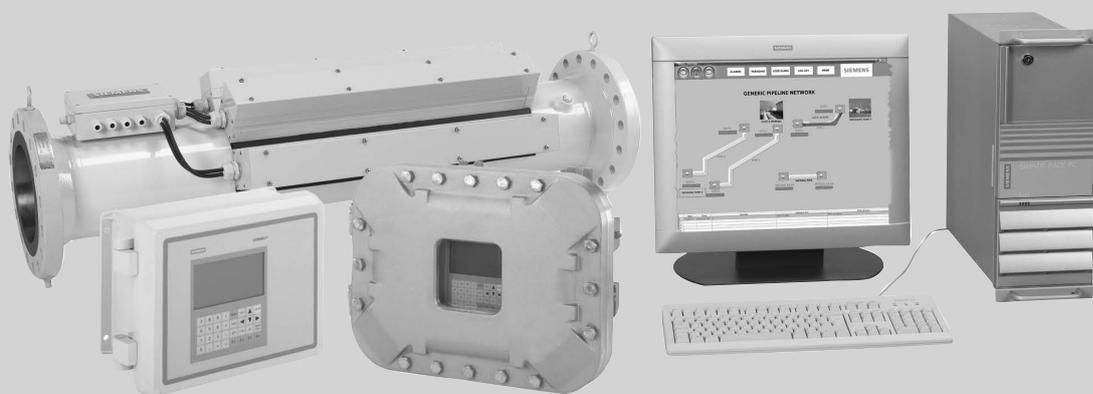


Ultrasonic flowmeters

FUS-LDS Leak Detection System

Operating Instructions - August 2012



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Ultrasonic Flowmeters FUS-LDS Leak Detection System

Operating Instructions

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

| |
|--|
|  DANGER |
| indicates that death or severe personal injury will result if proper precautions are not taken. |
|  WARNING |
| indicates that death or severe personal injury may result if proper precautions are not taken. |
|  CAUTION |
| indicates that minor personal injury can result if proper precautions are not taken. |
| NOTICE |
| indicates that property damage can result if proper precautions are not taken. |

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

| |
|--|
|  WARNING |
| Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed. |

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction

These instructions contain all the information you need for using the device.

The instructions are aimed at persons mechanically installing the device, connecting it electronically, configuring the parameters and commissioning it as well as service and maintenance engineers.

Note

It is the responsibility of the customer that the instructions and directions provided in the operating instructions are read, understood and followed by the relevant personnel before installing the device.

1.1 Items supplied

- PC with Master Station software
- 19-inch Display Screen
- SIMATIC Keyboard
- SIMATIC Optical USB Mouse
- Relay Module
- WinCC Runtime software DVD
- SITRANS F Literature CD

For additional items refer to your packing slip.

Inspection

1. Check for mechanical damage due to possible improper handling during shipment. All claims for damage are to be made promptly to the shipper.
2. Make sure the scope of delivery and the information on the type plate corresponds to the ordering information.

1.2 History

The contents of these instructions are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement.

The following table shows the most important changes in the documentation compared to each previous edition.

| Edition | Remarks |
|---------|---|
| 9/2011 | First edition of Operating Instructions for the SITRANS FUS-LDS Leak Detection System. |
| 9/2012 | Second edition of Operating Instructions for the SITRANS FUS-LDS Leak Detection System. This document replaces all previous instructions for use. The most important changes are as follows: <ul style="list-style-type: none">• Master Station software upgrade to version 2.10• SIMATIC WinCC software version upgrade to SP3• Relay Module circuit board• Updated System Alarm Status Codes• Added ModBus chapter including Alarm Code tables and Register Map procedures and printouts. |

1.3 System Requirements

System Requirements

The following are the recommended computer system requirements for the SITRANS FUS-LDS Leak Detection System.

Note

Requirements may differ depending upon commercial availability. Special equipment requests are available on demand. For additional information contact your Regional Business Developer.

- Operating System: Microsoft Windows XP professional/ Windows 7, with SP3 Pack
- Software: SIMATIC WinCC version 7.0 SP3
- Monitor: 19-inch flat screen
- CPU: Intel Pentium IV
- Clock Speed: 3.0 GHz
- Cache: 512 KB
- Chassis; Desktop/Rack mount
- RAM: 512 MB
- Available PCI slot

- Hard Drive: 60.0 GB
- Optical Storage: 8X DVD-ROM / CD-RW Drive
- USB ports: 4 total (2 front / two back)
- Serial ports: 2 DB-9 ports as COM 1 and COM2
- Keyboard: USB Standard keyboard
- Mouse: USB optical two-button scroll mouse
- AC power cable: 5 foot minimum
- Network: External RJ45
- Modem: Internal 56K V.92 Modem
- Audio: Capable

1.4 Further Information

Product information on the Internet

The Operating Instructions are available on the CD-ROM shipped with the device, and on the Internet on the Siemens homepage, where further information on the range of SITRANS F flowmeters may also be found:

Product information on the internet (<http://www.siemens.com/flow>)

Worldwide contact person

If you need more information or have particular problems not covered sufficiently by these Operating Instructions, get in touch with your contact person. You can find contact information for your local contact person on the Internet:

Local contact person (<http://www.automation.siemens.com/partner>)

Safety notes

2.1 General safety instructions

| |
|--|
|  CAUTION |
| Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance. |
| Only qualified personnel should install or operate this instrument. |

Note

Alterations to the product, including opening or improper modifications of the product, are not permitted.

If this requirement is not observed the manufacturer's warranty will expire.

2.2 Certificates

Certificates are posted on the Internet and on the documentation CD-ROM shipped with the device.

See also

Certificates on the Internet (<http://www.siemens.com/processinstrumentation/certificates>)

Description

3.1 Introduction

The Siemens SITRANS FUS-LDS Leak Detection System (FUS-LDS) and WinCC Interface are the ideal tools for petroleum and chemical pipelines needing early detection of small or catastrophic leaks. The leak detection function is a high priority in the transportation of valuable and/or hazardous liquids. This is especially true when pipelines pass through high risk environmentally vulnerable terrain.

The FUS-LDS system includes a Master Station console, WinCC GUI Interface and a specified amount of Site Stations. The FUS-LDS Master Station operating program implements overall system control. The operating program loads automatically upon power-up of the console. After initialization, a Windows Main System display appears on the console's screen.

You can access all FUS-LDS Master Station functions either by using a mouse to select the pull down menus from the Windows Menu Bar, or by pressing the keyboard Hot Keys to select the desired function.

Fundamental Principals of Leak Detection

Volume In = Volume Out - The FUS-LDS enables balanced transfers of product throughout the pipeline system and tracks batch volumes of product.

Temperature Effects - The FUS-LDS monitors and compensates for expansion and contraction of liquid and pipe as a result of temperature changes in the liquid or environment.

Fluid Properties - The FUS-LDS identifies the current liquid at each site station based upon its sonic properties. This information can be utilized to track liquid batches and identify interfaces of differing liquids.

Applications

In addition to its primary purpose, Siemens FUS-LDS provides other unique functions that can be used to improve the affectivity of general pipeline operations and maintenance. Among the functions available, depending on the particular model flowmeter used, are:

- Leak Detection
- Scraper Detection
- Leak Location
- Gas/Water Detection
- Aeration Detection
- Interface Detection
- Product Type Identification
- Batch Tracking

3.1 Introduction

The Siemens FUS-LDS uses non-intrusive clamp-on transit-time flowmeters exclusively. Recommended flowmeters for combined leak detection and leak location are SITRANS FUH1010 Standard Volume and FUH1010 Precision Volume flowmeters. Transit-time systems offer significant performance advantages when compared to conventional flowmeter technologies.

Training

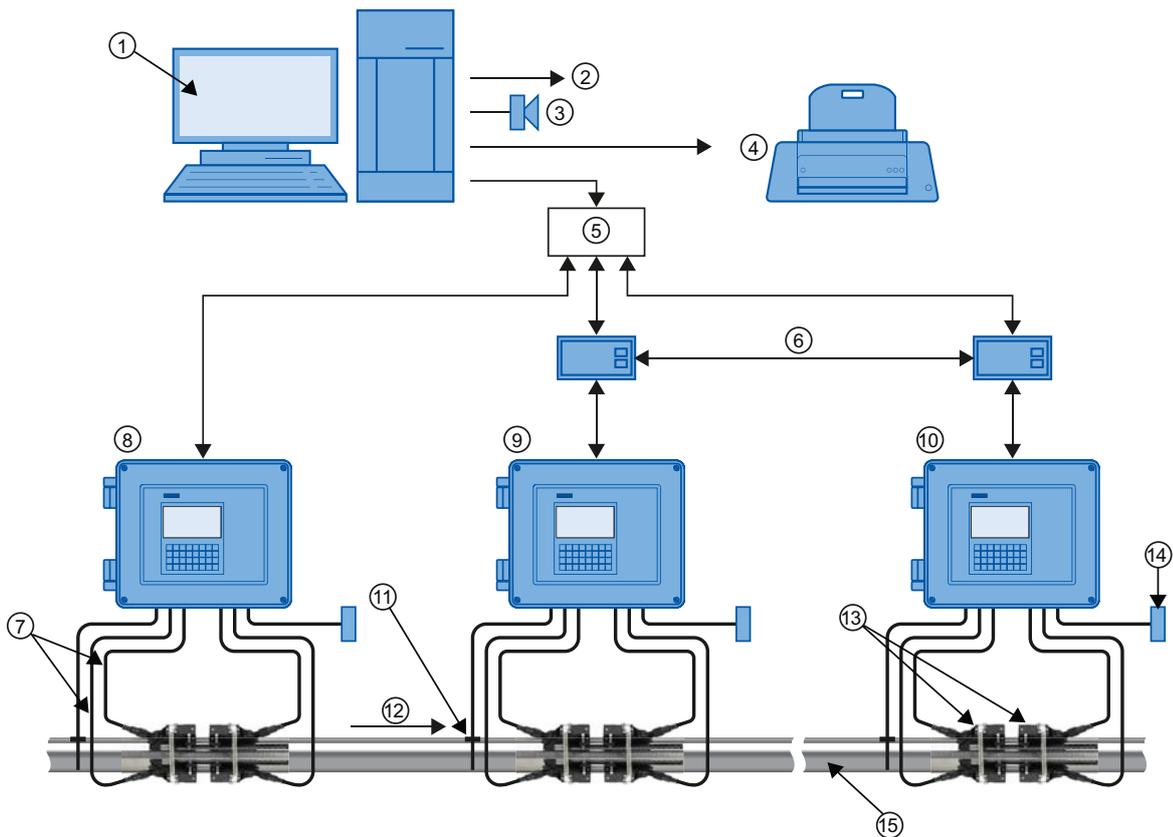
The Siemens FUS-LDS is a user-friendly design but Siemens offers post start-up services to assist in all aspects of system operation, optimization and maintenance. Also, users can request continuous operational support, especially during system optimization.

Siemens recommends that FUS-LDS operators participate in the Indoctrination & Training courses that are offered. These courses provide operating details and text material beyond the scope of this operation instructions manual. After completing the training courses, operators will find the Siemens FUS-LDS simple to operate and maintain. Operators will also become familiar with the unique functions listed above since they are valuable aids for general pipeline operations.

3.2 System Components

Introduction

The figure below illustrates a typical leak detection system. It includes a Master Station, a number of Site Stations and a typical communication system. You should identify the FUS-LDS system type installed on your pipeline so that you can focus on the optional features that apply specifically to your system.



- | | | | |
|---|---------------------------------------|---|---------------------------------------|
| ① | Master Station Console & Data Storage | ⑧ | Site Station 1 |
| ② | To User's Computers | ⑨ | Site Station 2 |
| ③ | Leak Annunciator | ⑩ | Site Station "n" |
| ④ | Color Printer | ⑪ | Clamp-on Liquid Temperature Sensor |
| ⑤ | RS-232 Polling | ⑫ | Flow direction |
| ⑥ | Modem Data Link | ⑬ | Clamp-on Flow Sensors |
| ⑦ | Dual Path Flow Detection | ⑭ | Ambient Temperature Sensor (optional) |

Figure 3-1 Typical Leak Detection System Configuration

Site Stations

A typical Site Station consists of a SITRANS FUS-LDS flowmeter with clamp-on flow sensor assemblies and clamp-on liquid RTD temperature sensors.

FUS-LDS Master Stations

FUS-LDS Master Stations are delivered with the leak detection software installed.

The sensitivity and speed with which the system detects pipeline leaks requires the Master Station to process a vast amount of real-time data. Therefore, the Master Station cannot share processing time with other tasks, as is done with conventional SCADA (Supervisory Control And Data Acquisition) system computers. However, if necessary, numeric data can be transferred from the FUS-LDS Master Station to your main or SCADA computer through ModBus.

To maintain a constant observation of leaks, it is strongly recommended that the Master Station NOT be taken off-line at any time. The Master Station screen will only show data from the previous 72 hours. The Master Station permits the periodic extraction of archived data stored on its hard disk. A Master Station can store an unlimited amount of accumulated data up to the limit of the hard drive and each archive file stores each day's data. To review this data, Siemens recommends using an optional Review Station and software.

See also

Master Station Graphic Screens (Page 35)

Installation

4.1 Installation and Start Up

The installation and start up of the FUS-LDS Leak Detection System are part of the normal commissioning procedure and performed by the factory.

Topology File

The Topology file contains an actual description of the pipeline being serviced by the FUS-LDS.

- The Topology file defines all the pipeline parameters.
 - Pipe Segments
 - Pipe Dimensions
 - Liquid Tables
 - Optimization Data
- It contains information on the type of communication to be used by the system.
- When the Master Station is optimized all changes are accomplished in the Topology file.
- After optimization the new Topology file is uploaded into the Master Station.

Initial Settings

Usually, Master Stations are delivered with leak warning and alarm thresholds set somewhat above specified limits. This prevents false alarms from developing before the factory completes the final optimization.

4.2 Communications

Basic Polling Sequence

Upon initialization, the Master Station broadcasts date and time commands to synchronize the time-of-day clocks on each Site Station. The Master Station issues date and time synchronization commands every six hours to ensure synchronization of the real time clocks of all Site Stations.

Note

Site Stations do not have to respond to a date/time command.

- On the first minute after synchronization, the Master Station broadcasts a data report command to all Site Stations to capture data. All Site Stations prepare for a polling request by storing the data report for that minute. Thus, all Site Stations collect their data at exactly the same time.
- The Master Station then collects data reports from each Site Station for further processing.
- Each Site Station (i.e. flowmeter) is identified individually by its own network ID number.
- The polling data can be displayed on the Trace Diagnostic screen Hot Keys <Alt>+<F4> (see Master Station Graphic Screens (Page 35)).
- After the Master Station collects all the data reports, the network remains passive until the next minute when the Master Station repeats its data report request.

Polling Sequence Communications

- If a communication fault occurs the Master Station will continue to poll the same site station for a reply.
- If the Master Station does not receive a valid reply after successive tries, a communication fault alarm is displayed and leak detection is suspended on that segment until communication is restored.
- During a communication fault the Master Station will use fill data, copied from the last valid report (a flat line data trace=no real data).

Operation

5.1 Introduction

Preliminary Performance Considerations

Unlike conventional SCADA and pressure-based leak detectors, FUS-LDS is specifically designed for leak detection. The system is completely self-contained, consisting of a Master Station with supporting Site Stations. We do not rely on data provided by instruments designed by other vendors to accomplish the primary leak detection task.

Adverse Application Conditions

The FUS-LDS features real-time detection of Site Station application conditions, and generates an AppCon factor to adjust the leak detection sensitivity dynamically if conditions deteriorate. This preserves the best sensitivity during normal conditions and minimizes or prevents false alarms only if application conditions deteriorate.

5.2 Optimization

Optimization Procedures

Siemens provides an Optimization Service, which is recommended for users who have only recently begun to utilize the FUS-LDS. Since optimization is a specialized and skilled activity, we recommend that users who want to optimize their systems themselves attend our Siemens Optimization training courses.

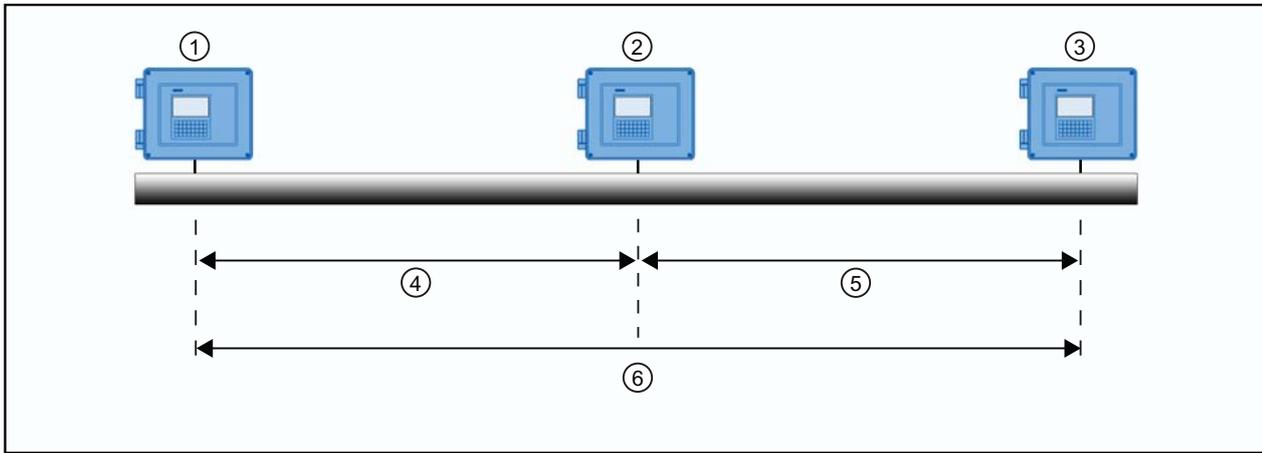
5.3 System Operation Overview

The Master Station acquires time-correlated digital flow and temperature data from its Site Stations via the FUS-LDS communication system. The Master Station performs a comprehensive analysis of the Site Station data to disclose possible leak events anywhere on the pipeline.

The FUS-LDS uses volume balance as the basic means of detecting a leak. It computes the volume balance by comparing the difference in the liquid volume entering and leaving the pipeline segment. The figure below shows the relationship between the volume balance of individual pipeline segments and the overall volume balance of the entire pipeline. Calculation of the segment volume balance allows the FUS-LDS to pinpoint a possible leak location to a specific segment. The SoniLocator function (Hot Keys <Alt>+<F6>) further pinpoints a possible leak location.

5.3 System Operation Overview

The Master Station registers pipeline segment volume balance data once per minute. This data is called the 1-minute delta. Three additional time integration registers receive this data. Each provides a separate time integration period. The following table lists the available time integration registers.



- ① Site Station 1
- ② Site Station 2
- ③ Site Station 3
- ④ Segment 1- Seg 1 Vol Balance
- ⑤ Segment 2- Seg 2 Vol Balance
- ⑥ Pipeline Volume Balance

Figure 5-1 Pipeline Volume Balance Schematic

Table 5- 1 Time Integration Registers

| Screen | Rolling Average |
|-----------------|-----------------|
| 1-minute delta | 1 minute |
| 5-minute delta | 5 minutes |
| 15-minute delta | 15 minutes |
| 60-minute delta | 60 minutes |

Short integration periods show large leaks very quickly. Longer integration periods show smaller leaks before they become excessive. Each integration period has its own alarm threshold. Alarm thresholds represent the volume that triggers the Master Station’s audio/visual alerts.

The Master Station routes the compensated 1-minute delta (or warning delta) to its 5-minute, 15-minute and 60-minute rolling average integration period registers. These have lower leak detect thresholds than the 1-minute integration period. Usually, the 60-minute integration period will be about three to five times more sensitive than the 1-minute period.

5.4 System Menus

Introduction

The system menus provide access to the main functions of the Master Station. The following paragraphs describe all of the system menus and their sub-menus.

- File
- Display
- Zero Functions
- Setup
- Network Diagnostics
- Help

These menus are displayed in the Windows Menu Bar as shown below.

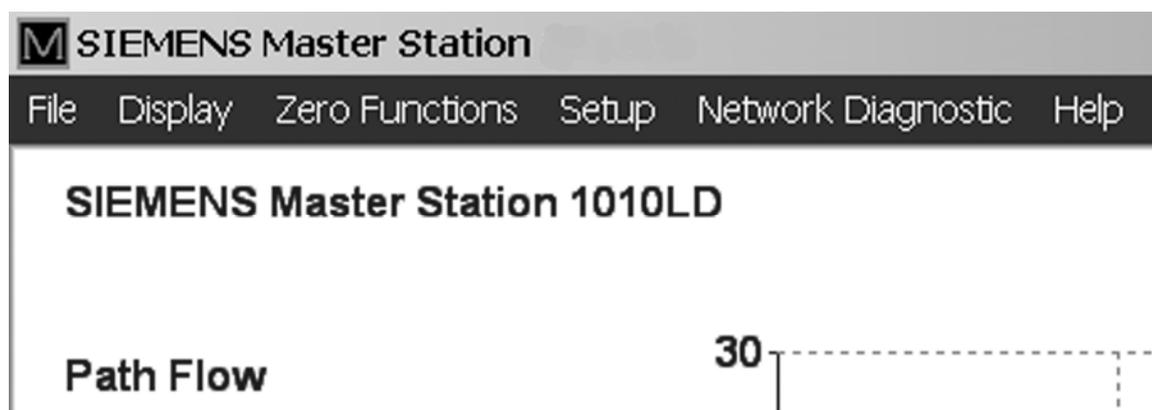


Figure 5-2 Menu Bar

The menu control operates like any Windows based program. To select one of the Menu functions:

- Using the mouse, point to a function in the Menu Bar.
- Click left mouse button once on the selected function (e.g. File).
- The sub-menu will open.
- Point to and highlight another function (e.g. Print Setup). To select it, click once with the left mouse button.

You can also use the keyboard to select the menu functions by pressing and holding the <Alt> key and then pressing the first letter of the menu function. For example,

- Press and hold the <Alt> key and then press the <F> key.
- This key sequence will select the File menu.

This first-character selecting technique is ideal for quick screen and function selections.

FILE MENU

The [File] menu lists the following file related functions:

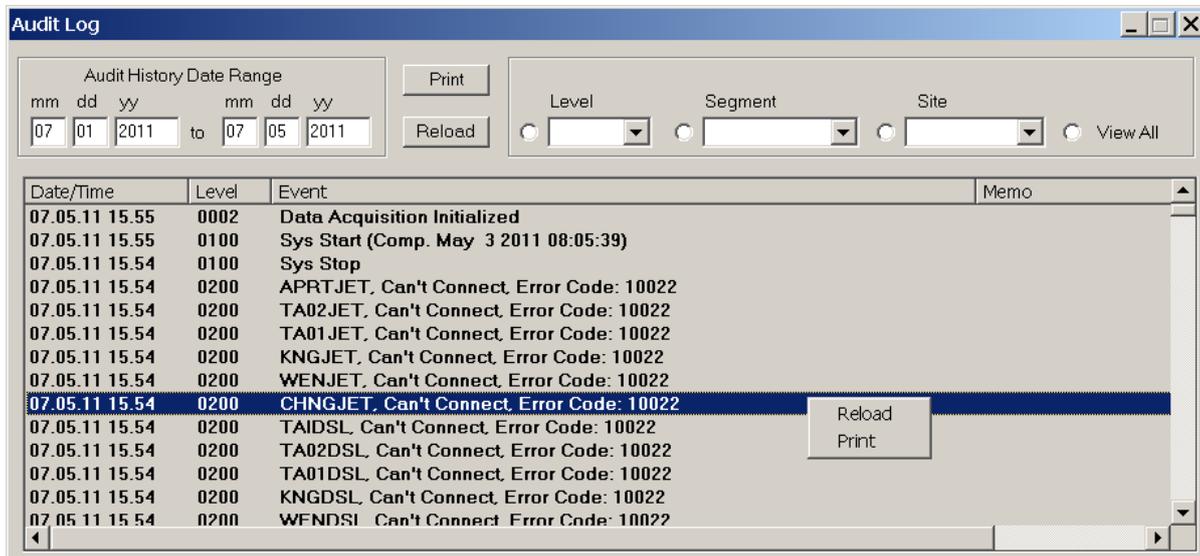
- Print - <Ctrl>+<P> - Select to print a screen.
- Print Preview - Select to view screen to be printed.
- Print Setup - Select to setup printers and related printer parameters.
- View Audit Log - Select to view Audit Log screen. See screen below.
- Print Audit Log - Select to print Audit Log screen.
- Update Topology File - Select to update changes to the Topology file.
- Exit - Select to exit program.

Audit Log

At the start of each month that month's Audit File will be created. It is a binary file whose name will be AUDmm_yy.ext; where *mm* is the month, *yy* is the year and *ext* matches the extension of the archive file.

Note

The Audit Log screen may also be viewed by double clicking the  icon located at the bottom right side of the selected graphic screen.



When the Audit Log dialog is invoked for a Poller (i.e. system operation in real-time) the current Audit Log file will be displayed. When the Audit Log dialog is invoked in Replay Mode the Audit Log for that archive's day will be displayed. The data range can be modified to increase or decrease the Audit Log listed. The operator can filter what is displayed by audit level, segment name, or site by selecting the desired value to show.

To sort the Audit Log in ascending/descending order, click on the associated column header. The sort order is toggled with each click.

A Reload and Print context menu is displayed by clicking the right mouse button anywhere on the Audit Log screen. (Refer to the Audit Log menu figure above and figure below.) This context menu contains two menu items: Reload and Print.



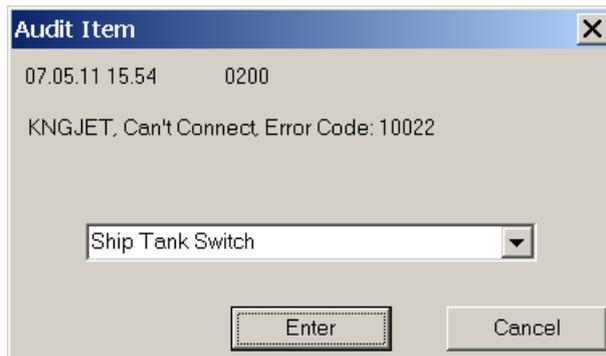
- The Reload menu item has the same function as the Reload button in the Audit Log screen.
- The Print function sends the contents of the Audit Log listed to the printer.

Note

If the Audit Log data has been sorted or filtered it will be printed as it appears.

Audit Event Memo

To add or modify a Memo associated with an Audit Event, double click on the event line to bring up the [Audit Item] dialog shown below.



Audit Items

The operator can accept one of the predefined phases from a list or key in text and then press the <Enter> button. This updates the screen and the corresponding audit file's record.

Print Audit Log

Select to print the Audit Log.

Update Topology File

Note

This menu item will only be active with certain optimization changes. Please exercise caution when invoking this function.

Exiting Master Station Program

Operation of the Master Station program can be terminated in one of the following ways:

- Pointing to the File Menu and clicking on [Exit].
 - Pressing the <Q> key.
 - Pointing to the Close button [X] in the upper-right corner of the window.
-

Note

You will be required to enter the master password before the Master Station program actually terminates and returns to Windows. If you decide to quit while the Master Station is gathering data, the program will close the current archive as a partial archive. The default password is: 990LDN

When you re-invoke operation, it will scan the working directory and reload the current day's archive file. This allows the Master Station to recover from power cycles or temporary shutdowns with the leak detection information virtually intact.

DISPLAY MENU

The [Display] menu lists the following available numeric and graphic data screens as well as their corresponding Hot Keys:

Table 5- 2 Display Menu and Hot Keys

| Description | Hot Key | Description | Hot Key |
|----------------------------|---------|-------------------------------|----------|
| Report Diagnostic | none | AppCon | Alt+F5 |
| Backup Switch Report | none | Path dFlow | Alt+F7 |
| Summary | F1 | dF/dt | Alt+F8 |
| Segment Status | F2 | Path dVs | Alt+F9 |
| Site Data | F3 | S.G. or API number (see note) | Alt+F10 |
| Batch/Liquid Status | F4 | Liquident (Meas, Pred, Both) | Ctrl+ F1 |
| MultiGraph Delta | F5 | Flow | Ctrl+ F2 |
| MultiGraph Data | F6 | Temperature | Ctrl+ F3 |
| MultiGraph LiquiData | F7 | Vs | Ctrl+ F4 |
| MultiGraph Diagnostic | F8 | dVs/dt | Ctrl+ F5 |
| MultiGraph Optional | F9 | Signal Aeration | Ctrl+ F6 |
| Path Flow | F10 | Line Pack | Ctrl+ F7 |
| Pipe Delta (1,5,15,60) min | F11 | Pack Delta | Ctrl+ F8 |
| Delta (1,5,15,60) Min | Alt+F1 | Viscosity | Ctrl+ F9 |
| Flow and Total (Pipe) | Alt+F2 | Reynolds Number | Ctrl+10 |
| Scatter (1,5,15,60) Min | Alt+F3 | Pipe Balance | Shift+F1 |
| Trace Diagnostic | Alt+F4 | Pressure | none |

Note

The Specific Gravity screen will appear for metric systems. If not metric, the API number screen will appear.

ZERO FUNCTIONS MENU

The [Zero Functions] menu is used to reset the Master Station's flow total, site total and batch tracking registers. The following functions can be selected:

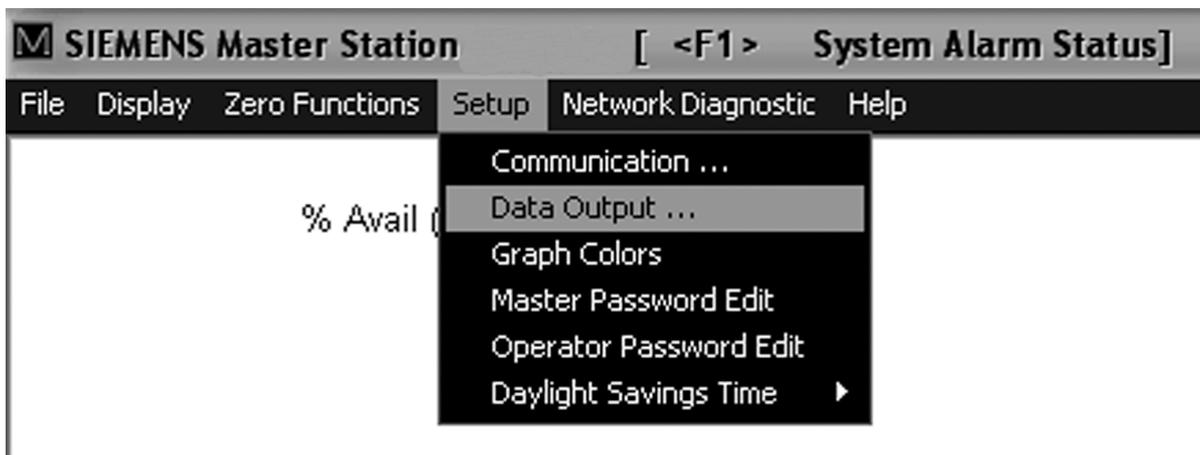
- Pipe Batch
- Pipe Flow Total
- Pipe Leak Total
- Communications Score
- Scraper

SETUP MENU

The [Setup] menu allows you to customize the Master Station communication protocols and screen color schemes to suit your needs. Also, you can set up two levels of password protection to limit access of Master Station functions to appropriate personnel.

Note

Once you set the passwords, you will only be able to change them by first entering the current password. Note that passwords are case sensitive (i.e. upper and lower case). The default password is: 990LDN



The Setup menu has the following selections:

Communication

The [Communication Setup] provides access to serial communications parameters. We recommend that you only alter these settings under factory supervision, or after consultation with the optimization team. The following functions are available:

Communication Setup

When the [CommsSetup] tab is selected, the following functions appear:

| |
|---|
|  WARNING |
| IMPORTANT Changing the Communication Setup settings is not recommended and may have a negative impact on the system. Only trained service personnel should make any changes to the Communication Setup settings. |

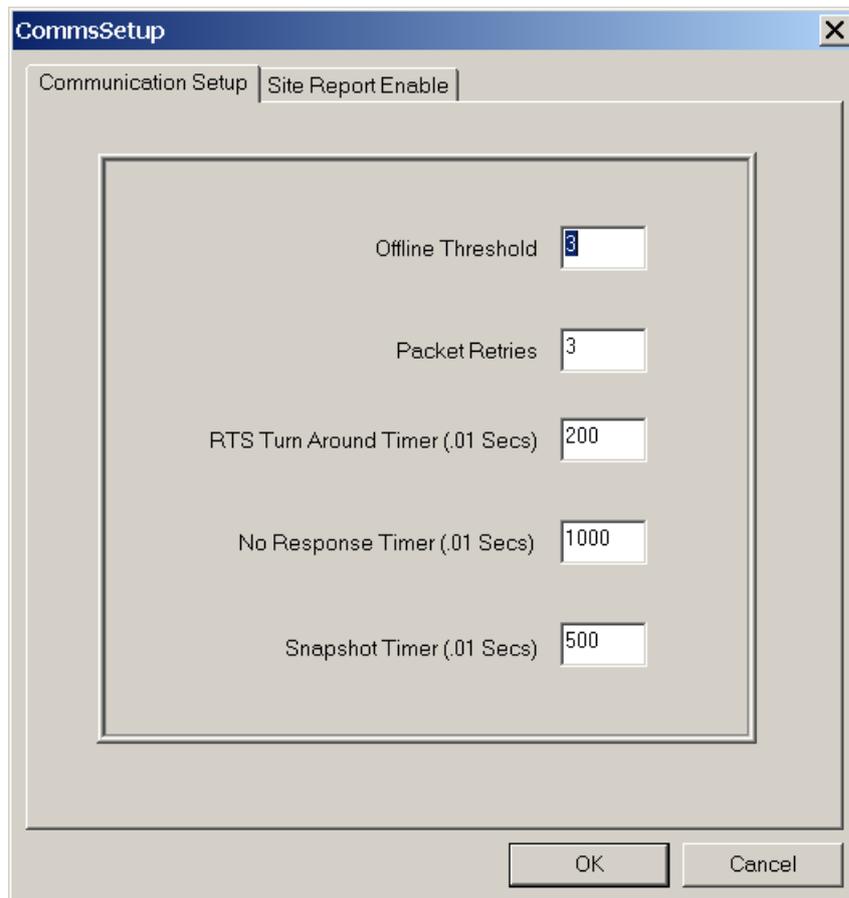
- Offline Threshold – the number of cycles the Master Station fails to retrieve data before issuing a Communications alarm and reverting to zero packet retries.
- Packet Retries - the number of failed retries before skipping to the next site station.
- RTS Turn Around Timer (.01 Secs)

Note

This function is typically bypassed with communications settings.

A Request-to-Send (RTS) response time, set in increments of .01 seconds, sent from the Master Station to the communication equipment. It indicates the amount of time elapsed before receiving a Clear-to-Send (CTS) signal.

- No Response Timer (.01 Secs) – a period of time, set in increments of .01 seconds, between packet retries.
- Snapshot Timer (.01 Secs) – a wait time, set in increments of .01 seconds, sent to notify all site stations to get their logger data ready to send.



The screenshot shows a dialog box titled "CommsSetup" with a close button (X) in the top right corner. It has two tabs: "Communication Setup" (selected) and "Site Report Enable". The "Communication Setup" tab contains five input fields, each with a label and a numerical value:

| Parameter | Value |
|----------------------------------|-------|
| Offline Threshold | 3 |
| Packet Retries | 3 |
| RTS Turn Around Timer (.01 Secs) | 200 |
| No Response Timer (.01 Secs) | 1000 |
| Snapshot Timer (.01 Secs) | 500 |

At the bottom of the dialog box are two buttons: "OK" and "Cancel".

To change the data for these selections simply position the mouse on the selected box, click the left mouse button once, type new numerical data and then click [OK].

Site Report Enable

When the [Site Report Enable] tab is selected, the screen lists all the Site Stations programmed in the Master Station topology file by Siemens.

| |
|---|
| ⚠ WARNING |
| IMPORTANT |
| Changing the Site Report Enable settings is not recommended and may have a negative impact on the system. |
| Only trained service personnel should make any changes to the Site Report Enable settings. |

To disable a site location:

1. Using the mouse, position the cursor over a location box.
2. Click the left mouse button once.
3. The [✓] inside the location box will disappear and the site will be disabled.

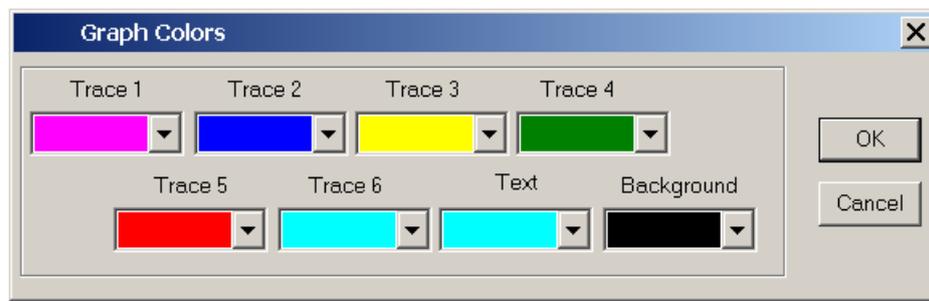


Graph Colors

This function allows you to customize the colors that the Master Station uses to distinguish between separate parameters appearing on the same data screen. A default color set is included that provides easily distinguishable colors for all combinations of data traces. The only fixed (reserved) color is red. The Master Station uses red to identify limits (e.g. leak and anti-leak thresholds). However, if necessary, the Master Station allows you to set your own color scheme.

To select a new graph color:

- Position the cursor on the scroll arrow and click with the left mouse button to open the Trace or Background box color menu.
- Position the cursor on the desired color and click once to select.
- After all selections are made, click [OK].



Master Password Edit

The [Master Password Edit] function permits access to any permitted functions that can make permanent changes to the operating console. The menus restricted by the Master Password are:

- Communication Setup
- Data Report Setup
- Update Topology File
- Quit

After you enter a correct Master Password (e.g. 990LDN), you can reset the password by entering the following in the [Set Master Password] menu:

- Enter the current password in the [Old] password window.
- Enter a new password in the [New] password window.



- Enter the new password in the [Confirm] password window.
- The Master Password will now be obsolete.

Operator Password Edit

The [Operator Password Edit] allows you to restrict the ability to acknowledge (reset) Master Station alarms. You can set or reset the Operator password by entering the following in the Set Operator Password menu:

Note

Leave the [Old] password window blank if this is the first time an Operator password is going to be set.

- Enter the current Operator password the [Old] password window.
- Enter a new Operator password in the [New] password window.



- Enter the new Operator password in the [Confirm] password window.
- The Operator Password will now be obsolete.

Note

The menus restricted by the Operator Password are:

[Alarm Acknowledge]

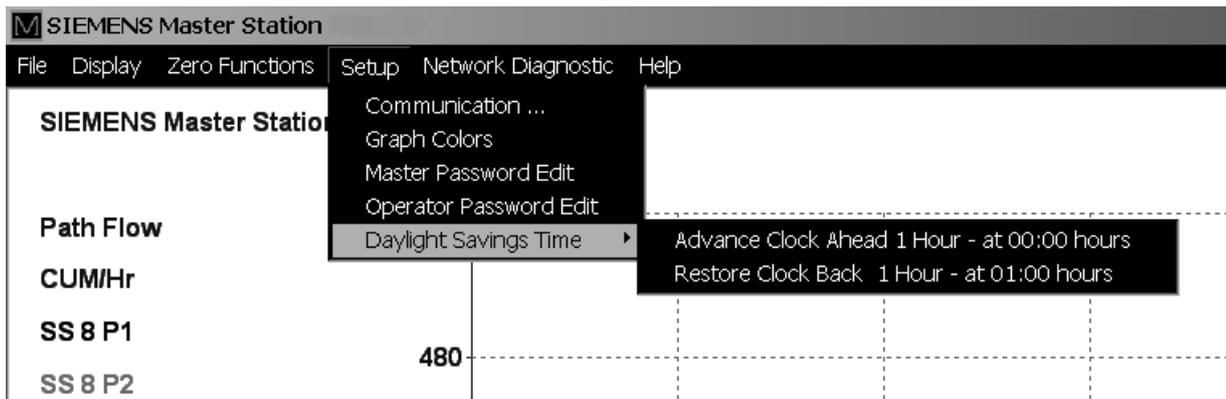
[Master Alarm Acknowledge]

[Zero Functions]

Daylight Savings Time

Daylight Savings Time can be reset on any calendar day or time desired. The settings are as follows:

- When [Advance Ahead 1 Hour-at 00:00 hours] is selected, the Master Station resets the clock ahead one hour at 12:00 midnight the next day.
- When [Restore Clock Back 1 hour - at 01:00 hours] is selected, the Master Station sets the clock back one hour at 1 AM the next day.



NETWORK DIAGNOSTIC MENU (available in Polling Mode only)

The [Network Diagnostic] menu allows the user to communicate directly to a Site Station in either Network Mode or Terminal Mode and make adjustments. In addition, the screen provides status information during Network Mode.

⚠ WARNING

IMPORTANT

Failure to communicate with site stations properly may result in system failures.

Only trained and experienced persons knowledgeable with this system should attempt to communicate with site stations.

1. At the Menu Bar, position the cursor on [Network Diagnostic] and click with the left mouse button once.



2. Click the left mouse button again and the Network Diagnostic screen will appear.

5.5 Master Station Screen Selection

- 3. Input the network Destination ID of the desired site.
- 4. Press the <?> key and the <Enter> key and the Site Station's Remote menu will be displayed on the screen.



5.5 Master Station Screen Selection

The Master Station console includes warnings and alarms to alert you to a possible leak event. When you receive an alert, the user interface provides instant Hot Key access to most Master Station graphic and numerical data screens. Using these screens, you will be able to locate, view and analyze the data so that you can decide quickly.

The Master Station activates the alarms if any of the four integration time periods show an alarm condition. You can only reset the alarm by accessing the Master Station and acknowledging the alarmed parameter. This ensures that you will be at the Master Station console, ready to analyze the alert.

The graphic screens have three categories:

- Single Function Graphic Screens
- MultiGraph Screens (one of which allows you to select your own parameters)
- Numerical Data Screens

Selecting Data Screens

You can use two methods to select the data screens:

- Pointing and selecting with a mouse

You can select any screen from the Display Menu by pointing to it with a mouse and clicking once on the selections.

- Pressing Hot Keys

You can move directly to most screens by pressing a single Hot Key (e.g. <F6>), or by pressing a modifier key plus a Hot Key (e.g. <Alt> + <F6>). The modifier key is identified by its first initial (e.g. <AF1> means press the <Alt> key + <F1> key). These are called combination hot-keys.

Some Hot Keys allow you to toggle through related displays (e.g. <AF1> toggles through the 1, 5, 15 and 60-minute delta screens).

- Basic Hot Keys
 - <M> = Master alarm acknowledge function
 - <P> = Modify scraper info. (Batch Screen)
 - <Q> = Quit Program
 - <Ctrl>+<P> = Print Screen

Note

The Display drop down menu selection [Pressure], the Report Diagnostic menu [Report Diagnostic] and [Backup Switch Report] selections do not have associated Hot Keys.

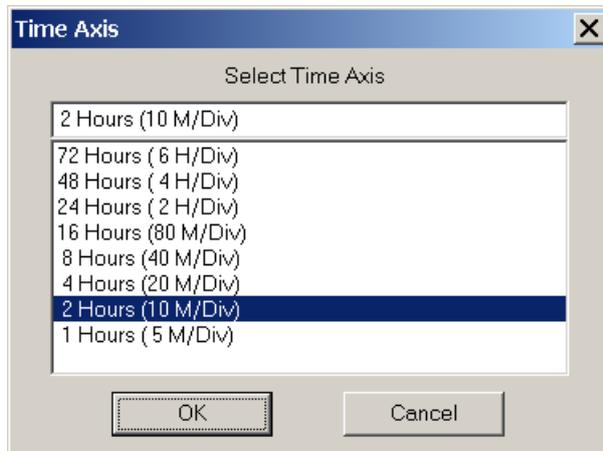
Selecting the X or Y Axis

Once a graphic screen is selected its X- or Y-Axis data can be changed. For example:

To change the X-Axis data:

1. Select a graphic screen (e.g. press Hot-Key combo <Ctrl>+<F2> to select the Flow Screen).
2. Use the mouse to position the cursor over the X-Axis.
3. Double-click the left mouse button.

4. A Time Axis Menu appears that allows the Time Axis data of the graph to be changed. The following hour/minute choices are available:



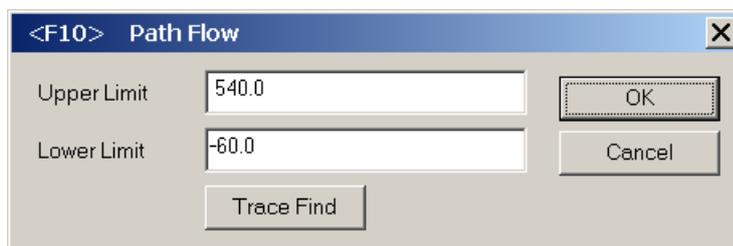
5. To select a different X-Axis time, position the cursor over the desired time and click the left mouse button once to highlight the selection.
6. Click [OK] or press the <Enter> key and the X-Axis time will be changed to the new value.

To change the Y-Axis data:

Note

Not all Y-Axis graphic screen data can be changed.

1. Select a graphic screen (e.g. press Hot-Key combo <Ctrl>+<F2> to select the Path Flow Screen).
2. Use the mouse to position the cursor over the Y-Axis.
3. Double-click the left mouse button.
4. A Path Flow context menu appears that allows numerical data to be changed by the user for Upper Limit and Lower Limit parameters. The Trace Find function is also included.



5. Change the Upper and Lower Limits of the graph, use the mouse to position the cursor in the data window and input new numerical data. Pressing [OK] will scale the graph to limits selected.
6. To select [Trace Find], position cursor and click left mouse button once. The Trace Find function will automatically adjust the Y axis, centering the most current data, by the difference between the upper and lower limits.

5.6 Master Station Graphic Screens

Summary Screen - System Alarm Status - Hot Key <F1>

If you receive a warning or alarm, we recommend that you view this screen first. It instantly indicates which pipeline segment(s) triggered the warning or alarm. This screen uses a color scheme to highlight the suspect pipeline segment(s). The following list explains the color scheme and its implications:

- GREEN = normal conditions
- YELLOW = leak warning or empty site
- FLASHING RED = leak alert, site fault or communication fault
- SOLID RED = Acknowledged leak alarm and site fault
- BLUE = Condition opposite of leak (Anti-Leak)

If a Site Station next to a pipeline segment signals a fault condition, that Site Station's icon will be displayed as flashing red, rather than its normal green color.

To invoke the Master Alarm Acknowledge Function press the <M> key.

The Summary screen (System Alarm Status) allows you to highlight any pipeline segment shown on the screen. To highlight a pipeline segment simply point to it with a mouse and click once. When you highlight a particular pipeline segment, the Master Station sets all its available screens to show data for that pipeline segment, or adjoining Site Stations. This allows you to use the Hot Keys to move quickly through all the screens necessary to confirm or reject the suspected leak condition.

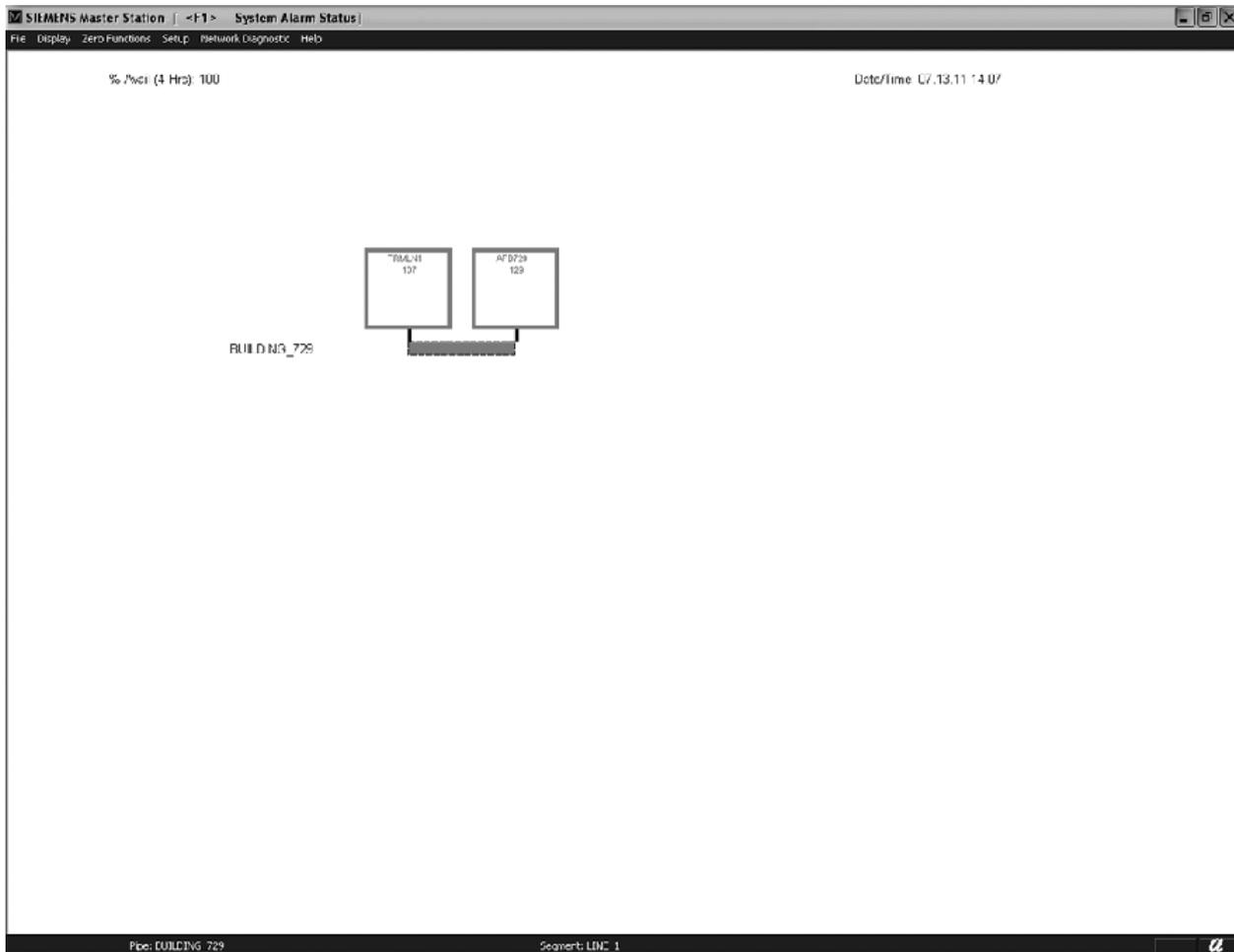
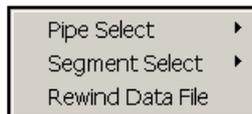


Figure 5-3 Summary Screen (System Alarm Status) <F1>

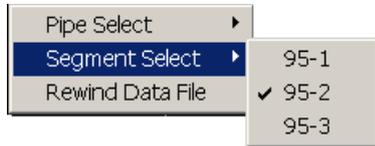
Selecting a Context Menu

- Select a function from the Display menu or press a Hot Key (e.g. Press <F6> key to select the MultiGraph Data screen).
- Press the right mouse button once.
- The context menu will appear and list the following choices but choices may vary depending on the selected screen:



Selecting Context sub menus

To select the Context sub-menu, point mouse to the right of context menu selection and the related data will appear. For example:



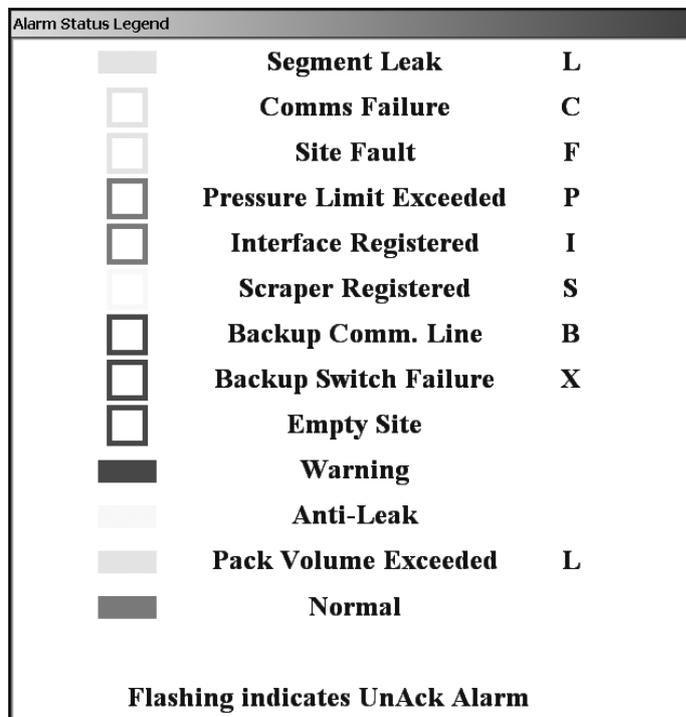
- **Pipe Select** - Lists all pipes (e.g. L3-LINE).
- **Segment Select** - Lists all pipeline segments of selected pipe. Selected pipeline segment description will appear (e.g. 95-2).
- **Rewind Data File** - Rewinds the data file to the beginning. (Only in replay mode.)

System Alarm Status Legend

The System Alarm Status Legend is only available on the Summary (F1) screen. The legend lists and displays the colors and related icons (e.g. a red bar), fault descriptions, and alarm letter codes.

To display the System Alarm Status Legend:

1. Move the mouse to a clear section of the System Alarm Status screen.
2. Press and hold the left mouse button and the legend will appear in the lower right corner of the screen. (When the mouse button is released the legend will disappear.)



The system pipeline segment and Site Station alarm colors and their related alarm codes are as follows:

Table 5- 3 System Alarm Status Legend

| Colors and Icons | Descriptions | Alarm Code |
|--------------------------------|-------------------------|------------|
| Red Bar | Segment Leak | L |
| Red Box | Comms Failure | C |
| Red Box | Site Fault | F |
| Green Box | Pressure Limit Exceeded | P |
| Green Box | Interface Registered | I |
| Blue Box | Scraper Registered | S |
| Yellow Box | Backup Comm. Line | B |
| Yellow Box | Backup Switch Failure | X |
| Yellow Box | Empty Site | |
| Yellow Bar | Warning | |
| Blue Bar | Anti-Leak | |
| Red Bar | Pack Volume Exceeded | L |
| Green Bar | Normal | |
| Flashing indicates UnAck Alarm | | |

Segment Status List Screen - Hot Key <F2>

The Segment Status List Screen shows the numeric value of the four leak integration periods, plus the current alarm threshold settings. You should view this screen to examine, in detail, the parameters the Master Station used to declare a warning or alarm condition shown on the System Alarm Status screen <F1>. The numeric data for a particular integration period will assume the color that indicates the pipeline segment’s current status (e.g. yellow for warning, red for alarm). Similarly, anti-leak warning data assumes the color blue.

The Segment Status List shows other important data:

- Current AppCon value (the pipeline segment’s application condition).
- Current AppCon computation parameters.
- Current Pack Delta (the packed volume value).
- Current Pack Delta Alarm Threshold value.
- Current Leak Volume and the time that the leak started (if leak alarm is present).
- Current Thermal Model variable including, in parentheses, how many sections were used for the computation and the current minute’s thermal compensation volume, which is added or subtracted from the pipeline segment’s one-minute Delta.

Segment Status Screen Descriptions

- Integration: Leak rate integration time.
- Delta: Current pipeline segment delta.
- Threshold: Segment delta required to trigger alarm. Typical settings are:
 - 3.0% delta in 1 min 2.0% delta in 5 min
 - 1.5% delta in 15 min 1.0% delta in 60 min.
- % of Design - Leak detection percent threshold of total throughput for each integration period.
- Appcon Delta: Current delta times Appcon factor. Delta used to declare a leak.
- Pipe Delta: Averaged delta of all pipeline segments surrounding the chosen segment.
- Appcon: Application condition (confidence factor).
- Pack:
 - Static line fill
 - Volume packed into line (Total Volume)
 - Pack total during a pack event
 - Pack Volume Alarm (when pack total exceeds pack volume).
- Propagation: Time delay between Site Stations.
- Total: Accumulation of delta during leak (after leak declared). Can set a total value that must be exceeded before declaring a leak.

Total Packed Volume

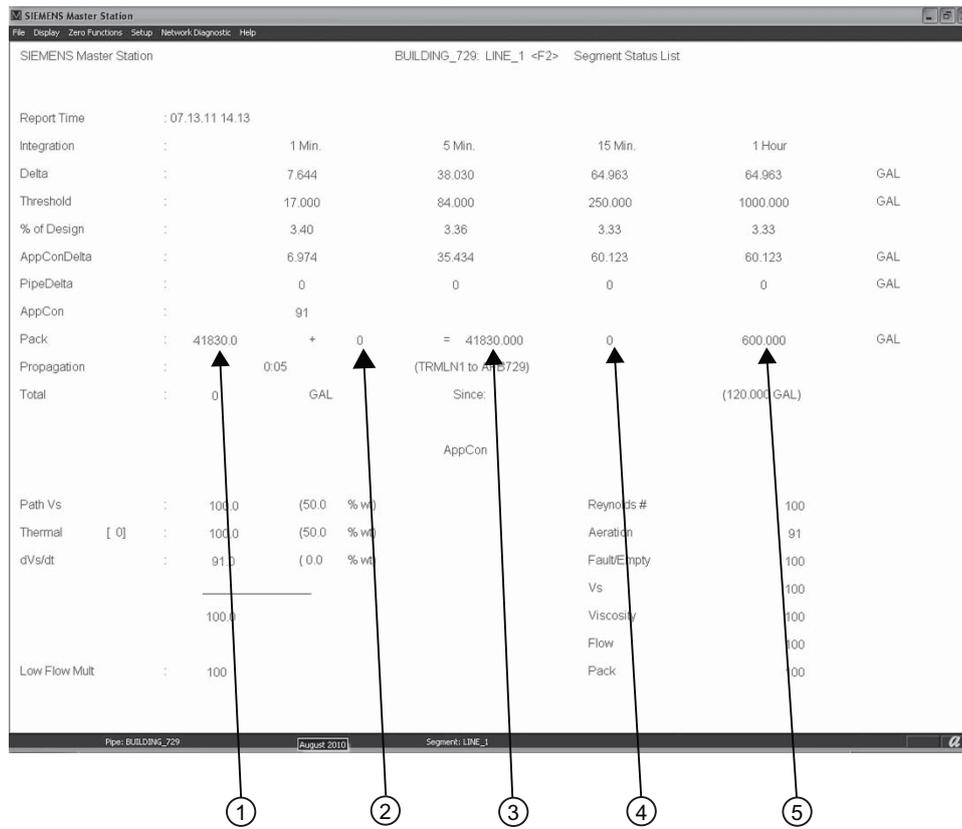
In addition, the Master Station displays the Total Packed Volume on the Segment Status List screen <F2>. The Total Packed Volume is derived by adding the static line volume (i.e., the line fill under static conditions) to the line packed volume. This is represented in the following form on the [Pack] line of the <F2> screen as:

[Static Line Volume] + [Added Packed Volume] = [Total Packed Volume]

The Segment Status List screen <F2> also displays the AppCon data in a manner that allows the quick and easy identification of system desensitizing due to a decreased AppCon factor.

Furthermore, the Segment Status List screen shows Total Volume of the pipe as it changes due to pressure and temperature as shown below.

5.6 Master Station Graphic Screens



- ① Segment volume at static pressure
- ② Added Pack Volume
- ③ Total Packed Volume
- ④ Packed Volume Delta
- ⑤ Alarm Threshold

Figure 5-4 Segment Status List

Segment Status Screen - Hot Key <F2> toggle

The first time you press the <F2> Hot Key the Segment Status List screen is selected. Pressing <F2> again toggles the display to the Pipe Delta Screen.

If you receive a pipeline segment leak alarm via the System Alarm Status Screen (Summary <F1>), use the Pipe Delta screen to examine the pipeline segments both upstream and downstream of the alarmed pipeline segment to confirm the leak.

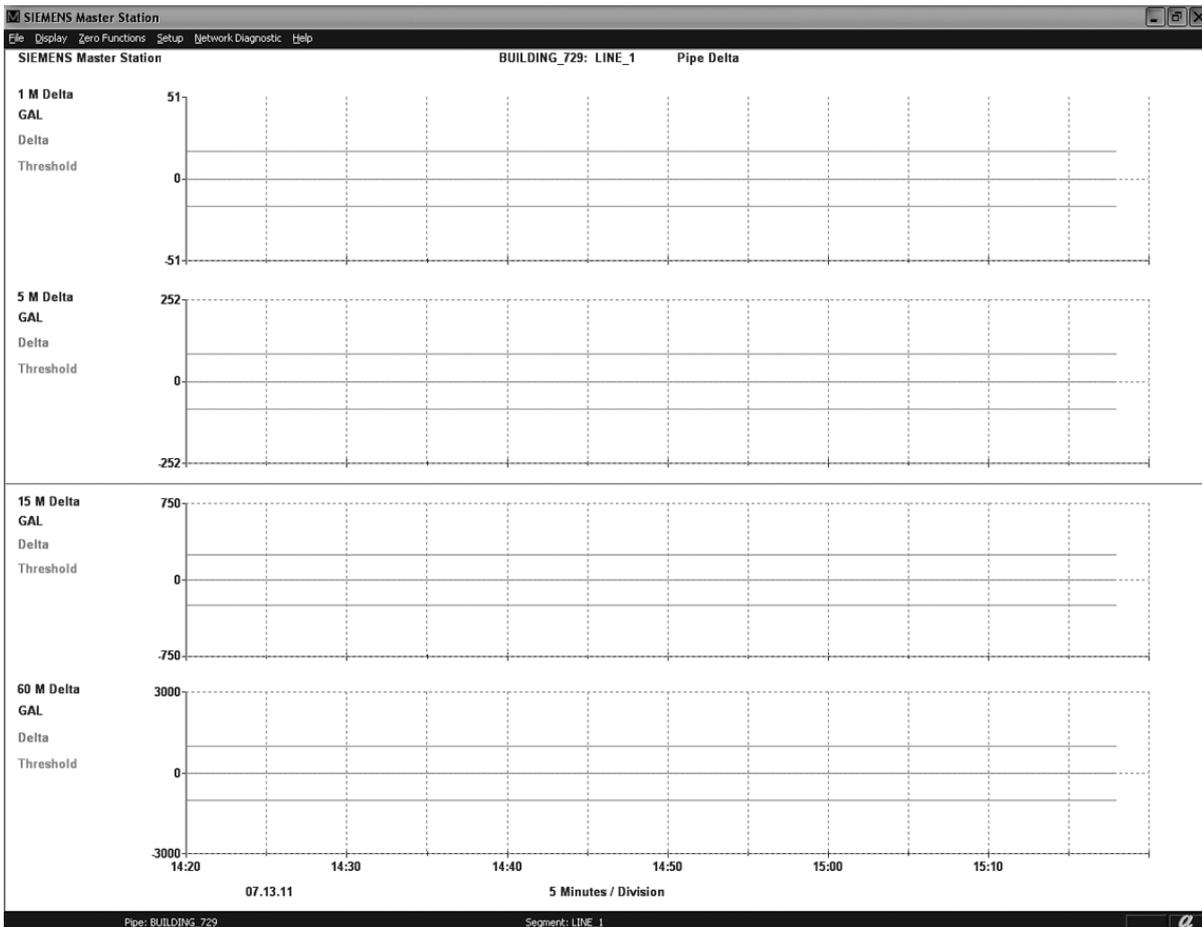
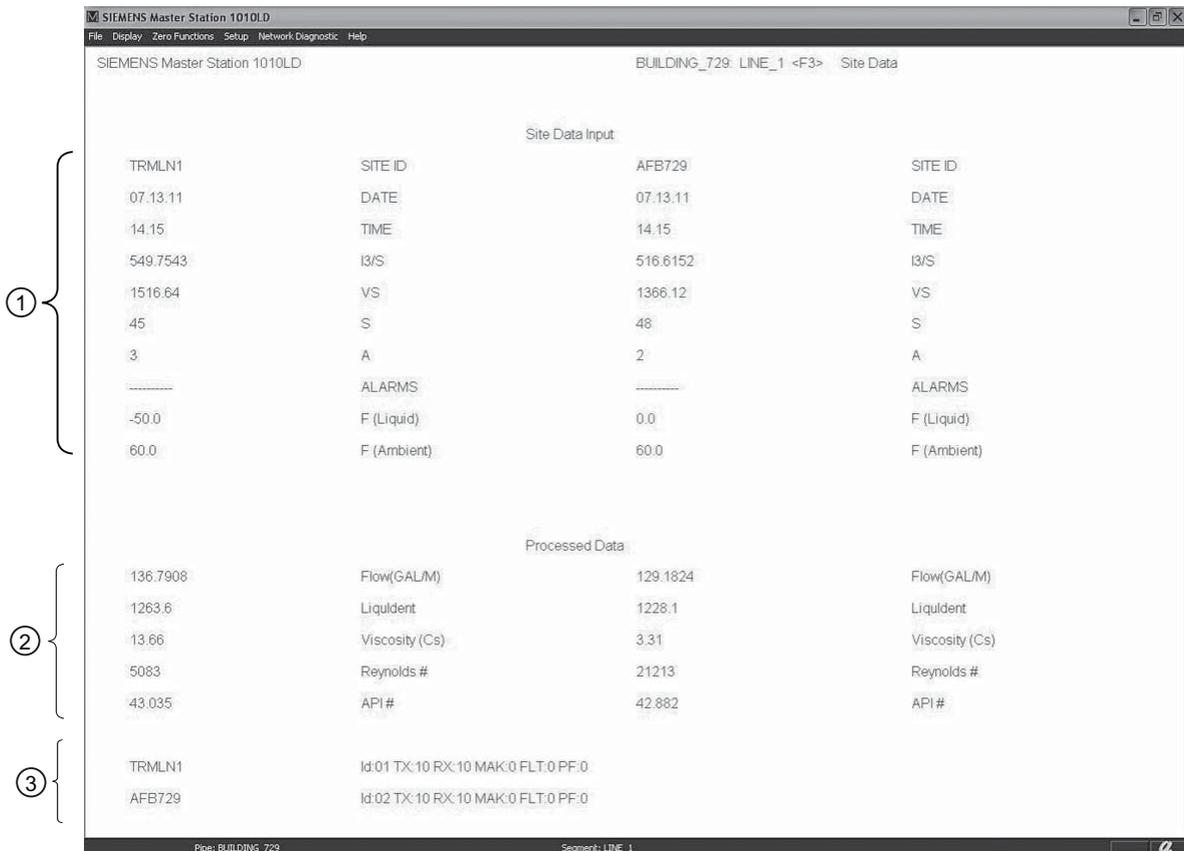


Figure 5-5 Pipe Delta Screen <F2> Toggle

Site Data Screen - Hot Key <F3>

The Site Data <F3> screen shows the current data, including all Site Station alarm conditions reported by the two Site Stations next to the selected pipeline segment.

Pay particular attention to any Site Station diagnostic alarm codes. This screen also shows data relating to the communication system.



- ① Raw data from Site Station
- ② Processed data with optimization compensation applied
- ③ Communication Score

Figure 5-6 Site Data Screen <F3>

Communication Score

The communication score is used to determine how well the network is functioning. Typical communication data is defined as follows:

Id:01 TX:10 RX:10 MAK:0 FLT:0 PF:0

- Id - network identification number
- TX - number of data transmissions
- RX - number of data received
- MAK - number of meter Makeups
- Number of Packet failures

Batch/Liquid Status Screen - Hot Key <F4>

This screen includes liquid batch identification with the batch volume reported in the units selected at optimization (e.g. gallons, cubic meters, etc.). You would use this screen to locate the leading interface of each liquid batch currently moving through your pipeline. It also shows the leading interface's estimated time to arrival (ETA) at the next Site Station.

When the Batch/Liquid Status screen is selected, press the <P> key to enter or modify the Scraper information.

Note

Batches on the pipeline graphic are differentiated by assignable colors.

Note

Due to the complexity of batch tracking, the <F4> screen interprets flow in the negative direction as zero flow. This DOES NOT apply to any other negative flow functions offered by the Leak Detection System.

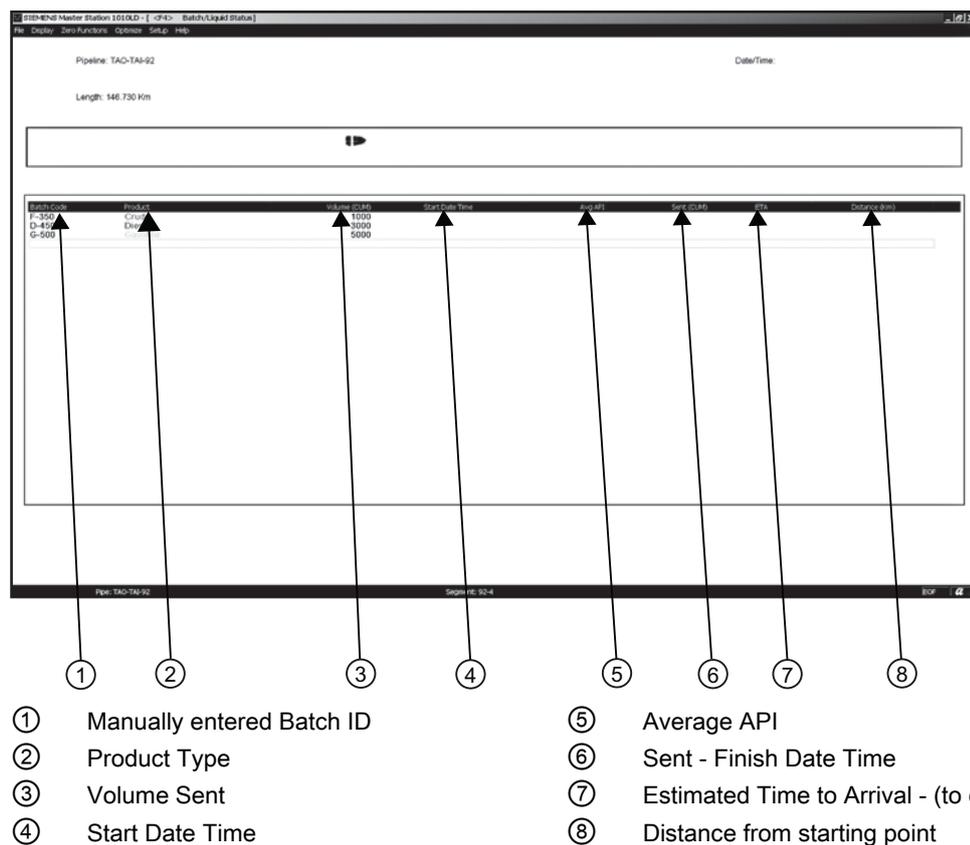


Figure 5-7 Batch/Liquid-Status Screen <F4>

Manually Adding a Batch

1. Select the Batch/Liquid Status screen from the Display menu on Windows menu bar or press the <F4> key.
2. At the keyboard, press the Insert key.
3. Batch will appear with the following selections:



4. Type a new batch code (e.g. G-450) in the Code box. Click [OK]. The cursor will move to the Product box.
5. Type a product name (e.g. Diesel) or select from the list of products in the Product box.
6. Move the cursor to the [Volume] box and click once. Type a volume (e.g. 3000) in the [Volume] box.
7. Click the arrow next to the [Product Color] box to view the product color selections. Scroll to the desired color and click to select it (e.g. blue).
8. To store the new Batch, click [OK]. Add additional batches as desired.
9. Click on the first batch entered to highlight it. Press the <Enter> key.
10. The Batch screen will appear again. Click the [Start] box [✓] to inform the FUS-LDS the first batch has entered the pipe.

The new batch code, product name, and volume settings will be listed on the screen under the appropriate column. The product name will be displayed in the selected product color.

Deleting a Batch Entry

1. Move the cursor over the Batch and click once to highlight it.
2. To delete, press the Delete key.

Scraper "Pig" Tracking

The Batch/Liquid Status screen <F4> provides the following "pig" tracking enhancements:

- A marker that tracks its progression along the pipeline (can be modified by an adjustable distance or slip factor).
- Indication of the distance from start (pipeline entrance).
- Indication of the estimated arrival at the next Site Station.
- Adjustable scraper placement (to correct errors, etc.) This also allows you to manually locate a scraper at any point along the pipeline.
- The ETA (estimated time of arrival) of the scraper at the next Site Station.

Scraper "Pig" Operation

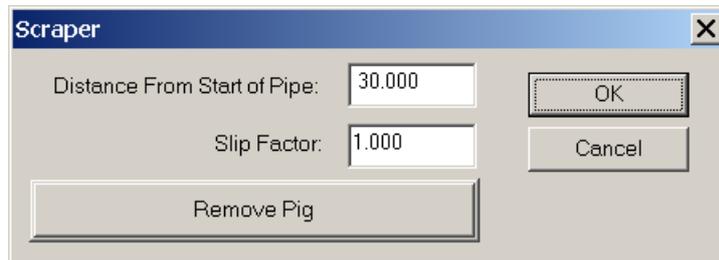
The Master Station triggers scraper tracking upon receiving the first scraper passage message from a Site Station. At that time, a Marker appears on the <F4> Batch/Liquid Status screen that shows the scraper's progression along the pipeline.

Slip Factor

A "slip factor" (i.e. a multiplier to the flow velocity) can be entered to compensate for the difference between the liquid flow velocity and the velocity of the Scraper (Pig). The slip factor ranges from 1.00 to 0.00. Entering 1.00 indicates that the scraper is moving at the same velocity as the liquid. Entering 0.00 causes the scraper to remain at its current location until a non-zero slip factor is entered. Since every Site Station transmits a scraper detection message, the ETA display can be used to determine if position or slip factor requires adjustment.

Manually Adding a Scraper (Pig Marker)

1. Select the Batch/Liquid Status screen from the Display menu on the Windows menu bar or press the <F4> key.
2. Press the <S> key to select the Scraper sub-menu.
3. The Scraper sub-menu will appear with the following selections:



The image shows a dialog box titled "Scraper". It has a close button (X) in the top right corner. The dialog contains two input fields: "Distance From Start of Pipe:" with the value "30.000" and "Slip Factor:" with the value "1.000". There are three buttons: "OK", "Cancel", and "Remove Pig".

4. To insert new distance data, move the cursor to the [Distance From Start of Pipe] box and click the left mouse once.
5. Type in a distance (e.g. 15 km).
6. Move the cursor down to the [Slip Factor] box and click the left mouse button once.
7. Type in a Slip Factor (e.g. 0.900). Note: The default Slip Factor value is 1.000.
8. Click [OK] to store the new Distance and Slip Factor values. Press <Enter> and a Scraper icon (Pig Marker) appears within a simulated pipeline at the top of the screen (refer to Batch/Liquid Status screen <F4>).

Removing the Scraper

1. Move the cursor to the [Remove Pig] button and click the left mouse button once.
2. The Distance and Slip Factor data as well as the Scraper icon will be removed.

MultiGraph Delta Screen - Hot Key <F5>

This screen provides a simultaneous display of the selected pipeline segment's in-out flow volume difference for the four integration periods (1, 5, 15 and 60 minutes). Also, it provides the trend of this data for the time base you selected (1, 2, 4, 8, 16, 24, 48 or 72 hours). Analysis of these trends will provide further validation of a current alarm condition. Also, you can use this screen to categorize the magnitude of the indicated leak (e.g. small, moderate or catastrophic).

Note

IMPORTANT

The F5 screen only shows the pipeline segment data that is currently selected at the F1 System Alarm Status screen. Also, a right mouse click on the F5 screen, or any other screen, will open the [Pipe Select] and [Segment Select] context menu. Selecting either of these will indicate the current selected pipe or pipeline segment.

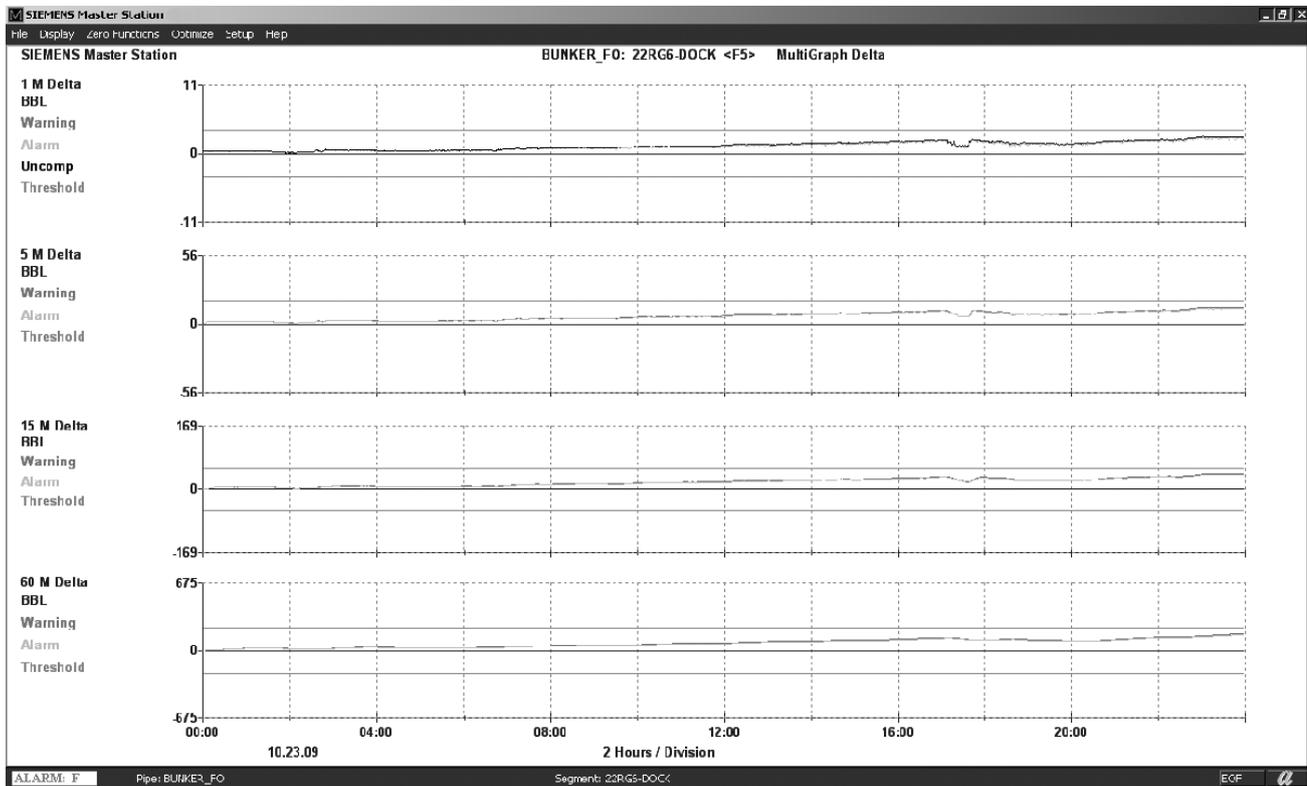


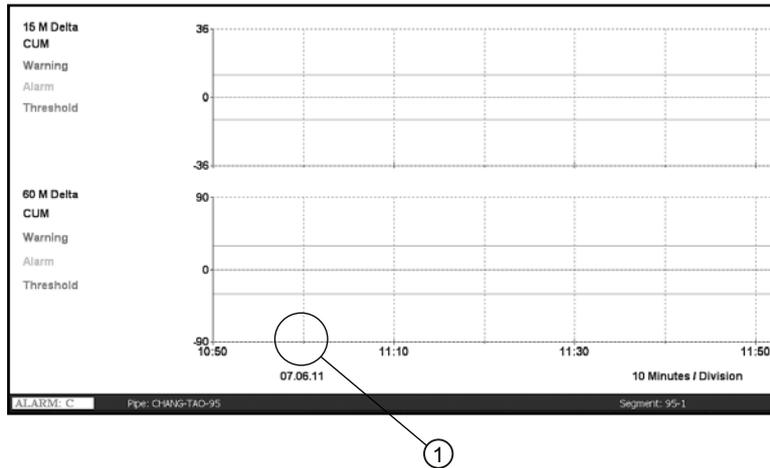
Figure 5-8 MultiGraph Delta Screen <F5>

Changing the Time Base

If you decide that the current time base does not provide enough trending for a positive analysis, you can access Time-Axis for a quick switch to a more productive time-base.

To change the time base:

1. Position the cursor on the X-Axis and double-click the left mouse button.



- ① Double-click on X-Axis

2. Move the cursor to the new time base and click left mouse button once to select.

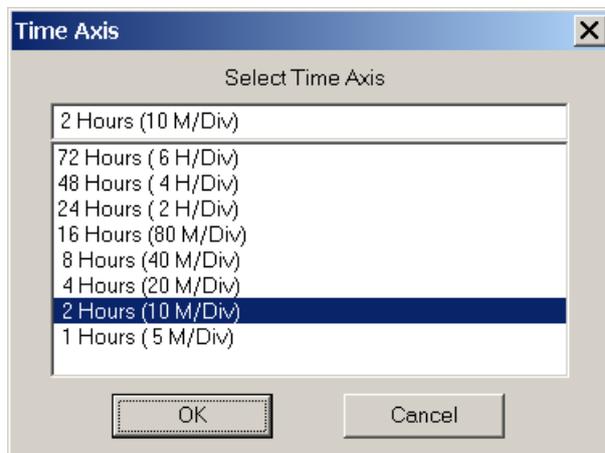


Figure 5-9 TimeAxisMenu

3. Click [OK] (or press <Enter> key). The MultiGraph Delta screen will adjust to that time-base immediately.

Evaluating Alarm and Warning Conditions

You should consider the following when you evaluate an alarm or warning condition:

- Is the 1-minute Delta still trending upward?
- What are the trends of the 5, 15 and 60-minute Deltas?

- How long has the current condition existed?
- Are the Site Station pipeline segment alarms operating properly (see <F1> and <F3> screens)?
- Is this leak condition associated with an established non-leak event?
 - Line Pack (see MultiGraph Diagnostic screen <F8>)?
 - Extreme temperature change or interface arrival (see MultiGraph Data screen <F6>)?
- Is there any other unusual condition that may explain the breaching of an alarm threshold (use other appropriate screens, such as MultiGraph LiquiData <F7>)?
- Are there unusual liquid conditions or properties (check Signal and Aeration <F8> and MultiGraph LiquiData <F7> screens)?

MultiGraph Data Screen - Hot Key <F6>

The primary purpose of the MultiGraph Data screen is to determine the validity of an alert condition. It provides a composite display of the current and past trends of the following four parameters:

- The flow rate from both Site Stations of a selected pipeline segment.
- The 1-minute delta of a selected pipeline segment.
- Liquident data from both Site Stations of a selected pipeline segment.
- The measured and computed liquid temperature and the measured ambient temperature from both Site Stations of a selected pipeline segment.

You will find it extremely useful to examine this data over any time period (based on your X-Axis time base selection). For example, this screen will allow you to:

- Identify spurious liquid conditions (i.e., presence of gas or water).
- Confirm a Line Pack condition.
- Detect an interface within a selected pipeline segment.
- Locate an Interface at either of the two Site Stations.

MultiGraph Data Screen selection

1. Position the cursor on the Windows menu bar.
2. Click once on the Display menu.
3. Move the cursor highlight over MultiGraph Data and click once to select screen.
4. The MultiGraph Data Screen can also be selected by pressing the Hot Key <F6>.

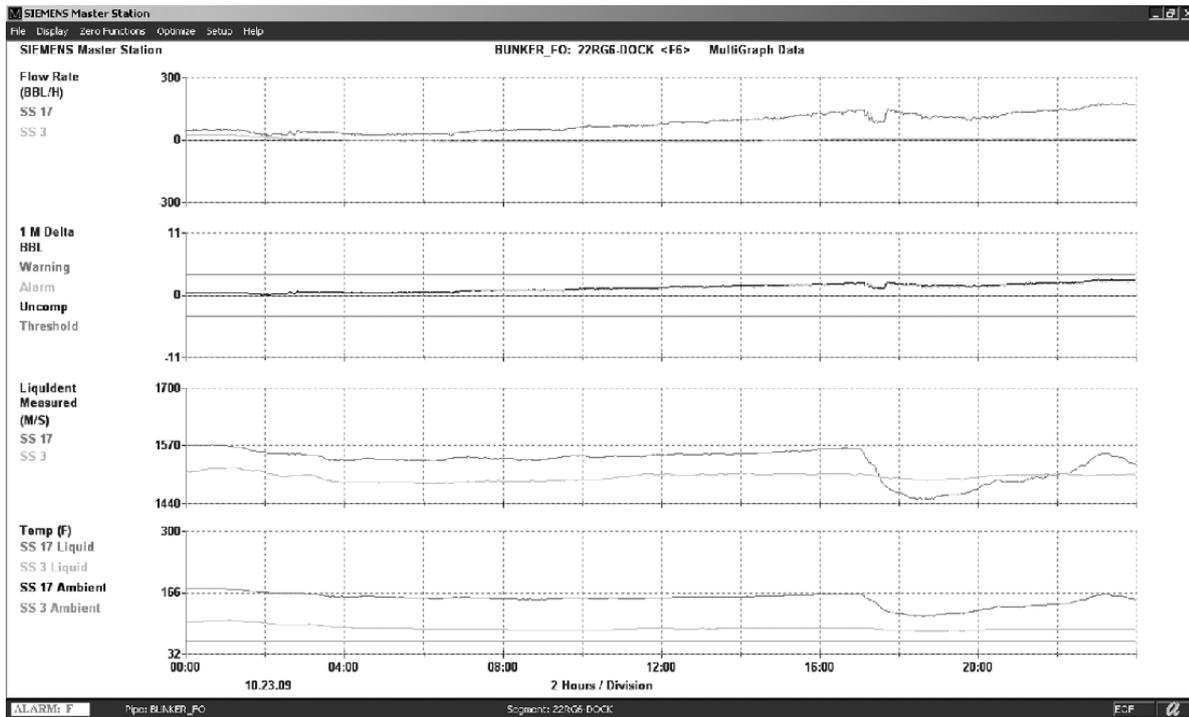


Figure 5-10 MultiGraph Data Screen <F6>

MultiGraph LiquiData Screen - Hot Key <F7>

This screen is used to identify the properties of all liquids flowing through a selected pipeline segment and its entry and exit Site Stations. It shows the following time correlated data:

- **Liquident Value:** Liquident reveals any spurious liquid conditions, such as water contamination or non-homogeneity of a nominally uniform Batch.
- **Reynolds Number:** The Reynolds Number allows you to recognize possibly adverse pipeline operating conditions.
- **Liquid Viscosity:** Liquid Viscosity allows you to correlate the performance of pumps, and other operating conditions affected by viscosity.
- **API Number:** The API Number is based on the measured Liquident value and allows you to identify the type of liquid(s) flowing through the pipeline.

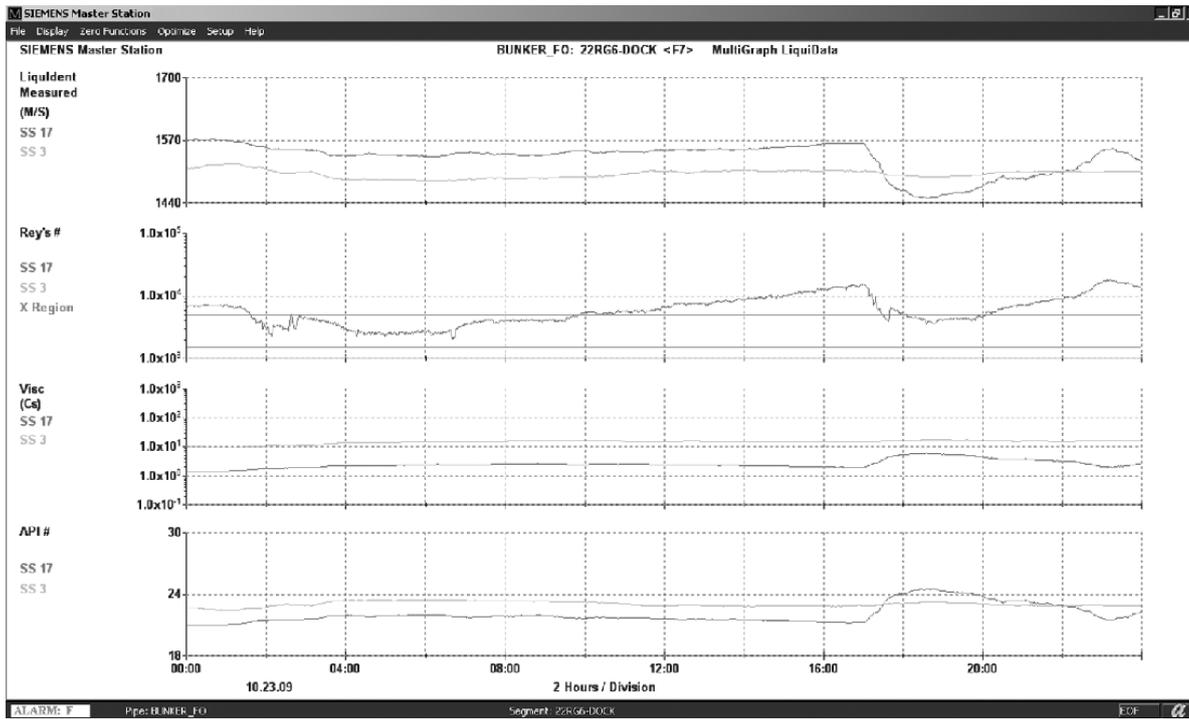


Figure 5-11 MultiGraph LiquiData Screen <F7>

MultiGraph Diagnostic Screen - Hot Key <F8>

The MultiGraph Diagnostic screen shows time-correlated data reflecting the current and past condition of the Site Stations located at each end of a selected pipeline segment. This data includes:

- **Path Flow** - The Path Flow is the reported flow rate from a Site Station before any compensation is applied. This data allows you to observe Site Station flow detection. Flow rate deviation could be caused by adverse flow profile conditions at the Site Station location.
- **Path dVs** - Path dVs is the difference in liquid sonic propagation velocity, as measured by a Site Station's two individual measurement paths (this applies only to dual-beam Site Stations). Close sonic velocity conformance of both measurement paths confirms proper Site Station set-up, operation and acceptable liquid homogeneity.

- **Signal and Aeration** - Signal and Aeration shows the signal strength and the aeration level (related to liquid homogeneity) at the two Site Stations located at each end of the selected pipeline segment. If you encounter low signal levels or high aeration levels you should investigate conditions at the Site Station locations because these conditions influence the validity of a leak alarm. The [Trace Diagnostic] screen (Alt+F4) will show you which measurement path is responsible for a deteriorated signal.
- **Line Pack** - This signal identifies either Line Pack or Line Unpack. Line Pack identification prevents current leak data from triggering false 1-minute delta alarms. It also prevents corruption of the 5, 15, and 60 minute integration warning and alarm registers. The red line indicates the pack/unpack event declaration threshold.

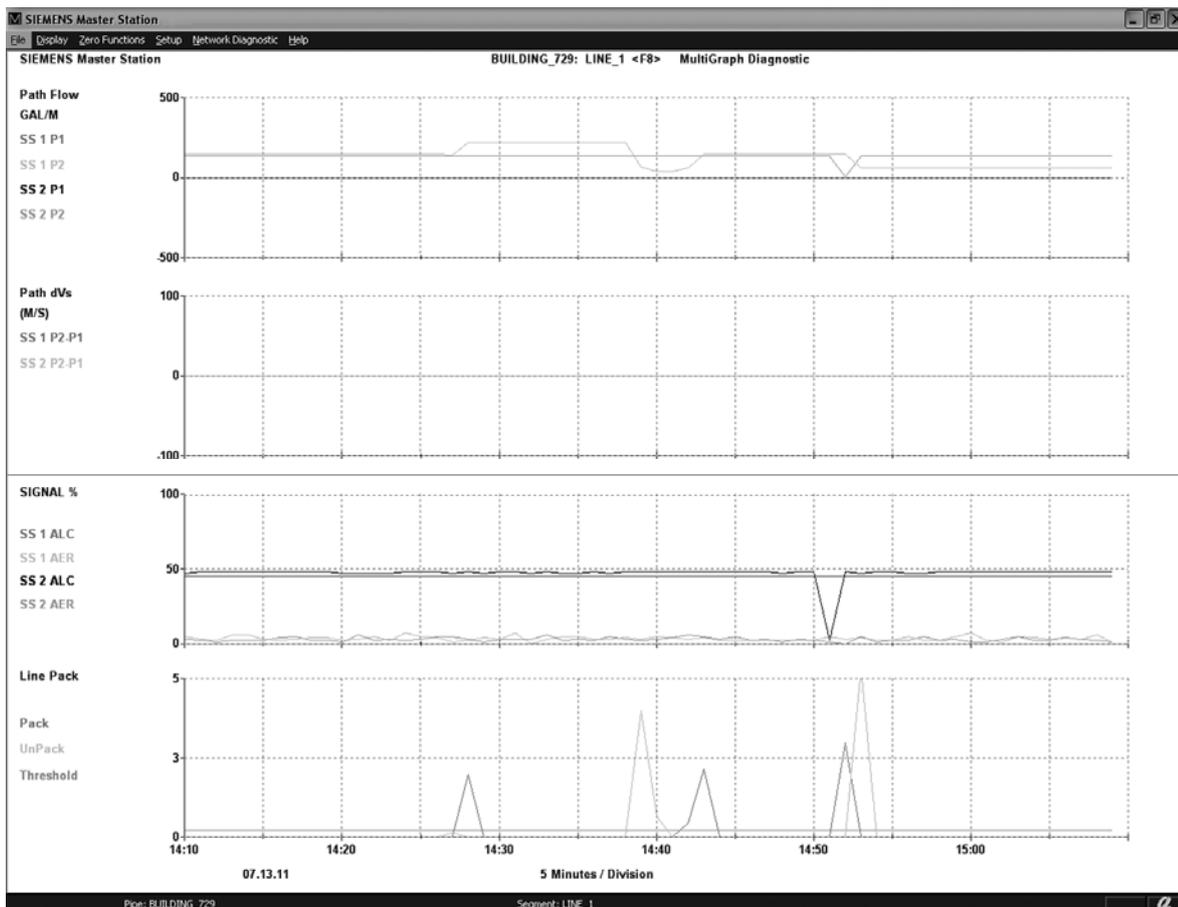


Figure 5-12 MultiGraph Diagnostic Screen <F8>

MultiGraph Optional Screen - Hot Key <F9>

This screen allows you to combine four separate FUS-LDS data screens. After you gain experience in operating FUS-LDS on a particular pipeline, you will be able to decide which time-correlated data elements are most effective for confirming or rejecting leak alerts. After you select the parameters for this screen, the Master Station will retain your data combination and scaling, even if you shut the system down. However, you can select new data elements at any time via the [Selects Graphs...] menu item in the context menu.

The figure below shows a typical [MultiGraph Optional] screen combination. It includes the current and past data trends of liquids flowing through the pipeline. This example includes the following time-correlated data:

- Flow Rate (CUM/Hr)
- 1 M Delta CUM
- Path Flow CUM/Hr
- Line Pack

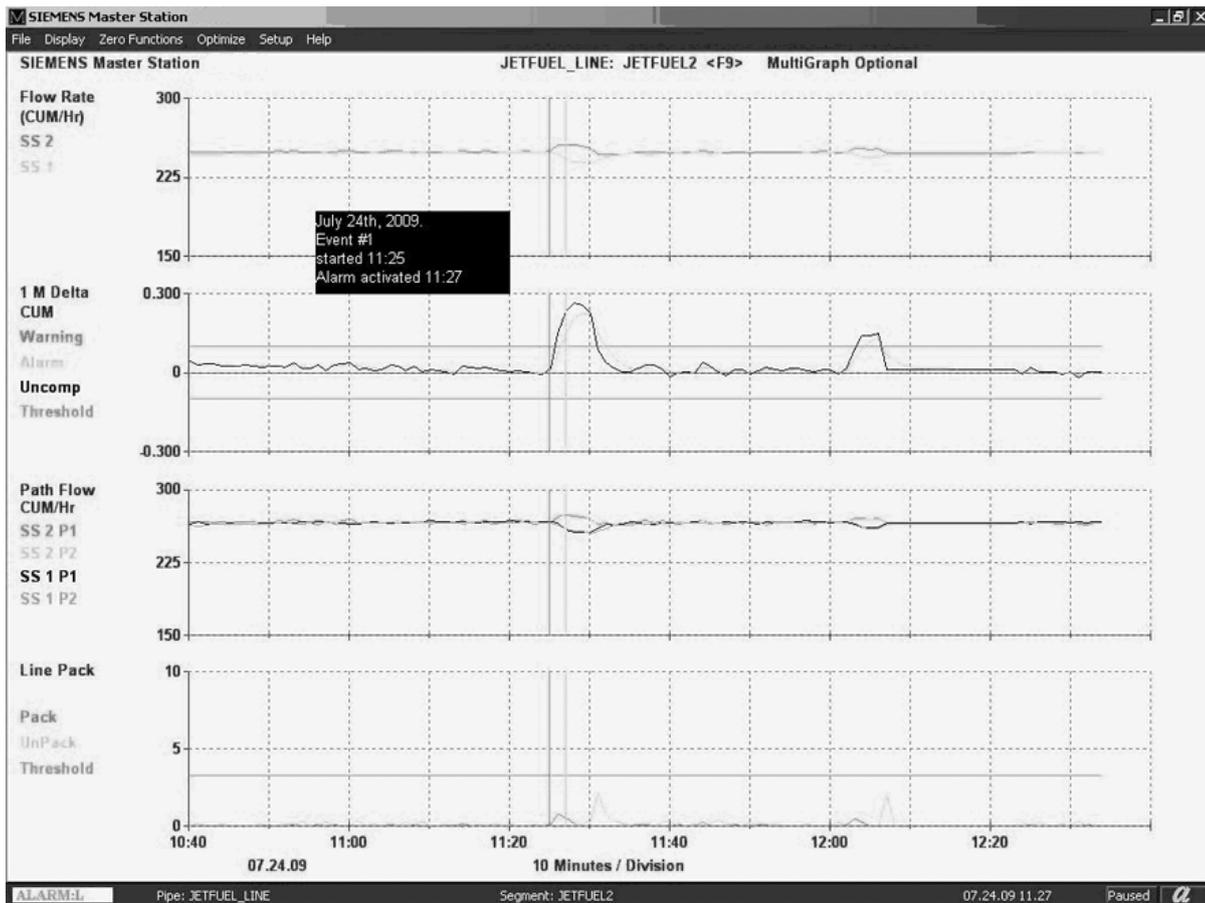


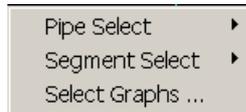
Figure 5-13 MultiGraph Optional Screen <F9>

MultiGraph Optional Context Menu Selection

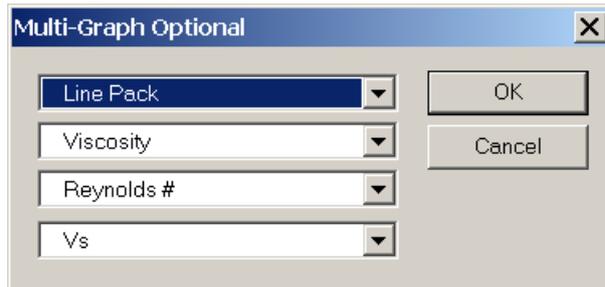
To create a MutliGraph screen combination:

1. Select the [MultiGraph Optional] screen by pressing Hot Key <F9>
2. Press the right mouse button once.

- The context menu will appear and list the following choices:



- Click [Select Graphs...]
- The [Multi-Graph Optional] context menu will appear.



- Click the scroll arrow in the first box to open the screen list.
- Scroll to the desired screen selection, highlight it and click once to select. The screen name will appear in the box.
- Repeat for the other screen selection boxes.
- Click [OK] to store screen selections. The four screen selections will appear on the MultiGraph Optional screen.

Individual Delta Screens - Hot Keys <Alt>+<F1>

You can choose to view the individual integration period deltas (1 min, 5 min, 15 min or 60 min) on separate screens. This provides a greater display resolution than is possible with the MultiGraph Delta screen (<F5>). To toggle between the integration periods, hold down the <Alt> key and then repeat pressing the <F1> key until you select the integration period you wish to view.

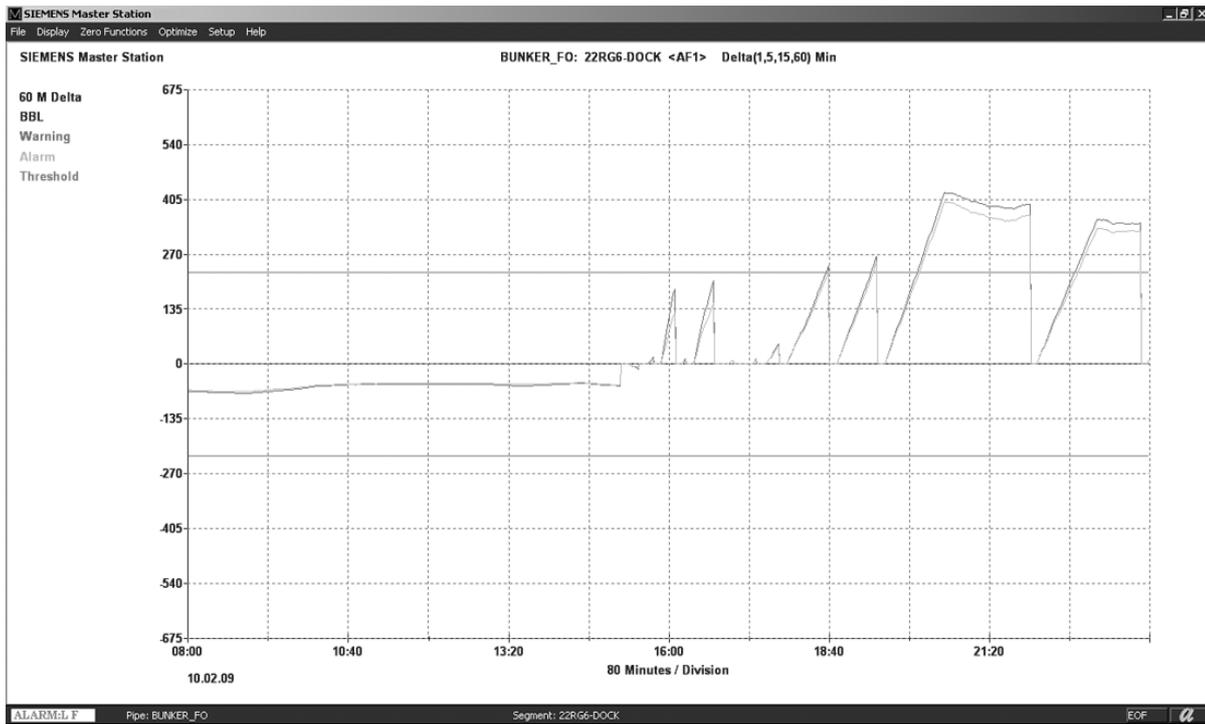


Figure 5-14 1 Minute Delta Screen <Alt>+<F1>

Flow and Total (Pipe) Screen - Hot Keys <Alt>+<F2>

The Flow and Total (Pipe) Screen shows the real-time flow rate through the selected pipeline segment and the flow total of the previous 24 hours.

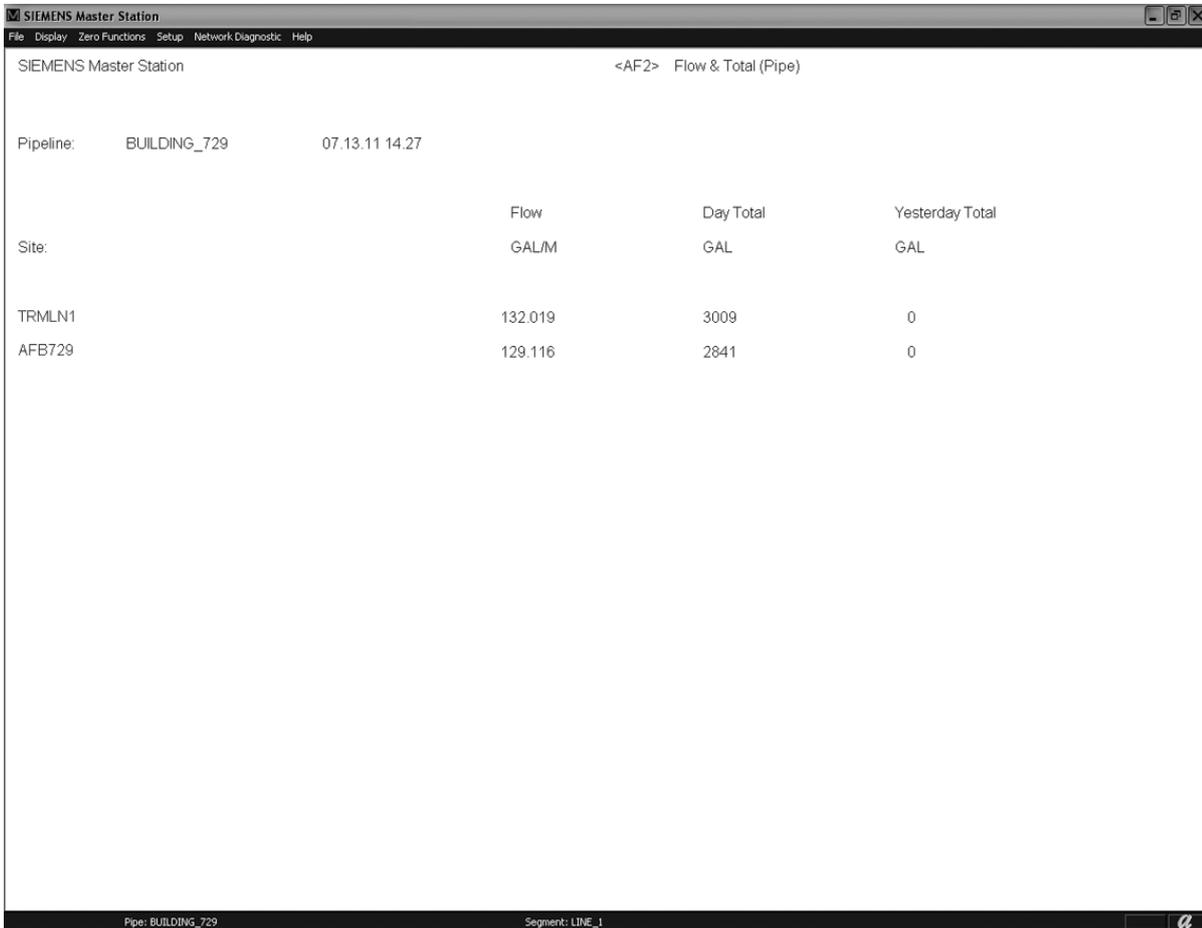


Figure 5-15 Flow and Total (pipe) Screen <Alt>+<F2>

Trace Diagnostic Screen - Hot Keys <Alt>+<F4>

The Trace Diagnostic screen shows the incoming diagnostic data from the two Site Stations located at each end of a selected pipeline segment. You would use this screen to check the condition of the FUS-LDS communication system and to view individual measurement path diagnostic data.

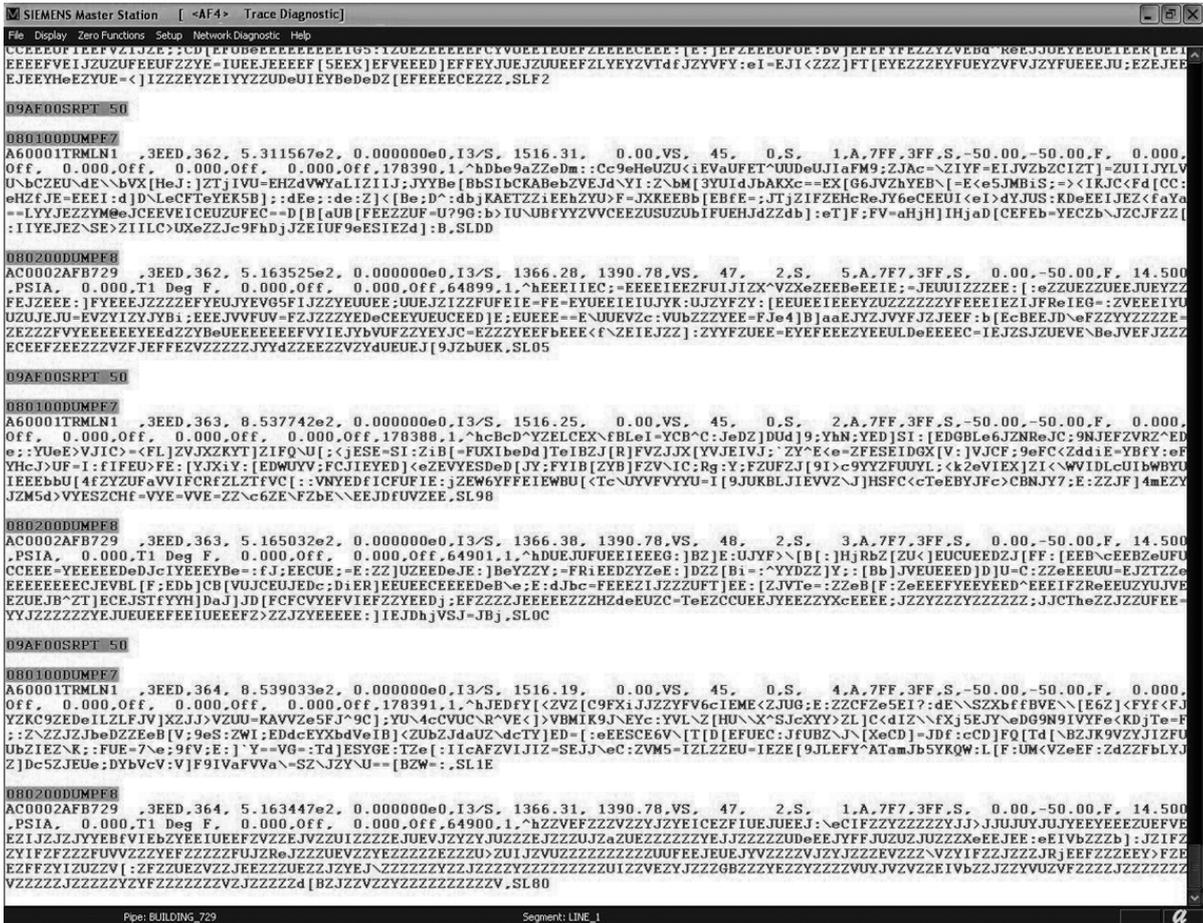


Figure 5-16 Trace Diagnostic Screen <Alt>+<F4>

AppCon Screen - Hot Keys <Alt>+<F5>

This screen shows the AppCon proprietary "application condition factor" for any pipeline segment that is selected. Its function is to reduce or eliminate the possibility of false alarms if pipeline segment application conditions deteriorate. The Master Station creates an alarm-delta. The alarm-delta is the warning-delta value multiplied by a computed variable called AppCon.

The Master Station bases the current AppCon value on actual application conditions as reported by each Site Station's diagnostic data function.

Therefore, if application conditions deteriorate, the AppCon value decreases accordingly. This results in a lowering of the alarm-delta. This technique minimizes the potential for false alarms. Essentially it creates a dynamic alarm threshold that responds to changing application conditions, making it less likely that a given pipeline segment volume imbalance will breach the alarm threshold.

The AppCon algorithm combines various application condition values into a single factor that ranges from zero to one. The Master Station uses the AppCon factor as a multiplier for the 1-minute warning delta to produce the 1-minute alarm delta.

During the leak detection system's optimization phase, the AppCon variable is subject to change when observing and recording pipeline operations. The AppCon condition factor is a way of providing the FUS-LDS with artificial intelligence. For example, while the FUS-LDS observes the pipeline, it learns how to anticipate future events from past experiences.

Note that The Master Station routes both the 1-minute warning delta values and the 1-minute alarm delta values into the 5, 15 and 60 minute integration periods. Thus, the alarm data for each of these integration periods has already been conditioned by AppCon. If it is decided to further optimize these integration periods, it can be accomplished by simply optimizing the 1-minute delta AppCon parameters.

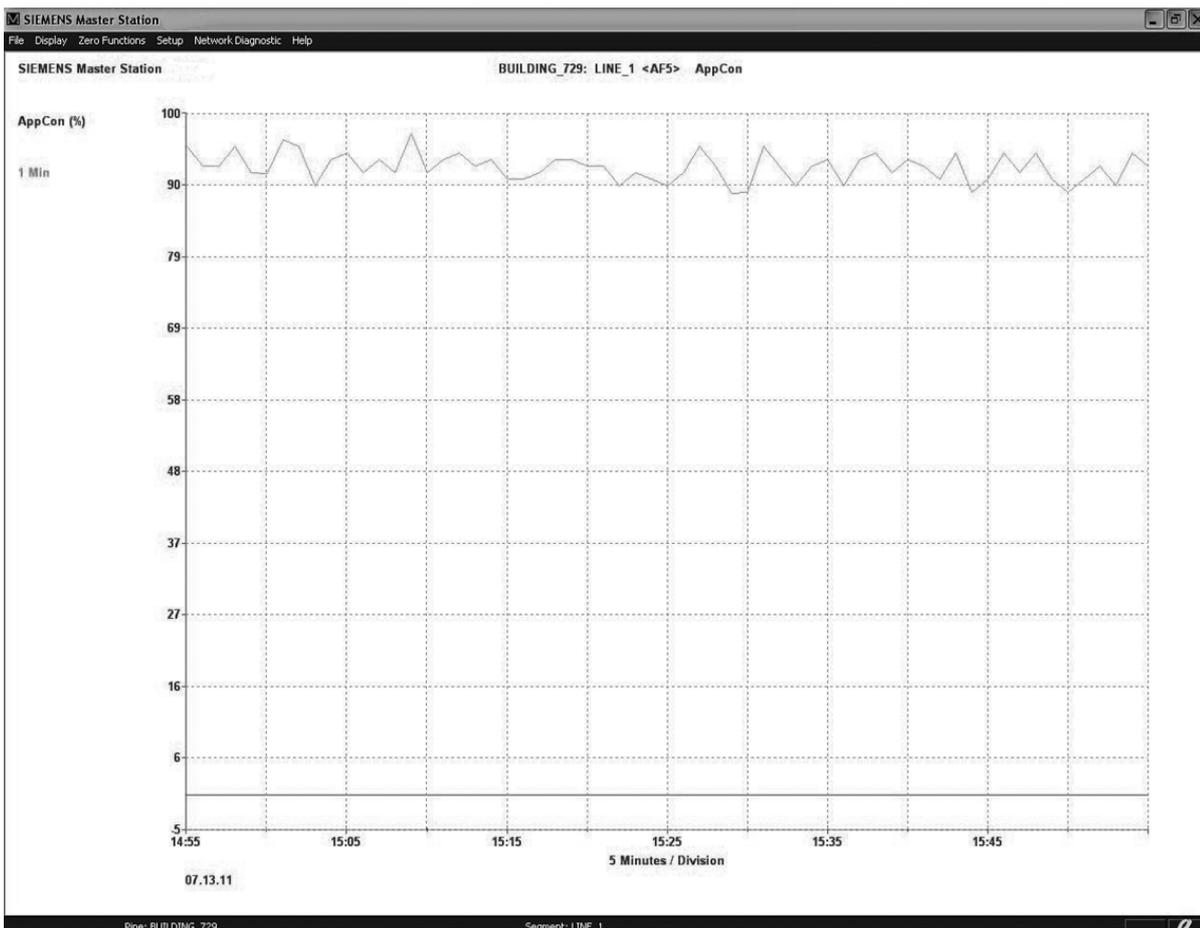


Figure 5-17 AppCon Screen <Alt>+<F5>

Adverse Application Conditions - The FUS-LDS features real-time detection of Site Station application conditions, and generates an AppCon factor to adjust the leak detection sensitivity dynamically if conditions deteriorate. This preserves the best sensitivity during normal conditions and minimizes or prevents false alarms only if application conditions deteriorate.

SoniLocator Screen (Optional) - Hot Keys <Alt>+<F6>

In the event of a pipeline leak, a sudden drop in pressure occurs radiating a pressure wave both upstream and downstream from that point at the speed of sound in the liquid. This drop in pressure decreases the density of the liquid, which results in a sudden drop in the current value of the liquid's sonic propagation velocity (V_s). V_s is measured at each of the upstream and downstream Site Stations (metering points) an average of ten times per second. The decrease in V_s is detected and time stamped with the arrival of the pressure wave's leading edge. Since both Site Stations have synchronized time clocks, the relative arrival times of the pressure waves at each Site Station is easily determined. The accuracy of the location function is dependent on the resolution of time stamping and the sonic propagation velocity. The leak will be located providing that:

- The pressure wave table is able to travel the entire pipeline segment.
- The magnitude of the pressure transient must be greater than the pressure fluctuations during normal pipeline operation.

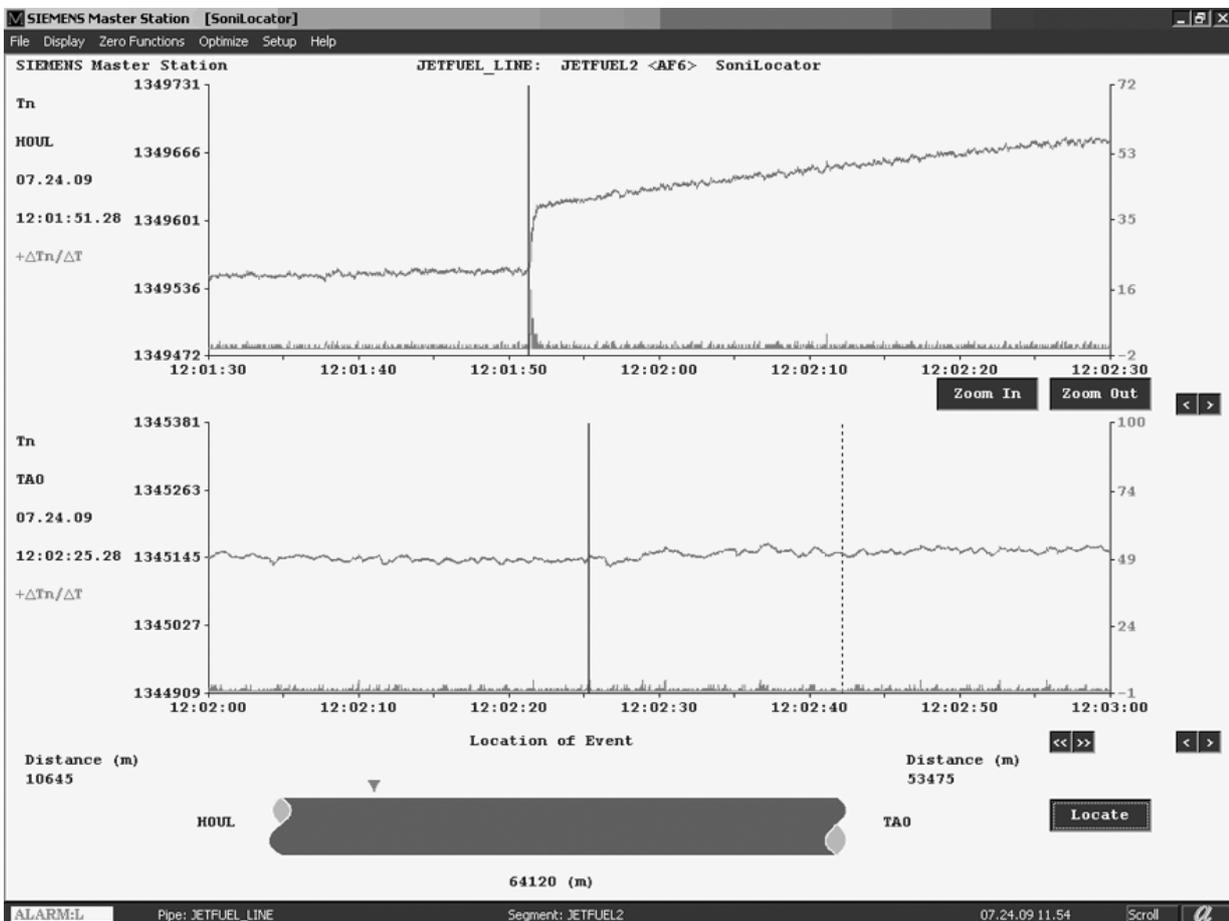


Figure 5-18 SoniLocator <Alt> <F6>

Liquident Screen - Hot Keys <Ctrl>+<F1>

The Liquident screen is a single data display that shows the current and past trends of our proprietary liquid identifier, Liquident, as reported by the two Site Stations located at each end of a selected pipeline segment. Liquident is the numeric value of a liquid's sonic velocity (Vs) at a reference temperature (Vs/T) of 15.5° C (60° F).

During optimization a Liquident table is created within the Master Station to reflect the full complement of liquids, their densities and their viscosities as compared to their temperature compensated sound speeds.

Liquident is a multipurpose parameter. The Master Station uses Liquident for density and viscosity calculation, Line Pack volume computation and thermal compensation. You could use the Liquident screen for custody transfer, confirming the presence of spurious liquids (e.g. water), marking the passage of an interface, or batch tracking. To assure accuracy, the Master Station uses either the computed or measured line pressure and temperature to compensate the reported Liquident value.

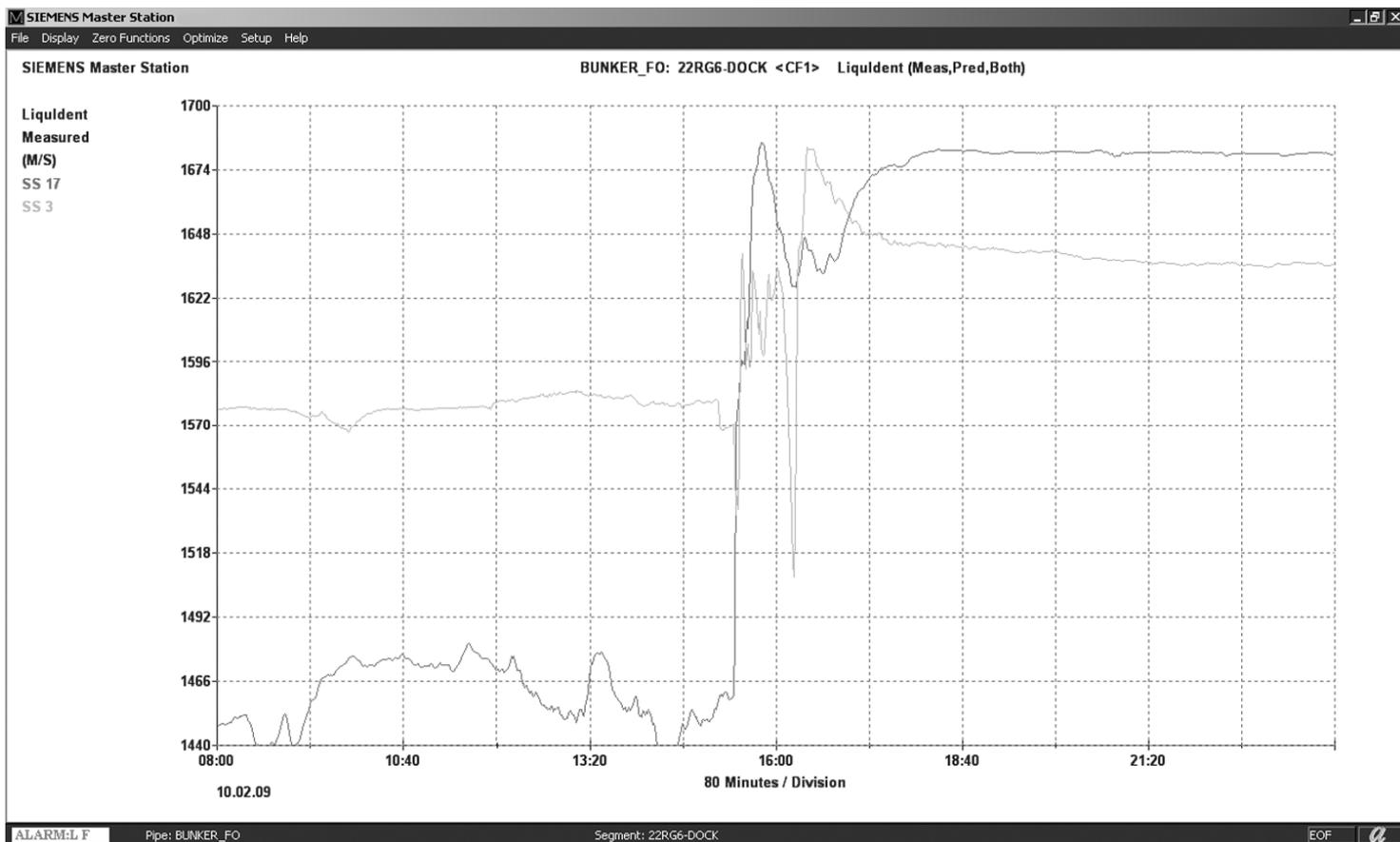


Figure 5-19 Liquident Screen <Ctrl>+<F1>

Flow Screen - Hot Keys <Ctrl>+<F2>

This screen shows the time-correlated current and past flow rate data as reported by the two Site Stations located at each end of a selected pipeline segment. Scaling this display to the highest possible resolution will show you trends of flow in sufficient detail to reveal most flow-related events. Typical events include the operation of valves and pumps, and a pipeline segment volume imbalance caused by Line Pack.

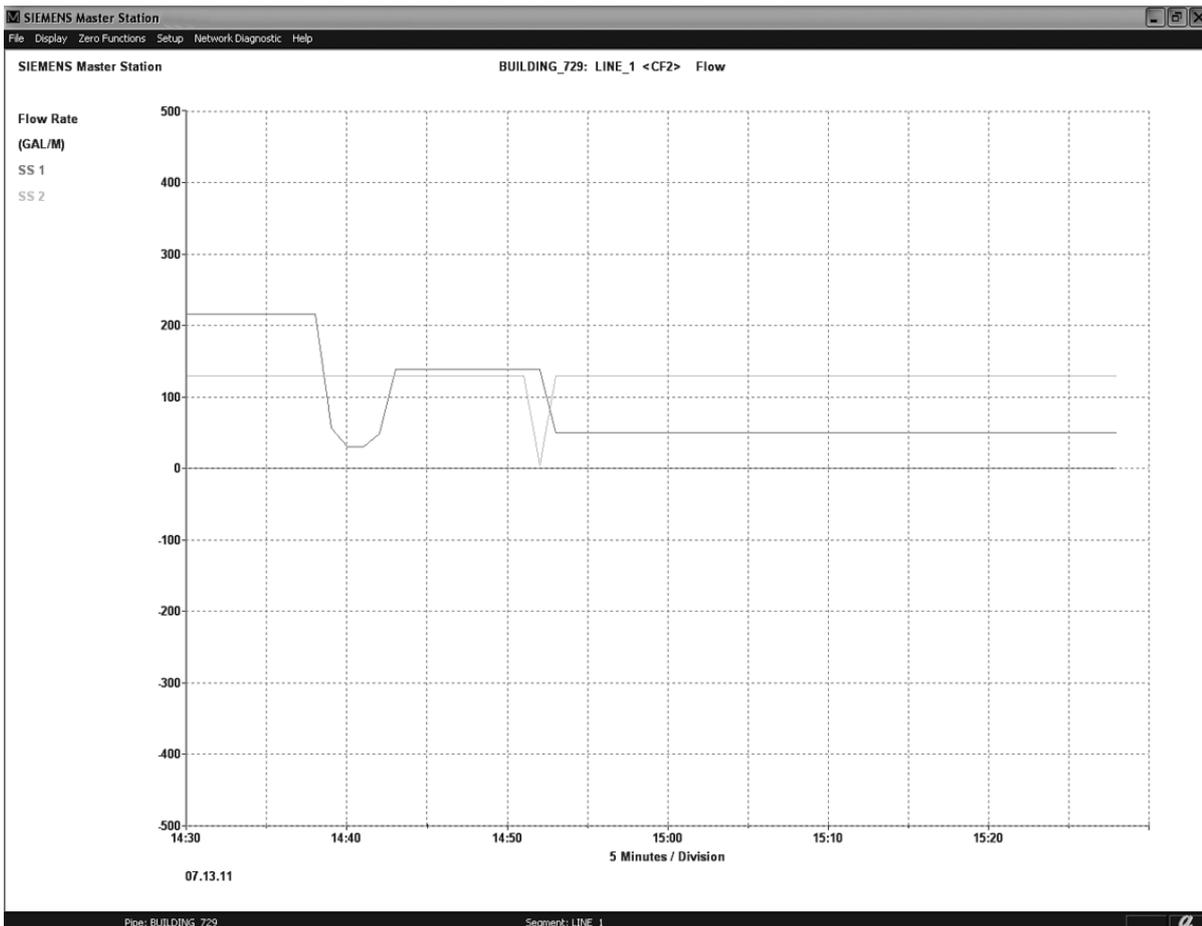


Figure 5-20 Flow Screen <Ctrl>+<F2>

Signal and Aeration Screen - Hot Keys <Ctrl>+<F6>

The Signal and Aeration screen shows the time-correlated current signal strength and aeration signals as reported by the two Site Stations located at each end of a selected pipeline segment. You would use this data to analyze Site Station or liquid conditions.

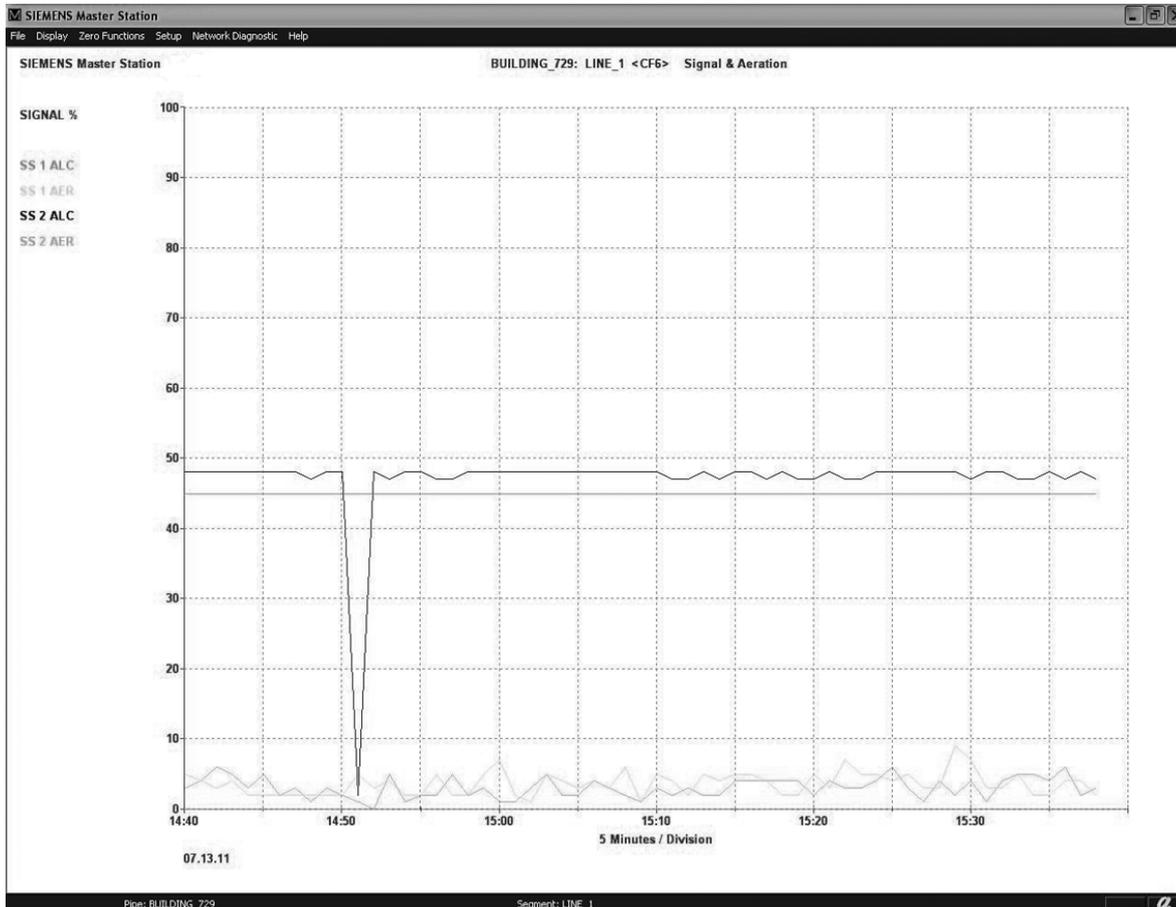
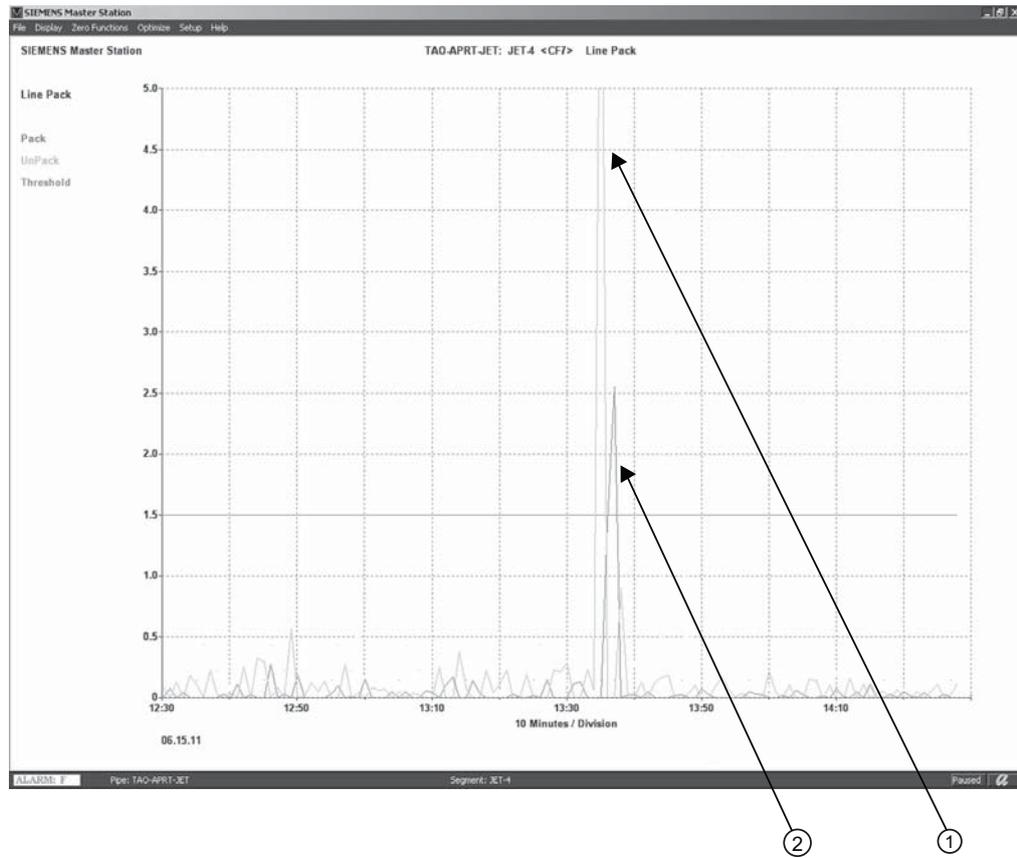


Figure 5-21 Signal and Aeration Screen <Ctrl>+<F6>

Line Pack Screen - Hot Keys <Ctrl>+<F7>

The Line Pack screen shows current and previous Line Pack detection signals. You can compare a Line Pack condition with flow rate and Liquident to help you to decide if a leak alert is due to excessive Line Pack or an established leak.

Whenever a liquid begins to flow through a pipeline there is more liquid entering the pipeline than leaving the pipeline--this is Line Pack. The FUS-LDS senses Line Pack and Unpack events through relative changes of flow rate between the adjoining site stations. Optimization sets the appropriate thresholds for each.



- ① Pack
- ② UnPack

Figure 5-22 Pack and Unpack Trends

Pack Delta Screen - Hot Keys <Ctrl>+<F8>

This Pack Delta screen shows the current volume of liquid that is packed into the selected pipeline segment at the current flow rate. As the flow rate changes (revealed by Line Pack or Unpack data on the <Ctrl>+<F7> screen), this screen dynamically shows the change in volume of liquid packed into the selected pipeline segment. If the pack volume goes beyond the established norm for any given flow rate it will exceed the screen's visible alarm threshold. This will trigger a leak alarm. Therefore, you can use this screen to detect catastrophic leaks during Line Pack conditions.

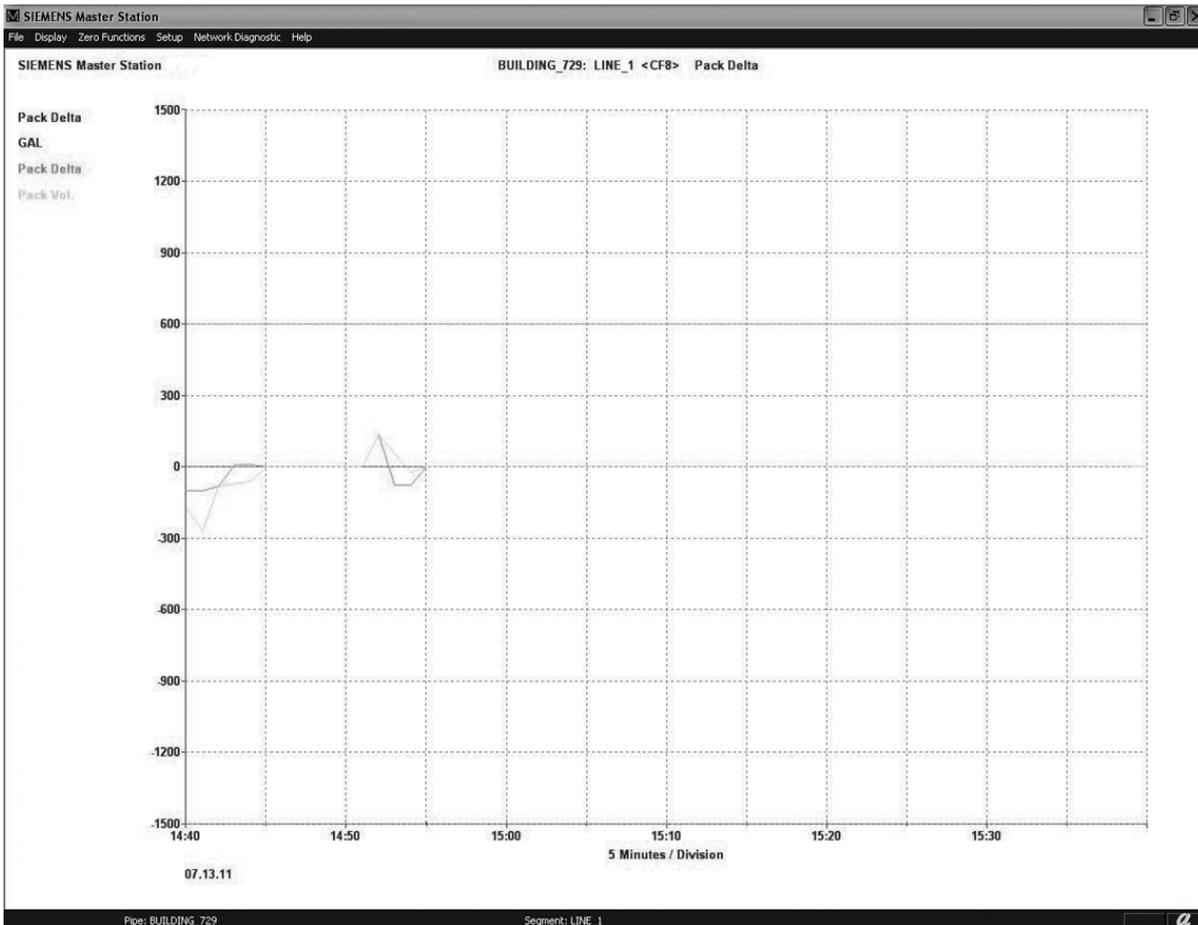


Figure 5-23 Pack Delta Screen <Ctrl>+<F8>

5.7 Secondary Graphic Screens

Introduction

The following paragraphs describe Master Station graphic screen functions that are of secondary use.

Network Diagnostic Screen - No Hot Key (see Display menu or Windows menu bar)

The Network Diagnostic screen shows diagnostic data from the two Site Stations located at each end of a selected pipeline segment. It is similar to the Trace Diagnostic screen. However, the Master Station transmits the data from the Report Diagnostic screen via its auxiliary port to a SCADA system, external computer, etc. You can select the content and frequency of this diagnostic report from the [Setup Menu / Data Output] from the Windows menu bar.

Path Flow Screen - Hot Key <F10>

This screen allows you to see uncompensated flow profiles. Although this data does reflect the result of zero correction when performed at the Site Station, it does not represent any Reynolds number corrections or calibration offsets.

Pipe Delta Screen - Hot Key <F11>

The Pipe Delta screen operates with multiple pipeline segments on a single pipeline. To use this screen a specific pipeline segment must be selected. When selected the Pipe Delta screen will sequence through the 1, 5, 15 and 60 minute deltas each time the <F11> key is pressed and display the average flow through all Site Stations "upstream" of the selected pipeline segment versus all Site Stations "downstream" of the selected pipeline segment. To toggle between delta periods press <F11>.

Scatter (1, 5, 15, 60) Min - Hot Keys <Alt>+<F3>

This screen displays a "scatter plot" of any selected data, such as Liquident or flow, etc., versus the 1, 5, 15 or 60 minute Delta data selectable by successive repeated pressing of the <Alt>+<F3> keys. If there is a correlation of the leak event with a specific value of the selected data, you can decide if this is a false alert. If the alert is false, optimization of the correlated data will often minimize or prevent future false alerts. Failure to find any data correlation increases the chances that the reported leak alert is real. Thus, action to remedy the reported leak can be taken immediately and with confidence.

Path Differential Flow Screen - Hot Keys <Alt>+<F7>

This screen provides a simple method for viewing the differences in flow behavior of the individual paths of dual path Site Stations (Path dflow).

Flow Acceleration (dF/dT) Screen - Hot Keys <Alt>+<F8>

This screen shows the force of flow acceleration on the pipeline. You may also use this screen to detect changes in pipeline flow control valve settings.

Path Differential Sonic Propagation Velocity - Hot Keys <Alt>+<F9>

This screen provides a simple method for viewing the difference in Vs behavior of the individual paths of dual path Site Stations (Path dVs).

S.G. Screen - Hot Keys <Alt>+<F10>

This screen shows the current API number (or Specific Gravity for metric systems) of the liquid passing through the two Site Stations of the selected pipeline segment. The Master Station uses the Liquident value to calculate the API/S.G. number.

Note

The Specific Gravity screen will appear for metric systems. If not, the API number screen will appear as shown.

Segment Temperature Data Screen - Hot Keys <Ctrl>+<F3>

This screen shows the measured and ambient temperatures measured at the pipeline segment.

Vs (Sonic Velocity) Screen - Hot Keys <Ctrl>+<F4>

This screen displays the measured liquid sonic velocity reported by the two Site Stations of the selected pipeline segment.

dVs/dt Screen - Hot Keys <Ctrl>+<F5>

This screen shows the differential (rate of change) of the measured sonic velocity (Vs) of the liquid flowing through the selected pipeline segment by dividing the pipeline segment end Vs delta by the delta in time.

Viscosity Screen - Hot Keys <Ctrl>+<F9>

This screen shows the current computed viscosity corrected to base temperature. It also shows the past viscosity trends of the liquids in the selected pipeline segment's Site Stations. If the FUS-LDS is fed by external Viscometers, then this screen shows those measurements as well.

Reynolds Number - Hot Keys <Ctrl>+<F10>

This screen shows the current and past trends of the computed Reynolds Number of liquids passing through the two pipeline segment Site Stations. This screen displays the transition region between turbulent and laminar flow as red lines.

Pipe Balance Screen - Hot Keys <Shift>+<F1>

The Pipe Balance Screen shows a bar graph that represents the instantaneous (1-min.) volume balance among all of the Site Stations installed on the pipeline. The zero point on the vertical axis is the average of the liquid volumes passing through all pipeline segments. Each bar represents a Site Station's volume offset from the average. This screen allows you to view information about the entire pipeline at one time. Depending on the application, this may be beneficial in determining the existence of a leak by observing whether the volume of liquid that has passed the Site Station in a minute has decreased for all of the sites downstream of the point of alarm.

Pressure Screen - No Hot Key (see Display menu)

The FUS-LDS can receive an analog pressure input from Site Stations equipped with analog input modules that are connected to an external pressure sensor. The Master Station includes this variable in its Liquident computation. The Pressure Screen provides alarm thresholds for the pressure variable.

5.8 Review Station

Archive Overview

- A Master Station "Poller" archives data files at the end of each day at midnight 00:00. It saves these files to the Master Station directory.
- Archive files are named with a date, revision and an extension which describes the pipeline.
 - Example: 082108A1.PMX
- Archive files are saved in the Polling Master Station for three months. On the first of each month files older than three months are purged from the Poller.
- Archive files should be copied to the review station for permanent storage and for later review. In addition, the latest Topology file should also be copied.
- The Review Master Station is typically network connected to the Master Station making file copy quick and easy.

Master Station Review Mode

- A Master Station Review is recommended to analyze data that has been archived by a Master Station.
- A Review Station can also be used to optimize a master station console.

FUS-LDS Data Processing

The system performs its leak detection function by issuing visible Leak Warnings and Alarms. Upon an alert or warning, you consult various data screens to help decide if the pipeline is leaking; and if so, to what extent (see Master Station Graphic Screens (Page 35) details).

The FUS-LDS provides valuable tools for general pipeline operations. For example, the system provides interface detection, liquid type identification and batch tracking.

Site Stations (depending on system type) collect the following data every 1/10 of a second to be processed by the Master Station:

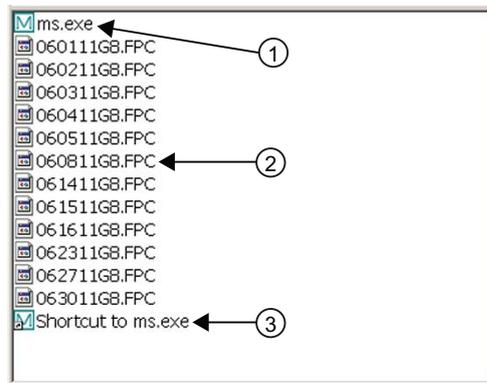
- Flow Rate
- Liquid Temperature
- Ambient Temperature
- Liquid Sonic Properties
 - Sonic Propagation Velocity, V_s
 - Sonic Signal Strength, V_{alc}
 - Liquid Aeration, V_{aer}
 - Time-Stamped Maximum Rate of Change of Sonic Propagation Velocity
- Site Station Diagnostic Data
 - Empty Alarm
 - Flow Direction
 - Operation Fault
 - Aeration Alarm
- Auxiliary Inputs -Site Stations can accept the following inputs via a SITRANS F flowmeter (or equivalent):
 - Pressure
 - Viscosity
 - Specific Gravity
 - 1 Auxiliary Input

The Master Station can then monitor the custom data transmitted to it by the Site Station(s).

Once per minute, the FUS-LDS Master Station receives Site Station data and then processes and archives it. It displays the processed data, either numerically or graphically, with a user-specified scaling and time base. This data reflects the previous 1, 2, 4, 8, 16, 24, 48 or 72 hours. This comprehensive data provides operators with all they need to disclose the existence of a leak as well as valuable information on general pipeline operations.

Starting a Master Station Review

- Right click on the Windows executable file (e.g. ms.exe) and create a shortcut.
- Drag one of the archive files over to the shortcut.
- The Master Station Review will begin.



- ① Executable
- ② Archive Files
- ③ Shortcut

Figure 5-24 Starting a Review

Navigating the Review Station

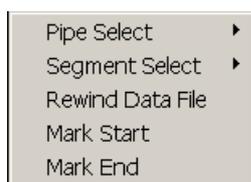
When opened, the Review Station begins to upload the attached data file.

- The review processing speed is based upon the size of the data file. The data file size is determined by the number of pipeline segments in the Leak Detection system.
- Pressing the [R] key will rewind the file to the beginning.
- When the rewind is complete [EOF] (End of File) will appear at the bottom right of the screen.
- Pressing the Space Bar will start or stop the file progression.

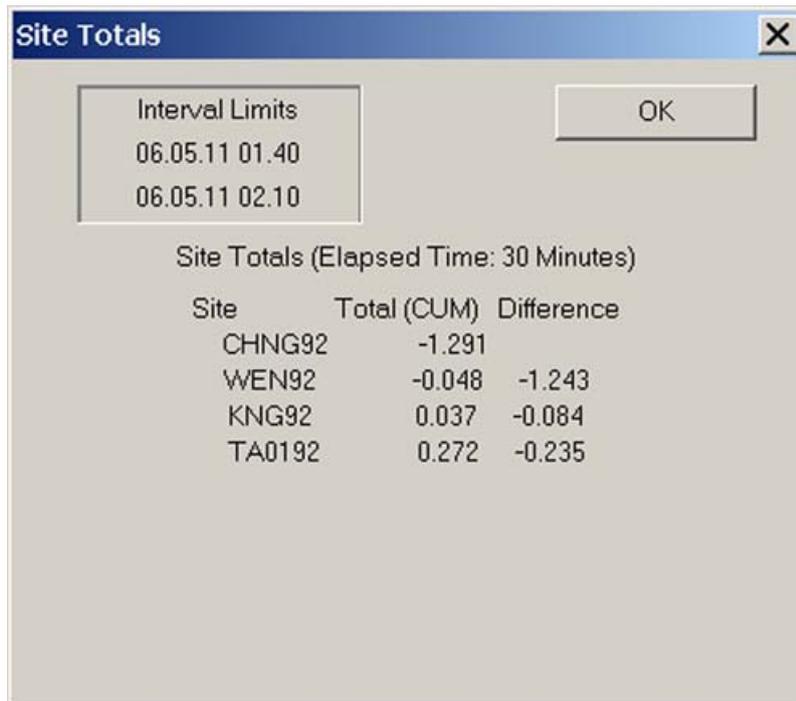
Starting and Stop Cursors

Some analysis functions require setting a start and stop cursor. The cursors define the time period for analysis. To set the cursors:

1. Begin scroll mode by pressing the <Left Arrow> key during replay and scroll back until the desired start time is on the screen.
2. A right mouse click anywhere on the screen will display a window that has a [mark start] and [mark end] command.



3. When [mark start] is selected a vertical line appears on the screen. Drag the mouse pointer to move the line to the desired start point. The exact time is displayed at the bottom right corner of the screen.
4. Click the left mouse button to select the [mark start] time. The line will turn a magenta color.
5. Select the [mark end] in the same manner. The [mark end] line will turn blue when selected.
6. For example, to compute the Site Totals, select [Optimize] from the Windows menu.
7. Scroll to [Computation Functions] and click the left mouse to select [Site Totals...].



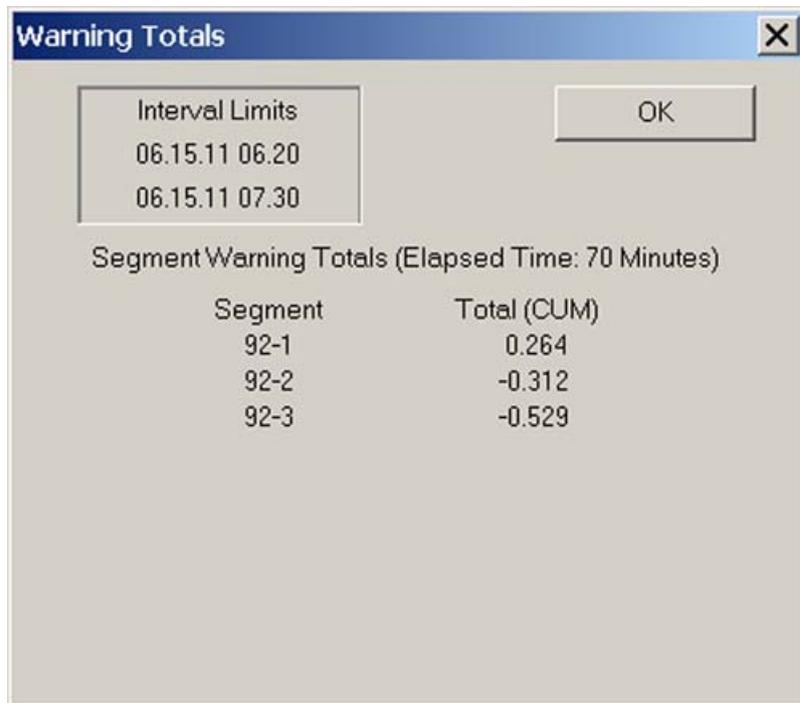
8. The Interval Limits, Site Totals (Elapsed Time) and time differences will appear.

Warning Totals

The Warning Totals are the total computed delta volume of two sites in a pipeline segment during a leak alarm condition.

To compute the Warning Totals:

1. Stop polling.
2. Set the cursors for the desired [mark start] and [mark stop] time.
3. At the Windows Menu Bar select [Optimize], [Computation Function] and then select [Warning Totals...]. The computation will begin and display the Warning Totals once they are computed. See figure below.

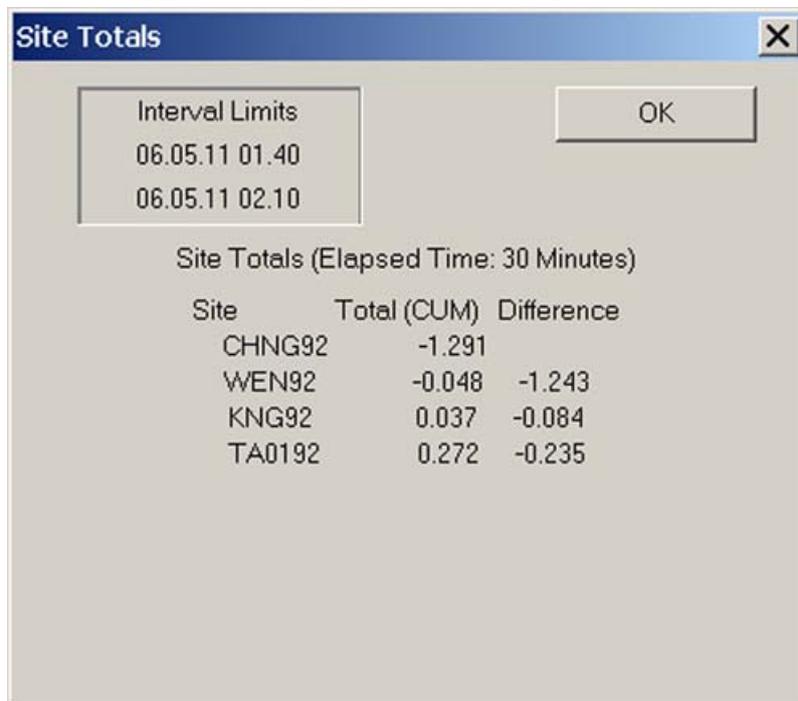


Site Totals

Site Total is the total computed flow volume of two sites in a pipeline segment for a selected time period. This can be useful for determining the total volume in a batch.

To compute the Site Totals:

1. Stop polling.
2. Set the cursors for the desired [mark start] and [mark stop] time.
3. At the Windows Menu Bar select [Optimize], [Computation Function] and then select [Site Totals...]. The computation will begin and display the Site Totals once they are computed. See figure below.



WinCC GUI Interface

6.1 Introduction

Introduction

This section describes the functions, features and construction of the WinCC Leak Detection System (FUS-LDS) Graphic User Interface (GUI) Inquiry screens. These screens graphically illustrate to the user the status of a pipeline in a customized version of the customer's pipeline map. It offers the operator a simplified leak detection screen to monitor the status of a pipeline in order to take action in the case of small or catastrophic leaks. The advantage of the WinCC GUI Inquiry screen is that it is user friendly and reduces the amount of time to train an operator to use the system to monitor pipelines against leaks.

Operation Requirements

The WinCC GUI Inquiry screen operates in the WinCC Runtime.

- 6AV63812BE070AX0 - WinCC System Software V7.0 SP3
- RT 2048 (2048 POWER TAGS)
- Runtime, on DVD
- Single License
- 5 Languages (DE, EN, IT, FR, ES)
- EXEC. Under XP Prof/ WINDOWS 7 (32 BIT)

Design Requirements

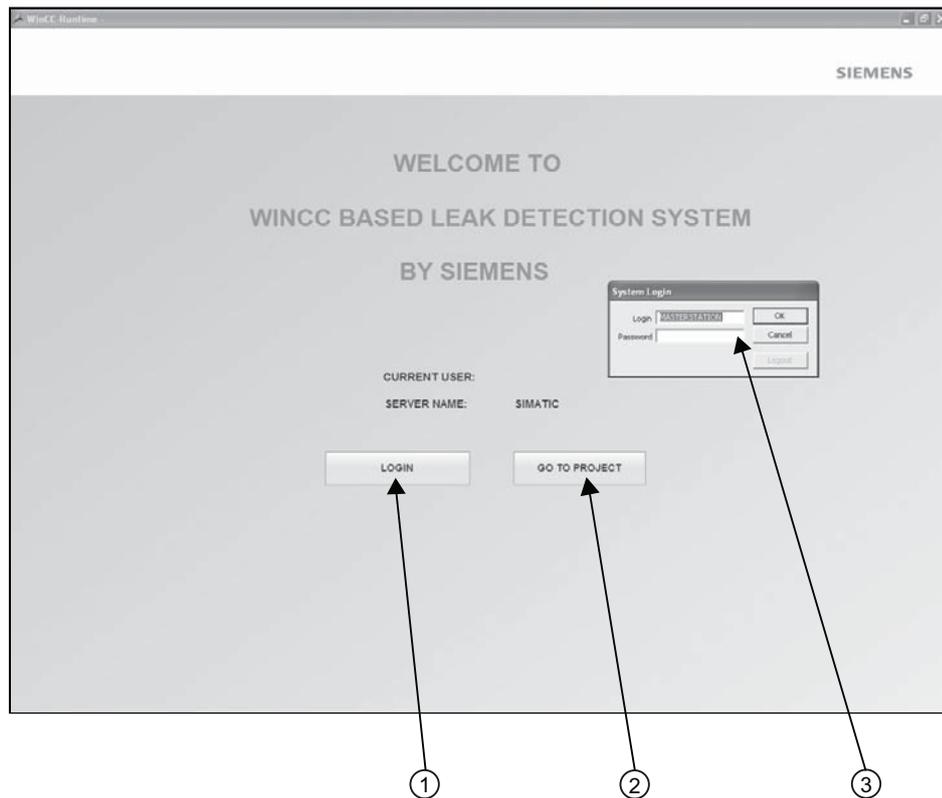
Initial equipment requirements to design WinCC GUI Inquiry screens require the following components or their equivalents:

- 6AG41042AP213BX4 - SIMATIC IPC547D (RACK PC, 19", 4U); INTE
- 6ES77900AA010XA0 - SIMATIC PC, Optical USB Mouse 3 Button Wheel Mouse with PS/2 Adapter for SIMATIC PG and PC
- 6GF62201DA01 - SCD 19101-D, LCD Display 19", Desktop with Protection Glass UL1950 / IP 20, Resolution 1280X1024, 30-97 KHz
- 6ES76480CB000YA0 - SIMATIC PC Keyboard / International USB Interface USB PS/2 Adapter

6.2 Logging In and Out

To access the WinCC FUS-LDS Leak Detection System the operator must first log in.

1. After the system is powered up the WinCC GUI Welcome screen appears.
2. Click the [LOGIN] button. The System Login menu will be displayed.
3. Enter your Master Station password and click [OK].
4. Click the [GO TO PROJECT] button and the opening screen will be displayed.

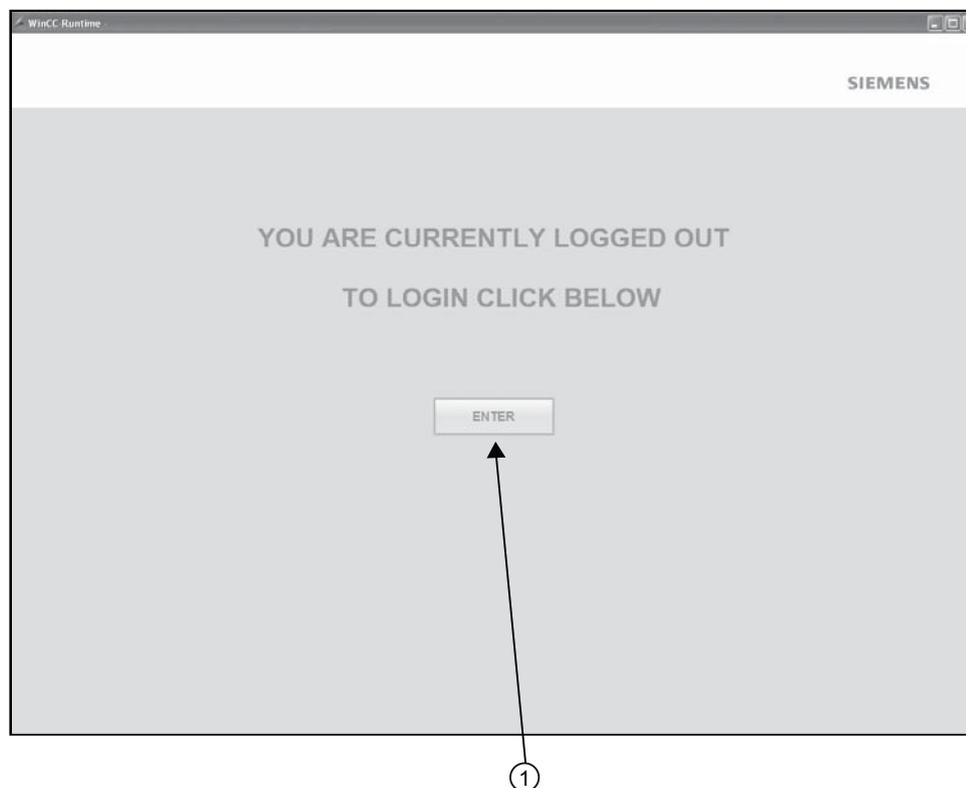


- ① [LOGIN] button
- ② [GO TO PROJECT] button
- ③ System Login menu

Figure 6-1 Log in Screen

Logging Out

When the Log Out screen appears, the operator can re-enter the WinCC FUS-LDS Leak Detection System by pressing the [ENTER] button.



① [ENTER] button

Figure 6-2 Log Out Screen

After pressing the [ENTER] button the Login screen is displayed and the operator must go through the Login procedure again.

WinCC Program Exit

To exit the WinCC program click the [X] at the top right corner of the Windows screen.

6.3 Screen Navigation

Opening Screen

The WinCC GUI Inquiry Opening Screen (see figure below) provides the user with a Menu Bar, Pipeline Map, Graphic inserts, Site Stations, pipeline segments, site identification, pipeline identification, real-time Site Station display and alarm log. The Opening Screen is the primary screen the user should have displayed while the pipeline segment is being monitored, both in a dynamic and/or static state.

Note

WinCC GUI Inquiry screens and the Master Station screens display identical data and their data screens can be easily displayed interchangeably.

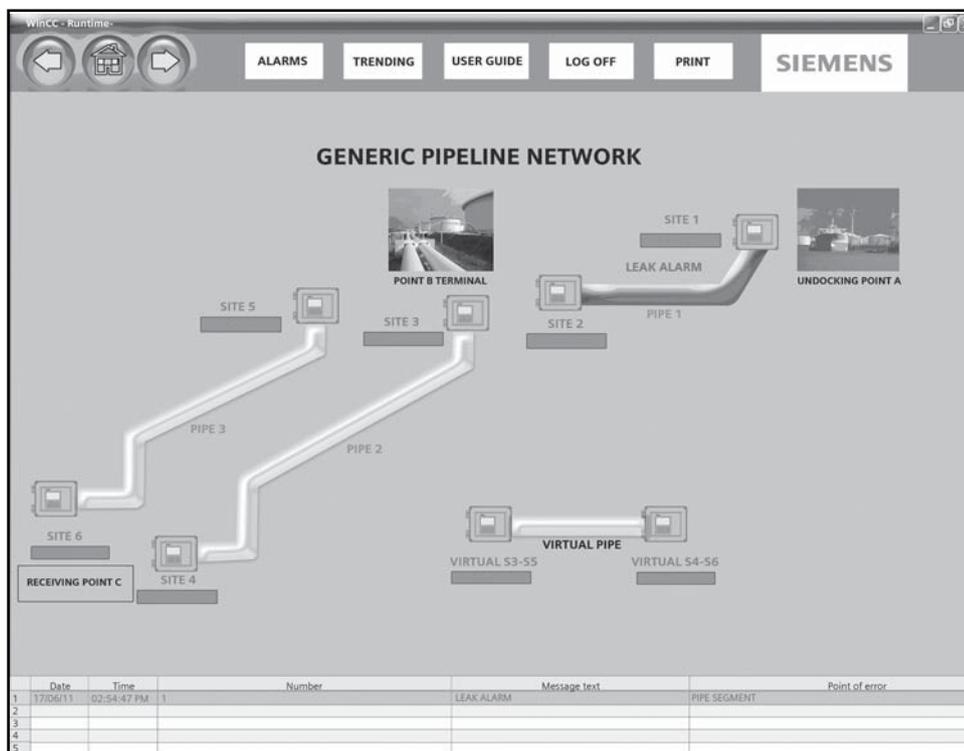
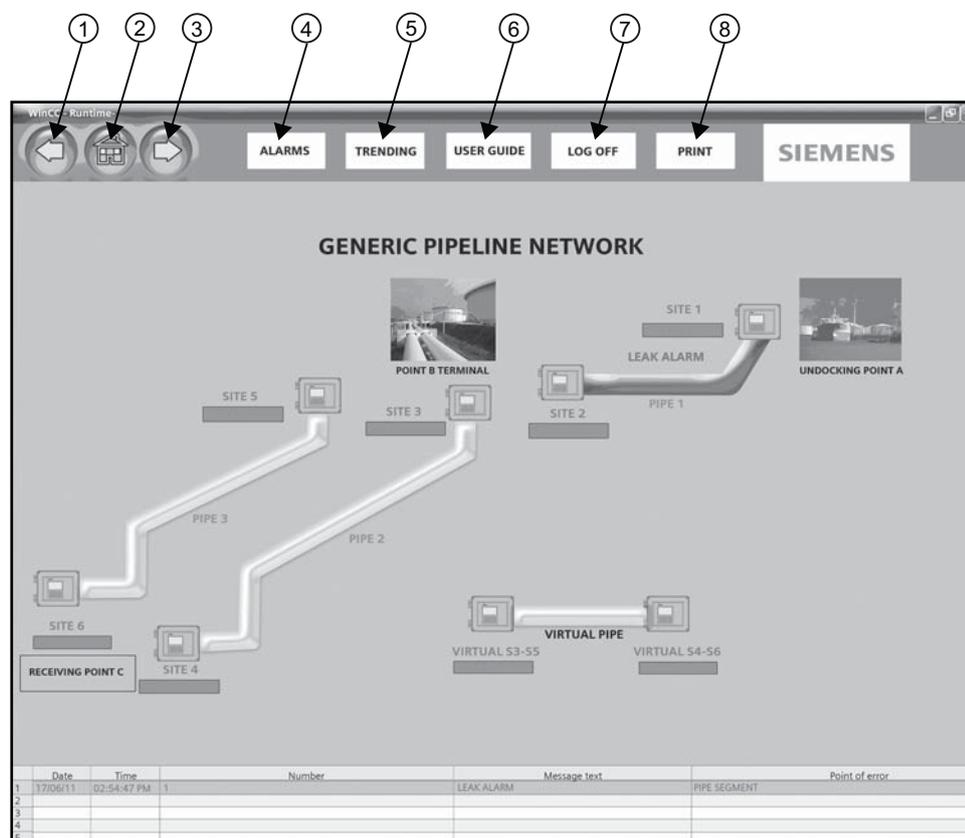


Figure 6-3 Opening Screen

Menu Bar

The Menu Bar provides access to the main functions of the Inquiry screens. These functions are displayed in the Menu Bar as shown below. The WinCC GUI Inquiry screens provide access to the main functions of the Opening Screen.



- | | | | |
|---|---|---|---|
| ① | Left Key - back to previous screen | ⑤ | Trending - select to check data trends |
| ② | Home Key (Navigation) - use to select opening screens | ⑥ | User Guide - click to select pdf manual |
| ③ | Right Key - forward to next screen | ⑦ | Log Off - click to log off FUS-LDS |
| ④ | Alarms - select to check alarm conditions | ⑧ | Print - select to print WinCC screens |

Figure 6-4 Menu Bar

Menu Bar Definitions

- Left Key – Allows the user to go back to previous screen.
- Home Key (Navigation) – Allows the user to return to the opening screen and navigate to other screens.
- Right Key – Allows the user to go forward to an advanced screen.
- Alarms – Directs user to the Alarm Log screen.
- Trending – Directs user to the Master Trending Screen.

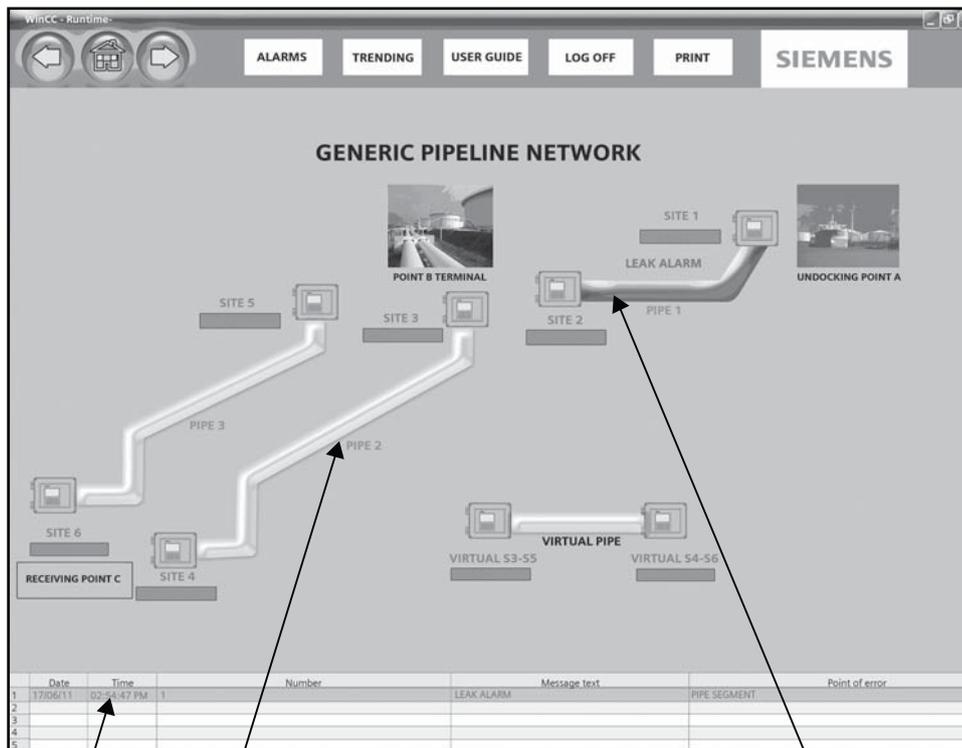
Note

Additional trend screens that are not available can be displayed in the Master Station.

- User Guide – Selects the operating manual. Manual is stored in pdf format.
- Log Off – Takes the user out of the WinCC GUI Inquiry screens and logs off of the WinCC Runtime program.
- Print – Allows the operator to print the current WinCC screen.

Pipeline Map

The Pipeline Map screen can be designed based on the pipeline operator's map, the environmental design or to reflect the Pipeline Control system used. The Pipeline Map is designed prior to usage of the WINCC GUI Inquiry screen in the initial development phase of the Master Station Topology file and the WinCC Runtime system.



- ① Alarm Log
- ② Pipeline Segment
- ③ Leak Alarm

Figure 6-5 Pipeline Map

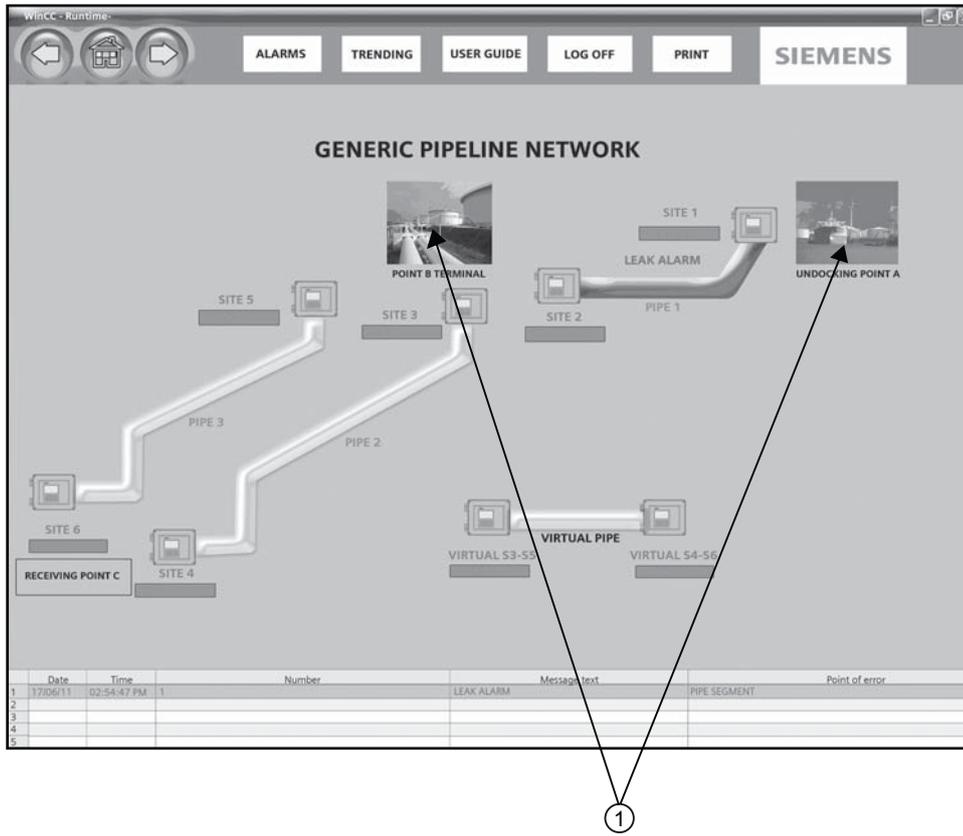
The standard items in the Pipeline Map are the Site Stations and the pipeline segments. The Site Station identification and the pipeline segment labels are created during the topology development phase. The key feature to the Pipeline Map is its ability to instantly identify a leak alarm.

This screen uses a color scheme to highlight the Site Station or the pipeline segment that may have a leak condition. The following list explains the color scheme and its implications:

- No Color: Status Normal
- Flashing Red: Leak Alarm or Site Fault – Needs to be acknowledged
- Solid Red: Leak Alarm has been acknowledged
- Red "F": Fault Alarm
- Red "C": Communication Alarm
- Blue: Anti-Leak Warning

Graphic inserts

The WinCC GUI Inquiry screens give the operator the option to use a graphic insert in order to make the screen easier to monitor. The system operator has the ability to insert screen graphics and digitally download photographs of actual sites, or other imagery related to industry standards. Additionally, the WinCC program directory supplies a database with pictures and symbols to complete any representation needed to properly monitor the pipeline segment.



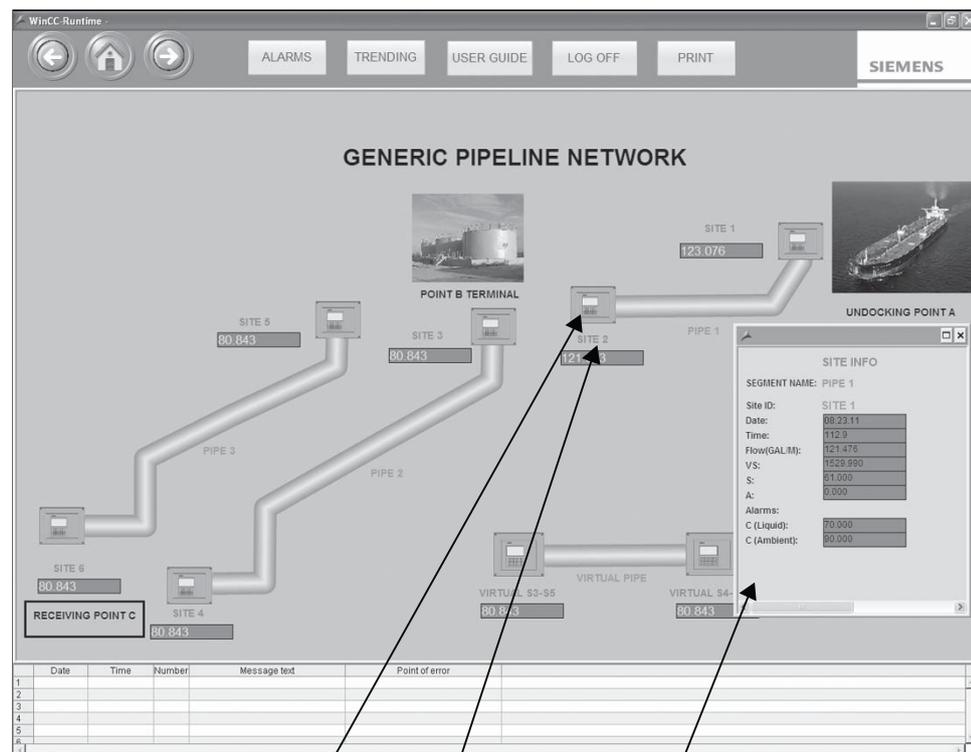
① User inserted graphics

Figure 6-6 Graphic Inserts

6.4 Pop-up Menus

Site Station Pop-up Screens

The WinCC GUI Inquiry screens offer the ability to look at information on the Site Stations while the system continues to monitor the pipeline. All the user needs to do is pass the mouse over the desired Site Station and click. A pop-up screen will appear with information relating to that Site Station (see figure below). During the development of the Topology file specific information that the operator requires for a Site Station can be detailed in the pop-up screen. Refer to the Glossary for Site Data definitions and details.



- ① ② ③

- ① Site Station
- ② Site ID
- ③ Pop-up Screen

Figure 6-7 Site Station Pop-up Screen

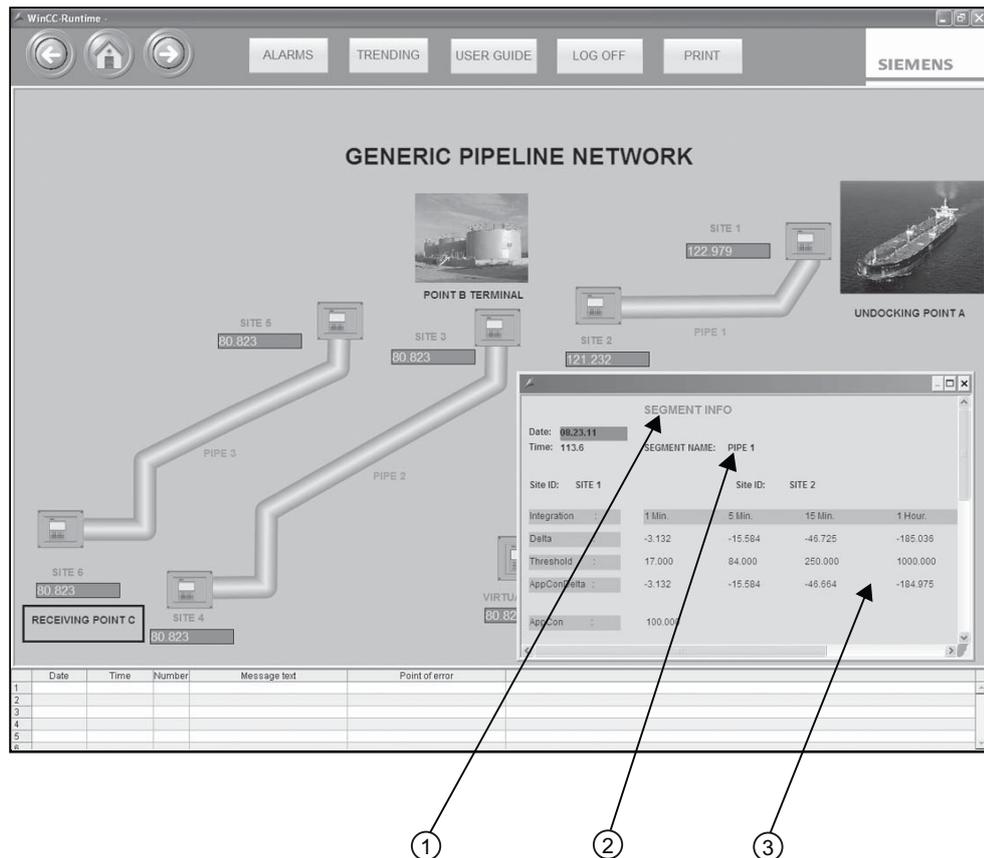
Site Station Site Data

Typical Site Station Site Data items include:

- Segment Name - pipeline segment name
- SITE ID - a unique network identification number
- Date
- Time
- Flow Total
- Vs - Sonic Velocity
- S - Signal ALC
- A - Aeration
- Alarms
- C (Liquid temperature)
- C (Ambient temperature)

Pipeline Segment Pop-up Screens

The WinCC GUI Inquiry screens offer the ability to look at information on the pipeline segment while the system continues to monitor the pipeline. All the user needs to do is pass the mouse over the desired pipeline segment and click. A pop-up screen will appear with information relating to that pipeline segment (see figure below). During the development of the Topology file specific information that the operator requires for a pipeline segment can be detailed in the pop-up screen.



- ① Segment Info
- ② Pipeline Segment Name
- ③ Pop-up Screen

Figure 6-8 Pipeline Segment Pop-up Screen



Figure 6-9 Pipeline Segment Screen-enlarged view

Pipeline Segment Site Data

Typical Pipeline Segment Site Data items include:

- Date
- Time
- Segment Name - pipeline segment name
- SITE ID - a unique network identification number
- Flow Total
- Vs - Sonic Velocity
- S - Signal ALC
- A - Aeration
- Alarms
- C (Liquid temperature)
- C (Ambient temperature)

See also

Master Station Graphic Screens (Page 35)

6.6 Trend Screens

Introduction

The WinCC GUI offers Trend screens, also known as MultiGraph Delta Screens.

Screen Navigation

1. In order to navigate to the Trend screen while in the WinCC GUI, the operator must click on the [Trending] button in the Menu Bar. The Master Trending Screen will be displayed and the desired pipeline segment can be selected.

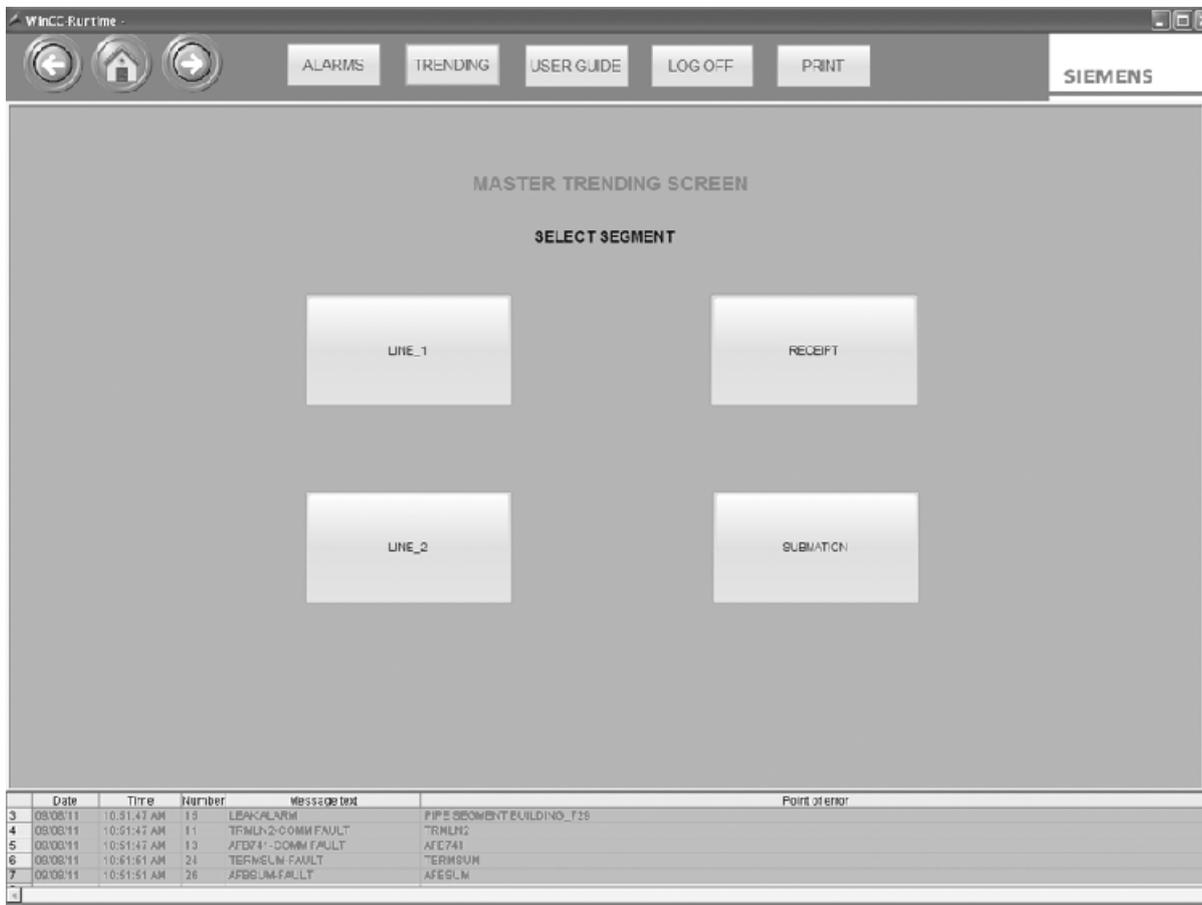


Figure 6-11 Master Trending Screen

2. When a pipeline segment is selected (e.g. Line_1) a Master Trending Screen is displayed.



Figure 6-12 Pipeline Segment Trends

3. Select a variable from the Master Trending Screen list (e.g. Multi Graph Liquidata) and the trends for that variable will be displayed.

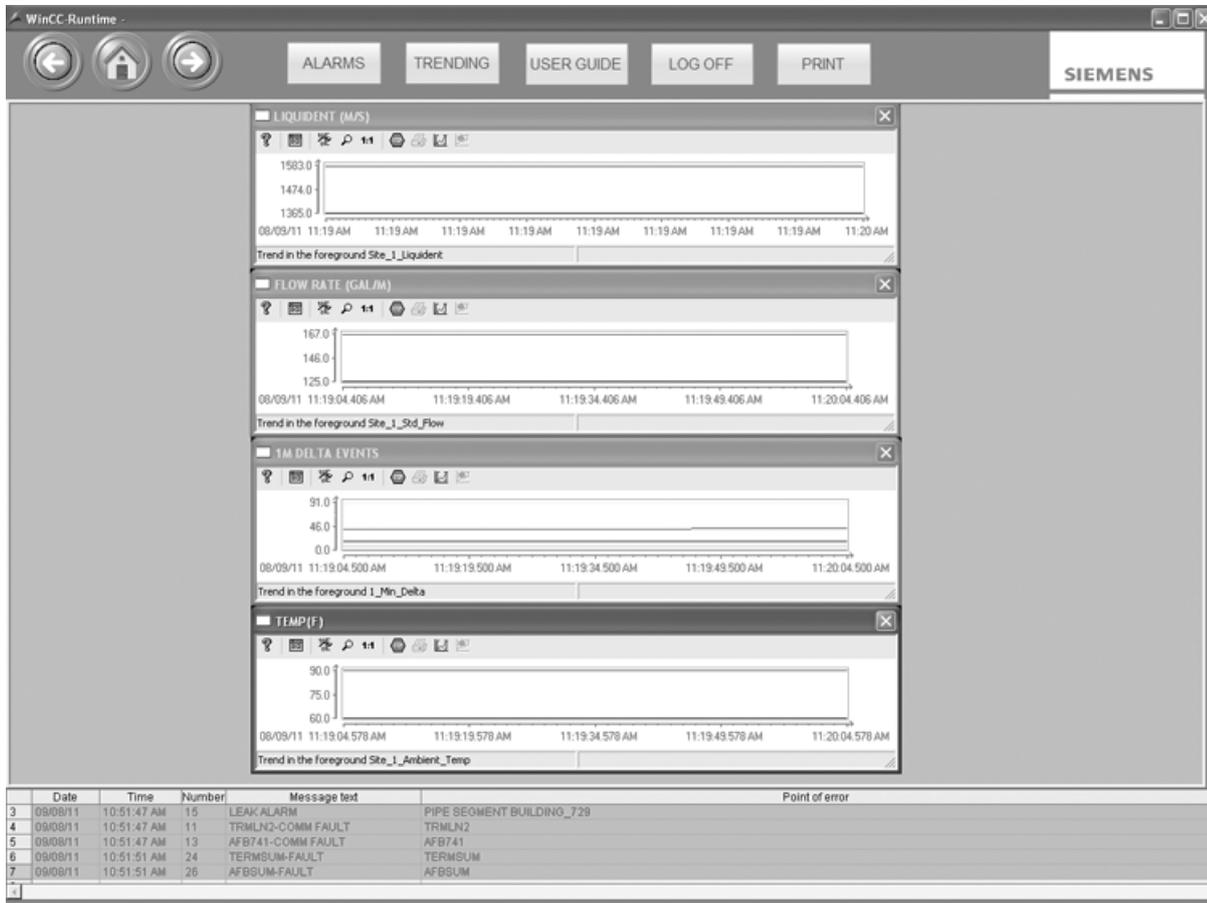


Figure 6-13 Trending Sample Screen

4. For other Trending options switch from the WinCC GUI to the FUS-LDS Master Station. For example, once in FUS-LDS Master Station, Hot Key <F5> can be used to navigate to the MultiGraph Delta screen (see figure below).

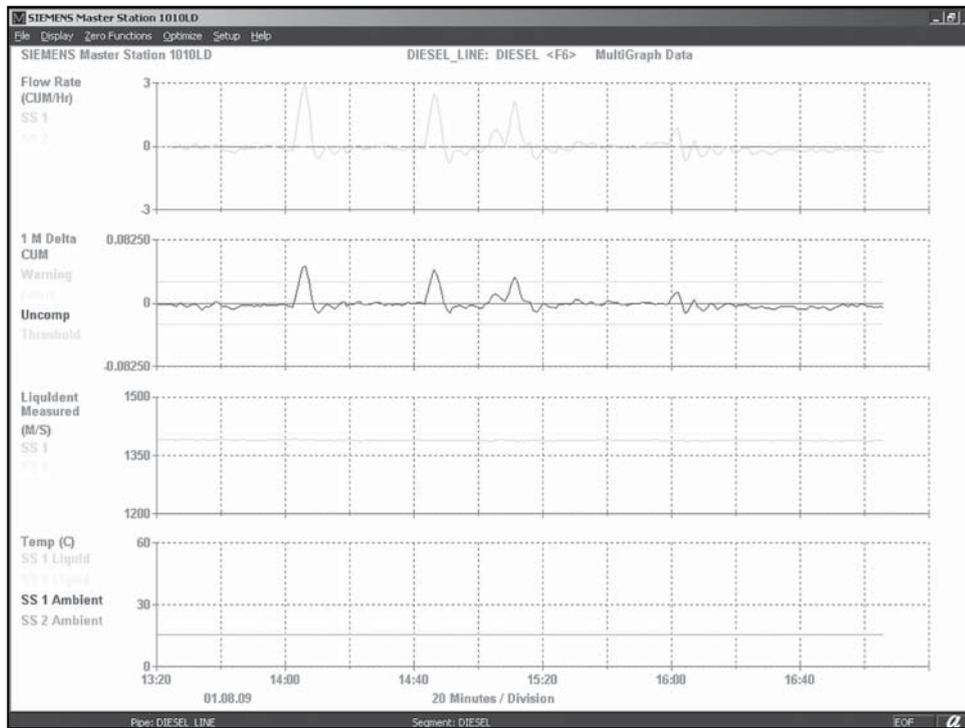
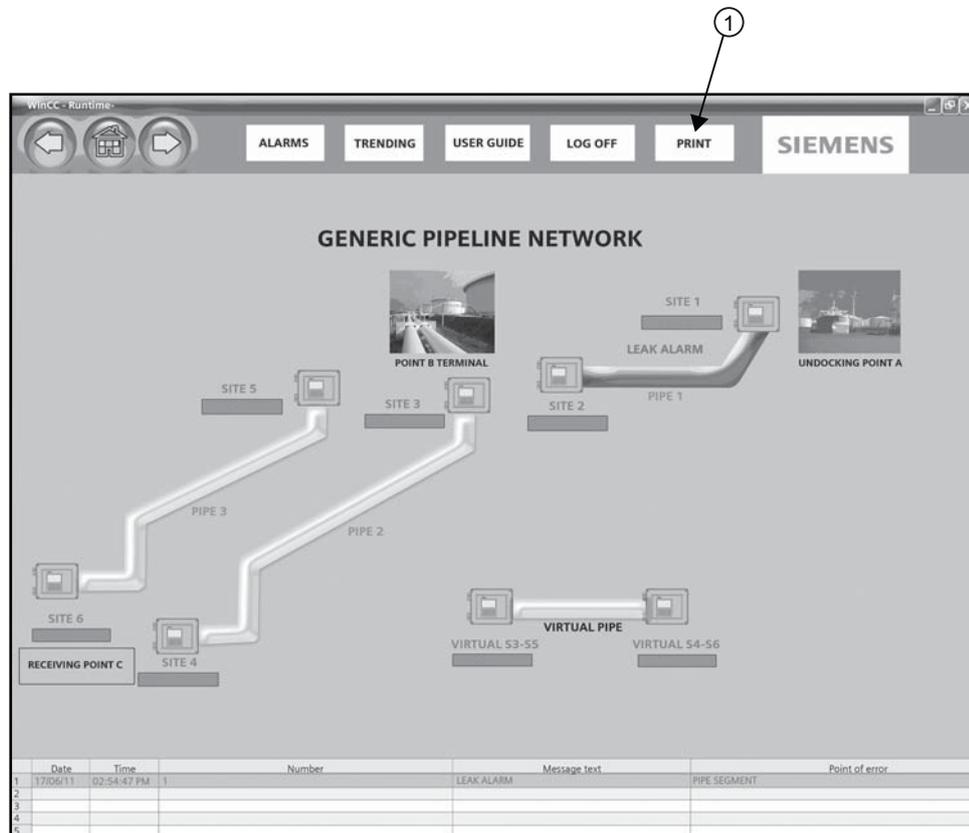


Figure 6-14 MultiGraph Delta Screen - Hot Key <F5>

Refer to the Master Station Graphic Screens (Page 35) chapter and the MultiGraph Delta screen explanation for details on using other Trend screens.

6.7 Printing

By clicking the Print button in the Menu Bar, the operator can print the current WinCC GUI screen (see figure below).



① Print button

Figure 6-15 Print Screen

Refer to the Master Station Data Archiving (Page 95) chapter for details on printing and archiving other system data.

Alarm, error, and system messages

7.1 Alarm Conditions

Alarm Conditions

When operating the Master Station and monitoring the Summary <F1> screen, the monitoring of all pipeline segments on all pipelines is possible. You will notice quickly a warning or alarm condition by simply noting the color of the graphic representations (icons) of the pipeline segments and Site Stations. A yellow or red pipeline segment icon requires your immediate attention.

If the warning delta display of any of the four integration periods (MultiGraph Delta <F5> screen) exceeds the upper red leak alarm threshold, the Master Station changes the color of the suspected pipeline segment's icon to yellow (see Summary <F1> screen). The Master Station will not issue an audible or visual alert for this condition. If the Master Station detects a leak alarm condition it triggers audible and visible alarms.

Leak Alarm

The Master Station declares a leak alarm when the alarm delta trace exceeds the upper leak alarm threshold (shown in red on the <F5> screen) for any of the four integration periods. The suspected pipeline segment's symbol (see <F1> screen) will switch to a flashing red. In this case, the Master Station de-energizes the system alarm relay.

To acknowledge an alarm, do one of the following:

- At the Summary <F1> screen, double-click on a pipeline segment.
- Press the <M> key anywhere in system.
- Double-click the Alarm Status window located on the lower left side of the status bar. (The Alarm Status will only appear if there is an unacknowledged alarm condition.)

The Master Station responds to your alarm acknowledgment by generating an audit trail real-time printout (see Data Archiving (Page 95)). On delta screens where the alarm delta trace falls below the threshold that will indicate an anti-leak condition and the pipeline segment symbol will turn blue. Usually, this condition implies the need for additional Site Station or Master Station optimization. The Master Station will not issue a relay alarm closure for this condition.

Note

When a *Scraper* has been detected the site will flash blue.

7.1 Alarm Conditions

System Alert Chart

This chart lists the typical I/O connections and functions of the FUS-LDS Relay Module board that can be used to help determine if a Leak Alarm, Site Fault or Communication failure is present.

Table 7- 1 PCI-DIO24 Relay Module

| Indicator | Relay No. | Function | Terminal |
|-----------|-----------|--|----------|
| L | A1 | Segment Leak | 1 |
| F | A2 | Site Fault | 2 |
| C | A3 | Communications Fault | 3 |
| P | A4 | Pressure Fault | 4 |
| I | A5 | Interface Registered | 5 |
| S | A6 | Scraper (Pig) Detected | 6 |
| B | A7 | Failure in Primary Communications Line | 7 |
| X | A8 | Failure in Backup System | 8 |

When the Master Station determines that a leak has occurred in any segment, the Master Station will indicate the leaking segment by opening the corresponding relay, as shown in the table below. "Open" means this relay makes an open circuit.

| Segment | Legacy Relay (Obsolete) | FUS-LDS Relay Module |
|---------|-------------------------|----------------------|
| 01 | KB0 | A9 |
| 02 | KB1 | A10 |
| 03 | KB2 | A11 |
| 04 | KB3 | A12 |
| 05 | KB4 | A13 |
| 06 | KB5 | A14 |
| 07 | KB6 | A15 |
| 08 | KB7 | A16 |
| 09 | KC0 | A17 |
| 10 | KC1 | A18 |
| 11 | KC2 | A19 |
| 12 | KC3 | A20 |
| 13 | KC4 | A21 |
| 14 | KC5 | A22 |
| 15 | KC6 | A23 |
| 16 | KC7 | A24 |

Confirming Leak Validity

When you acknowledge an alarm, the following steps should be taken to confirm the validity of the leak alert:

1. Select the Summary screen <F1> (System Alarm Status) to identify the pipeline segment(s) that caused the alert.
2. Select the Site Data screen <F3> to confirm proper operation of the Site Stations.
3. Select any or all of the available MultiGraph and individual display screens to determine if the current data and data trends supports the conclusion that a leak is in progress, or has occurred at a prior time.

7.2 Data Archiving

Introduction

The Master Station creates an archive of all Site Station data and generated audit trails. It will retain this archive on its hard drive but data archiving is limited to hard drive size.

Data Archiving

The basic Master Station data file archival functions are as follows:

- At the start of each day (midnight), the Master Station creates an "archive" file that will contain all data that will be received that day.
- Archive files are usually named with a date, revision and an extension which describes the pipeline.
Example: 082108A1.PMX.
- Archive files can be reviewed using a review station console on separate PC.
- In addition to file archiving, the Master Station can be configured to print any status condition (alarm) at the time of occurrence.

Hewlett Packard© Printing Notes

When using a Hewlett Packard© printer with a Siemens leak detection system, please note the following:

- The audit trail data generated by the FUS-LDS is placed into the buffer of the printer. Printing starts when either a page is full or a form-feed is received.
- When the printer has data in its buffer (but not a full page), the "form-feed" light will flash indicating there is data in its buffer. Pressing the "form-feed" button will initiate printing.
- Audit trail data stored in the printer buffer will automatically print prior to any printing of the Master Station screens or prior to the Master Station shutting down.

Training Courses

The Master Station provides several screens to help you verify a leak alert. Interpreting these screens is actually quite straightforward. However, hands-on training would be far more effective.

Therefore, this manual will not attempt to present in-depth screen data analysis techniques. To do so would require your participation in our FUS-LDS Training Courses, prior to accepting the responsibility of operating our Master Station.

ModBus

8.1 ModBus Alarm Code Tables

Alarm Codes

The FUS-LDS ModBus communications alarm code conditions, their site colors and alarm letters are listed in the following screen shots and tables.

To view the Report Diagnostic menu:

1. Select [File] from the tool bar and then select [Report Diagnostic].
2. The red bracket illustrates where the alarm registers are located in the registers listings.

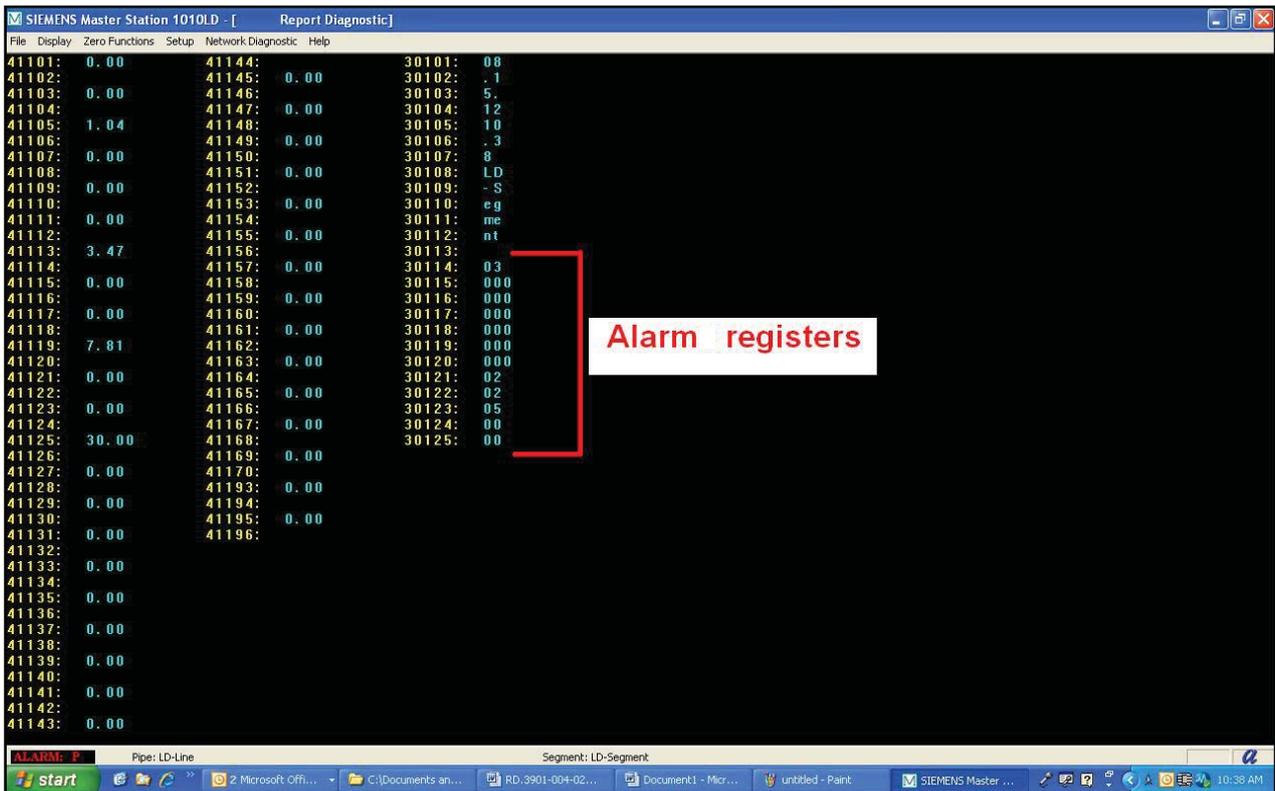


Figure 8-1 Alarm Register Locations

The following figure illustrates the section of the Report Diagnostic register map screen showing only the ModBus alarm registers. The table below is an example that describes the Alarm Register fields, register types and registers.

8.1 ModBus Alarm Code Tables

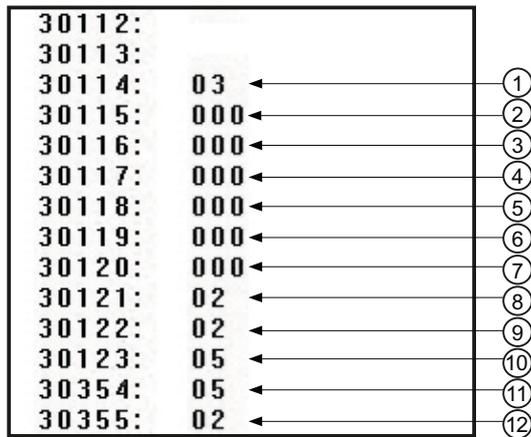


Figure 8-2 Register Map

Table 8-1 Alarm Register Descriptions

| | Field | Register Type | Registers |
|---|---|---------------|---------------|
| ① | Status | Input | 30114 - 30114 |
| ② | Site 1 Alarms | Input | 30115 - 30115 |
| ③ | Site 2 Alarms | Input | 30116 - 30116 |
| ④ | Site 1 Path 1 Alarms | Input | 30117 - 30117 |
| ⑤ | Site 1 Path 2 Alarms | Input | 30118 - 30118 |
| ⑥ | Site 2 Path 1 Alarms | Input | 30119 - 30119 |
| ⑦ | Site 2 Path 2 Alarms | Input | 30120 - 30120 |
| ⑧ | Site 1 Summary Alarms and Acks. (Decimal) | Input | 30121 - 30121 |
| ⑨ | Site 2 Summary Alarms and Acks. (Decimal) | Input | 30122 - 30122 |
| ⑩ | Segment Summary Alarms and Acks. (Decimal) | Input | 30123 - 30123 |
| ⑪ | System Alarms | Input | 30354 - 30354 |
| ⑫ | System Alarms (Decimal) | Input | 30355 - 30355 |

The following tables list the alarm code conditions, their site colors and alarm letters.

Table 8-2 Site Alarm Codes

| Condition | Site Colors and Letters | Corresponding Number |
|--|------------------------------|----------------------|
| No alarms | Solid Green | 00 |
| Unacknowledged Communications Failure | Flashing Red and Letter C | 02 |
| Acknowledged Communications Failure | Solid Red and Letter C | 01 |
| Unacknowledged Site Fault | Flashing Red and Letter F | 04 |
| Acknowledged Site Fault | Solid Red and Letter F | 03 |
| Pressure Alarm | Flashing Green and Letter P | 06 |
| Interface Detect | Flashing Green and Letter I | 00 |
| Pig Detect | Flashing Blue and Letter S | 08 |
| Acknowledged Pig | Solid Blue and Letter S | 07 |
| Switch to Backup Communications | Flashing Yellow and Letter B | 00 |
| Acknowledged Switch to Backup Communications Line | Solid Yellow and Letter B | 00 |
| Backup Communications Switch Option Failure | Flashing Yellow and Letter X | 00 |
| Acknowledged Backup Communications Switch Option Failure | Solid Yellow and Letter X | 00 |

Table 8-3 Segment Alarm Codes

| Condition | Site Colors and No Letters | Corresponding Number |
|---|----------------------------|----------------------|
| No alarms | Solid Green | 00 |
| Unacknowledged Leak Alarm | Flashing Red | 02 |
| Acknowledged Leak Alarm or Pack Volume Exceeded | Solid Red | 01 |
| Anti-Leak | Solid Blue | 03 |
| Either site with an alarm other than a Pig Detect, a Leak Warning, or temporary acknowledged Leak alarm (until the next poll) | Solid Yellow | 05 |

Table 8- 4 System Alarm Codes

| Condition | Site Colors and Letter(s) | Corresponding Number |
|---|---------------------------|----------------------|
| No alarms | None | 00 |
| Leak | Letter L | 01 |
| Communications Failure | Letter C | 02 |
| Communications Failure and Leak | Letters C and L | 03 |
| Site Fault | Letter F | 04 |
| Site Fault and Leak | Letters F and L | 05 |
| Site Fault and Communications Failure | Letters F and C | 06 |
| Site Fault, Communications Failure and Leak | Letters F, C and L | 07 |

ModBus Register Maps

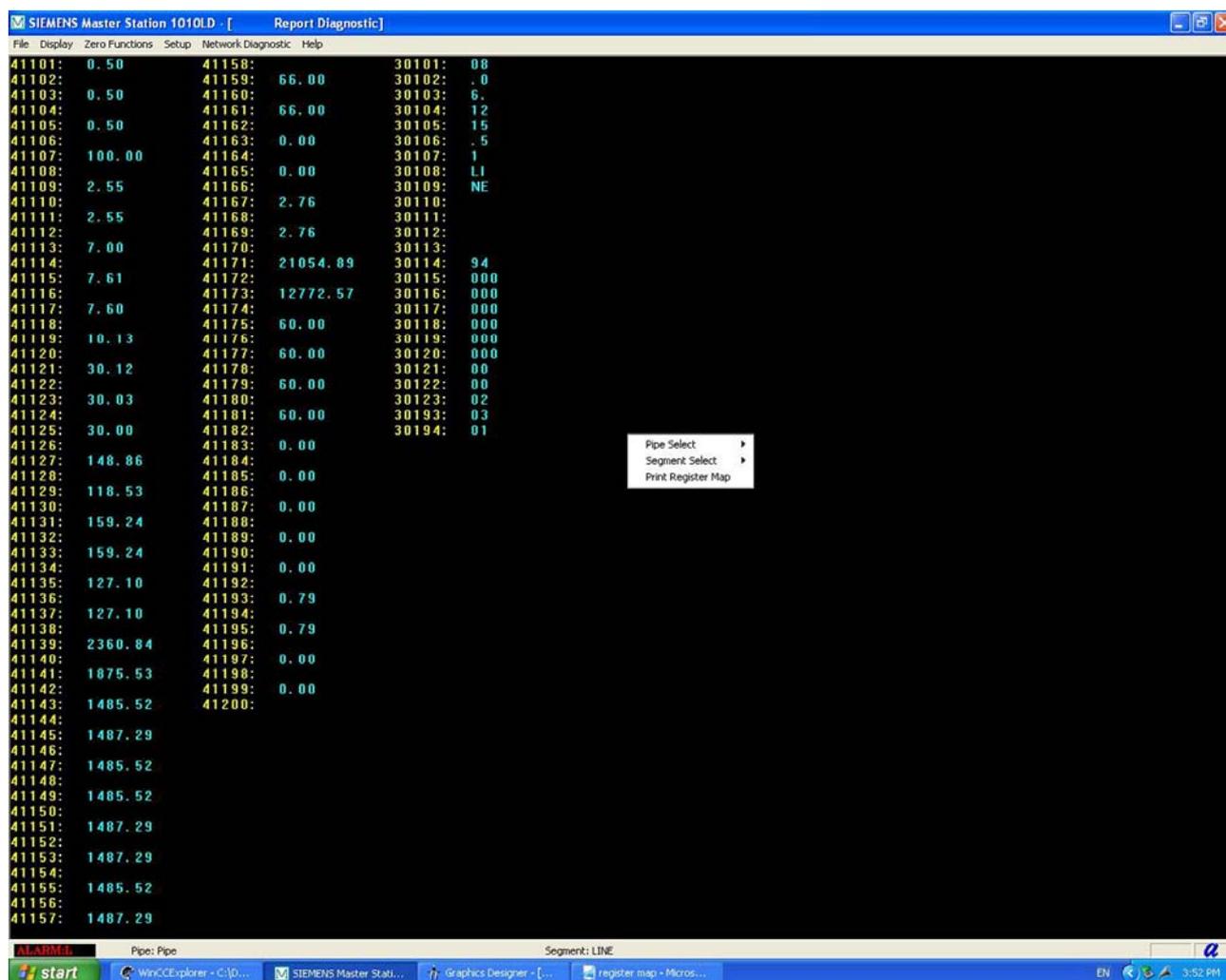
To generate a register map:

1. At the top menu bar select [Display] and left click.
2. Scroll to [Report Diagnostic] and left click.
3. The current diagnostic report data will be displayed.

Printing a Register Map

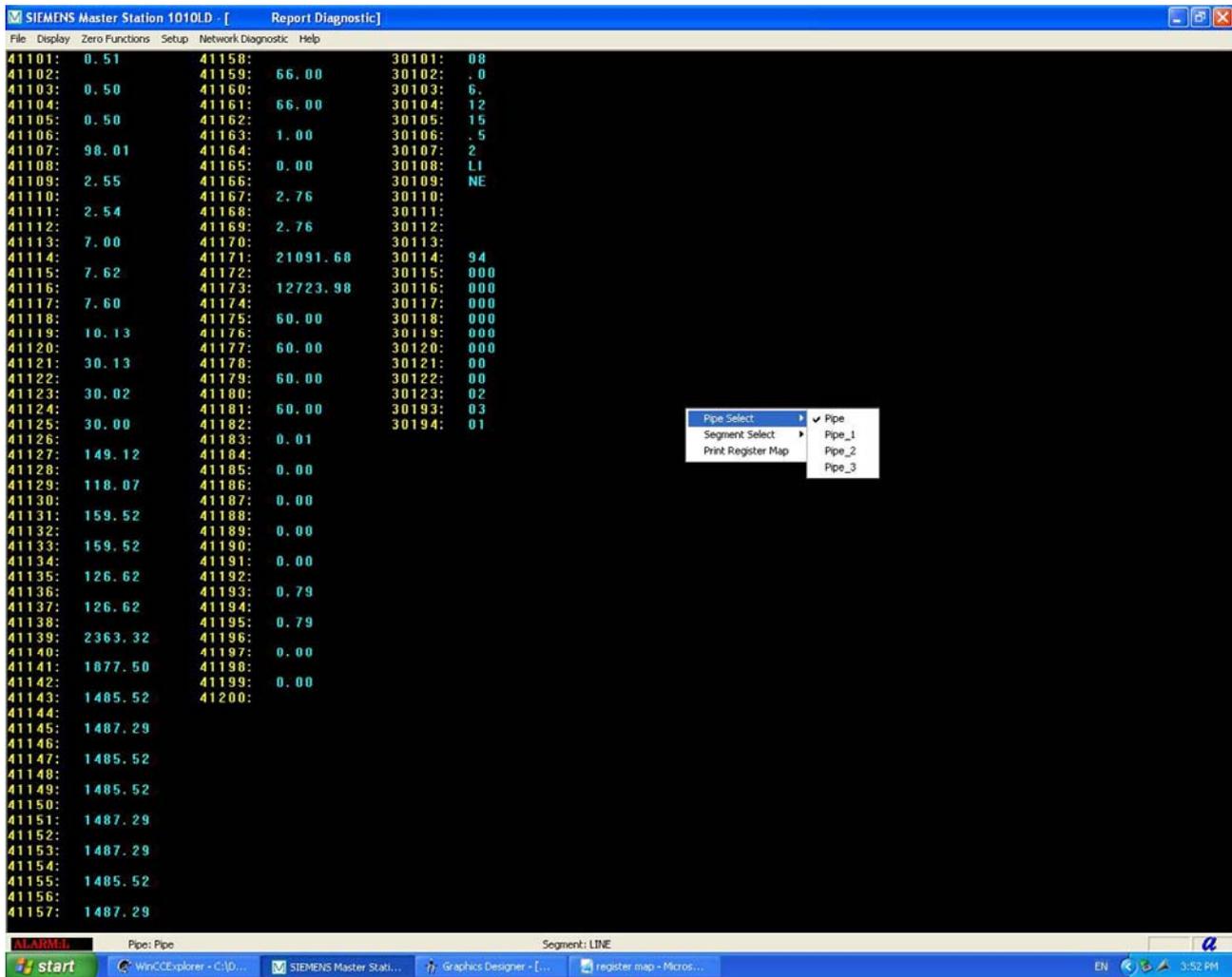
To print out a register map listing:

1. Right click any where on the Diagnostic screen and a context menu will appear.

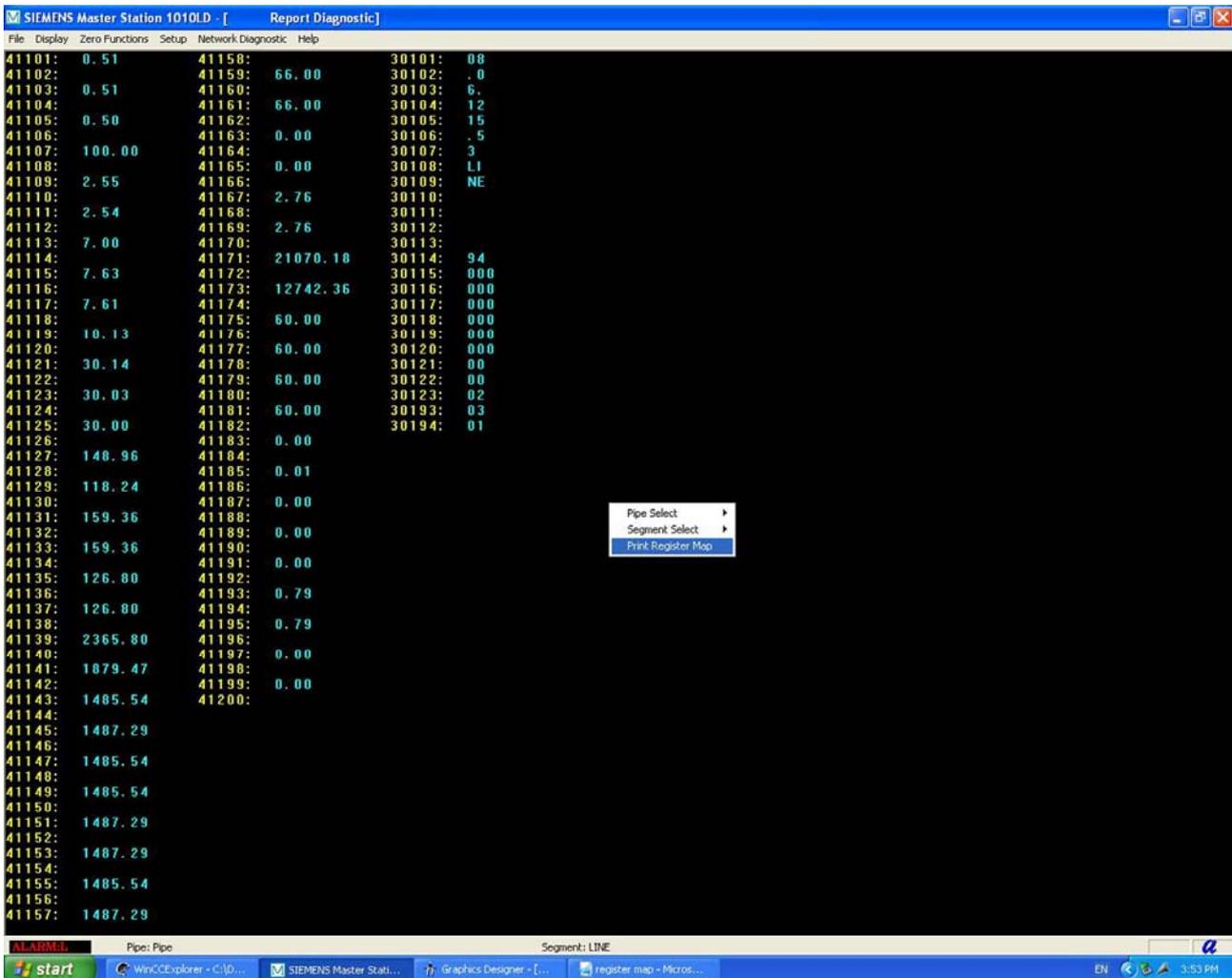


2. Click on [Pipe Select] then [Pipe].

8.1 ModBus Alarm Code Tables



3. Then scroll down to [Register Map] and click.



4. The Register Map will print. See the example shown below.

Register Map Printout

The following is a typical Register map print out.

August 13, 2012 16 Bit Register : Word Normal Page 1 of 2

Siemens Side Channel Modbus Register Map

Segment SEGMENT1: Field Selection EFFFFFFF

| Field | Register Type | Registers |
|----------------------------------|---------------|----------------|
| Date | Input | 30101 -- 30104 |
| Time | Input | 30105 -- 30107 |
| Segment Name | Input | 30108 -- 30113 |
| 1 Min Delta | Holding | 41101 -- 41102 |
| 1 Min AppCon Delta | Holding | 41103 -- 41104 |
| 1 Min Delta Threshold | Holding | 41105 -- 41106 |
| 1 Min AppCon | Holding | 41107 -- 41108 |
| Status | Input | 30114 -- 30114 |
| 5 Min Delta | Holding | 41109 -- 41110 |
| 5 Min AppCon Delta | Holding | 41111 -- 41112 |
| 5 Min Delta Threshold | Holding | 41113 -- 41114 |
| 15 Min Delta | Holding | 41115 -- 41116 |
| 15 Min AppCon Delta | Holding | 41117 -- 41118 |
| 15 Min Delta Threshold | Holding | 41119 -- 41120 |
| 60 Min Delta | Holding | 41121 -- 41122 |
| 60 Min AppCon Delta | Holding | 41123 -- 41124 |
| 60 Min Delta Threshold | Holding | 41125 -- 41126 |
| Site 1 Std Flow | Holding | 41127 -- 41128 |
| Site 2 Std Flow | Holding | 41129 -- 41130 |
| Site 1 Path 1 Flow | Holding | 41131 -- 41132 |
| Site 1 Path 2 Flow | Holding | 41133 -- 41134 |
| Site 2 Path 1 Flow | Holding | 41135 -- 41136 |
| Site 2 Path 2 Flow | Holding | 41137 -- 41138 |
| Site 1 Flow Total | Holding | 41139 -- 41140 |
| Site 2 Flow Total | Holding | 41141 -- 41142 |
| Site 1 Vs | Holding | 41143 -- 41144 |
| Site 2 Vs | Holding | 41145 -- 41146 |
| Site 1 Path 1 Vs | Holding | 41147 -- 41148 |
| Site 1 Path 2 Vs | Holding | 41149 -- 41150 |
| Site 2 Path 1 Vs | Holding | 41151 -- 41152 |
| Site 2 Path 2 Vs | Holding | 41153 -- 41154 |
| Site 1 Liquident | Holding | 41155 -- 41156 |
| Site 2 Liquident | Holding | 41157 -- 41158 |
| Site 1 ALC | Holding | 41159 -- 41160 |
| Site 2 ALC | Holding | 41161 -- 41162 |
| Site 1 AER | Holding | 41163 -- 41164 |
| Site 2 AER | Holding | 41165 -- 41166 |
| Site 1 Alarms | Input | 30115 -- 30115 |
| Site 2 Alarms | Input | 30116 -- 30116 |
| Site 1 Path 1 Alarms | Input | 30117 -- 30117 |
| Site 1 Path 2 Alarms | Input | 30118 -- 30118 |
| Site 2 Path 1 Alarms | Input | 30119 -- 30119 |
| Site 2 Path 2 Alarms | Input | 30120 -- 30120 |
| Site 1 Summary Alarms and Acks. | Input | 30121 -- 30121 |
| Site 2 Summary Alarms and Acks. | Input | 30122 -- 30122 |
| Segment Summary Alarms and Acks. | Input | 30123 -- 30123 |
| Site 1 Viscosity | Holding | 41167 -- 41168 |

Figure 8-3 Register Map Printout Page 1

August 13, 2012

16 Bit Register : Word Normal

Page 2 of 2

Siemens Side Channel Modbus Register Map**Segment SEGMENT1: Field Selection EFFFFFFF**

| Field | Register Type | Registers |
|-------------------------|----------------------|------------------|
| Site 2 Viscosity | Holding | 41169 -- 41170 |
| Site 1 Reynolds | Holding | 41171 -- 41172 |
| Site 2 Reynolds | Holding | 41173 -- 41174 |
| Site 1 Liquid Temp | Holding | 41175 -- 41176 |
| Site 2 Liquid Temp | Holding | 41177 -- 41178 |
| Site 1 Ambient Temp | Holding | 41179 -- 41180 |
| Site 2 Ambient Temp | Holding | 41181 -- 41182 |
| Pack | Holding | 41183 -- 41184 |
| UnPack | Holding | 41185 -- 41186 |
| Pack Delta | Holding | 41187 -- 41188 |
| Site 1 Pressure | Holding | 41189 -- 41190 |
| Site 2 Pressure | Holding | 41191 -- 41192 |
| Site 1 Specific Gravity | Holding | 41193 -- 41194 |
| Site 2 Specific Gravity | Holding | 41195 -- 41196 |
| System Alarms | Input | 30354 -- 30354 |
| System Alarms(Decimal) | Input | 30355 -- 30355 |

Figure 8-4 Register Map Printout Page 2

Service and maintenance

9.1 Periodic Maintenance

Routine surveillance of operating conditions is recommended to confirm that no event has affected the Leak Detection System operation. For this purpose, each Site Station features a comprehensive real-time Diagnostic Menu that reports current operating conditions. The Master Station can retrieve and display much of this information over the FUS-LDS communication system. If any Site Station reports a fault alarm, this causes the Master Station's Segment Status Alarm screen to change that Site Station's symbol from green to red. However, you must also be alert to other indications that the FUS-LDS is not performing in a normal way, such as the failure to provide fresh data reports once per minute.

The Siemens Leak Detection Training Program provides instruction in all aspects of the FUS-LDS operation evaluation, diagnosis, and maintenance. We urge the personnel assigned to maintenance to attend these classes, which can be held in the field or at our facilities.

Site Station Diagnostic Menu

As we mentioned earlier, our Site Stations are among the most reliable of all flow and temperature sensing instruments. However, as with all instruments, it is impossible to completely rule out electronic component failure, or damage to the flow or temperature sensors due to internal or external influences. Therefore, we recommend that users monitor the condition of each Site Station periodically.

Fortunately, it is not necessary to visit the sometimes remote location of a Site Station to examine its condition. Most of the Site Station's diagnostic parameters are reported to the Master Station once per minute via the communication network. This simplifies diagnosing the condition of a Site Station.

It is much easier to maintain our Site Station than any conventional intrusive flowmeter. Servicing this equipment never requires you to stop flow or open the pipe. Also, all Site Station modules are of interchangeable plug-in design. The non-intrusive clamp-on flow and temperature sensors can be replaced quickly, whenever necessary. Finding and replacing a defective module is extremely simple. This is based on either Diagnostic Menu indications, or by the very quick "sequential interchange" method.

We recommend that instead of storing individual spare parts, you retain one spare operational Site Station at your instrument maintenance facility. This permits convenient staff training, and you can use this Site Station to test modules removed from a suspect Site Station in the field. Also, if you purchase one of our portable clamp-on Site Stations, you could use it to confirm that a suspected Site Station is indeed defective, or to maintain system operation temporarily during maintenance.

Master Station Maintenance

The following paragraphs introduce the basic maintenance procedures for the Master Station.

Operating Program

The FUS-LDS Master Station Console uses a PC compatible personal computer. Therefore, maintenance procedures would be identical to those that apply to such equipment. The current version of our Master Station operating program runs under the Microsoft Windows 95/98/NT/XP/Windows 7 operating systems.

The Master Station program file and FUS-LDS archive data files must reside in the same directory. This directory must also contain the pipeline's Topology file, which provides application-specific data to the Master Station.

The Topology file is a non-case-sensitive file that uses a specific 8-character/3-character extension filename format: XXXXXXXX.XXX

The first six characters are used to identify the customer name. (Note: Up to six characters can be used.) For example: Anycom

Characters seven and eight are used to identify the customer installation and/or successive optimized versions of the Topology file. They can be represented by any alphanumeric character from 0 - Z. For example: A1

The 3-character file extension indicates that this is a Topology and is represented as: .top

A typical customer Topology file might be named: AnycomA1.top

Program Initialization

Upon initialization, The Master Station program searches for a second file, NV.LDN, that stores all user options and set-up information. If the Master Station does not find NV.LDN, it will issue a request for the name of the Topology file to be used. Note that you can always restart the Master Station by erasing NV.LDN. The Master Station will also request that you enter a password. Note that the password is case-sensitive. The Master Station is shipped enabled with a default password: 990LDN

Note

If you erase the NV.LDN, the passwords set by user along with any user settings will be erased and return to default. Caution should be exercised when erasing the NV.LDN.

Communication System Maintenance

We can configure the FUS-LDS to operate with various types of communication systems. The choice of communication system depends primarily on compatibility with the customer's existing equipment. For example, we could establish FUS-LDS communications through a Satellite data transmission system. Any communication system component that fails will affect the data transmission. Therefore, troubleshooting a defective communication system will require a systematic examination of all network components. Any communication system failure will be immediately evident at the Master Station, which reports any failure to receive expected data.

9.2 Service Support

System Installation Supervision

Siemens can handle all aspects of FUS-LDS installation, including the contracting of any local services that may be required. However, in many cases, our customers prefer to provide these services either directly, or through a selected contractor's services. In either case, we recommend direct Siemens Installation supervision and coordination. This service ensures that all aspects of the installation meet the required standards and to deliver the highest possible level of performance.

System Start-Up

System start-up includes programming the Site Stations and overseeing the initialization of each Site Station's operating system. Also, we insert the pipeline's Topology parameters in the Master Station Topology file.

System Optimization

Normally, during the optimization process, Siemens Pipeline Division Engineers will dial into your Master Station to collect data for one or two weeks, depending on the amount of flow activity on the pipeline. This should be sufficient for preliminary Site Station optimization. Once we complete the preliminary Site Station optimization, normal operation of the Master Station and the communication system can proceed. The receipt of Site Station data via the communication system will permit further Master Station optimization, if required.

Optimization of the Site Stations and Master Station usually takes from 2 to 6 weeks, depending on how much flow data we obtain. After this period, you will be able to obtain reliable reports on your pipeline conditions. If you participated in our training program, you will be able to perform all required operations. We can conduct a simulated leak at this time, to ensure that you can operate the system and generate reports on pipeline integrity and operation.

More opportunities for enhanced optimization will present themselves as we gain operational experience and collect more data. We can optimize the system at any time to improve the way that the FUS-LDS Topology file parameters represent the actual pipeline conditions.

9.3 USA Service and RMA Support

Service Support and RMA Request Form

The following information is for service support and Return Material Authorization (RMA) procedures within the USA.

Tech Support Hotline: 1-800-333-7421

<http://www.siemens.com/automation/support-request>

RMA Request Form: <http://www.pibusales.com/RMA/default.asp?type=cust>

9.4 Unit repair

| |
|--|
| NOTICE |
| Repair and service must be carried out by Siemens authorized personnel only. |

Note

Siemens defines flow sensors as non-repairable products.

9.5 Technical support

If you have any technical questions about the device described in these Operating Instructions and do not find the right answers, you can contact Customer Support:

- Via the Internet using the **Support Request:**
Support request (<http://www.siemens.com/automation/support-request>)
- Via Phone:
 - Europe: +49 (0)911 895 7222
 - America: +1 423 262 5710
 - Asia-Pacific: +86 10 6475 7575

Further information about our technical support is available on the Internet at
Technical support (<http://support.automation.siemens.com/WW/view/en/16604318>)

Service & Support on the Internet

In addition to our documentation, we offer a comprehensive knowledge base online on the Internet at:

Service and support (<http://www.siemens.com/automation/service&support>)

There you will find:

- The latest product information, FAQs, downloads, tips and tricks.
- Our newsletter, providing you with the latest information about your products.
- Our bulletin board, where users and specialists share their knowledge worldwide.
- You can find your local contact partner for Industry Automation and Drives Technologies in our partner database.
- Information about field service, repairs, spare parts and lots more under "Services."

Additional Support

Please contact your local Siemens representative and offices if you have additional questions about the device.

Find your local contact partner at: <http://www.automation.siemens.com/partner>

See also

Local contact person (<http://www.automation.siemens.com/partner>)

9.6 Return procedures

Enclose the delivery note, the cover note for return delivery and the declaration of decontamination form on the outside of the package in a well-fastened clear document pouch.

Required forms

- **Delivery Note**

- **Cover Note for Return Delivery** with the following information

Cover note (<http://support.automation.siemens.com/WW/view/en/16604370>)

- product (ordering number)
- number of devices or spare parts returned
- reason for the return

- **Declaration of Decontamination**

Declaration of Decontamination

(http://pia.khe.siemens.com/efiles/feldg/files/Service/declaration_of_decontamination_en.pdf)

With this declaration you certify *that the returned products/spare parts have been carefully cleaned and are free from any residues.*

If the device has been operated together with toxic, caustic, flammable or water-damaging products, clean the device before return by rinsing or neutralizing. Ensure that all cavities are free from dangerous substances. Then, double-check the device to ensure the cleaning is completed.

We shall not service a device or spare part unless the declaration of decontamination confirms proper decontamination of the device or spare part. Shipments without a declaration of decontamination shall be cleaned professionally at your expense before further proceeding.

You can find the forms on the Internet and on the CD delivered with the device.

Troubleshooting

Adverse Conditions

The Siemens FUS-LDS is a leak detection system and not a leak prevention system. As such, it is not intended to interfere with the user's system automation and control, or usurp the responsibility of the user to make final decisions as to the existence, cause or effects of a leak. The Siemens FUS-LDS simply provides the best tools available to aid the user in making these important decisions quickly and as accurately as possible.

The following adverse conditions may decrease the leak detection ability of the system:

- Line Pack affecting one minute integration period
- Low Reynolds number (within transition region)
- Interface occurring within a pipeline segment with a large viscosity differential between the liquids
- Pulsating flow rate - no steady state flow
- Occurrence of Empty or Fault condition at a Site Station
- Low signal at a Site Station
- Substantial liquid aeration content or non-homogeneity
- Substantial temperature and pressure transients
- Flow profile aberrations
- Non-Newtonian liquids
- Pipeline segment length of 40 kilometers (25 miles) or more
- Current conditions not consistent with those detected during optimization

Glossary

Active Memory

Section of RAM allocated for active site parameters (all current values). The flowmeter receives site-specific operating instructions from Active Memory.

Alarm

A leak detection alarm that can be caused by a meter fault, communications error between site stations or a leak event indicating a significant imbalance between in a segment between two site stations.

Alphanumeric Field

An 8-character data entry field that allows you to specify a Site Name or a Security code.

AppCon

The Application Condition factor reduces or eliminates the possibility of false alarms if segment applications conditions deteriorate.

Arrow Keys

Use the <Up, Down, Left and Right> Arrows to navigate through the Installation Menu in their respective directions. The <Up or Down> Arrows allow you also to scroll through option list items.

Asterisk

Refers to the marker used in the Installation Menu to indicate a current option list selection. When you access an option list, you can move the asterisk with the <Up or Down> Arrows to a new selection, then press <ENTER> to select the item.

CLR (Clear) Key

Use the <CLR> key to erase a numeric value or clear a selection from a multiple select option list.

Cursor

This refers to the highlighted text and the arrow cursor that you move via the arrow direction when navigating through menus or menu cells.

Data Entry

Refers to data entered into a menu cell (either numeric or option list selection).

Datalogger Memory

Memory segment that stores data items logged during operation. You can view the Datalogger contents either on-screen or transmit it to an external device via the RS-232 serial port. The amount of Datalogger memory depends on how many sites reside in Site Storage memory.

ENTER Key

Use the <ENTER> key to store a current numeric value or option list item.

Flowmeter

Refers to the flowmeter itself (the transmitter and sensors combined).

Graphic Screen

Refers to the integral display screen.

Initial Makeup

An internal process performed during installation, where the flowmeter acquires a receive signal and enhances other parameters for optimal operation at a site.

In-process Makeup

An internal process where the flowmeter recovers its Initial Makeup parameters after a fault condition interrupts operation.

Installation Menu

The flowmeter's overall menu structure. It allows you to define all aspects of operation for the flowmeter.

Interface m/s

Refers to an alarm function that declares the passage of a liquid or gas interface by a comparison of the relative sonic velocities of the two liquids or two gases.

LAPTOT

Refers to a system function that freezes the Totalizer display, while the Totalizer continues to update its registers.

Leak Detection System (FUS-LDS)

The FUS-LDS is the complete leak detection system including the Master Station, Site Stations and communication devices.

Liquident

The transit-time Site Stations include a proprietary Liquident sonic signature function for positive identification of the liquid being measured. Liquident can be defined as a measure of a liquid's density in relation to its viscosity. The LDS computes Liquident by measuring a liquid's sonic propagation velocity and its temperature. The Site Stations determine the liquid's sonic propagation velocity using the transit-time technique. The Site Stations also measure a liquid's temperature using a proprietary high precision clamp-on RTD resistive temperature sensor. After computing the Liquident value, the system computes liquid density and viscosity using a liquid parameter database.

Local Display

Refers to the transmitter integral display screen.

Master Station

The computer console that operates running leak detection software. It gathers all the leak detection data from the site stations.

Menu

Sub-sections of the Installation Menu that allow you to define specific operational functions (e.g., RS-232 Setup).

Menu Cell

A location within a menu where you define either a single numeric value or option list selection that supports the Sub-Menu's function. Certain view-only menu cells show reference data appropriate to the current application.

NEGFLOW

Totalizer mode for negative flow total only.

NETFLOW

Totalizer mode that combines positive and negative flow totals.

NOTOT

System function that disables the internal Totalizer.

Number Index

Computed sensor spacing index based on the estimated sonic velocity measurement. This Index can not be overridden by installer.

Numeric Data

Refers to a value entered into a menu cell. An example would be the pipe outer diameter.

Numeric Entry

Refers to a number you type into menu cell that stores numeric data.

Numeric Keys

Use the numeric keys to type a numeric value where appropriate.

OpSys ROM

The Read-Only-Memory that stores its basic operating instructions and permanent defaults.

Optimization

The process used to gather and analyze flow data in a newly installed LD system and then to make adjustments to optimize the performance of that system.

Option List

Lists of options presented at menu cells that allow you to select either a single item or multiple items (depending on the function that the menu cell controls).

Pack

In a segment, Pack is the period of time it takes flow to be pumped from one site station meter to the second site station meter.

Parameters

Refers to value (either numeric or list selection) stored in a menu cell.

Pipe

One or more pipeline segments in a connected in series.

POSFLOW

Totalizer mode for positive flow total only.

Register

Refers to a memory location used by the flowmeter to store data such as the flow total, etc.

Reynolds Number

The Reynolds Number is used for flow profile compensation and is a function of viscosity and flow velocity. The Reynolds Number display screen indicates the current and past trends of the computed Reynolds Number for liquids monitored by the two Site Stations of the selected segment.

Segment

A single section of pipe between two Site Stations.

Sensor

Refers to entire spool piece in some instances. Flow sensors that the flowmeter uses to measure the flow rate. Also called transducers and abbreviated as Xdcr.

Silent Station

A Silent Station is a remote viewing console that receives the identical data that is sent to the Master Station with the exception that the Silent Station only receives the data via the Master Station Ethernet connection and not directly from the Site Stations.

Site Name

A user-entered name that the flowmeter associates with a stored Site Setup. You retrieve a particular Site by selecting its name from a site name list.

Site Setup

A collection of parameters used by the flowmeter to service a specific site (or location). The flowmeter allows you to store several independent Site Setups.

Site Station

A typical Site Station is a measuring point that consists of a SITRANS F LDS flowmeter with clamp-on flow sensor assemblies and clamp-on liquid and ambient RTD temperature sensors.

Site Storage Memory

Section of RAM allocated for permanent data storage. This memory segment stores inactive site setups (including a backup of active site). The flowmeter's Site Setup storage capacity depends on the dynamic memory allocation as dictated by each application. In addition, the flowmeter uses Site Storage Memory to store configurable operating parameters such as pipe, liquid or gas tables.

SoniLocator

Siemens software that senses abrupt changes in the sonic velocity of flow to detect the exact location of a leak within a segment of pipe.

Spacing Index

Refers to the Number Index used by the flowmeter to determine the space between the upstream and downstream sensors on clamp-on systems.

Spacing Offset

Fixed sensor offset assigned by the flowmeter. This can be overridden by the installer.

Threshold

At normal flow rate threshold determines what percentage of that flow rate will trigger a flow imbalance in a segment.

Topology File

A customized file that determines the configuration and management of the leak detector system.

TOTCNT

A Totalizer pulse count function used for Batching or Sampling.

Transducer

Also known as a sensor.

UnPack

When flow is stopped in a pipeline segment an imbalance is created and flow moves in the opposite direction.

Vaer

This is the presence of un-dissolved gases in a scale of 0-100%. A reading of >10% may result in erroneous flow measurements..

Valc

Valc is the amount of sensor strength on a scale of 0 - 100%: >30% is recommended.

Vps

The sonic propagation velocity of a pipe.

Vs

The sonic velocity of a liquid or gas.

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Get more information

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