WHITE PAPER

SmartPlant® Instrumentation TestDrive

General Guidelines for Installers

INTERGRAPH®

Contents

1. Introduction

Intergraph® SmartPlant® Instrumentation – the industry-leading instrumentation solution – helps EPCs better design plants. Owner operators can prevent failure by better managing and storing the history of your instrumentation and control system as well as prevent unscheduled shutdowns by better planning maintenance. This solution also assists in planning plant expansions or control system modernizations.

SmartPlant Instrumentation provides a single source of instrumentation information that you can easily access and update, and ensures consistency across the different instrument tasks and deliverables. SmartPlant Instrumentation pays for itself by providing information quickly and accurately, since there is a single source for the data, eliminating the need to search for information in multiple locations. Take advantage of automation.

Experience the benefits today. TestDrive the solution for yourself.

The TestDrive scenario for SmartPlant® Instrumentation is accompanied by a database called SPITestDrive_raw.db (Sybase database) and may not fit other databases.

Each new TestDrive session should start with this database. That's why it's called raw.

The current database version is 09.00.03.0185 (the pre-released version of SmartPlant Instrumentation).

For proper operation when preparing the database in the TestDrive environment, it is important to take into account the following:

1. Upgrade the database to the RTM version.
2. Update the "…\Temp" directory path in the Preferences.
3. Update the path of the hook-up file location (**Preferences → Hook-Ups → File Locations → Template for default layout**) with the correct path to the file Btall.sma.
4. All other preferences are ready for this TestDrive scenario.

2. TestDrive Tutorial

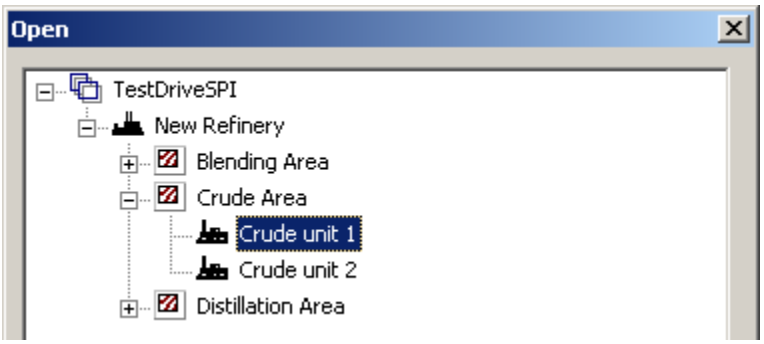
In this TestDrive, you will experience the strengths of SmartPlant Instrumentation.

Try the following workflows:

1. Add new tags and loops to the Instrument Index list.
2. Complete process data and calculate an orifice plate. Experience the power of SmartPlant Instrumentation while filling basic engineering data.
3. Create a specification sheet. Learn how easy it is to fill a new data sheet with engineering data.
4. Assign a spec sheet to a Specification Binder to discover the strength of the built-in document binder. Learn how you can use SmartPlant Instrumentation to quickly and efficiently track documents.

2.1. Starting SmartPlant Instrumentation

On SmartPlant Instrumentation startup, the TestDrive platform will display the logon information required (User name = DBA, Password = DBA). User should select **Crude Unit 1** → **OK**.



[SmartPlant Instrumentation should be set so it opens with only the domain explorer open.]

Press **F7** to open **Domain Explorer**.

3. Basic Engineering in SmartPlant Instrumentation

3.1. Add a Loop and Instruments

In this task, you will add a new open flow loop with a flow element and a flow transmitter. For the flow element, you will select an existing process line. The instrument types that you select are pre-configured to comply with these instrument types.

1. In the domain explorer tree view, expand the **New Refinery → Crude Area → Crude Unit 1 → Loops.**
2. Select the **Loops** node, from the right click menu select **New → Loop^...^**).
3. In the **New Loop Number** dialog, type in the new loop name **101-F -301** (pay attention to the fixed text and the hyphens) and press **OK**.
4. On the **Loop Number Properties** dialog, note the Measured variable property (Flow).
   a. Fill in any description.
   b. Select any P&ID drawing from the list, then press **OK**.
5. Select **Yes** when prompted if you want to add new tag number.
6. On the **New Tag Number** dialog, type the new instrument name **101-FE -301** (pay attention to the fixed text and the hyphens) and press **OK**.
7. On the **Select Instrument Type** dialog, select **FE - D/P TYPE FLOW ELEMENT (Flow)** and press **OK.**
8. Explore the **Tag Number Properties** dialog. Note the ellipsis button (…) next to each pick list. This button enables quick access to support tables, other information, and various plant entities, such as the P&ID drawing number and line number.
9. For the **Line** property, select **4”-P-1501-11H**. This line already has pre-defined process data which will be copied later to the flow element.
10. Click **New** to add the following instrument:
    a. Add new tag **101-FT -301**. Select instrument type **FT - D/P TYPE FLOW TRANSMITTER**. Note that the I/O type is set to **AI** (Analog Input).
    b. Add new tag **101-FI -301.** Select instrument type **FI – Flow Indicator (DCS).**
    c. Press **OK** to close the dialog.
11. On the domain explorer, expand loop **101-F -301**. You can right-click the loop or any of its components, and select Properties from the pop-up menu to open its properties dialog.

    Tip: Selection of instrument type is required only when there are multiple choices of the same abbreviation of that instrument type in the name.

3.2. The Instrument List

In this task, you will explore the Instrument Index browser.

1. From the menu, select **Module** → **Instrument Index** or select the **Index** icon.
2. Click the **Browse** icon from the bottom toolbar.
3. Explore some of the instrument index features.

Note: Yellow properties are write-protected, while white properties are editable.

- You can count records by clicking the "Count" icon.
- Values for pick lists can be selected from support tables. These tables are accessible by selecting the **Open Supporting Table** ... command from the pop-up menu when you highlight a cell with pick lists and right-click the mouse button.
- Click the **Print** icon to invoke the Instrument list report. In the print preview, you can revise the document and compare with previous versions of the document.
- Select any tag number and click the 'Documents' icon to view its documents.
- Double-click the **Tag Number** header to sort by the instrument name. Repeat to sort by descending order.

3.3. Add Process Data

Engineering process data can be filled directly in SmartPlant Instrumentation. It can also be filled remotely using the external process data editor and later imported into SmartPlant Instrumentation. Working under the process data workflow enables process engineers to control when process data can be used by instrumentation engineers.

1. Double-click the "Loop Name" header.
2. Scroll down to loop **101-F -301**.
   a. Hint: You can use the **Find** icon to locate the loop.
3. Highlight tag number **101-FE -301** and then click the **Process** icon.
4. When prompted to copy line data, click **OK**.
5. Experience process data units of measure conversion. Change the **Upstream pressure** unit of measure to **psi**. Observe the value being re-calculated.
6. Under the **Additional Properties** section, next to the **Required range**, fill a range of 0-40 m^3/h @flow.

You can proceed to the flow element calculation or try the revision and archive.

3.3.1. Revisions and Archiving

In this task, you will generate the process data report. Later you will revise the document and experience the comparison feature.

1. Click the **Report** icon. When prompted to save the process data, answer **Yes**.
2. Reports can be revised and archived inside the application. Click the **Revision** icon.
3. Select any revision method and click **New**. Fill revision data and click **OK**.
4. Close the report tab (hint: right-click on the tab name and select **Close**).
5. Change the Normal flow rate from **30** to **28.**
6. Re-open the process data report.
7. Click the **Compare** icon. Select **Compare the current report with an archived res. port** and click **OK.**
8. Select the revision and click **OK.**
9. In the **Changes report**, review the process data changes.
10. Switch back to the process data report. Review the marked change.

Now try to calculate a flow element.

3.4. Calculate a Flow Element

SmartPlant Instrumentation includes various flow element calculations as well as other types of calculation. In this task, you will calculate an orifice plate.

1. From the main toolbar, click the **Calculation** icon.
2. In the dialog, type the tag number **101-FE -301** according to the mask, then click **OK**.
3. The calculation opens with the process datasheet (the same as in process data module). Click the **Calculate** icon.
4. In the “Flowmeter calculation” dialog, input the following data:
   a. Flowmeter type = Square edge orifice
   b. Sub-type = Flange tapping [ISO 5167 (1998) R.W. Miller]
   c. Orifice material =^310 S.S.
   d. Select the “Calculate discharge coefficient”
   e. In the “Select calculate field” frame, select the “Orifice Diameter” option.
   f. In the Full scale flow option, select “m^3/h” and “@Flow” condition, then enter the value of 36.
   g. In the differential range units, select **inH2O** as unit of measure and then type **100** as the value (make sure to leave the option button unchecked).
   h. Click **Calculate**. The orifice diameter and beta ratio are displayed.
   i. Click **Close** and then **Save**.
   j. Click **Report** to see the output calculation sheet.

After filling the process data and calculating the orifice, the next step would be to fill in the datasheet so EPCs can produce a package and deliver it to various vendors for bids.

3.5. Create Datasheet

SmartPlant Instrumentation enables you to present your datasheets in the format that best meets your needs and according to your organization standards. Datasheets (or, as they are called in SmartPlant Instrumentation, specification sheets) can be customized once to suit your needs.

To add a specification sheet, follow these steps:

1. From the main menu, select **Module** → **Specification**.
2. From the toolbar, select **Open Spec**.
3. In the **Open Specification** dialog, enter item number **101-FE -301**.
   a. Hint: use the **Find** button to look for certain tags.
4. In the **Form number** box, enter **11** or use the **Find** button to look up the form.
5. In the **New Specification** dialog, accept the document name **101-FE -301-SP**.
6. Click **OK.**
7. The specification sheet opens with some process data and calculation results already populated.
8. At this point, you can continue to fill in additional technical data as you like.
9. When complete, click **Save**.
10. Click **Print** to review the report. The report and the form are identical (WYSIWYG).

At this point, basic engineering data (index, process data, calculation, and specification sheet) is ready to be used by designers and engineers.

The next step is to add the data sheet to a specification binder.

3.6. Binder Module

The binder module is used to gather documents in packages called binders so these binders can be printed, revised, and sent for reviews or construction easily.

3.6.1. Binder Types

There are two types of binders:

3.6.1.1 Specification Binder

Each specification binder includes several types of documents, such as:

- Instrument specification list (index sheet)
- General notes sheet (per entire package)
- Form notes (per each form)
- Specification sheets
- Changes report (from previous revision)

The binder package enables the user to easily group specifications for bidding, purchase, or construction purposes; track the changes; and control the revision.

3.6.1.2. Document Binder

The document binder can include any document.

3.6.2. Add Datasheet to a Specification Binder

In this task, you will add a specification sheet to an existing binder, review the binder features, and revise the package.

1. From the main menu, select **Modules** → **Document Binder.**

The Document binder screen opens. The left pane displays the available binders. The right pane displays additional details – in this case, the documents in the binder. You can open any of these documents by double-clicking it.

2. In the hierarchy tree (left pane), expand the binder.
   a. Select the **Specification Sheets** folder. The documents assigned are displayed in the tree and in the right window: Each row displays the tag number, the document name, the form number, the process case (if used), the revision, and a flag if the data has changed.
   b. The change flag is set automatically by the software when the data changes, but the user can also change it manually.
   c. The change flag controls the revision of the relevant spec sheet when revising the package.
3. Select **Specification Sheets** → **Assign Specification**...
4. In **Find Items,** click **Find** .
5. Scroll down and select **101-FE -301**.
6. Press **OK**. The document is added to the list of specifications.
7. To review/set the specification change notification flag, select **Specification Sheets** → **Specification change notification** ... Documents marked as **Yes** (or new ='#') will acquire a new revision number when the package is revised.
8. Click **OK**.
9. You can view a "Working issue" of the package. Select the **TestDrive Demo, Technical Specification** → **Print** command.
10. Select Working issue, then **OK**
11. After a short processing, you should see a preview of the documents. Use the Next Report and other navigation icons to review the informal package.
12. Close the print preview tabs.
13. To revise the package, select **Specification Sheets** → **Revisions^**...
14. Type a document name (or accept the existing name).
15. Select revision method from the list.
16. Click **New** and fill in the revision information.
17. Click **OK.**
18. Press **OK** when prompted that data was saved successfully.
19. At this point, you can print preview the formal binder. Repeat step 9 – only this time, select **Formal issue** and select the revision, then press **OK**.

4. Detail Engineering in SmartPlant Instrumentation

Your next tasks are related to the wiring module detail engineering.

SmartPlant Instrumentation enables you to design the wiring of your plant, making it easy to extract detailed wiring reports and loop drawings.

In the following exercises, you will terminate the instrument's cable to a junction-box, assign the instrument to an Input/Output (I/O) card, and run the automatic cross wiring. Next, you will generate some wiring reports and a loop diagram.

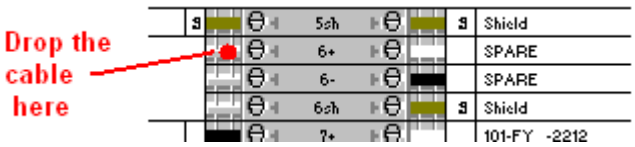
4.1. Conventional Instruments

4.1.1. Connect an Instrument to a Junction-Box

While you created the flow transmitter 101-FT -301, SPI also created a device panel (a termination panel) and cable connected to it in the background based on the instrument type profile.

You will now connect that cable to a junction box. The junction-box is already connected with a multi-paired cable to a marshaling panel.

1. In the domain explorer tree view, expand the **New Refinery > Panels by Category > Junction Boxes > 101-JB-DCS-001**. Note the two terminal strips **TS-1** & **TS-2**.
2. Select **TS-1** node and expand it to see its terminals.
3. Highlight **TS-1**, From the right click menu select **Actions** → **Connection**…The connection screen opens displaying the terminal strip and the connected cables and wire tag numbers.
4. In the domain explorer, navigate to **New Refinery** → **Cables** → **101-FT -301**. Expand the cable to see its pair and wires.
5. In the domain explorer, select the cable. From the right-click menu, select **Actions** → **Connection**… The connection screen of the device panel opens. Close the connection screen.
6. While the connection screen of the junction box is open, select **PR#1** of the device cable (from the domain explorer). Drag and drop it onto the left side of terminal **6+**.



7. The **Cable Connection Definition** opens. This screen enables you to define how to connect the cable by selecting the cable-end, the terminal, and how to connect each pair. Set the following:
   a. Cable end to connect = **End 2**.
   b. Start at Terminal = **6+**.
   c. On the grid in the right side select Connection type = **3 in a row** (make sure the row is highlighted).
8. Click **Connect**. The screen closes and the cable is connected.
9. On the right side of terminals 6+, 6-, and 6sh, you see the junction-box cable connected with the wire tags already updated. This is because the tag's signal is propagated along the connections.

4.1.2. Navigate along Connections

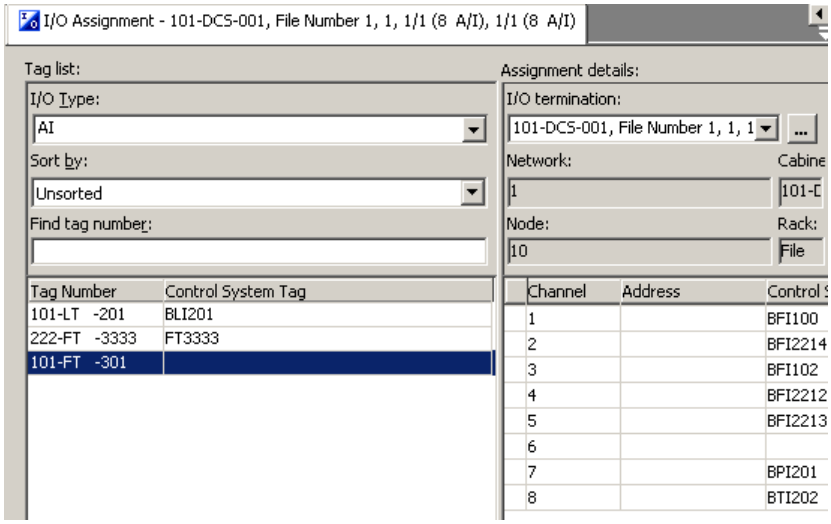
The next task will demonstrate how it is possible to navigate along connections. With the connection screen still open, click on **PR#1** so it's not highlighted (in case it is).

1. Select the wire that is connected to the right side of terminal **6+**.
2. From the right-click menu, select the **Open Adjacent Connection** command.
3. The connection screen of **101-MR-DCS-001,FT-1** opens.
4. Note that terminals **6+, 6-, & 6sh** are connected on the right side via the junction box multi-pair cable, but there are no connections on the right side.

4.1.3. Making the I/O Assignment

The I/O assignment is the allocation of tags and signals to the appropriate control system (DCS/ PLC) input or output. In the next step, you will assign flow transmitter **101-FT -301** to a vacant analog input channel on the DCS I/O card.

1. In the domain explorer tree view, expand the **New Refinery > Panels by Category> DCS Panels > 101-DCS-001**. You see the racks (enclosures) File Number 1 – 3.
2. Expand File Number 1. You see ten channels (1-10).
3. Expand slot 1 to see I/O card **1/1 8 (AI)**.
4. Expand card **1/1 8 (AI)** to its lower levels. The card has a strip **(1/1 8 (AI))** with eight Channels 1-8 where each channels has three terminals.
5. Occupied channels, such as 1, also display the assigned control system tag.
6. To open the I/O assignment screen, select card **1/1 8 (AI)** → **Actions** → **I/O Assignment…**
7. The I/O assignment screen opens. Channel 6 is vacant.
8. From the toolbar, click the **Filter** icon.
9. In the **Filter for** section, select the **Uncoupled instruments** option and press **OK**.
10. In the tag list window, you will see tag **101-FT 301**.

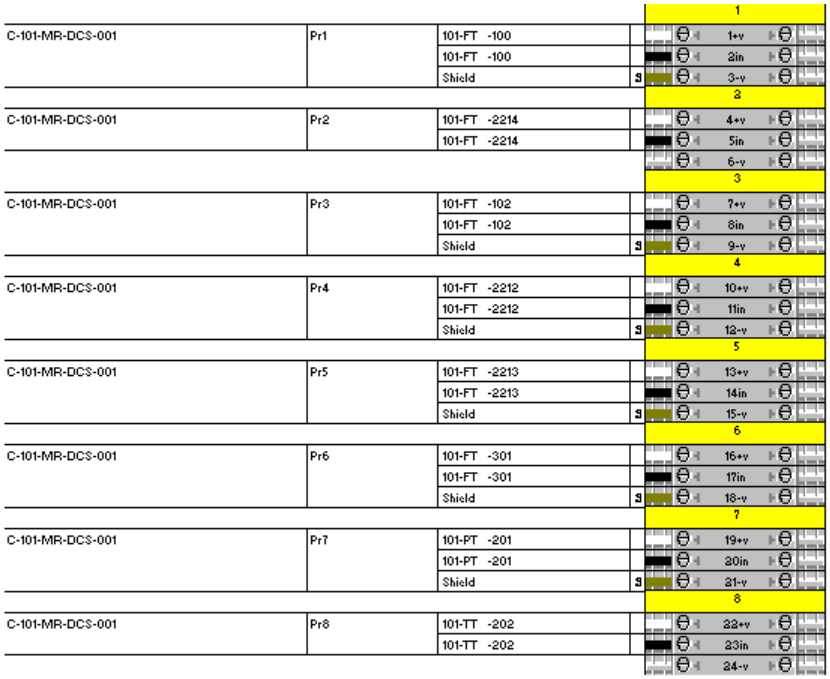


11. Drag and drop tag 101-FT -301 from the tag list pane onto Channel #6 in the right side.
12. Press **OK** to accept the suggested Control system tag. You have completed the I/O assignment task. You can now generate the I/O assignment report.
13. With the I/O assignment screen open, press the **Report** icon from the toolbar. Explore the report, and when complete, close it.

4.1.4. Complete the Wiring

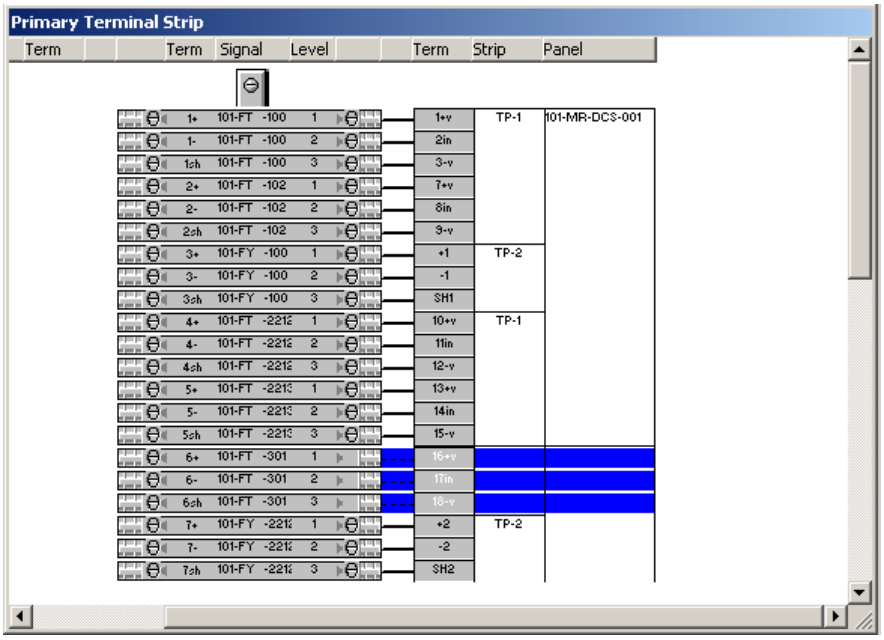
So far, you have connected the instrument from the field side and made the I/O assignment. The I/O card where you made the I/O assignment is connected via a cable to the marshaling.

1. Close the I/O assignment screen.
2. Open the connection screen. From the domain explorer, select I/O card **1/1 8 (AI)** → **Actions** → **Connections**.



   The connection screen opens. Note the grouping of terminals as per the I/O channels.
3. Select the wire that is connected to terminal **16+v**, right-click → **Open Adjacent Connection**.
4. The connection screen of **101-MR-DCS-001.TP-1** opens. Note the missing cross wires of the flow transmitter 101-FT -301. The next step is to complete the cross wires of the flow transmitter. Since we have almost complete signal running from the field to the control system with some missing cross wires in the middle, designers can use the **Auto Cross wiring** feature to complete the wiring.
5. From the domain explorer tree view, navigate to **New Refinery** → **Panels by Category** → **Marshaling Racks** → **101-MR-DCS-001**.
6. Select **FT-1** → **Actions** → **Cross Wiring**.

7. From the toolbar, click the **Auto** icon. SmartPlant Instrumentation displays the proposed cross wires and their destinations (highlighted in blue).



8. To accept the proposed cross wires, click the **Cross** icon.

At this point, you have completed the wiring activities of this loop.

You can now check some of the reports.

4.1.5. Generate a Loop Diagram

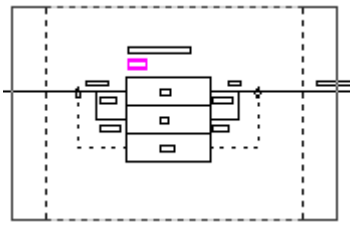
1. In the domain explorer tree view, expand the **New Refinery > Crude Area > Crude Unit 1 > Loops**.
2. Scroll down to select loop **101-F -301**.
3. From the right-click menu, select **Apply Generation Method > Enhanced Report > By Loop**.
4. Select the loop. From the right-click menu, select **Reports > Generate Loop Drawings^…**
5. Press **OK** in the following dialog.
6. Wait a few seconds for the loop to be generated.
7. Maximize the application window with the loop diagram.
8. Press the Fit  icon.
9. You can zoom into area, zoom in, or zoom out using these  icons, respectively.

Note: Continue to the next report with the loop drawing open.

4.1.6. Generate a Panel-Strip Report

Now try the following report to see how easy it is to use SmartPlant Instrumentation as a design tool.

1. Press the Fit icon.
2. Zoom into the area of the first junction-box.



3. Select the text **TS-1** (below 101-JB-DCS-001).
4. Press the **Generate Item Report** icon.
5. From the list, select **Panel-Strip,** then press **OK.**
6. Wait for the report to be processed. When done, press the **Fit** icon.
7. Explore the report.

Note: Continue to the next report with the panel-strip drawing open.

4.1.7. Generate a Strip-Signal Report

SmartPlant Instrumentation makes designing quick and simple.

1. Press the Fit icon.
2. Zoom into the middle area where the main junction-box and strip names appear.
3. Select the **TS-1** text.
4. Press the **Generate Item Report** icon.
5. From the list, select **Strip Signals,** then press **OK.**
6. Wait for the report to be processed. When done, press the **Fit** icon.
   Note: Once the report is generated, it is possible to arrange it and re-position the objects and to move objects between the sheets.
7. When done, close the Enhanced Report application and all its reports.

4.1.8. Generate a Hook-Up Drawing

Note: When preparing the TestDrive, you need to redefine the hook-up symbols as per the installation drive and directory. Otherwise, the hook-up will not be generated.

SmartPlant Instrumentation includes an installation detail module. Tags can be assigned to hook up drawings as they are being added to the database by virtue of the instrument type profile. This is the case with 101-FT -301.

1. In the domain explorer tree view, expand the **New Refinery → Hook-Ups → FLOW → FLOW INSTR. BELOW RUN-LIQUID**
2. Explore the objects below the hook-up name. The numbers represent the items required for the installation.
3. Select an item. Right-click to select **Properties**.
4. Click **OK**.
5. Select the hook-up name **FLOW INSTR. BELOW RUN-LIQUID.**
6. Right-click and from the pop-up menu select **Reports → Generate Hook-Up Drawing**…
7. Press **OK**.
8. When the drawing is opened, fit it and explore its content.
9. When done, close the Enhanced Report application.

4.2. Fieldbus Instruments

SmartPlant Instrumentation supports Fieldbus instruments and wiring. Foundation Fieldbus network is basically a digital two-wire network where all instruments are connected to these wires in parallel. Foundation Fieldbus instruments can also do the control inside of them, eliminating the need for an expensive control system. There are strict rules on the number of instruments, cable lengths, and so forth to ensure good communication between the instruments in the control system. SmartPlant Instrumentation validation report checks these rules to verify they comply with industry standards.

In the next exercise, you will add a new fieldbus instrument, connect it to an existing fieldbus network, and activate its function block. You will then create two reports: the fieldbus wiring report and the fieldbus validation report.

Before making any changes to the fieldbus network, try to generate the Fieldbus Segment report.

4.2.1. Generate Fieldbus Segment Report

1. In the domain explorer tree view, expand the **New Refinery → Fieldbus Segments**.
2. Select **S1** fieldbus segment. Note the three instruments associated with this segment.
3. From the right click popup menu, select **Reports → Enhanced Segment Wiring…**
4. When the report is generated, maximize the window and press the Fit  icon.
5. Explore the report. The instruments are connected via connectors to junction boxes and then to the control system.
6. You can zoom into area, zoom-in or zoom-out using these  icons, respectively.
7. When done, close the Enhanced report application.

4.2.2. Add a Fieldbus Instrument

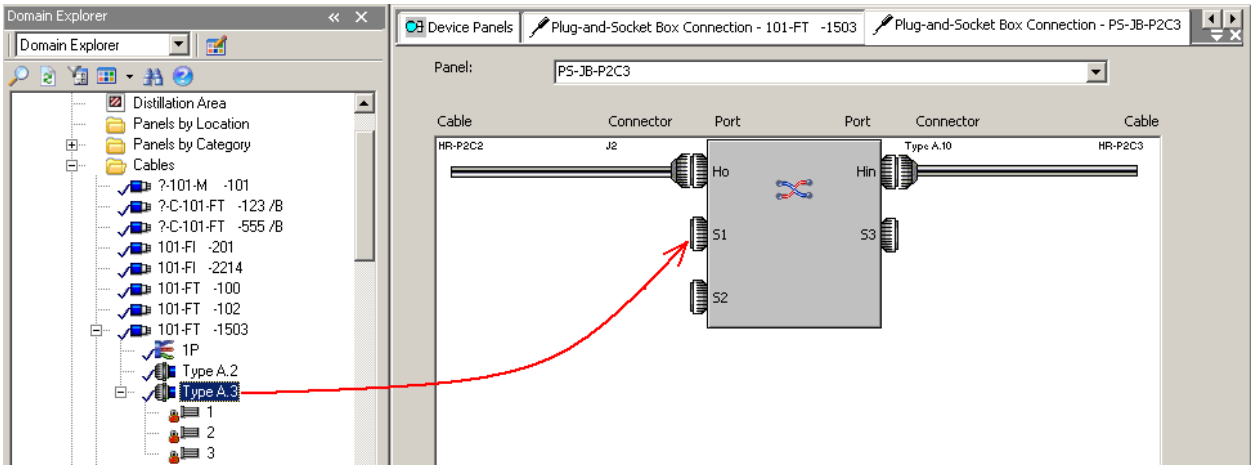
In this task, you will add a new Fieldbus flow transmitter.

1. In the domain explorer tree view, expand the **New Refinery → Crude Area → Crude Unit 1 → Instruments**.
2. Select the **Instruments** node. From the right-click menu, select **New → Instrument...**
3. In the **New Tag Number** dialog, select Tag class=**Foundation Fieldbus**.
4. In the tag number box type, input the new instrument name **101-FT -1503** and press **OK**.
5. On the **Select Instrument Type** dialog, select **FT - Fieldbus FT** and press **OK.**
6. On the Loop Name dialog, select **Cancel**.
7. On the Tag Number Properties, select the Fieldbus tab. This dialog enables you to fill specific fieldbus information as the current consumption and available function blocks. Note the **AI** (Analog input) function block that appears under **Associated function blocks**.
8. Press **OK**.

4.2.3. Connect the Fieldbus Instrument Cable to a Junction-Box

In this task, you will connect the instrument's cable to the Fieldbus junction box. Since the junction box is configured with connectors, the cable must also have an appropriate plug to connect to the junction box.

1. In the domain explorer tree view, expand the **Panel By Category → Junction Boxes.**
2. Select **PS-JB-P2C3**.
3. From the right-click popup menu, select **Actions → Connections…**
4. From the domain explorer tree view, expand the **Cables** node.
5. Select and expand cable **101-FT -1503**.
6. Select connector **Type A.3** and drag and drop it onto the S1 connector on the connections screen.

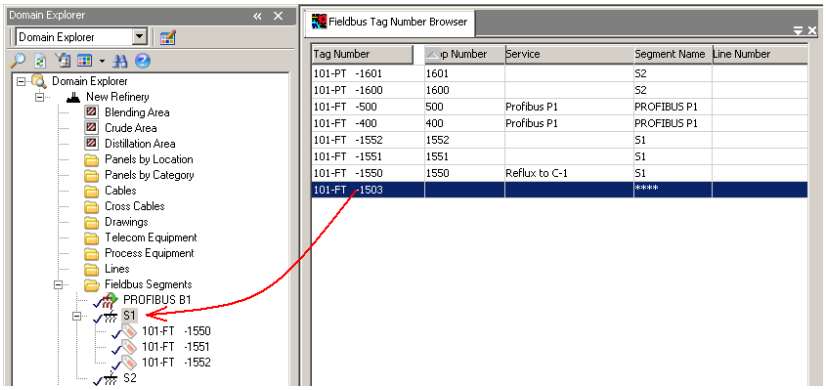


7. Close the connection screen.

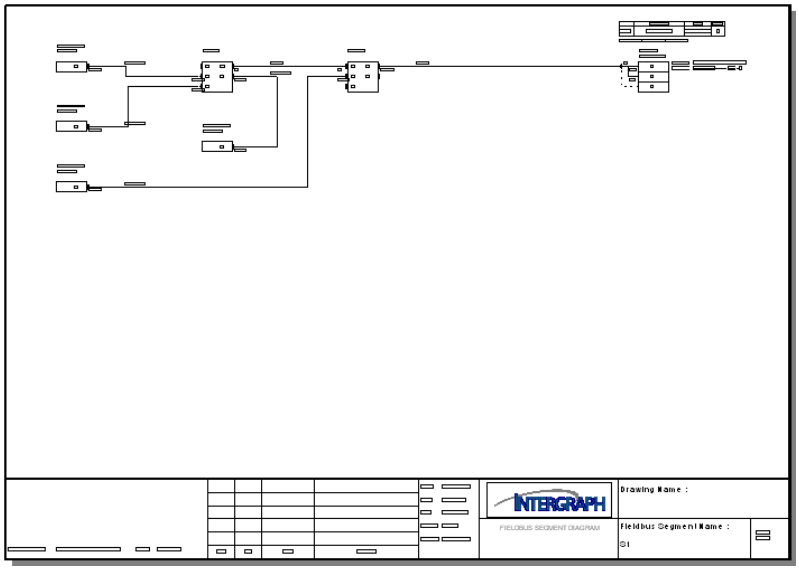
4.2.4. Associate the Fieldbus Tag with the Fieldbus Segment

In this task, you will associate the instrument with the fieldbus segment and then activate (enable) the analog function block.

1. In the domain explorer tree view, expand the **New Refinery → Fieldbus Segments**.
2. Select the **S1** segment.
3. Right-click and select **Actions → Fieldbus Tag Number Browser…**
   The browser displays all the networked tags and to which network they belong. Note that tag number 101-FT -1503 is not assigned to any of the networks.
4. Drag and drop tag 101-FT -1503 onto the S1 segment.



   Note that tag number 101-FT -1503 is added below the S1 segment.
5. In the tree view, select **101-FT -1503** to reveal the **AI** function block.
6. Select the AI. From the right-click popup menu, select **Actions → Enable**. The AI turns orange. When you click it, you will see the virtual device tag.
   At this point, you have completed adding and configuring the new tag as part of the Foundation Fieldbus segment.
7. Re-run the Fieldbus Segment Wiring Report as described in Section 4.2.1: *Generate Fieldbus Segment Report*.
8. You can move the lines and objects to arrange the drawing as you wish after the drawing is processed.



4.2.5. Run the Fieldbus Validation Report

Now try to generate the fieldbus validation report. At the top of the report, it states which tests have passed the validation, followed by the details of each test.

1. In the domain explorer tree view, expand the **New Refinery** → **Fieldbus Segments**.
2. Select the **S1** segment.
3. Right-click and select **Reports** → **Validation Report.**
4. Explore the report.

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