



Human Machine Interface User Manual

Willow Run Powertrain Groundwater Collection System





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Appendix A	List of HMI Screens
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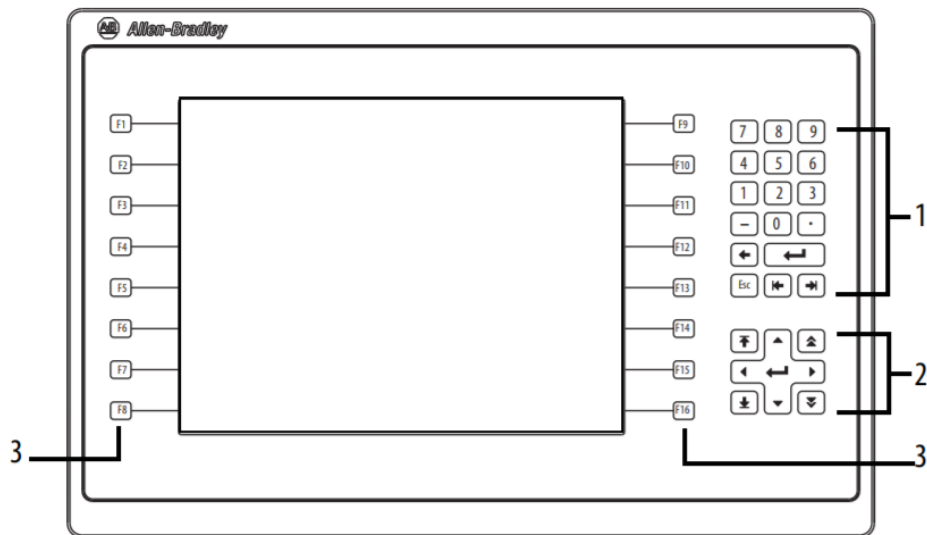
List of Acronyms

HMI	Human Machine Interface
PLC	Programmable Logic Controller
LI	Level Indication
FI	Flow Indication
FQI	Flow Quantity Indication
KI	Runtime
QI	Start Counter
HH	High-High
H	High
L	Low
LL	Low-Low
VFD	Variable Frequency Drive
CV	Control Value

1. Human Machine Interface

A Human Machine Interface (HMI) is a piece of hardware that displays information to the user in various forms; graphics, text, color indications, alarms, historical data and trends. The HMI receives this information typically from a Programmable Logic Controller (PLC) and displays it in such a way that is intuitive to the user.

This facility uses an Allen Bradley PanelView Plus7 Performance HMI Terminal, running Rockwell's FactoryTalkView Machine Edition software. The PanelView Plus7 Performance HMI Terminal has touch screen capabilities, along with physical keys on the front of the unit. Most actions performed on the HMI can utilize both features; touch screen and physical keys.



Item	Feature	Description
1	Numeric keypad	Contains numeric, decimal, minus, and the following keys: - Backspace - deletes the character to the left of the insertion point. - Enter - inputs the currently highlighted key or enters a blank line if the insertion point is in the text box of the virtual keyboard. - Tab-left, Tab-right - selects the previous or next control or input element. - Esc - cancels or dismisses a dialog.
2	Navigation keys	Provides navigation control. - Arrow keys - selects a key on the virtual keyboard that is above, below, left, or right of the selected key. Moves the cursor in selected direction if in the text box. - Home/End - moves the insertion point to the beginning or end of a text or numeric entry field. - Page up/Page down - goes to the next or previous pages of a list.
3	Function keys 6.5-in. terminal 10-in. terminal 15-in. terminal	Performs specific commands if events are configured for a screen or any of its graphic elements. For example, F1 can be configured to navigate to another screen. - F1...F6 and F7...F12 - F1...F8 and F9...F16 - F1...F10 and F11...F20

Figure 1.1: Allen Bradley PanelView Plus7 Performance Human Machine Interface Terminal

When powering up or resetting the HMI terminal, the restore process begins, which takes a few minutes to run through a series of diagnostic checks before the application is ran.

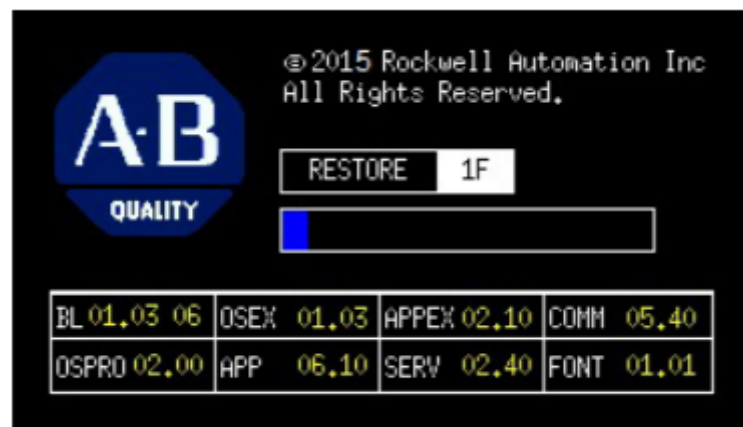


Figure 1.2: Allen Bradley Restore Screen on HMI

1.1 Login User

Once the restore process and diagnostics have completed, the application's **Login Screen** will be displayed. The Login Screen prevents unwanted users from using the application by requiring a username and password before being allowed to navigate to another screen.

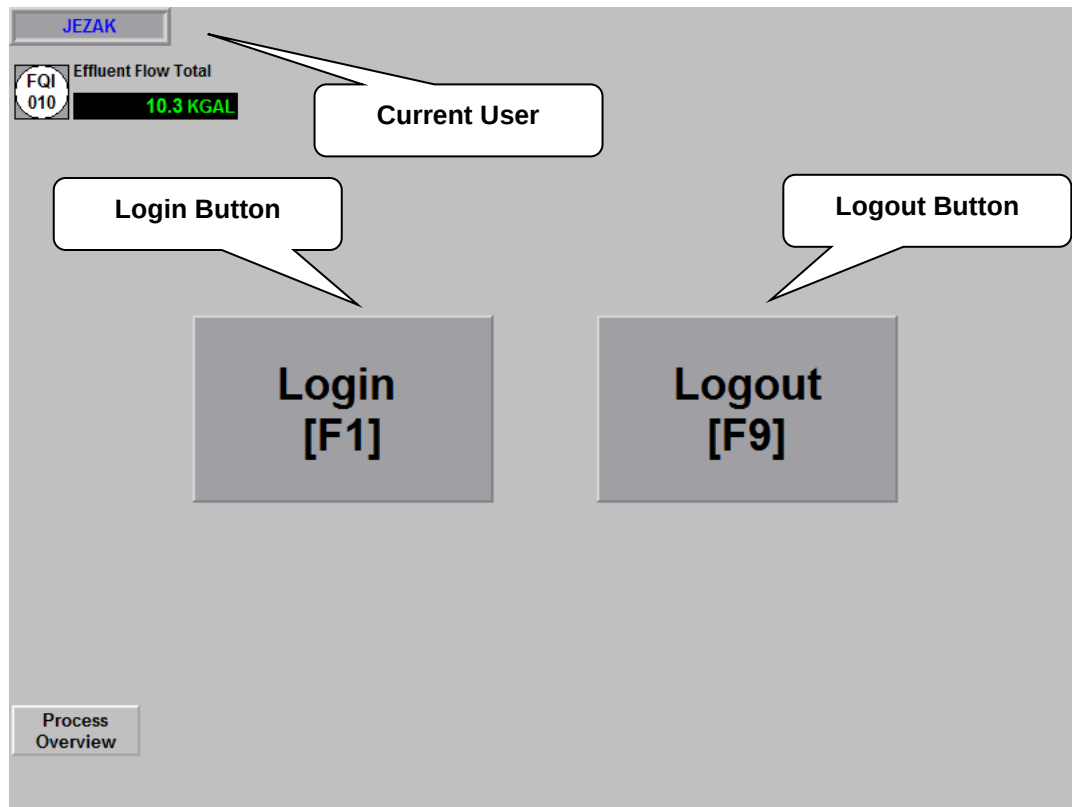


Figure 1.3: Login Screen - Initial HMI Display

The application automatically logs in the Default user, which has no security rights. Once a user logs in, it will grant access to various features; screen navigation, equipment controls, settings, diagnostics and information. Depending on the user's credentials and responsibilities, their approved login will unlock features only they are mainly responsible for. Other features outside of their responsibility will remain hidden or inaccessible.

To login, press the **Login** button on the screen or the **[F1]** function key on the terminal to display the **Login Popup** window. Press the **User Name** button on the screen or the **[F2]** function key on the terminal to type in a username. An on-screen keyboard will be displayed for the user to type in their information. Press the **Enter key (<J>)** on the screen or the terminal to accept the entered username and to return to the Login Popup window. Repeat similar steps to enter the associated password for the username. Once both username and password have been entered, press **Login** button on the popup or the Enter key (<J>) on the terminal to verify credentials. If successful, the blue username displayed in the upper-left corner of the screen will update to the current user.

A screenshot of a 'Login' popup window. The window has a light blue title bar with the word 'Login' in black. The main area is white and contains two input fields. The first field is labeled 'User Name' with '[F2]' below it, and the second is labeled 'Password' with '[F3]' below it. To the right of the first field is a button labeled 'Login' with '[Enter]' below it. To the right of the second field is a button labeled 'Cancel' with '[Esc]' below it. At the bottom of the window is a label 'Result:' followed by a wide, empty text box.

Figure 1.4: Login Popup

The user may navigate to the Login Screen and logout manually by pressing the **Logout** button on the screen or the **[F9]** function key on the terminal. Alternatively, if the application remains unused for a duration of time, the current user will be automatically logged out returning to the Default user, and the Login Screen will be displayed.

It should be noted that if multiple users are logged into the system remotely at the same time the screen locally and remotely will show all the movements by any of the users.

If further inactivity ensues, a screen saver will be displayed which dims the backlight and displays a moving image. The screen saver extends the life of the display. To clear the screen saver and return to the application, touch the screen or any function key on the terminal.

The only information the Login Screen shows is the Effluent Flow Total (in kilo-gallons) for the entire facility on the upper-left section of the screen. This information is for outside parties who do not have user credentials to access the application.

2. Common Features

Throughout the application, each screen will represent its specific area appropriately while maintaining common representation and controls. The following sections will explain these common features displayed throughout the application.

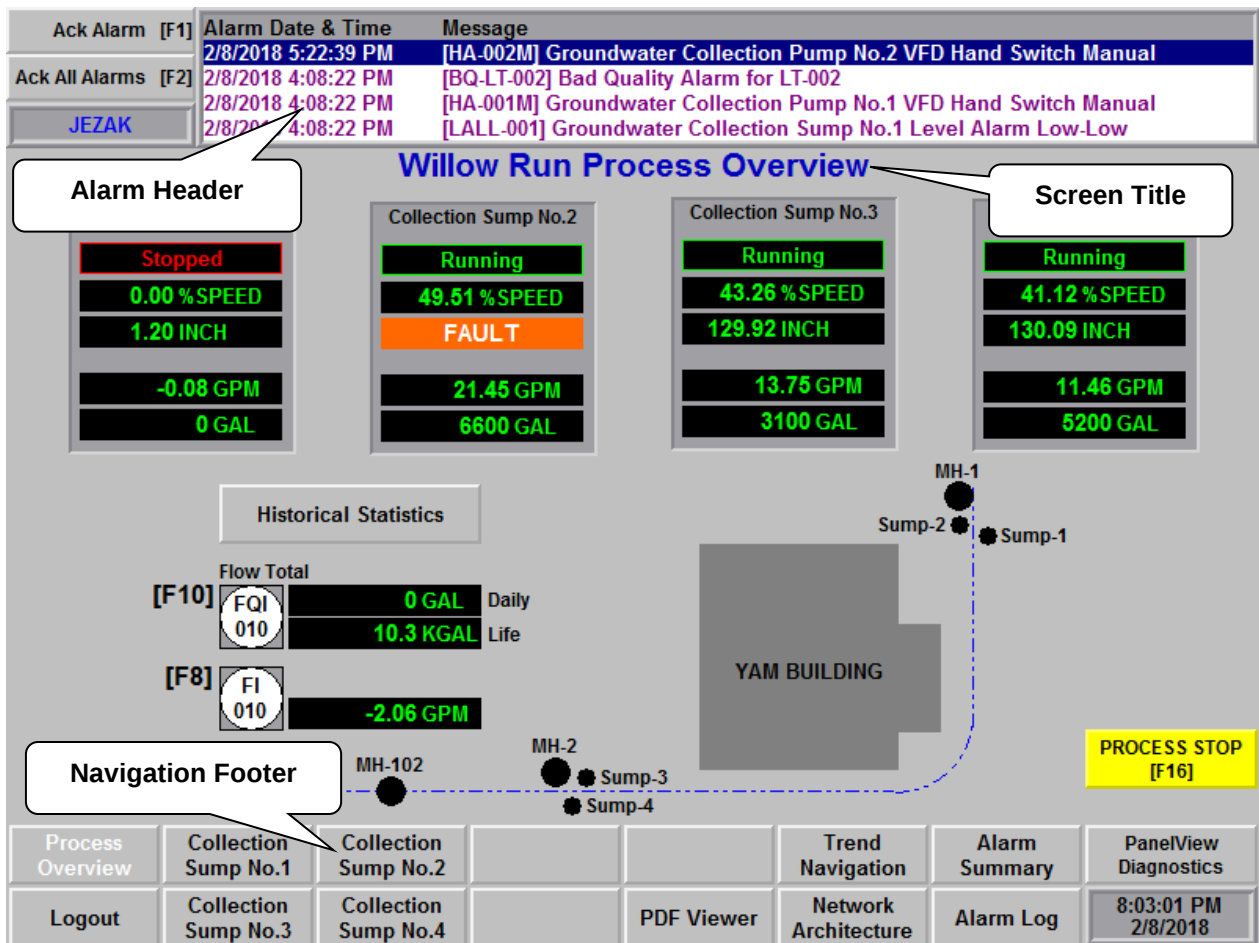


Figure 2.1: Common Features to Process Screens

2.1 Alarm Header

The Alarm Header at the top of each screen displays and manages abnormal situations within the application. These alarms should be further investigated in the field with attempts to clear and prevent alarm occurrences in the future. A healthy system will have no alarms listed.

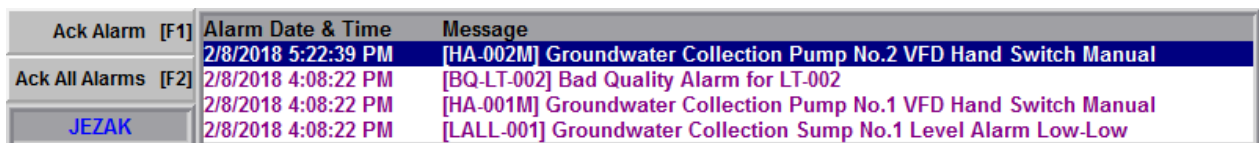


Figure 2.2: Alarm Header

In the middle of the Alarm Header is the **Alarm Summary**. The Alarm Summary displays active alarms with the triggered **Alarm Date**, **Alarm Time** and **Alarm Tag with Message**. Four active alarms can be viewed at once, with the most recent alarm listed at the top. On the terminal there are **Up and Down Arrow** keys, which allows the user to scroll through the various alarms that are active using the highlight cursor if there are more than four active alarms within the application.



The Alarm Summary lists each alarm that is presently active & unacknowledged, active & acknowledged and alarms that have returned to normal from an alarm state but are unacknowledged. Colors for the different alarm states are as followed:

- **Alarm Active & Unacknowledged:** Blinking Red and White Text
- **Alarm Active & Acknowledged:** Solid Purple Text
- **Alarm Returned to Normal & Unacknowledged:** Blinking Green and White Text
- **Alarm Returned to Normal & Acknowledged:** Not Listed in Alarm Summary

On the far left of the Alarm Header, are **Acknowledgment** buttons for the Alarm Summary displayed in the middle of the header. Required user acknowledgement prevents alarms from going undetected while the application is not being viewed. All alarms must be acknowledged and fixed in the field before it is removed from the Alarm Summary.

Ack Alarm [F1]: Acknowledges one alarm, which is presently active and highlighted in the Alarm Summary.

Ack All Alarms [F2]: Acknowledges all of the alarms, which are presently active in the Alarm Summary. Not all alarms may be presently viewable in the Alarm Summary if there are more than four active alarms within the application. It might be required to scroll down to see all alarms.

Below the Alarm Summary Buttons is a display that shows the current user logged into the application. This indication will change depending on which user logs into the system.

The Programmable Logic Controller (PLC) operates the facility while in RUN MODE. If the PLC is taken out of RUN MODE (physical key on processor or within its program), a display status will indicate that the **"PLC IS NOT IN RUN MODE"** for the specific PLC. This is an indication that the system is no longer operational and an Automation Engineer should be contacted.

2.2 Alarm Indications

The process section of the screens will also display the various alarm states to the user, giving a better representation of the alarm condition and location within the facility. The **Alarm Indications** will be displayed in a white box near the associated gray process tag block. Alarm Indicators will use the same color states as the Alarm Summary. [\[See Section 2.1 ALARM HEADER\]](#)

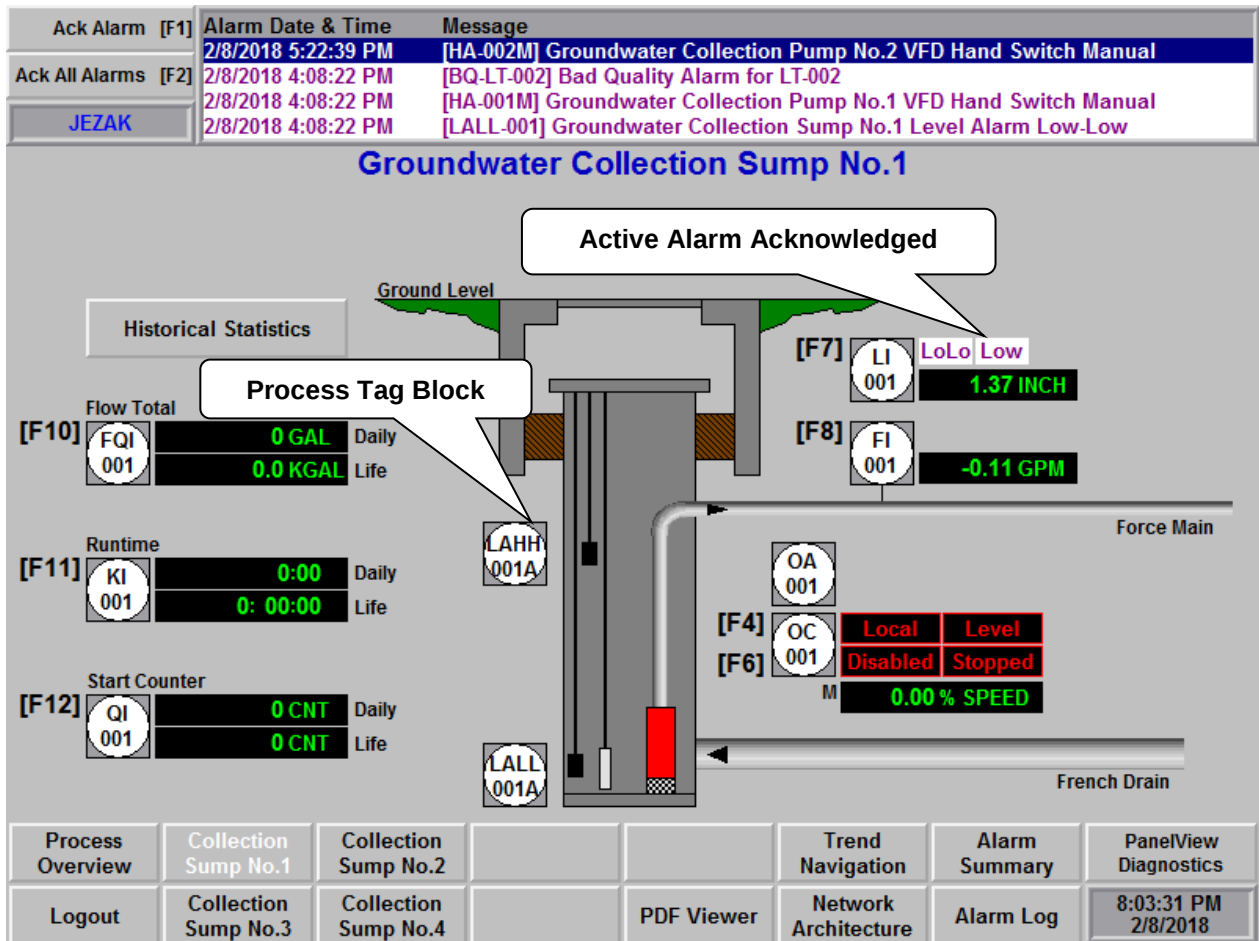


Figure 2.3: Alarm Indications

If the process value or control value has faulted, its numeric display and numeric bar filler will be covered up with an orange box, with white text stating **Fault**. Once the Fault condition has been resolved, the regular numeric displays will be restored.

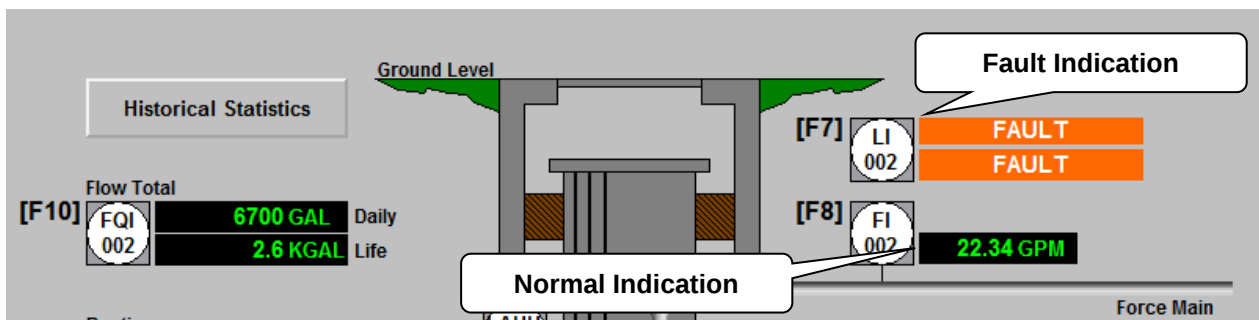


Figure 2.4: Fault Indications

2.3 Navigation Footer

The Navigation Footer is at the bottom of each screen and primarily calls other screens, allowing the user to navigate throughout the application.



Process Overview	Collection Sump No.1	Collection Sump No.2			Trend Navigation	Alarm Summary	PanelView Diagnostics
Logout	Collection Sump No.3	Collection Sump No.4		PDF Viewer	Network Architecture	Alarm Log	8:04:03 PM 2/8/2018

Figure 2.5: Navigation Footer

On the far left of the Navigation Footer are navigation buttons that enables the user to move to various process screens. When the user presses the various navigation buttons, the process screen will change accordingly. The current screen's associated navigation button text will change from black to white, indicating to the user that they are already on that screen.

On the far right of the Navigation Footer are navigation buttons that are primarily used for diagnostics and information; **Alarm Summary**, **Alarm Log**, **Trend Navigation**, **PDF Viewer**, **Network Architecture** and **PanelView Diagnostics**.

2.4 Alarm Summary

The Alarm Summary button will call a popup that displays a bigger Alarm Summary (compared to the one stationed in the Alarm Header). This enables the user to be able to view more than four active alarms. Lined at the top are the Alarm Summary Buttons for the present Alarm Summary Popup. This Alarm Summary will have the same features as the one in the Alarm Header. The popup itself cannot be resized, but can be closed by pressing the white X in the red button on the screen or the **[F9]** function key on the terminal.

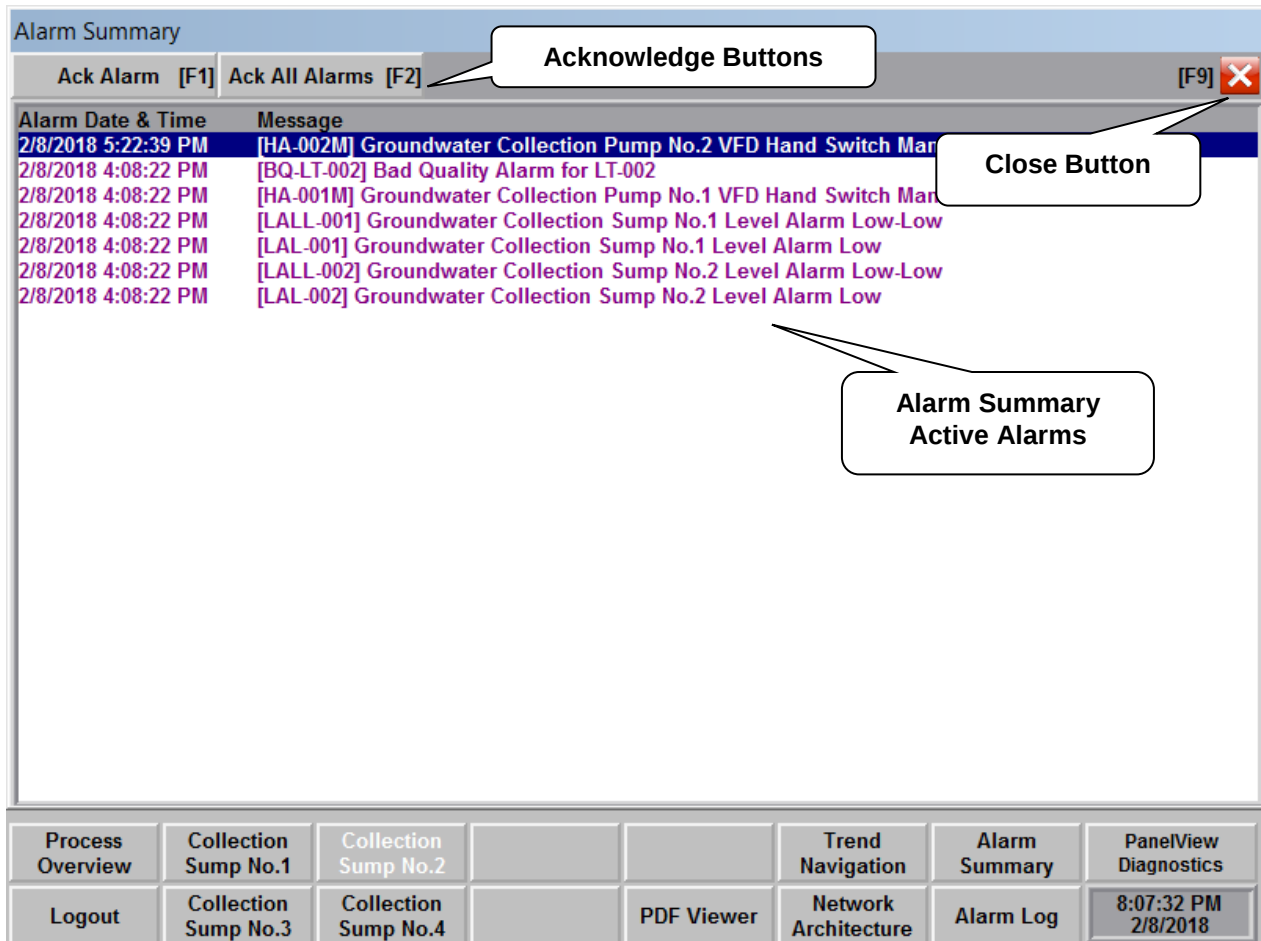


Figure 2.6: Alarm Summary Popup

2.5 Alarm Log

The Alarm Log button will call up the Alarm Log popup that displays a history of all alarm states and acknowledgements that the application has experienced over a duration of time. The Alarm Log displays Alarm Date, Alarm Time, Acknowledged Date and Time and Tag Name with Message. The popup itself cannot be resized, but can be closed by pressing the white X in the red button on the screen or the **[F9]** function key on the terminal.

Certain users will have access to the **Clear Alarm Log** button. This button clears all alarm states from history, leaving no recorded alarms in the Alarm Log. If the button is visible, the user can press the button on the screen or the **[F1]** function key on the terminal to perform the clearing action.



Alarm Log

Clear Alarm Log [F1]

Clear Button

Close Button

[F9] X

Alarm Date & Time	Acknowledge Time	Message
2/8/2018 8:06:53 PM	2/8/2018 8:07:24 PM	[BQ-FIT-002] Bad Quality Alarm for FIT-002
2/8/2018 7:54:27 PM	2/8/2018 7:58:33 PM	[FAL-004] Groundwater Collection Sump No.4 Flow Alarm Low
2/8/2018 7:48:24 PM	2/8/2018 7:48:35 PM	[FALL-003] Groundwater Collection Sump No.3 Flow Alarm Low-Low
2/8/2018 7:47:58 PM	2/8/2018 7:48:35 PM	[FAL-003] Groundwater Collection Sump No.3 Flow Alarm Low
2/8/2018 7:22:31 PM	2/8/2018 7:24:30 PM	[FALL-003] Groundwater Collection Sump No.3 Flow Alarm Low-Low
2/8/2018 7:21:30 PM	2/8/2018 7:24:30 PM	[FAL-003] Groundwater Collection Sump No.3 Flow Alarm Low
2/8/2018 7:16:09 PM	2/8/2018 7:19:30 PM	[FAL-004] Groundwater Collection Sump No.4 Flow Alarm Low
2/8/2018 7:14:37 PM	2/8/2018 7:14:52 PM	[FALL-004] Groundwater Collection Sump No.4 Flow Alarm Low-Low
2/8/2018 7:14:25 PM	2/8/2018 7:14:52 PM	[FAL-004] Groundwater Collection Sump No.4 Flow Alarm Low
2/8/2018 5:23:59 PM	2/8/2018 5:24:07 PM	[FALL-002] Groundwater Collection Sump No.2 Flow Alarm Low-Low
2/8/2018 5:23:59 PM	2/8/2018 5:24:07 PM	[FAL-002] Groundwater Collection Sump No.2 Flow Alarm Low
2/8/2018 5:22:39 PM	2/8/2018 5:22:49 PM	[HA-002M] Groundwater Collection Pump No.2 VFD Hand Switch Manual
2/8/2018 4:30:45 PM	2/8/2018 4:33:44 PM	[FAHH-004] Groundwater Collection Sump No.4 Flow Alarm High-High
2/8/2018 4:30:44 PM	2/8/2018 4:33:44 PM	[FAH-004] Groundwater Collection Sump No.4 Flow Alarm High
2/8/2018 4:08:22 PM	2/8/2018 4:08:22 PM	[BQ-LT-002] Bad Quality Alarm for LT-002
2/8/2018 4:08:22 PM	2/8/2018 4:08:22 PM	[HA-002M] Groundwater Collection Pump No.2 VFD Hand Switch Manual
2/8/2018 4:08:22 PM	2/8/2018 4:08:22 PM	[HA-001M] Groundwater Collection Pump No.1 VFD Hand Switch Manual
2/8/2018 4:08:22 PM	2/8/2018 4:08:22 PM	[LALL-001] Groundwater Collection Sump No.1 Level Alarm Low-Low
2/8/2018 4:08:22 PM	2/8/2018 4:08:22 PM	[LAL-001] Groundwater Collection Sump No.1 Level Alarm Low
2/8/2018 4:08:22 PM	2/8/2018 4:08:22 PM	[LALL-002] Groundwater Collection Sump No.2 Level Alarm Low-Low
2/8/2018 4:08:22 PM	2/8/2018 4:08:22 PM	[LAL-002] Groundwater Collection Sump No.2 Level Alarm Low
2/8/2018 1:17:59 PM	2/8/2018 1:18:04 PM	[LAL-001] Groundwater Collection Sump No.1 Level Alarm Low
2/8/2018 1:17:54 PM	2/8/2018 1:18:04 PM	[LALL-001] Groundwater Collection Sump No.1 Level Alarm Low-Low
2/8/2018 1:17:44 PM	2/8/2018 1:18:04 PM	[BQ-LT-001] Bad Quality Alarm for LT-001
2/8/2018 11:40:24 AM	2/8/2018 11:42:09 AM	[FAH-003] Groundwater Collection Sump No.3 Flow Alarm High
2/8/2018 11:35:18 AM	2/8/2018 11:38:54 AM	[FAHH-004] Groundwater Collection Sump No.4 Flow Alarm High-High

Process Overview

Collection Sump No.1

Collection Sump No.2

Trend Navigation

Alarm Summary

PanelView Diagnostics

Logout

Collection Sump No.3

Collection Sump No.4

PDF Viewer

Network Architecture

Alarm Log

8:07:44 PM
2/8/2018

Figure 2.7: Alarm Log Popup

2.6 Trends

The Trend Navigation button displays another navigation screen in which the user will be able to view the various trends throughout the application. Currently there are seven trends the user can navigate to by pressing the desired button on the screen or the associated function key [F4] – [F7] & [F12] – [F14] on the terminal.

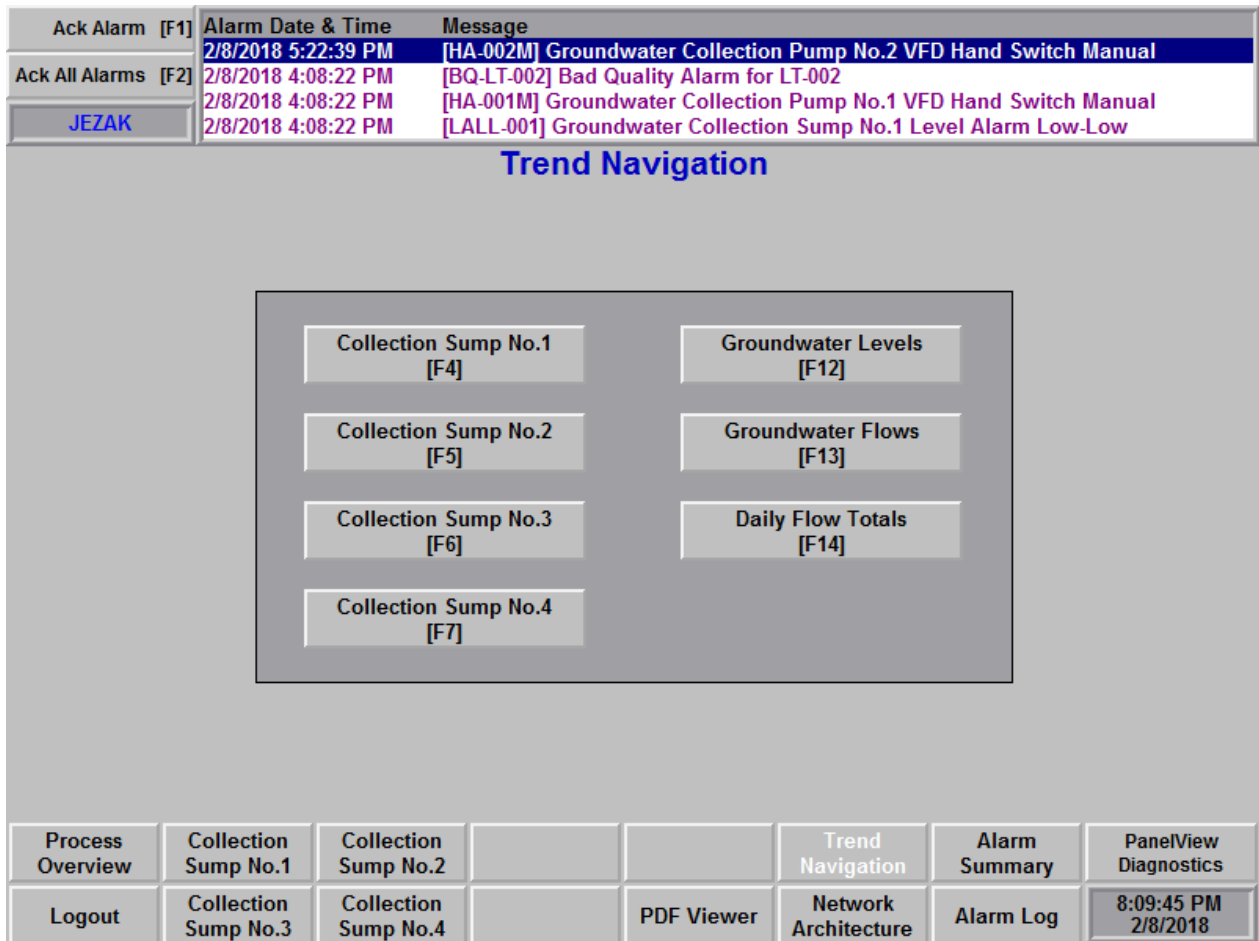


Figure 2.8: Trend Navigation Screen

When the user selects a trend from the Trends Navigation screen, it will display the desired **Historical Trend** and all of its associated pens. The historical pens that are being displayed on the trend are listed in the legend located on the far right column with their current values and engineering units. The vertical scale of the trend changes to reflect the scale of minimum and maximum values for the *selected* pen. Not all displayed pens within a trend have the same minimum and maximum values. To change the Y-Axis to a desired pen, press the **Next Pen** button on the screen or the **[F13]** function key on the terminal. This will cycle through the available pens for this specific trend, changing the color and the range of the Y-Axis to the desired pen.

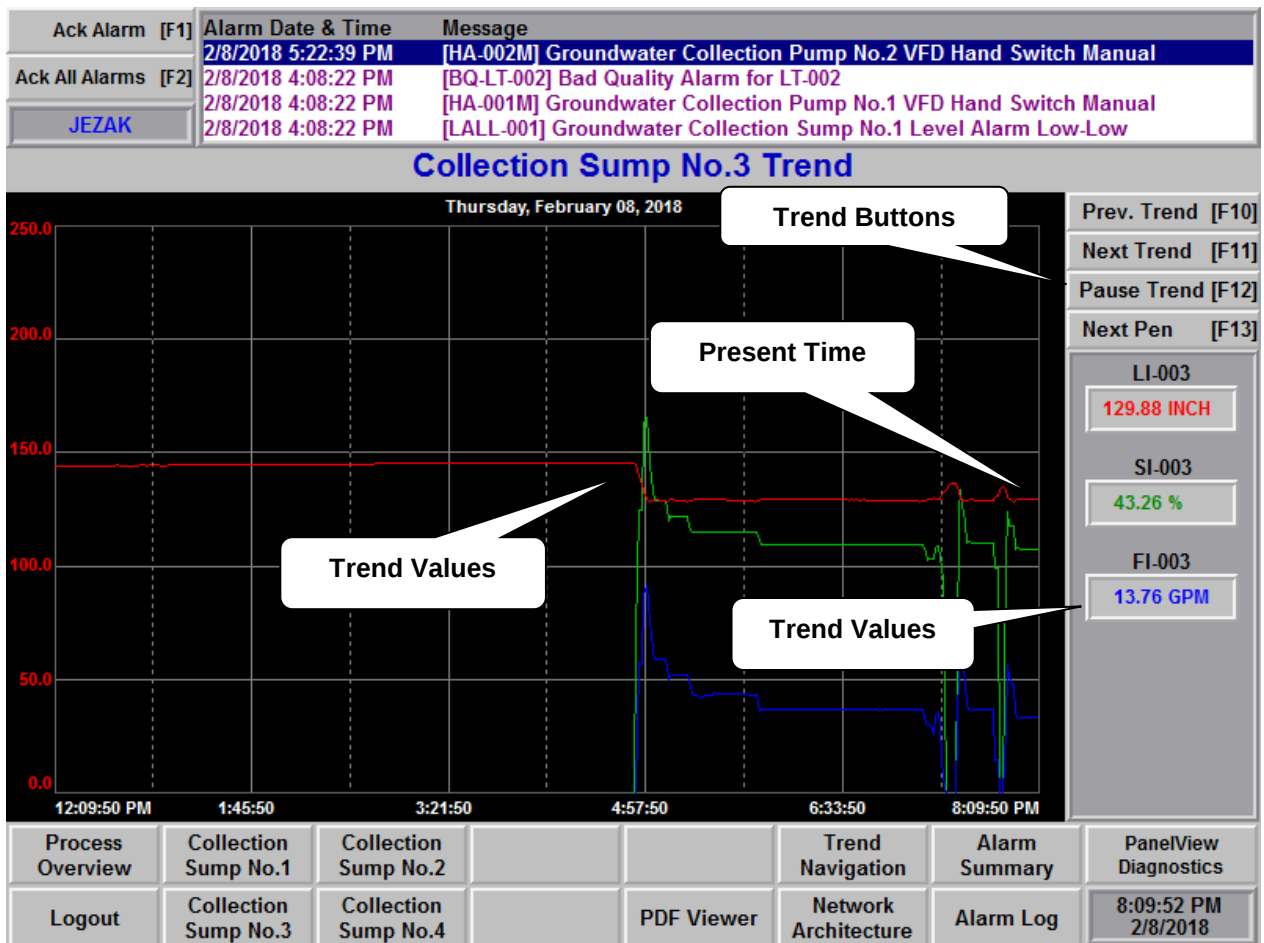


Figure 2.9: Historical Trend Screen

The trend updates every few seconds, placing new data on the right side of the trend. To halt the trend from displaying new data, press the **Pause Trend** button on the screen or the **[F12]** function key on the terminal. To resume displaying new trend data, press the Pause Trend button again or navigate to a new screen.

The trend retains a limited amount of historical data that the user can scroll back in time to view. In order for the user to manipulate the trend, they must bring it into focus. Typically, on all screens the Alarm Header has primary focus. To switch focus to the trend, the user must tap it a couple of times on the screen. Now all function keys on the terminal will be associated with the trend until focus is given back to the Alarm Header by tapping it, or navigating to a new screen.

With the trend in focus, the user can press the Arrow keys within the Navigation group on the terminal to move the trend to display older historical data [See Figure 1.1 HMI Terminal]. To display the oldest trend data, press the **Home key** on the terminal. To return to the newest trend data, press the **End key** on the terminal. To pan vertically, press the up and down arrow keys. Any changes made to the trend will automatically reset when the user navigates to a new screen.

To scroll between trends within the application without having to return to the Trend Navigation screen, press the **Previous Trend** and **Next Trend** buttons on the screen or the associated **[F10]** and **[F11]** function keys on the terminal.



2.7 PDF Viewer

The PDF Viewer button displays a list of PDF documentations that can be viewed from the application. These documents include facility drawings, instrument lists and equipment manuals.

To open one of these files the user must bring the list into focus by tapping it a couple of times on the screen. Now all function keys on the terminal will be associated with the list until focus is given back to the Alarm Header by tapping it, or navigating to a new screen. Use the navigation keys on the terminal to select which file to open, then press **Load Selection** button to confirm the selection and finally press **Launch PDF** button to display the file. Alternatively, the associated terminal keys **[F7]** and **[F15]** on the terminal can be pressed. These instructions on how to view a PDF can be viewed within the application by pressing the question mark in the upper right corner or by pressing the associated **[F9]** function key on the terminal.

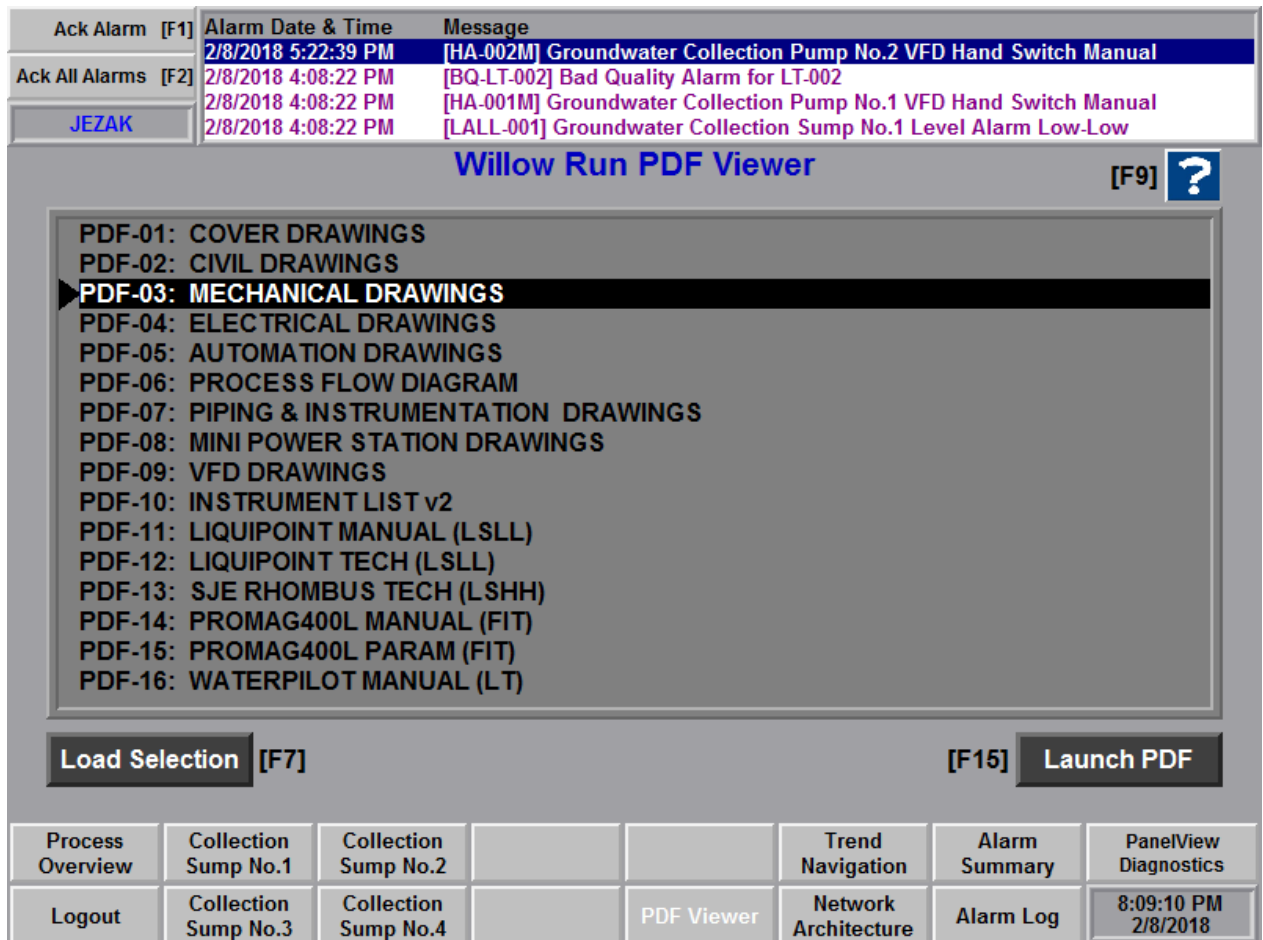


Figure 2.10: PDF Viewer Screen

Once the PDF file is open, the user may manipulate the document by touching the screen or using the toolbar across the top; open files, page navigation, zoom, search, previous page, next page, bookmarks. To return to the application and close the PDF file, press the X in the top right corner.

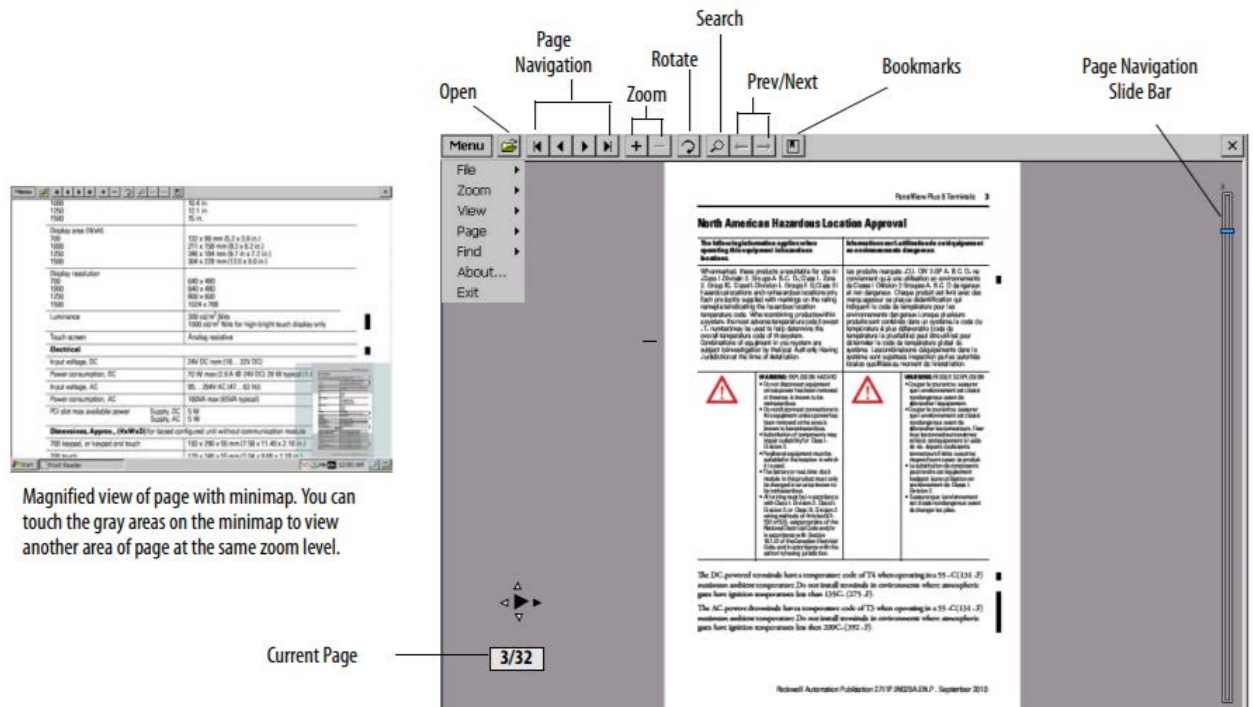


Figure 2.11: PDF File

2.8 Network Architecture

An Automation Engineer responsible for the system primarily uses the Network Architecture screen. At a quick glance, the user can determine if there are any critical alarms with the automation hardware and if communications between the hardware is operational by the green status lights.

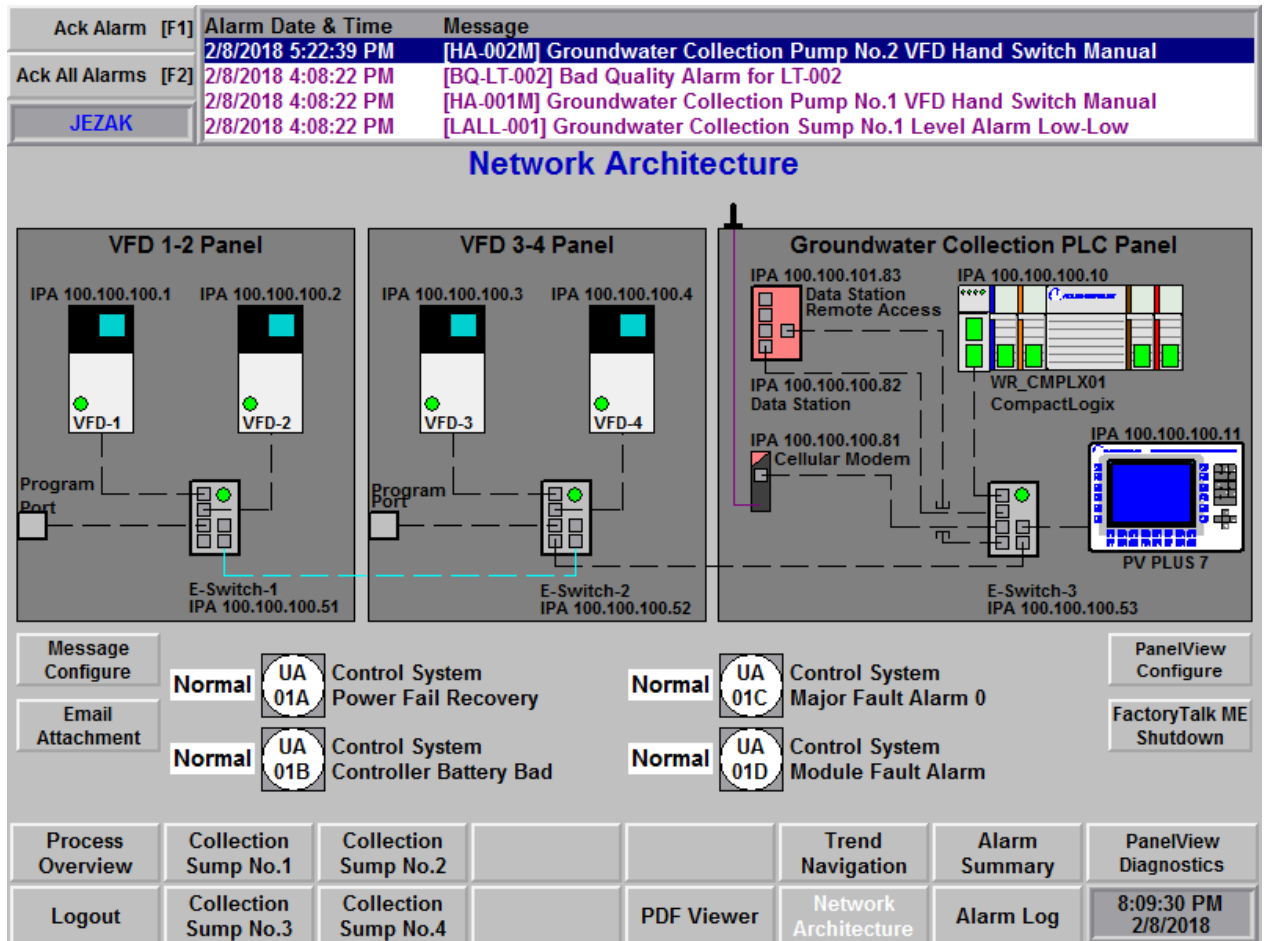


Figure 2.12: Network Architecture Screen

Depending on the user's credentials and responsibilities, their approved login might unlock features on the Network Architecture screen; PanelView Configure, FactoryTalk ME Shutdown, Email Attachment and Message Configure. These features are rarely used or changed once configured.

PanelView Configure button closes the application and opens the settings configuration for the Allen Bradley PanelView Plus7 Performance HMI Terminal, specific to Rockwell's FactoryTalkView Machine Edition software application. While the **FactoryTalk ME Shutdown** button closes the entire application, showing the desktop of the terminal's operating system.

Email Attachment and **Message Configure** are settings that allow the HMI Terminal to communicate with the outside world. Once a week the HMI Terminal sends out an Excel report through Email that contains data on the performance of the application. The HMI Terminal also has the ability to send text messages that notify when an alarm has become active. These screens allow the user to manage who receives these Emails and text messages.



Ack Alarm [F1]	Alarm Date & Time	Message
	12/12/2018 10:04:28 AM	[FAL-002] Groundwater Collection Sump No.2 Flow Alarm Low
Ack All Alarms [F2]	12/3/2018 6:22:04 AM	[FAL-001] Groundwater Collection Sump No.1 Flow Alarm Low

JEZAK

Message Configuration

[F9]

Emails containing Excel Weekly Reports. Each Email entry is limited to 82 characters. Separate entries with commas, no space following.

Email To: beth.landale@ghd.com

Email CC: daniel.beck@ghd.com,allie.murphy@ghd.com

Texts containing Daily Alarms. Each Text entry is limited to 82 characters. Separate entries with commas, no space following.
Enter service provider. Example: 7168562142@vtext.com,7162976150@vmobl.com

AT&T; @txt.att.net BOOST; @myboostmobile.com SPRINT; @messaging.sprintpcs.com
T-MOBILE; @tmomail.net VIRGIN; @vmobl.com VERIZON; @vtext.com or @vzwpx.com
GOGGLE; @msg.fi.google.com

Text To: 2488042850@vtext.com,7345455423@vtext.com

Text CC: 9063676376@txt.att.net,2484103589@vtext.com

Figure 2.13: Email and Messaging User Management

2.9 Panelview Diagnostics

The PanelView Diagnostics popup displays a history of commands, logins and errors that are associated with the application. The popup itself cannot be resized, but can be closed by pressing the white X in the red button on the screen or the **[F9]** function key on the terminal.

Certain users will have access to the **Clear Diagnostic** buttons. These buttons clears one or all diagnostic lines from history in the diagnostics log. If the buttons are visible, the user can press the buttons on the screen or the associated function keys on the terminal to perform the clearing action.

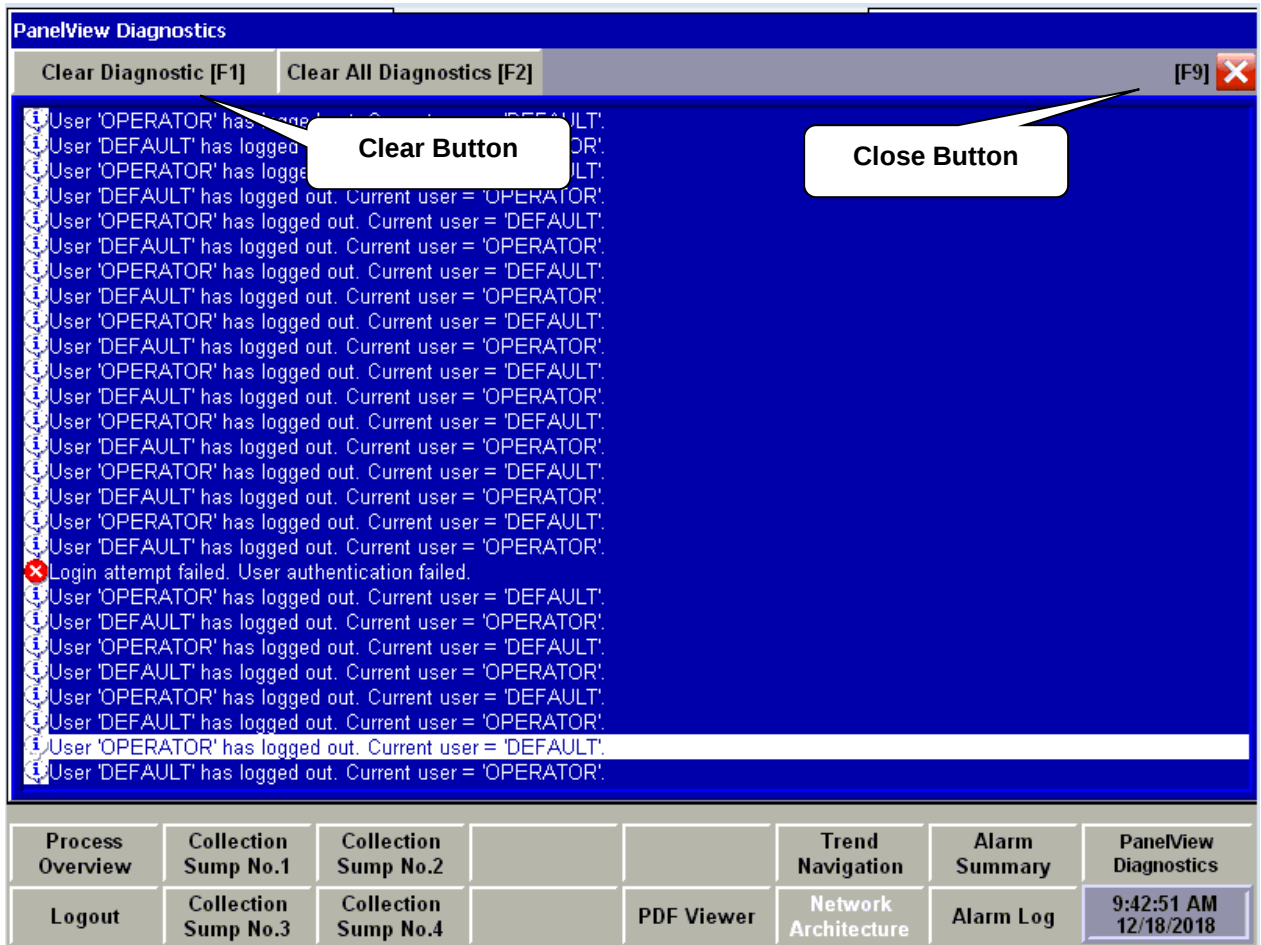


Figure 2.14: PanelView Diagnostic Popup

3. Process Screens

The Process Screen is located in the middle of the display, between the Alarm Header and the Navigation Footer and gives a visual representation of the specific area being controlled by the PLC. These screens provide; process flow direction, process values, daily statistics, operational status indications and popup windows with various information and control. Objects will have various functions if it is associated with a terminal function key [F1 – F16].

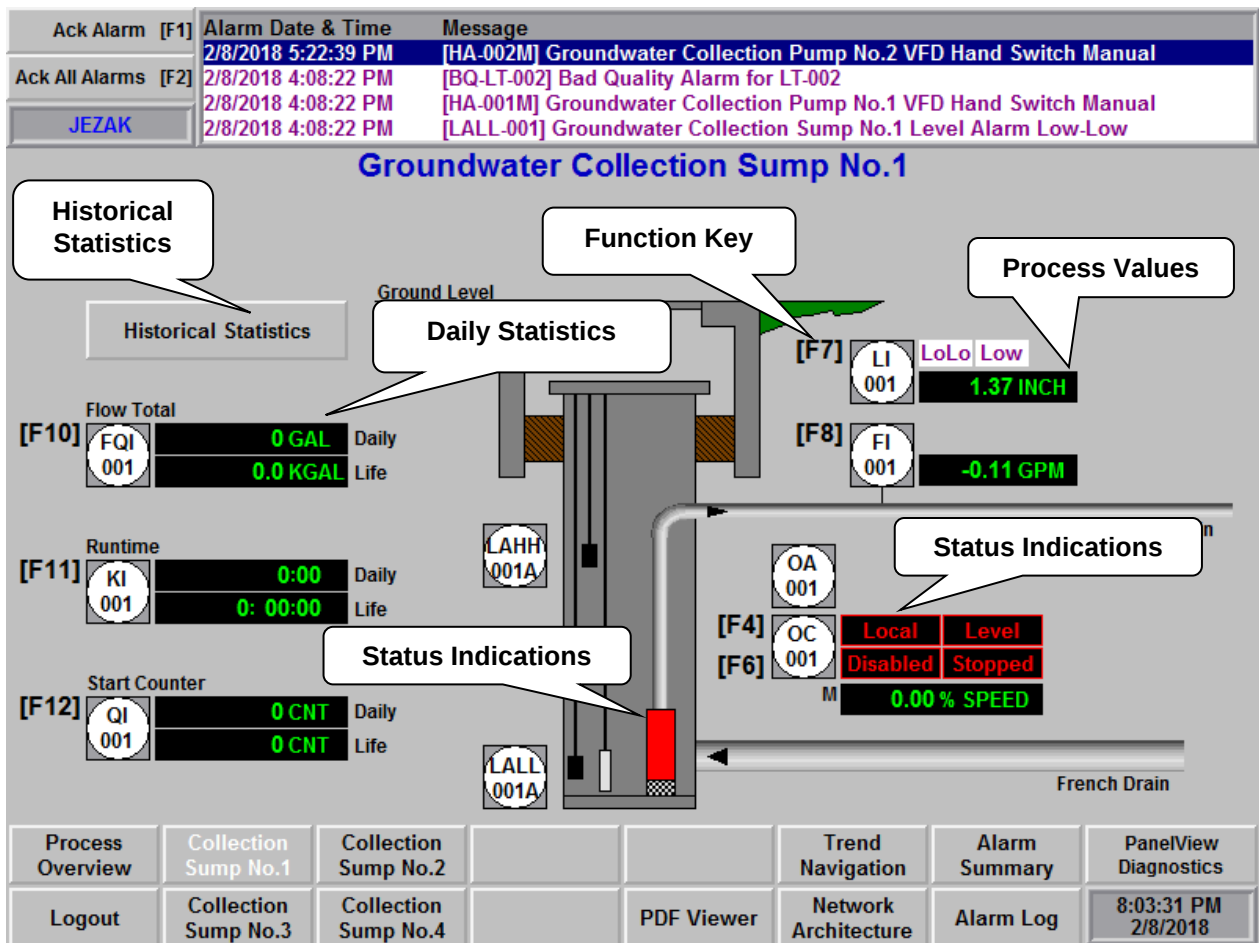


Figure 3.1: Common Process Screen

3.1 Process Values

Process Values are displayed next to a process tag block (grey square with white circle) and have green numeric displays with its associated engineering units on a black background. These indications are typically analog which means it could have a wide range of values depending on what is being represented; Level Indication (LI), Flow Indication (FI), Flow Quantity Indication (FQI), Runtime (KI), Start Counter (QI).

3.2 Alarm Setpoints

Most Process Values have alarms that notifies the user of an abnormal condition within the application. The associated alarms for a Process Value are displayed next to the common process tag block and within the Alarm Summary. [\[See Section 2.2 ALARM INDICATIONS\]](#)

The user can view and modify the alarm setpoints, which are values where the process value has entered an abnormal condition, by pressing the function key label on the screen next to the process tag block or the same function key on the terminal. Each process tag block will have its own designated function key to open an Alarm Setpoint popup specific to the Process Value it represents.

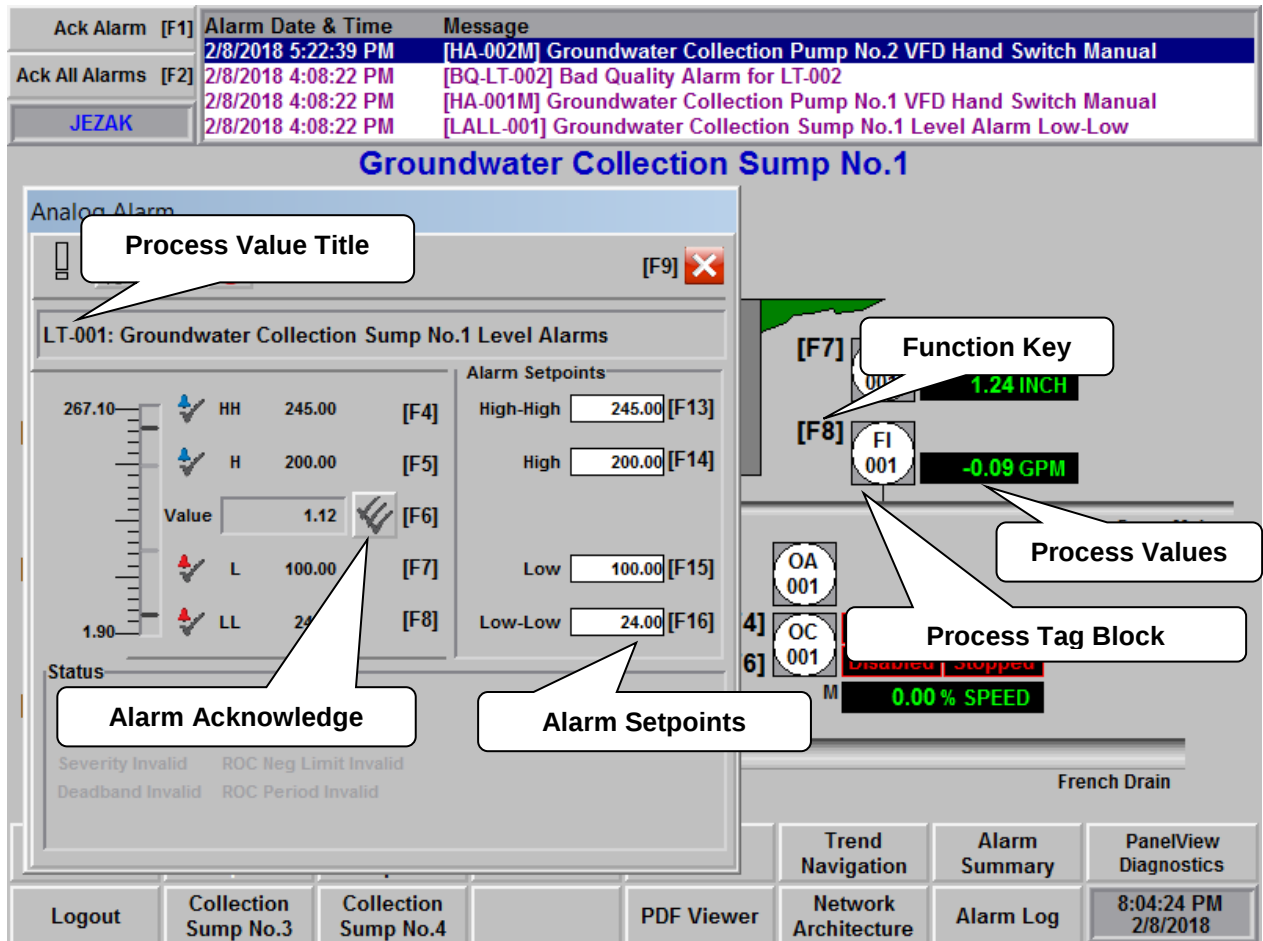


Figure 3.2: Alarm Setpoint Popup

Displayed at the top of the Alarm Setpoint popup is the title of the specific Process Value being represented. The user should realize and take caution, that all Alarm Setpoint popups look similar except for the titles and values. The popup itself cannot be resized, but can be closed by pressing the white X in the red button on the screen or the [F9] function key on the terminal.

A numerical bar graph represents the Process Value and its current reading shown as the green fill. Within the numerical bar graph are four horizontal hashes that represent each of the four Alarm Setpoints: **High-High (HH)**, **High (H)**, **Low (L)** and **Low-Low (LL)**. Each of their values and alarm states are shown to the right of the numeric bar graph; Red Bell – In Alarm Unacknowledged, Red Bell with Check – In Alarm Acknowledged, Blue Bell – Normal Unacknowledged, Blue Bell with Check - Normal Acknowledged. The user may acknowledge any of the alarms from the Alarm Setpoint popup by pressing the associated checkbox button when visible or its associated function key on the terminal.

Depending on the user's credentials and responsibilities, their approved login might allow Alarm Setpoints to be modified. By pressing the associated function key on the terminal, a blue numeric keypad will be displayed on the screen. Enter a value within the limits of the alarm setpoint, shown between the current value and the numeric pad, by touching the screen or using the terminal keys.



If a value outside of the allowable limit is entered, the display will turn red and it will retain its original value.

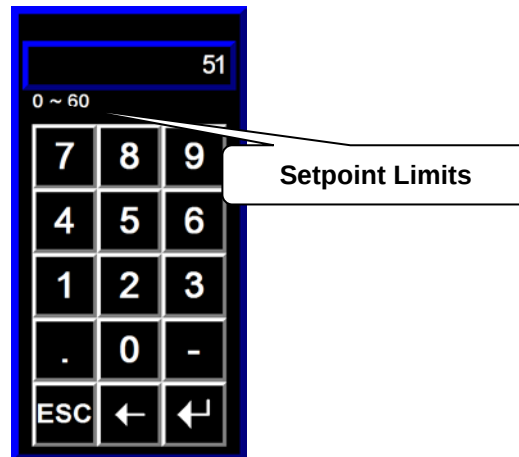


Figure 3.3: Numeric Keypad

Not only does the Alarm Setpoint need to be within its numeric limitations, but the alarm states have to be in sequential order. For example, a High-High Alarm Setpoint has to be the highest value and cannot be lower than the other three alarm conditions. If this is entered as such, the alarm instruction will fault and its status shown in red on the Alarm Setpoint popup. This error will need to be corrected in order for the alarm instruction to work properly.

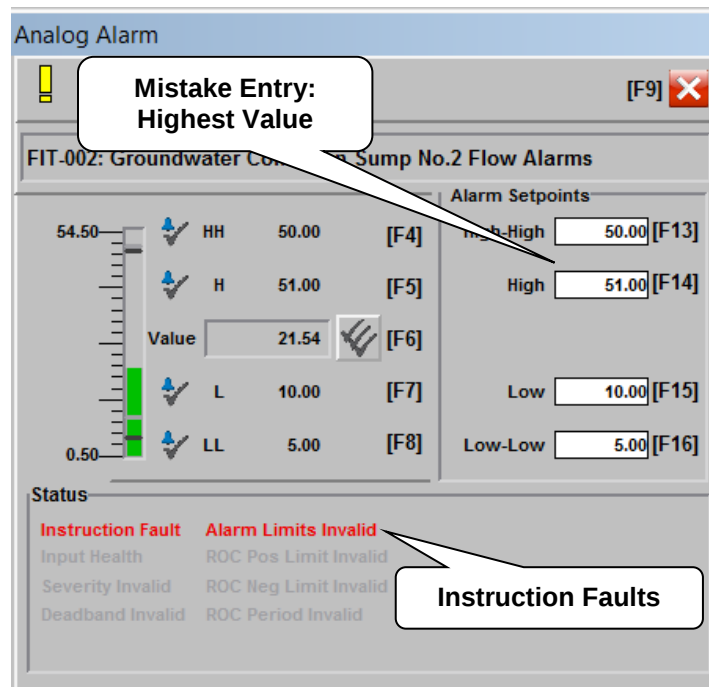


Figure 3.4: Alarm Setpoint Instruction Fault Status



3.3 Reset Values

Some Process Values do not have any associated alarms and are strictly for informational purposes. The FQI, KI and QI display values that steadily increase over time. At some point, it may become necessary or desired to reset these values back to zero.

Depending on the user's credentials and responsibilities, their approved login might allow these values to be reset by pressing the function key label on the screen next to the process tag block or the same function key on the terminal. Each process tag block will have its own designated function key to open a Reset popup specific to the Process Value it represents.

Displayed at the top of the Reset popup is the title of the specific Process Value being represented. The user should realize and take caution, that all Reset popups look similar except for the titles. The popup itself cannot be resized, but can be closed by pressing the white X in the red button on the screen or the **[F9]** function key on the terminal.

Once the action to reset a value has been confirmed, there is no means to undo this decision. Therefore, to decrease the accidental action to reset a value by the user, they must press the **[F8]** function key on the terminal. The touch screen in this situation is not operational, which is represented by the yellow button on the popup.

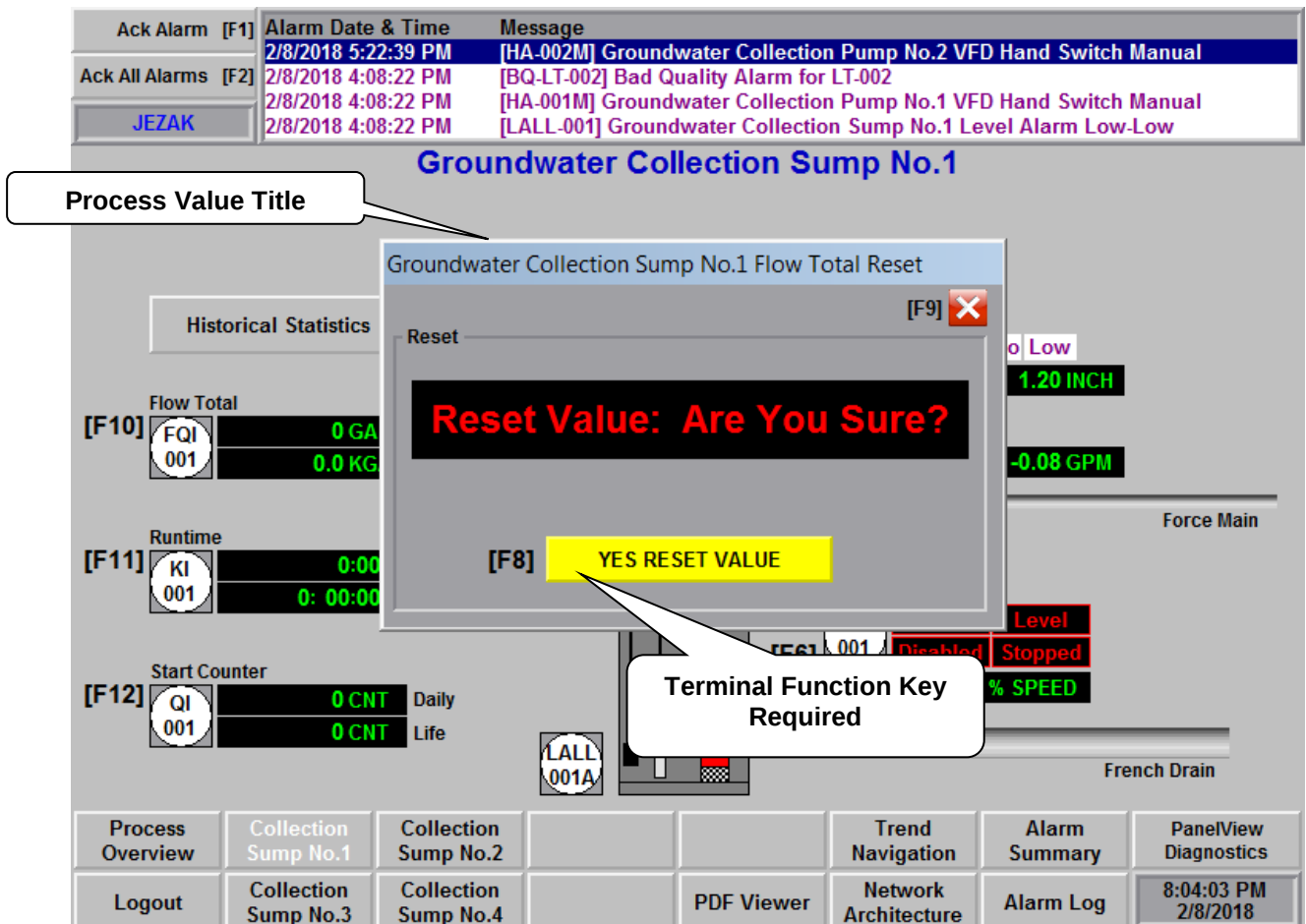


Figure 3.5: Reset Value Popup



3.4 Historical Statistics

The HMI Terminal has limited capabilities for historical data collection. As an alternative, the PLC has additional code to create and capture specific values at the end of the day; minimum and maximum daily values, average daily value, daily flow totalization, daily pump runtime and start counter.

These values are Emailed once at the end of the week from the HMI Terminal. [\[See Section 2.8 NETWORK ARCHITECTURE\]](#) Alternatively, they can be viewed live from the Process Screen by pressing the Historical Statistics button. The Historical Statistics popup shows seven days' worth of data, with the oldest day's data replaced as the days go by.

The Historical Statistics cannot be cleared or manipulated in any fashion. The user may touch one of the seven days to highlight focus on it while viewing the screen. The popup itself cannot be resized, but can be closed by pressing the white X in the red button on the screen or the **[F9]** function key on the terminal.

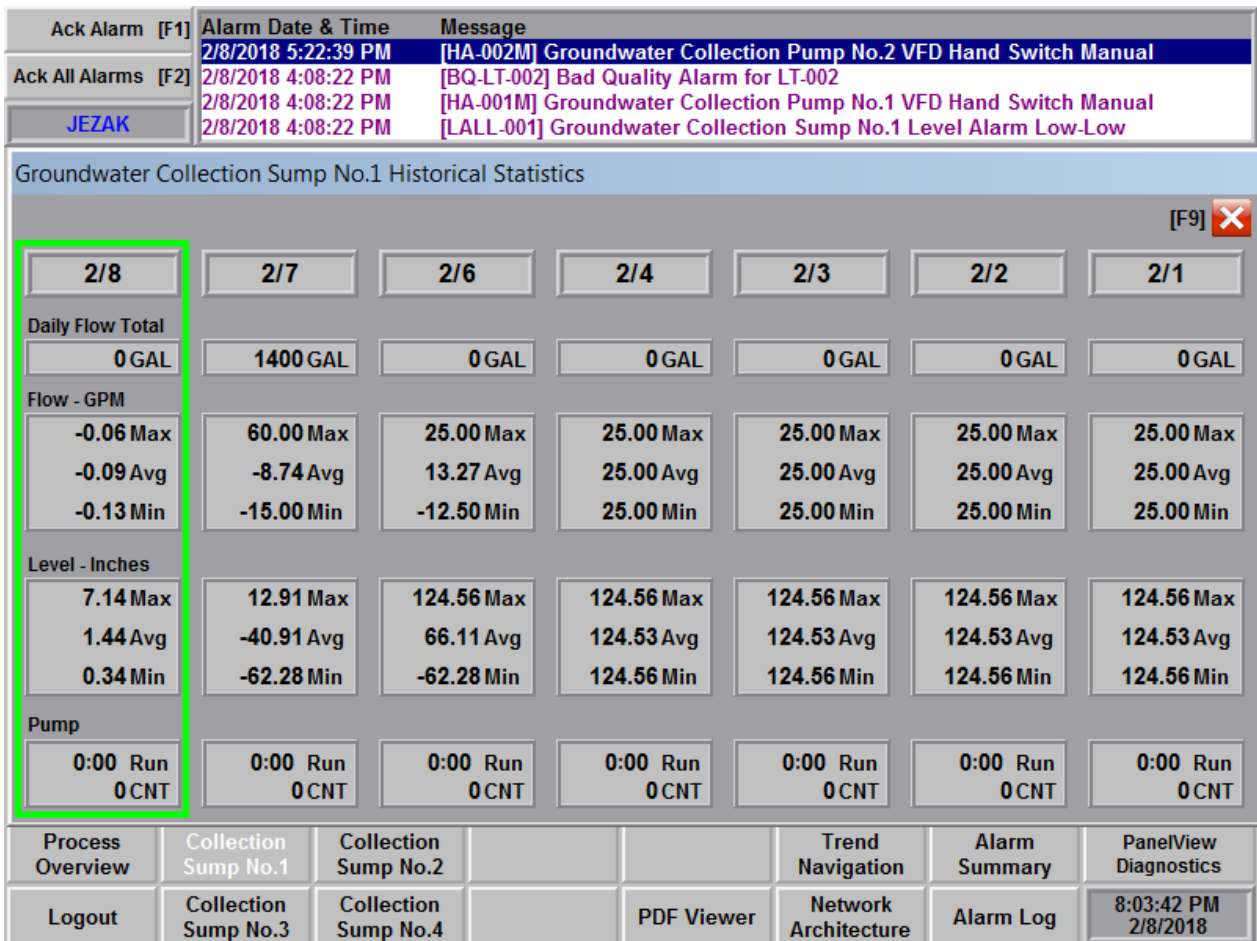


Figure 3.6: Historical Statistics Popup



3.5 Pump Controls

The pumps for this application have various areas in which it can receive commands for operation. In general, the pumps can be controlled locally at the variable frequency drive (VFD) enclosure or remotely through the HMI Terminal using PLC code. There is a hand switch on each of the pump's VFD enclosure that dictates what location has operational control. The hand switch must be in Remote to control the pump from the HMI Terminal. The user can view the status of this switch on the Process Screens next to the associated process tag block of the pump. This document only covers controls associated with the pumps through the HMI Terminal screens.

The Process Status of the pumps are shown next to their associated process tag block on the Process Screen. Typically the status will change state and color depending on the feedback of the process; Red – Closed/Stopped/Alarm, Green – Open/Running/Normal, Orange – Fault, Gray – No Status.

The user can view and modify the pump controls by pressing the **[F6]** function key label on the screen next to the process tag block or the same function key on the terminal for the associated pump. From the Pump Control popup, the user can **Enable** or **Disable** the pump by pressing the buttons or the function keys on the terminal. When the pump is disabled, the PLC will not start the pump for any reason. When the pump is enabled, the user has given *permission* to the PLC to start the pump but the pump may remain off due to other process conditions. Once all conditions have been satisfied and the pump has been enabled, will it begin to operate.

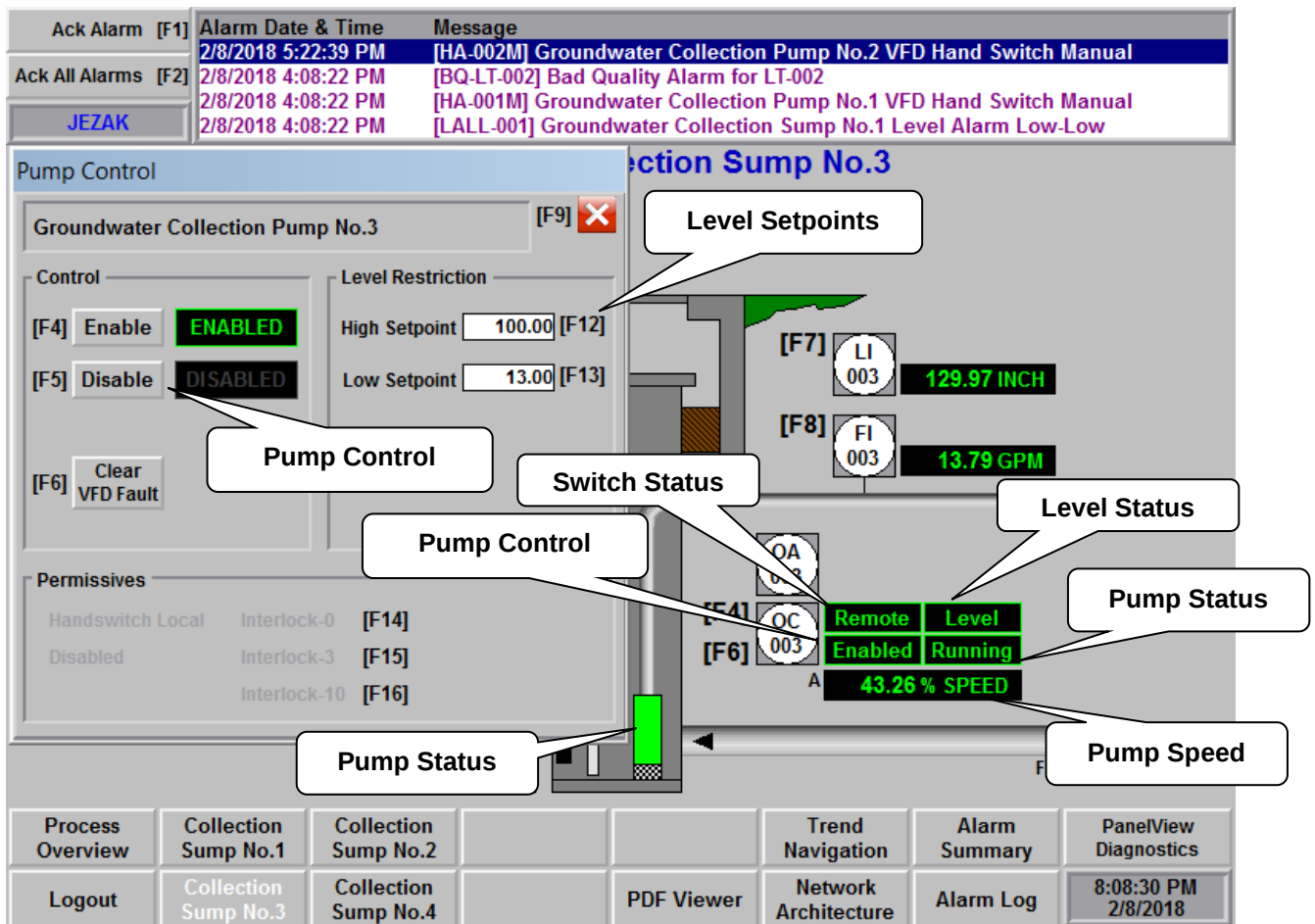


Figure 3.7: Pump Controls Popup

One of the conditions the PLC is viewing for pump operation is the **Level Restriction**. To prevent the pump from running dry or to operate in a set level range, the user may change the Low Setpoint value. Once the water level is below the Low Setpoint, the PLC will automatically turn the pump off until the water level has exceeded the High Setpoint therefore turning the pump back on. By pressing the associated function key on the terminal, a blue numeric keypad will be displayed on the screen to modify these values.

In addition to the Level Restriction, the PLC is looking for other various conditions listed as **Permissives**. If a Permissive is actively preventing the pump from running, it will be highlighted in red on the popup. Common Permissives between the pumps are Level Restriction, Hand Switch in Local, and user Disabled. Unique Permissives are typically the **Interlocks** associated with a specific pump and the alarms that makeup these Interlocks.

Interlocks can be viewed from the Pump Control popup by pressing the function key label on the screen next to the desired Interlock or the same function key on the terminal. This will display another popup specific to the Interlock that will display all alarms associated with it. An alarm is active if its associated circle is red, and green when normal. The pump will not start if any Permissives are in an alarm state.

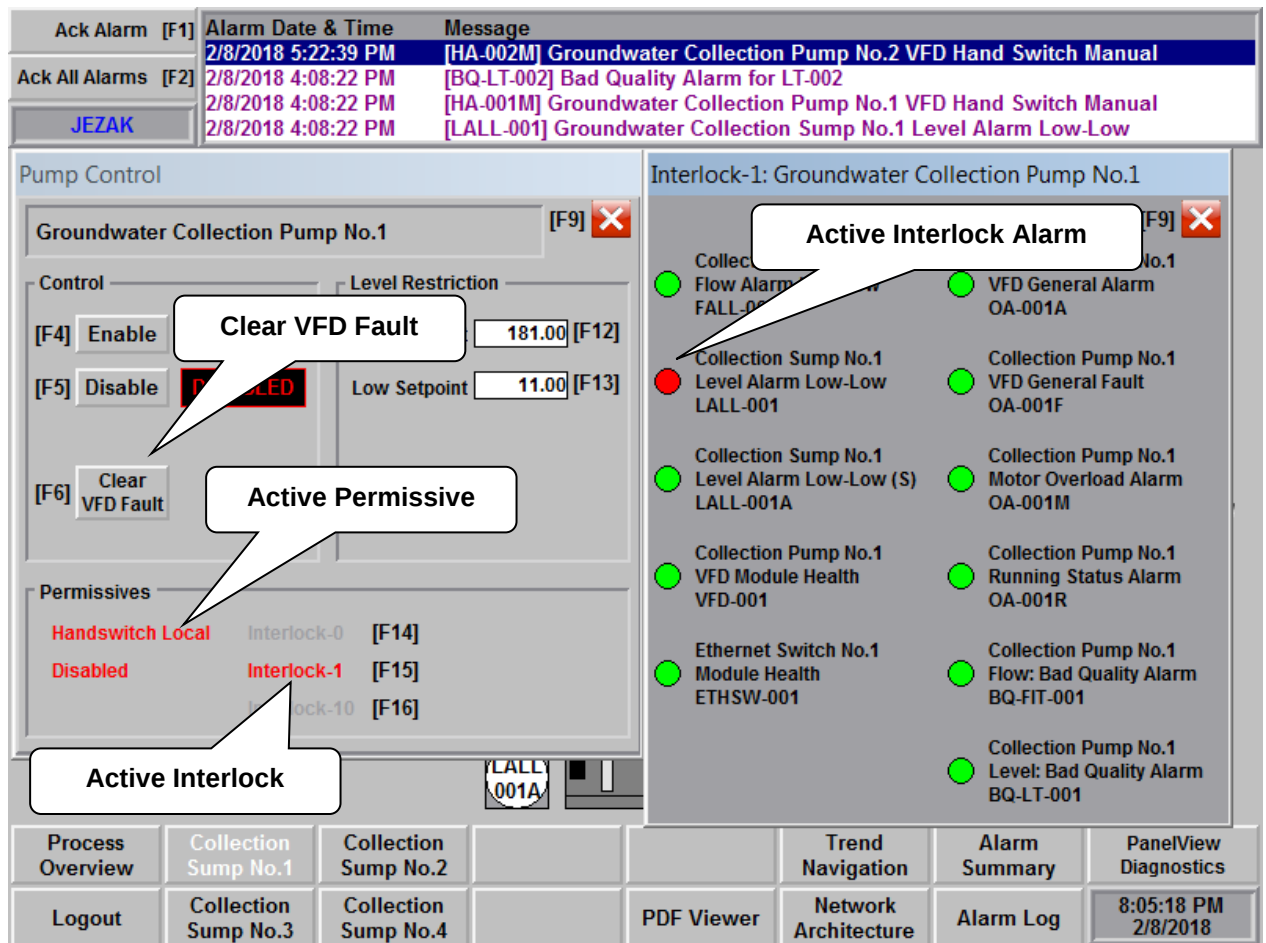


Figure 3.8: Pump Controls Interlock Pop-up

Faults may occur within the VFD, which will prevent the user from operating the pump remotely on the HMI Terminal. It is highly recommended to physically view the VFD in person to verify conditions and obtain the **Fault Code** from the local VFD Monitor. Once issues have been resolved it is possible to clear the VFD Fault from the VFD Monitor or from the Pump Control popup by pressing the function key label on the screen or the same function key on the terminal.

As a convenience to the user, it is possible to turn off all pumps at once from the Overview screen. Therefore, to decrease an accidental action to turn off all pumps by the user, they must press the **[F16]** function key on the terminal. The touch screen in this situation is not operational, which is represented by the yellow button on the screen labeled as **Process Stop** located in the lower-right hand corner.

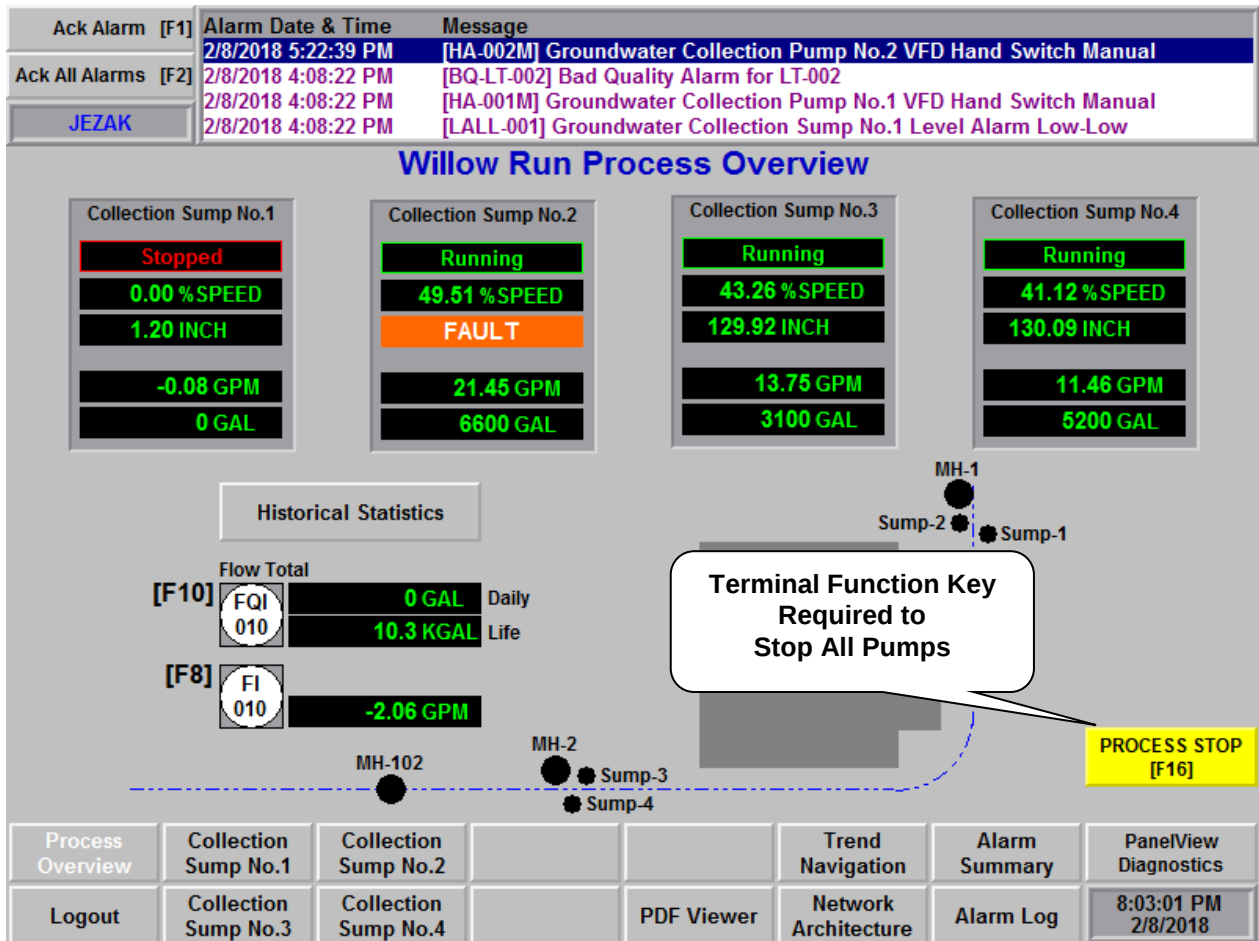


Figure 3.9: Process Stop Pushbutton

3.6 Level Controls

In addition to the Pump Controls, the user may desire to maintain a specific level or pump speed during operations by using the Level Controller. The user can view and modify the level controls by pressing the [F4] function key label on the screen next to the process tag block or the same function key on the terminal for the associated pump.

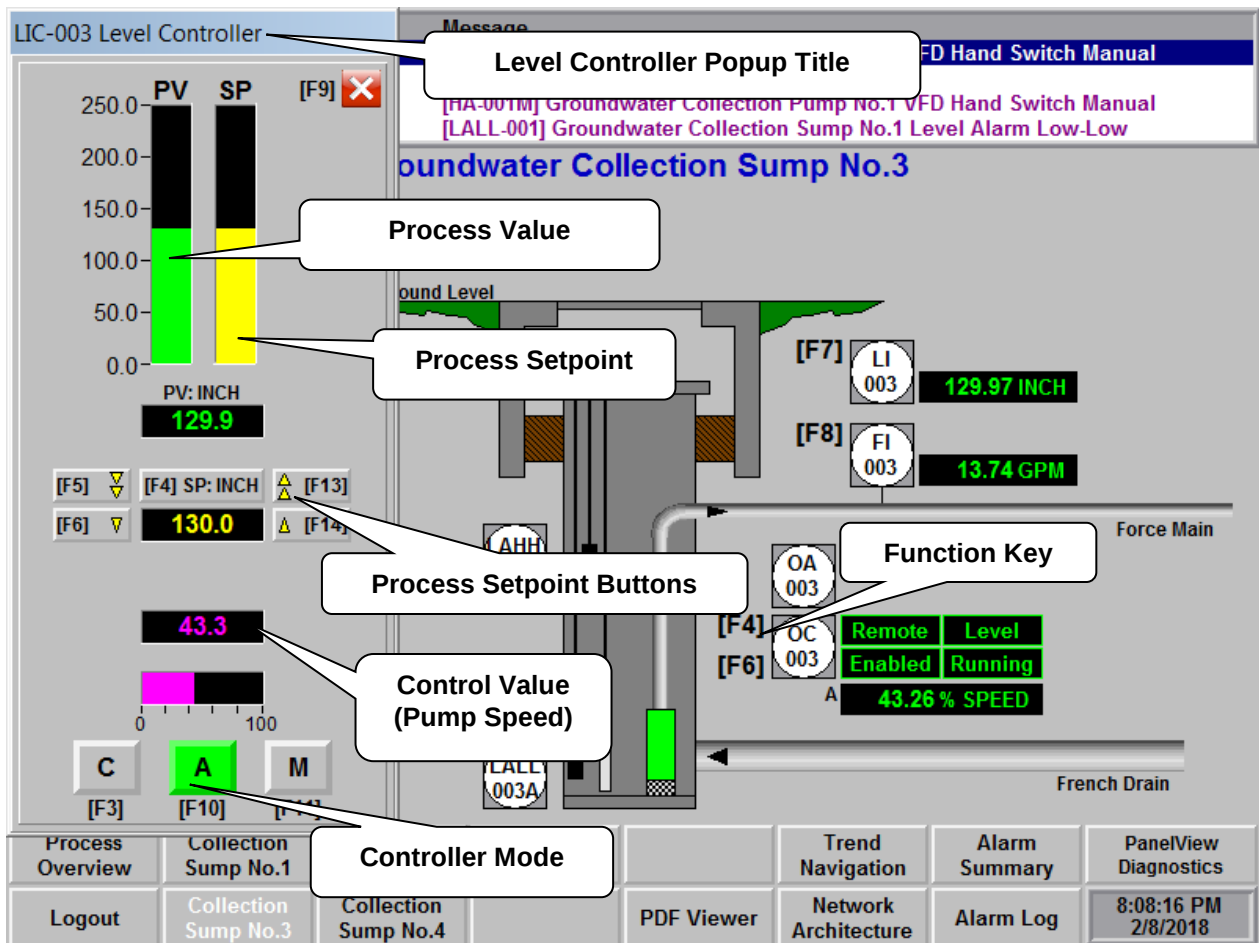


Figure 3.10: Level Controller Popup

Displayed at the top of the Level Controller popup is the title of the specific Process Value being represented. The user should realize and take caution, that all Level Controller popups look similar except for the titles and values. The popup itself cannot be resized, but can be closed by pressing the white X in the red button on the screen or the **[F9]** function key on the terminal.

The numerical bar graphs give a visual representation of the **Process Value** and its current reading shown in green, while comparing it to the desired **Process Setpoint** in yellow. The Process Setpoint is the value the user wishes to maintain the Process Value at while the pump is operational and in Auto Mode. The PLC will vary the **Control Value** (i.e. pump speed) in order to maintain the Process Value at the desired setpoint. The Control Value is represented by the horizontal numerical bar graph shown in magenta. If a value goes into a fault condition, the bar graphs will fill up with an orange background and white lettering stating Fault.

For precise readings of the numerical bar graphs, numeric displays are in the center of the Level Controller popup. They are represented with their associated color and engineering units; Process Value – green, Process Setpoint – yellow, Control Value – magenta.

The user can choose to operate in one of the three different modes: **Cascade (C)**, **Auto (A)**, and **Manual (M)**. To switch between these modes, the user has to press the desired button located on the bottom of the Level Controller or its associated function key on the terminal. The selected mode



of operation will be highlighted in green on the controller. On the process screen next to the associated process tag block, a letter will represent the current mode of operation for the Level Controller.

Cascade: The controller set in Cascade Mode will operate based on another controller's output condition. (**This mode is NOT used in this application**)

Auto: When the controller is in Auto Mode, the PLC will vary the Control Value automatically to maintain the Process Value at the user's desired Process Setpoint. The buttons associated with Manual Mode Control Value will disappear while in this mode.

Manual: The user will manually set the Control Value. While in Manual Mode, the Process Value and Process Setpoint values are disregarded. When initially switching into Manual Mode, the controller retains its current Control Value for a bumpless transfer.

The user has various methods to modify the Process Setpoint while in Auto Mode, and the Control Value while in Manual Mode by using push buttons and numeric entries. All entries are maintained after the controller popup has been closed.

The double arrow buttons pointing in the down or left direction, subtract 1% from the desired value, while the single arrow button subtracts 0.1%. The double arrow buttons pointing in the up or right direction adds 1% to the desired value, while the single arrow button adds 0.1%. To use these buttons, the user may press the button on the screen or press the associated function key on the terminal. The current value is shown in the numeric display.

Alternatively, the user can enter a specific value for the Process Setpoint or Control Value by pressing the button directly above the associated numeric display on the screen or press the associated function key on the terminal. A blue numeric keypad will be displayed on the screen, where the user can then enter the desired value by touching the screen or using the terminal keys. If a value outside of the allowable limit is entered, the display will turn red and it will retain its original value. The user will need to correct this value for it to update properly, or press the escape key **[ESC]** on the keypad. Once properly entered, the current value will be displayed in the numeric display.

When the pump is commanded to stop due it being disabled, a permissive or an Interlock, the Level Controller will be in **CV Initializing**, which is displayed below the Control Value numeric display when active. Essentially the Level Controller is locked out and forced to a Control Value of zero. Once the pump is allowed to operate, CV Initializing will clear and the Level Controller will resume controls.

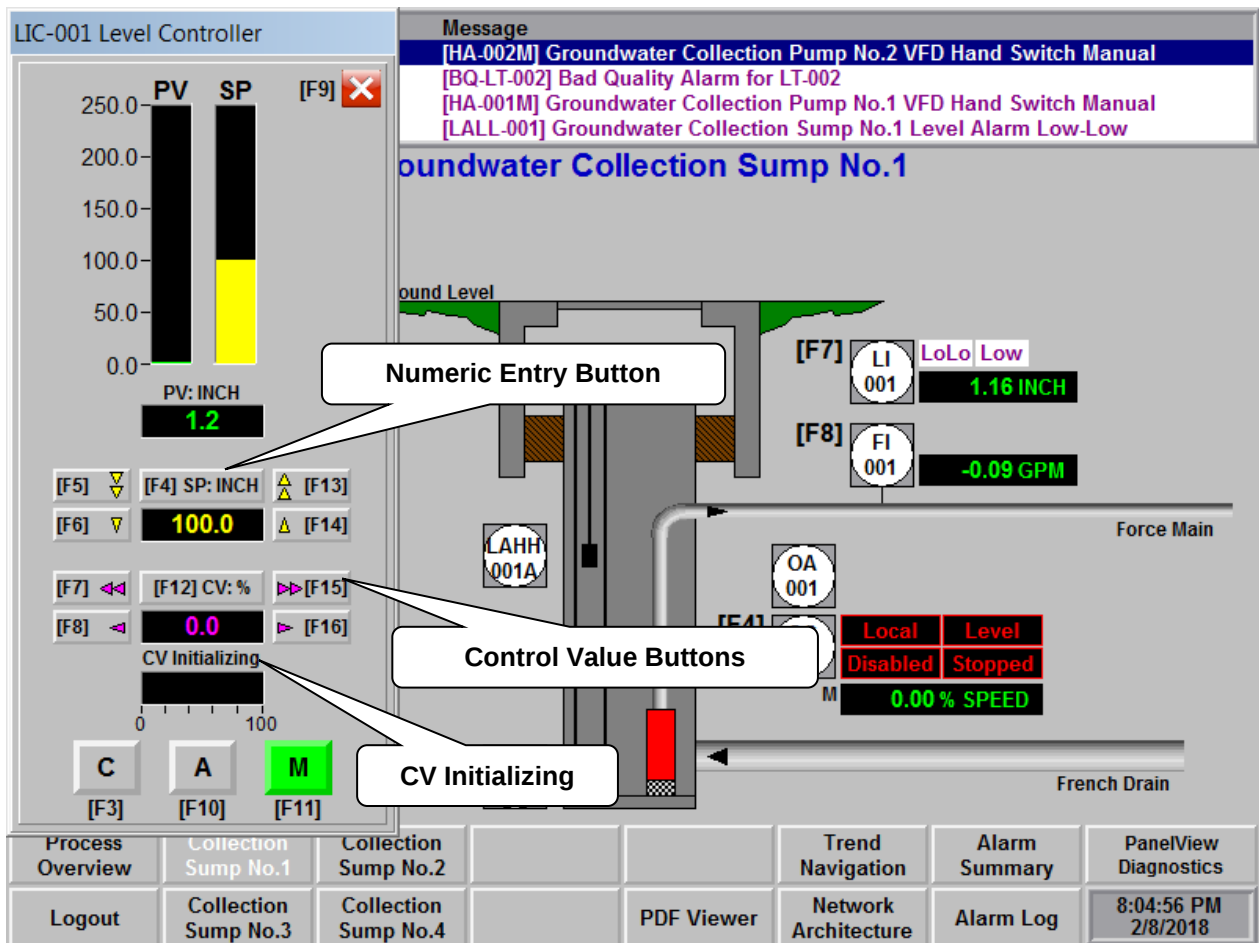


Figure 3.11: Level Controller Popup – CV Initializing

4. Communication Failure

Communication failure occurs when the HMI Terminal no longer has the ability to reach the PLC. Various reasons may cause the situation; power failure, wire failure, Ethernet switch fault, configuration settings or hardware fault.

These indications do not necessarily mean that the PLC and the overall process are no longer operating. Without further troubleshooting, all that is known from the initial observation is that the HMI Terminal is no longer displaying information from the PLC. An Automation Engineer should be notified of these conditions to help diagnose the root cause.

All or some objects displayed on the screen that are associated with a PLC value turns into a Wire Frame (an outline) when communications is lost, indicating to the user, that object is no longer functional. Alarm indicators will appear with orange text stating “Error” within a white box, while some Process Values will display asterisks when the HMI Terminal has lost communications with the PLC.

When communications are re-established, all items should appear and operate as normal.

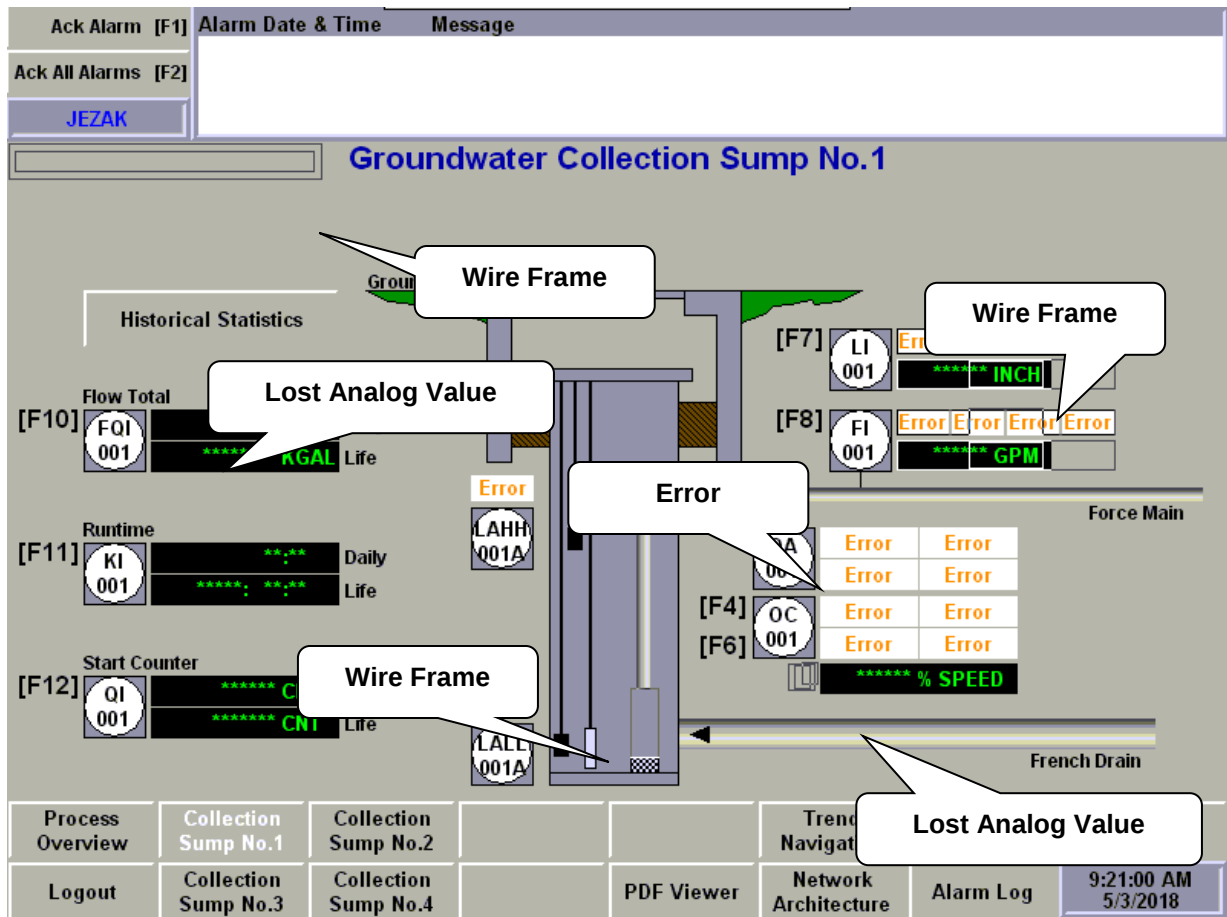


Figure 4.1: Wire Frame and Errors on Process Screen



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Appendices

Appendix A

List of HMI Screens

Appendix A List of HMI Screens

Process Screens:

- 1) Login / Logout
- 2) Willow Run Process Overview
- 3) Groundwater Collection Sump No.1
- 4) Groundwater Collection Sump No.2
- 5) Groundwater Collection Sump No.3
- 6) Groundwater Collection Sump No.4
- 7) PDF Viewer
- 8) Network Architecture
- 9) Trend Navigation
- 10) Collection Sump No.1 Process Values Trend
- 11) Collection Sump No.2 Process Values Trend
- 12) Collection Sump No.3 Process Values Trend
- 13) Collection Sump No.4 Process Values Trend
- 14) Groundwater Level Values Trend
- 15) Groundwater Flow Values Trend
- 16) Daily Flow Totals Trend

Popup Windows:

- 1) Alarm Summary
- 2) Alarm Log
- 3) PanelView Diagnostics
- 4) Historical Statistics
- 5) Level Controller
- 6) Pump Control
- 7) Interlock Status
- 8) Analog Alarm Setpoint
- 9) Reset Value

Appendix B

Training Checklist for HMI Usage

Appendix B Training Checklist for HMI Usage

- ____ 1. System Overview / HMI Function Keys (Tab, Esc, Home, etc.)
- ____ 2. Login User Accounts
- ____ 3. Alarm Header / Alarm Summary / PLC Status
- ____ 4. Alarm Conditions / Alarm and Fault Indicators
- ____ 5. Navigation Footer
- ____ 6. Alarm Summary
- ____ 7. Alarm Log
- ____ 8. Trends / Focus between Trend and Alarm Summary
- ____ 9. PDF Viewer
- ____ 10. Network Architecture / Weekly Emails / Alarm Texts / PV Diagnostics
- ____ 11. Process Screens / Process Values / Process Status
- ____ 12. Alarm Setpoints
- ____ 13. Reset Values
- ____ 14. Historical Statistics
- ____ 15. Pump Controls / Permissives / Interlocks
- ____ 16. Level Controller / Controller Modes / Numeric Entries
- ____ 17. Communication Failure / Wire Frame / Errors

Name _____

Signature _____

Date _____



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