect.

Figure 14-1. Run Staging Monitor



Graphic Symbol	Explanation
	Meter run and valve shut.
	Meter run and valve open.
	The PV value has not exceeded the Valid Flow Limit for the configured duration when the meter is called to Open, or the PV value has not dropped below the Valid Flow Limit when the meter is called to Close.

<u>Enable Staging</u>

Enable — Enables run staging for this station. **Note**: You must initialize run staging before you enable it.

Disable — Disables run staging for this station.

<u>Initialization</u>

Staging Status — Shows the status of the meter run staging process. Possible values are:

Normal	The run staging feature is operating normally.
Disabled	The run staging feature is not active.
Initializing	The software is setting up the tubes for run staging.
Ready to Enable	Click **Enable** to enable run staging.
Shutdown ESD	The station is in an emergency shut down (all valves closed).
Shutdown DirChg	The station is shut down while a flow direction change is about to start.

Initial Rank This is the rank the station will demand when you click the **Initialize** button.

Initialize Click this button to initialize run staging based on your entries in the Run Staging Configuration screen.

Rank Values Rank refers to the order in which a run is opened or closed, as flow varies through the station. The run ranked 1 will open first, to meet any demand for flow. The runs ranked 2 and higher will open as the flow through the station increases and more runs are required.

You assign ranks on the Run Mapping screen.

Maximum Rank The highest possible ranked meter run (tube) that can be opened for this station. This is equivalent to the number or runs assigned to the station, so if a station has 4 meter runs assigned to it, the maximum rank is 4.

Current Rank The highest ranked tube (meter run) currently open.

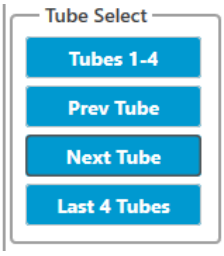
Requested Rank This is the highest ranked tube (meter run) which should be opened to meet the current requested demand. Because the valves for a tube open sequentially by rank, the requested rank might not be the same as the current rank.

Station Info

Station Flow Rate The current flow rate for the selected station.

Tube Control

Tube Select



The Tube select buttons are only visible if there are more than 4 tubes in the application. You can use them to move through the tubes in the application. If a particular option is not possible, that button disappears.

Tubes 1-4 Jump to show the first four tubes.

Prev Tube Scroll to show the previous tube.

Next Tube Scroll to show the next tube.

Last 4 Tubes Jump to show the last four tubes.

Tube *n*

Tube ID A name assigned to the tube.

Tube Status Reports the current status of the tube:

- **Config Fail** Invalid configuration for tube switching. This occurs when the run's low switch point is higher than the previous run's high switch point.
- **Disabled** Tube switching configuration and data are valid, but meter run staging is disabled.
- **Maint Mode** The corresponding meter run is in maintenance mode and meter run staging is disabled.
- **Normal** Tube switching configuration and data are valid, but meter run staging is disabled.
- **PV Fail** The process variable's questionable data bit (Q-Bit) is TRUE.
- **Q-Bit Fail** The flow rate calculated for the station is questionable.

	Shutdown The run is closed due to a shutdown command.
Target Rank	The rank configured for this run. When the requested rank matches the target rank, the run of that target rank opens. When the run opens, the current rank should match the target rank.
PV Value	The current value for the process variable associated with the tube. Depending on the configuration, this could be DP, flow rate, or velocity.
Valid Flow Limit	If the **Check Flow to Switch Tubes** feature is selected in the Station Settings section of the Run Staging Configuration screen, the process variable must exceed this limit for flow to be validated. In practical terms, when a run is requested to open, the actual rank will not be updated until the flow validation number is exceeded. If it fails to be exceeded prior to the end of the travel time, the run is marked as failed and the next higher-ranked run is requested.
Call Next Setpoint	The next setpoint is in the same units as the process variable and used to determine whether or not to increment the **Requested Rank** to thereby open an additional tube/meter run.
Next Deadband	The process variable must exceed the value of **Call Next Setpoint** for the number of seconds in **Next Deadband** before FBxStation Control changes the **Requested Rank**.
Call Prev. Setpoint	**Call Prev Setpoint** is in the same units as the process variable and used to determine whether or not to decrement the **Requested Rank**.
Prev. Deadband	The process variable must be less than the value of **Call Prev Setpoint** for the number of seconds in the **Prev DeadBand** field before FBxStation Control changes the **Requested Rank**.
A/M	Click this button to move the tube into the opposite state; auto to manual or manual to auto. The current state of the tube is shown to the right of the button:
	Auto When in auto mode, the **Called To** setting is determined by the tube switching logic.

	Manual — When in manual mode, you can change the **Called To** setting yourself from this page
Called To	This is the command to the tube. When the tube is in Auto mode, tube switching logic determines how to set this command. When the tube is in Manual mode, you can set this command yourself on the Valve tab.
Tube Fail	Shows whether the tube has failed. If there is no failure, shows “OK.”
Block Valve *n* **OLS CLS**	Shows the state of the open limit switch (OLS) and close limit switch (CLS). Possible states are: X — Red with white “X” – This limit switch is energized. Gray – This limit switch is not energized. Yellow – The valve is traveling.
Reset	If an error occurs in the meter run staging sequence that causes a meter run (or runs) to improperly open or shut, you must reset the staging sequence as follows: 1. Determine the root cause of the error then correct the condition. Typical causes might include invalid DP or counts measurements, or incorrect settings for “next” or “previous. 1. Disable meter run staging. 2. Click **Reset**. 3. Re-initialize meter run staging. 4. Re-enable meter run staging.

Chapter 15. Bi-Directional Flow Control Monitor

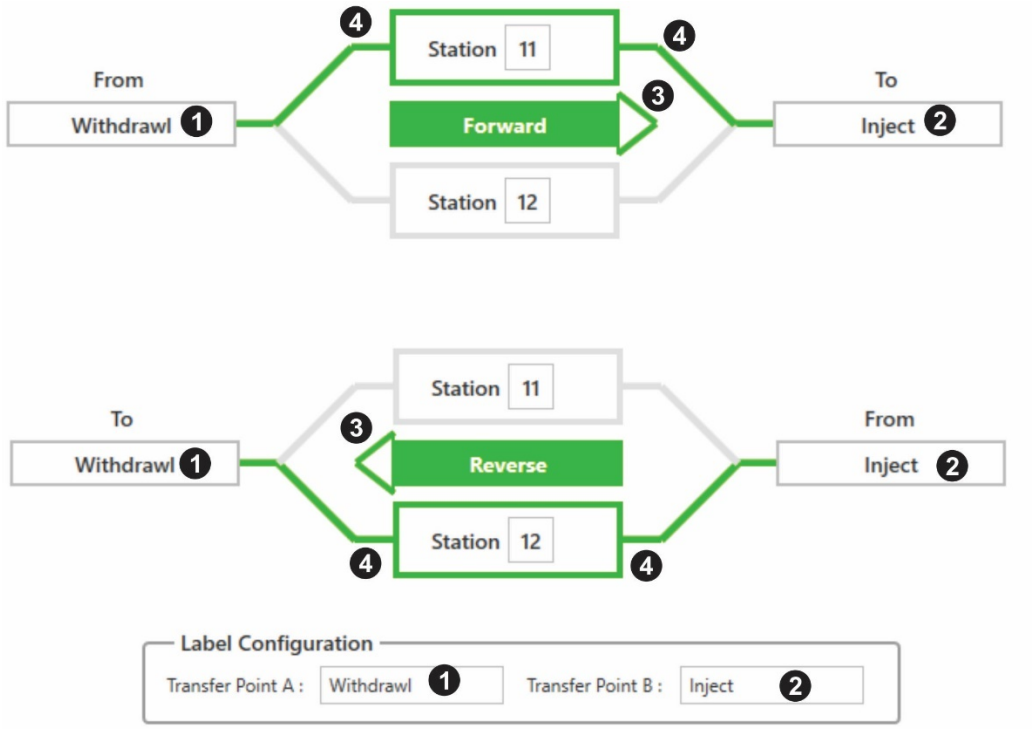
Tabs on the Bi-Directional Flow Control Monitor provide data on the current status of each station configured for bi-directional flow control.

To reach the Bi-Directional Flow Control Monitor screen, select **Bi-Directional Control Monitor** from the Station Control application menu in FBxConnect.

Once you select a station, the tab appropriate for the direction indication method for that station opens and populates with the most recent data from the station. You can update the data on the tab by clicking **Refresh**.

On each tab, the **Current Rates & Totals** section shows the direction of flow.

Figure 15-1. Flow Direction depicted in Current Rates & Totals



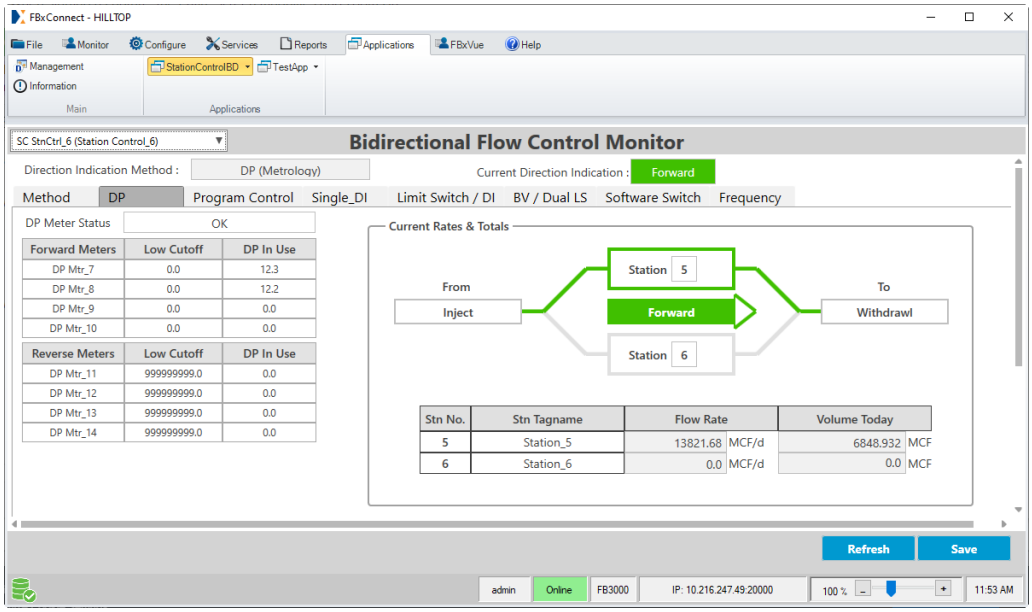
1	The **Transfer Point A** field on the corresponding configuration display determines the text shown in the left of the graphic.
2	The **Transfer Point B** field on the corresponding configuration display determines the text shown in the right of the graphic.
3	Arrow and text show direction of flow.
4	The station currently in control of flow is highlighted in **green**.

The sections that follow cover each tab in the Bi-Directional Flow Control Monitor.

15.1 DP (Metrology)

If you chose **DP (Metrology)** to determine flow direction, you can view the following:

Figure 15-2. Bi-Directional Control - DP



Current Direction Indication	Shows **Forward** for forward flow or **Reverse** for reverse flow.
DP Meter Status	The status can be one of the following: **OK** — Forward/Reverse meters configured correctly. **Number DP Meters Unequal** — The number of meters for forward and reverse stations do not match.
Forward Meters/ Reverse Meters	Shows the name of the meter.
Low Cutoff	Shows the low flow cutoff limit for this meter.
DP in Use	Shows the current differential pressure value for this meter.

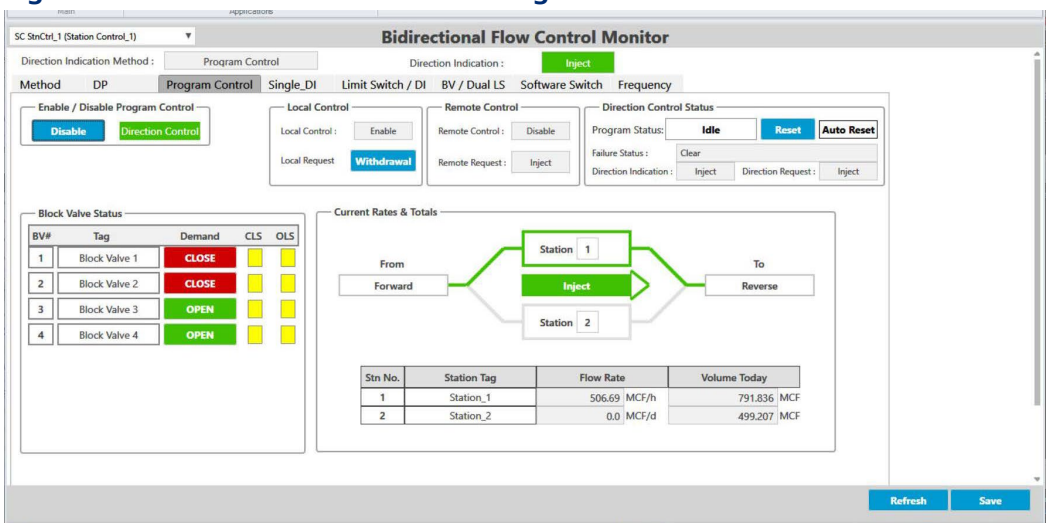
Current Rates & Totals

Stn No.	Shows the station number.
Stn Tagname	Shows the name for the station.
Flow Rate	Shows the current flow rate for the station.
Volume Today	Shows the calculated flow volume for the day for this station.

15.2 Programmed Control

If you chose **Programmed Control** to determine flow direction, you can view the following:

Figure 15-3. Bi-Directional Control – Programmed Control



Enable / Disable Program Control

Direction Control When Program Control is disabled, the Block Valve Demand indicators change to buttons, allowing manual control of each valve. Choose either:

- **Enabled** Click **Enabled** to enable program control to choose flow direction.
- **Disabled** Click **Disabled** to disable program control over flow direction.

Local Control

Local Control Shows either:

- **Enable** You can change the flow direction from this screen.
- **Disable** You cannot change the flow direction from this screen.

Local Request Click **Forward** (or **Delivery** or **Inject**) to request forward flow or **Reverse** (or **Receipt** or **Withdrawl**) to request reverse flow.

Remote Control

Remote Control Shows either:

- **Enable** Indicates that a remote SCADA system can change the flow direction.
- **Disable** Indicates that a remote SCADA system **cannot** change the flow direction.

Remote Request Shows the most recent direction request from the SCADA system:

- **Forward** Indicates that the SCADA system's last request was for forward flow.
- **Reverse** Indicates that the SCADA system's last request was for reverse flow.

Direction Control Status

Program Status Possible status values are:

- **Active** Currently switching direction.
- **Disabled** Programmed control not enabled.
- **External ESD** External ESD (emergency shut down) from Station Control input.
- **Fail ESD All** ESD (emergency shut down) fail mode. All valves shut.
- **Fail ESD Step** ESD (emergency shut down) fail mode. Proceeding in step mode.

Failing	One or more valves not in correct position.
Fail-Paused	Pause fail mode complete.
FailReset-Paused	Maximum number of reset attempts reached. Auto-Reset is paused.
Fail-Resetting	Auto-Reset currently in progress.
Fail-Rvrtd	Revert fail mode complete.
Idle	Waiting for direction change.
Reverting	Revert fail mode active.
Startup	Programmed control initially enabled.

Auto Reset

Note: Auto-Reset is only visible if it has been enabled on the Station Control Config Programmed Control tab.

Auto Reset	Auto Reset shows green if an auto reset is in progress.
Auto Reset	Auto Reset shows red if the maximum number of reset attempts has been reached.

Failure Status Shows the Valve number and Step number which caused the failure, for example: Valve1, Step1

Reset If a failure occurs, no further action occurs until you click the **Reset** button.

Direction Indication Shows the current flow direction.

Direction Request Shows the current demanded direction.

Block Valve Status

BV# Shows the block valve number.

Tagname Shows the block valve name.

Demand	Shows the currently demanded position for the block valve. When Program Control is enabled, the demand indicators display the currently demanded position of each valve. When control is disabled, the indicators change to buttons to allow manual control of each valve, and the button text indicates the valve command when activated.
CLS / OLS	Shows the current state of the OLS (open limit switch) and CLS (closed limit switch). Possible states are:

- Red with white "X" – This limit switch is energized (ON).
- Gray – This limit switch is not energized (OFF).
- Yellow – Valve is traveling.

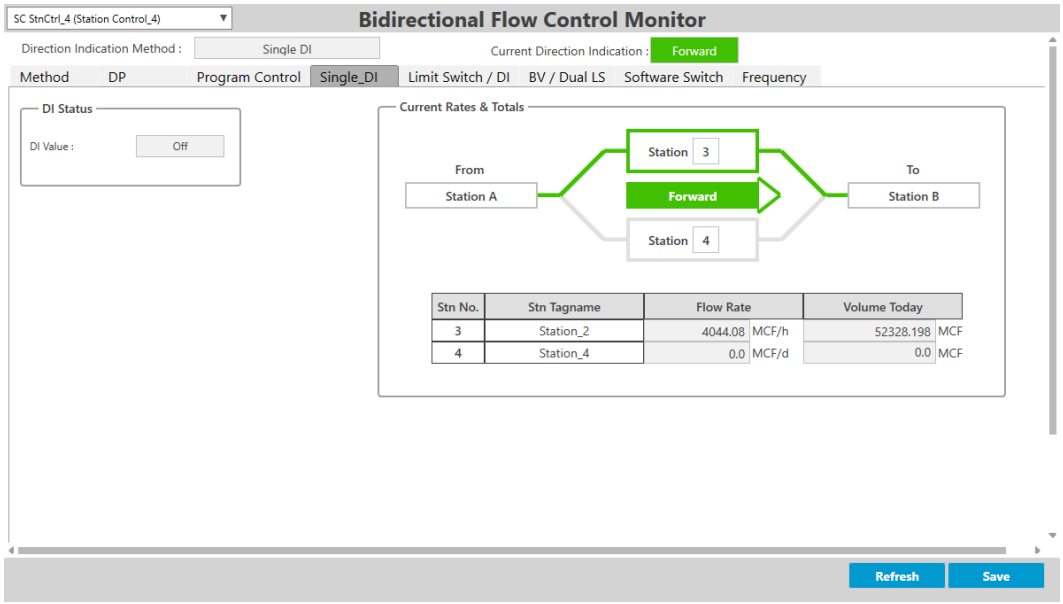
Current Rates & Totals

Stn No.	Shows the station number.
Stn Tagname	Shows the name for the station.
Flow Rate	Shows the current flow rate for the station.
Volume Today	Shows the calculated flow volume for the day for this station.

15.3 Single DI

If you chose **Single DI** to determine flow direction, you can view the following:

Figure 15-4. Bi-Directional Flow – Single DI



<u>DI Status</u>

DI Value	Shows the current state of the digital input that chooses the flow direction.

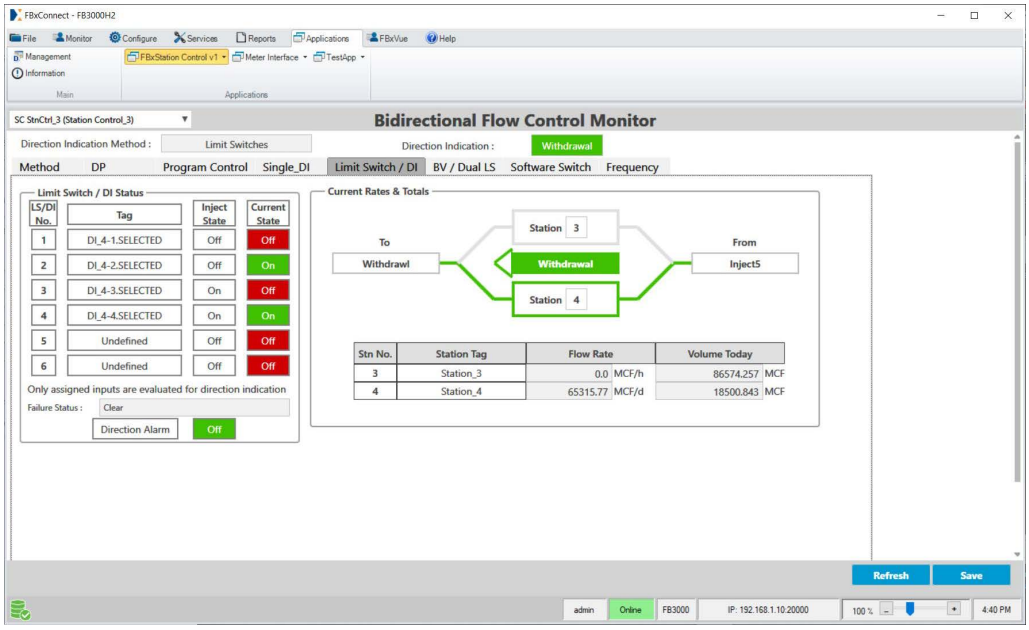
<u>Current Rates & Totals</u>

Stn No.	Shows the station number.
Stn Tagname	Shows the name for the station.
Flow Rate	Shows the current flow rate for the station.
Volume Today	Shows the calculated flow volume for the day for this station.

15.4 Limit Switches

If you chose **Limit Switches** to determine flow direction, you can view the following:

Figure 15-5. Bi-Directional Control – Limit Switch



Limit Switch / DI Status

LS/DI No. Shows the number of the open limit switch / digital input. **Note**: If a particular limit switch has no digital input assigned to it, it is not examined when determining the flow direction.

Tagname Shows the tag in the FB3000 that provides the status of the limit switch or digital input.

Forward State Forward State:

- **Off** Indicates that this LS/DI is Off when flow is in the forward state.
- **On** Indicates that this LS/DI is On when flow is in the forward state.

Current State Shows the current state of the limit switch/DI. **Off** is shown highlighted in **red**, **On** is shown highlighted in **green**.

Failure Status In a failure, shows the valve number which caused the failure; otherwise shows **Clear.**

Direction Alarm Each defined limit switch is evaluated to see if its **Current State** differs from the specified **Forward State**. If any such limit switch differs from the **Forward**

State, it triggers a direction alarm. If the status of the alarm is Off, there is no discrepancy between **Current State** and **Forward State.**

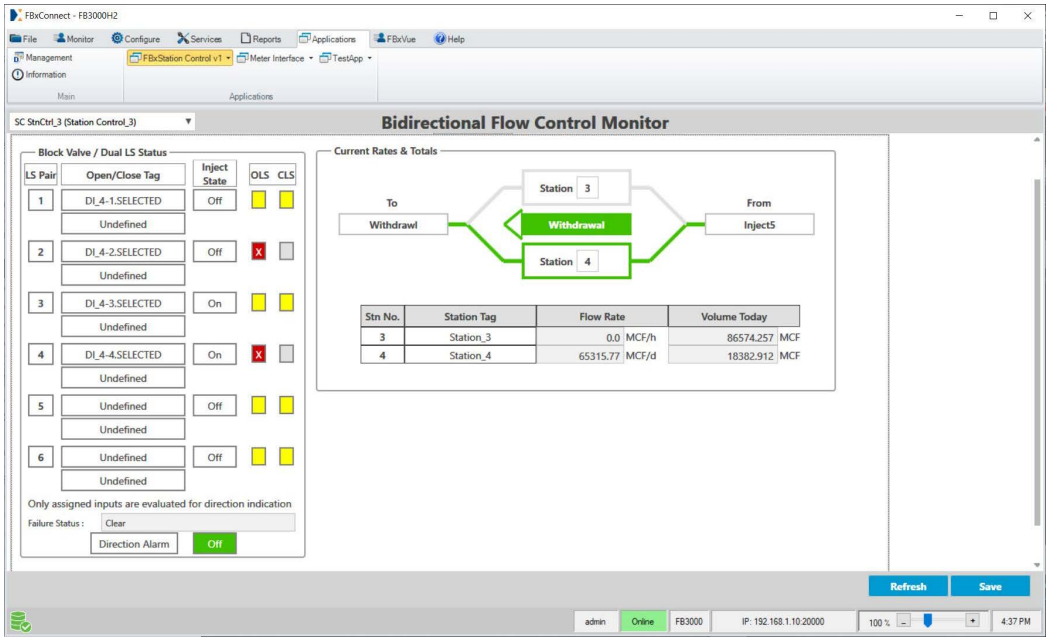
Current Rates & Total

Stn No.	Shows the station number.
Stn Tagname	Shows the name for the station.
Flow Rate	Shows the current flow rate for the station.
Volume Today	Shows the calculated flow volume for the day for this station.

15.5 Dual Limit Switches

If you chose **Dual Limit Switches** to determine flow direction, you can view the following:

Figure 15-6. Dual Limit Switches



Block Valve / Dual LS Status

LS Pair	Identifies the number of the pair of limit switches for a valve, one which turns on when the valve is fully open, the other which turns on when the valve is fully closed.

Open/Close Tagname

The upper box shows the tag in the FB3000 for the open limit switch for this valve.

The lower box shows the tag in the FB3000 for the closed limit switch for this valve.

Fwd State

Forward state

On Indicates that when flow for this pair of limit switches is in the forward direction, the open limit switch should be **on**.

Off Indicates that when flow for this pair of limit switches is in the forward direction, the open limit switch should be **off**.

OLS/CLS

Shows the current state of the OLS (open limit switch) and CLS (closed limit switch). Possible states are:

X Red with white "X" – This limit switch is energized.

Gray – This limit switch is not energized.

Yellow – The valve is traveling.

Failure Status

In a failure, shows the valve number which caused the failure; otherwise shows **Clear.**

Direction Alarm

Each defined limit switch is evaluated to see if its **Current State** differs from the specified **Forward State**. If any such limit switch differs from the **Forward State,** it triggers a direction alarm. If the status of the alarm is Off, there is no discrepancy between **Current State** and **Forward State.**

Current Rates & Totals

Stn No.

Shows the station number.

Stn Tagname

Shows the name for the station.

Flow Rate

Shows the current flow rate for the station.

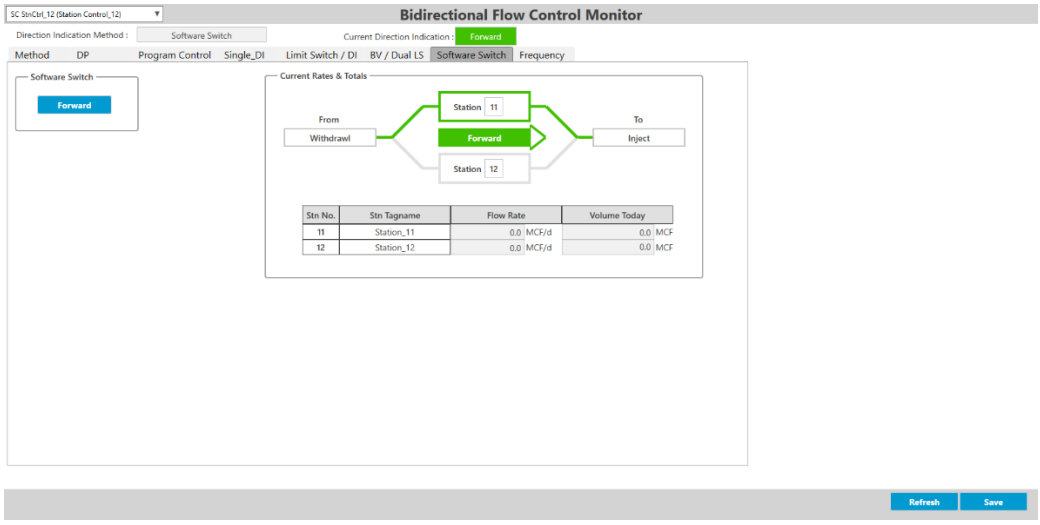
Volume Today

Shows the calculated flow volume for the day for this station.

15.6 Software Switch

If you chose **Software Switch** to determine flow direction, you can view the following:

Figure 15-7. Bi-Directional Control – Software Switch



Software Switch

Click **Forward** to toggle flow to the forward direction.

Click **Reverse** to toggle flow to the reverse direction.

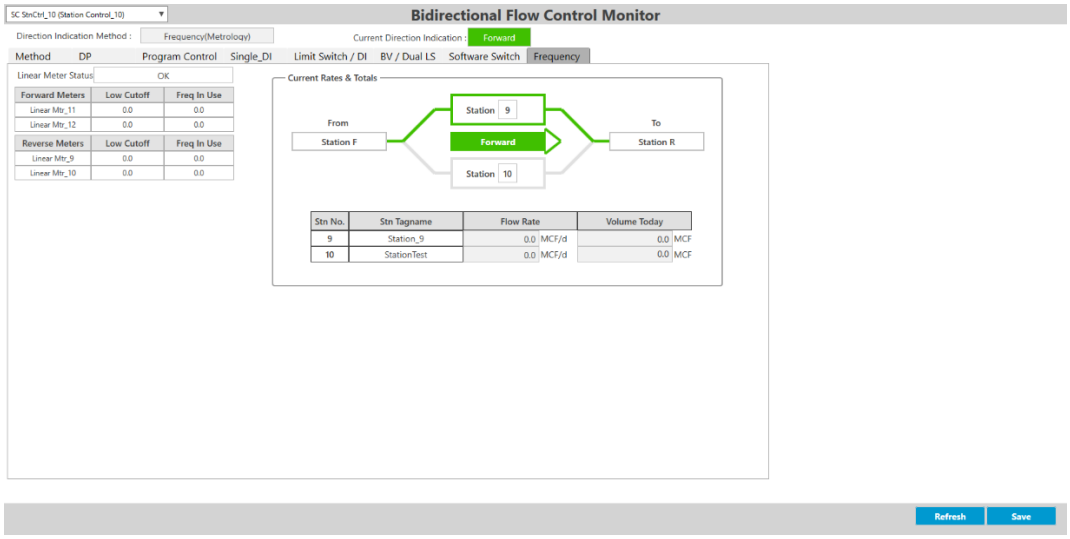
Current Rates & Totals

Stn No.	Shows the station number.
Stn Tagname	Shows the name for the station.
Flow Rate	Shows the current flow rate for the station.
Volume Today	Shows the calculated flow volume for the day for this station.

15.7 Frequency (Metrology)

If you chose **Frequency (Metrology)** to determine flow direction, you can view the following:

Figure 15-8. Bi-Directional Control - Frequency



Linear Meter Status — Shows the status of the linear meter currently in use. The status can be one of the following:

OK	Forward/Reverse meters configured correctly.
Number Linear Meters Unequal	The number of meters for forward and reverse stations do not match.

Forward Meters / Reverse Meters — Identifies the name of the linear meters used in the specified direction.

Low Cutoff — When flow drops below this value, valves for the station close.

Freq in Use — Shows the frequency used for this meter.

<u>Current Rates & Totals</u>

Stn No. — Shows the station number.

Stn Tagname — Shows the name for the station.

Flow Rate — Shows the current flow rate for the station.

Volume Today — Shows the calculated flow volume for the day for this station.

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