Chapter 2

Creating Projects and P&IDs

Learning Objectives

After completing this chapter, you will be able to:

- *Create a new project*
- *Create a new drawing*
- *Create a P&ID drawing*
- *Add an equipment to a P&ID*
- *Assign a tag to a line*
- *Add valves*
- *Add instruments and instrumentation lines*
- *Add fittings*
- *Add off-page connectors*
- *Validate the P&ID drawing*
- *Edit the drawing*
- *Substitute components*
- *Convert AutoCAD components into P&ID Symbols*
- *Work with the Project Setup dialog box*

INTRODUCTION

In this chapter, you will learn how to create a new project and a new drawing. Also, you will be briefly introduced to the P&ID module.

PROJECT MANAGER

The **PROJECT MANAGER** is used to access existing projects, create new projects, add new drawings to a project, re-order drawing files, and modify the existing information in a project. It also allows you to export and import data, create project reports, include referenced drawings (xrefs), and link or copy files to the project folders. By default, the **PROJECT MANAGER** is docked on the left of your screen. Figure 2-1 shows the **PROJECT MANAGER**.

The **PROJECT MANAGER** contains three tabs: **Source Files**, **Orthographic DWG**, and **Isometric DWG**. The **Source Files** tab contains a project tree that displays P&ID drawings, Plant 3D drawings, Pipe Specs, and all related files of the project. The **Orthographic DWG** tab contains the list of all the orthographic drawing files. The **Isometric DWG** tab contains the isometric line diagrams of the plant layout.

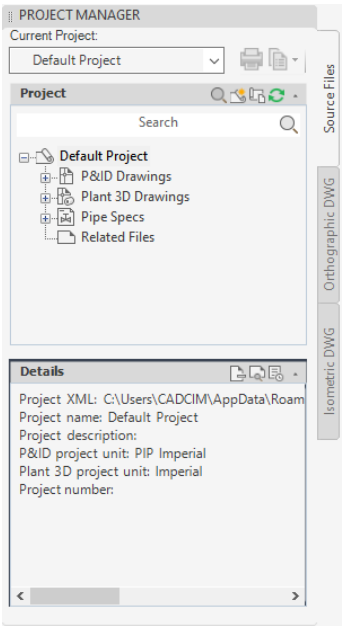

*Figure 2-1 The **PROJECT MANAGER***

CREATING A NEW PROJECT IN AutoCAD Plant 3D

To create a new project, choose the **New Project** option from the drop-down in the **Current Project** area of the **PROJECT MANAGER**. You can also create a new project by choosing the **New Project** option from the **Project Manager** drop-down list of the **Project** panel in the **Home** tab; the **Project Setup Wizard** with the **Specify general settings** page will be displayed, as shown in Figure 2-2. Alternatively, use the **NEWPROJECT** command to create a new project. Steps to create a new project are discussed next.

1. Enter a project name in the **Enter a name for this project** edit box. Next, enter a description of the project in the **Enter an optional description** edit box.

2. Choose the Browse button adjacent to the **Specify the directory where program-generated files are stored** edit box; the **Select Project Directory** dialog box will be displayed. Browse to the directory *C:\Users\user_name\Documents* and choose the **Open** button; the location of the project is automatically displayed in the edit box.

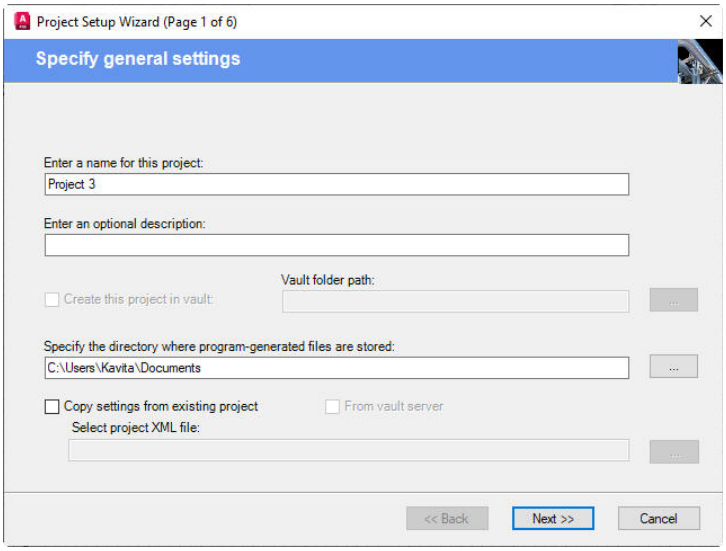

Figure 2-2 *The* ***Project Setup Wizard*** *with the* ***Specify general settings*** *page*

3. Clear the **Copy settings from existing project** check box, if selected, and then choose the **Next** button; the **Specify unit settings** page will be displayed, as shown in Figure 2-3.

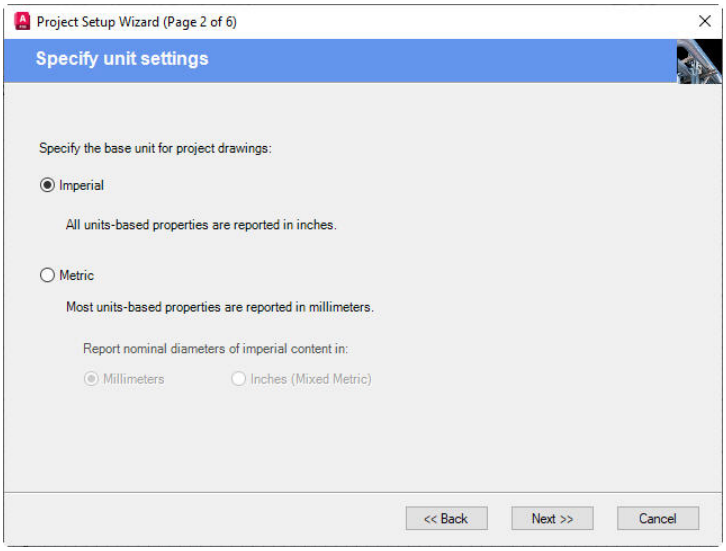

Figure 2-3 *The* ***Specify unit settings*** *page*

4. Choose the **Imperial** radio button, if not chosen by default, and then choose the **Next** button; the **Specify P&ID settings** page will be displayed, as shown in Figure 2-4.

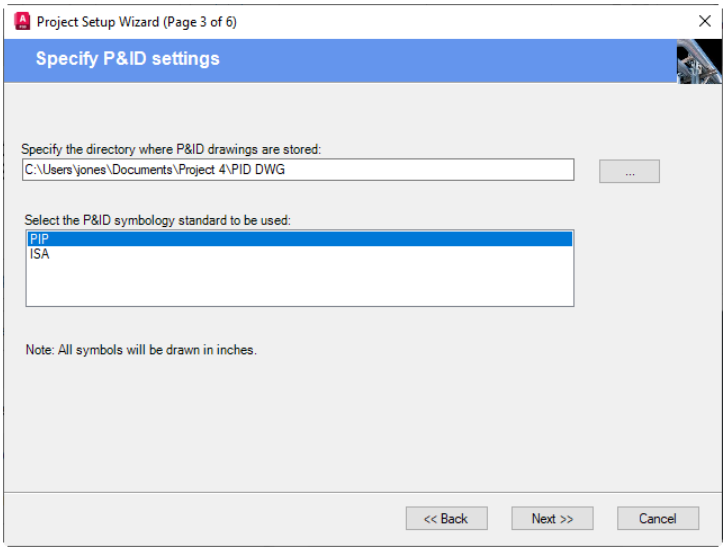

Figure 2-4 *The* ***Specify P&ID settings*** *page*

5. Specify the directory as *C:\Users\user_name\Documents\users_project\PID DWG* in the **Specify the directory where P&ID drawings are stored** edit box by using the Browse button available next to this edit box.

6. Select **PIP** as the P&ID standard from the **Select the P&ID symbology standard to be used** list box and choose the **Next** button; the **Specify Plant 3D directory settings** page will be displayed, as shown in Figure 2-5.

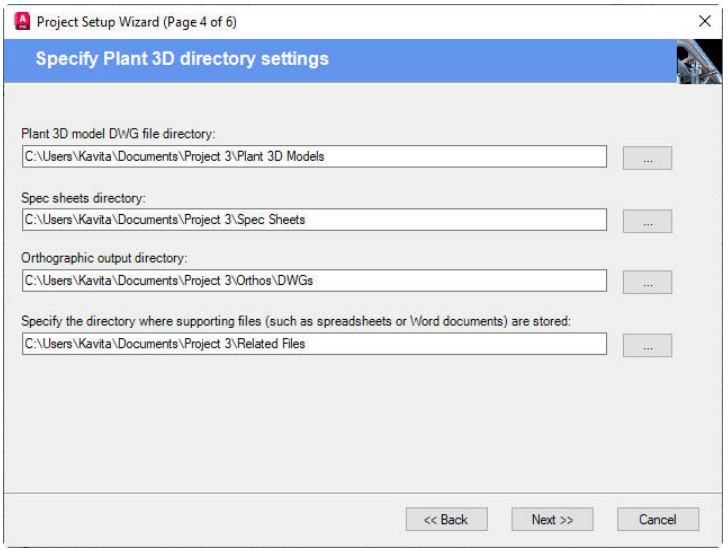

Figure 2-5 *The* ***Specify Plant 3D directory settings*** *page*

Note

In this book, the Imperial standard has been used throughout.

7. Accept the default settings in this page and choose the **Next** button; the **Specify database settings** page will be displayed, as shown in Figure 2-6.

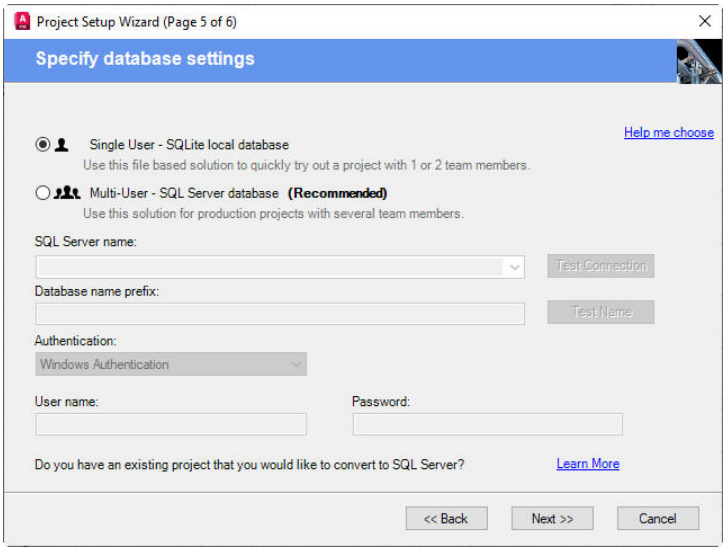

***Figure 2-6** The **Specify database settings** page*

8. In this page, select the option to specify the database settings. Select the **Single User - SQLite local database** radio button, if you are working on a stand-alone system.

   Note that you need to skip Steps 9 through 11, if you have selected the **Single User - SQLite local database** radio button.

9. If your system is connected to a server, select the **Multi User - SQL Server database** radio button. Next, you need to specify the server name in the **SQL Server name** edit box and then choose the **Test Connection** button next to it.

10. After connecting to the server, you need to enter a database prefix in the **Database name prefix** edit box. You can also choose the **Test Name** button to automatically generate a prefix.

11. Next, specify the authentication type by using the **Authentication** drop-down list. If you select **SQL Server Authentication**, you need to specify the user name and password in the **User name** and **Password** edit boxes, respectively.

12. After specifying the database settings, choose the **Next** button; the **Finish** page will be displayed.

13. Choose the **Finish** button; a new project will be created and listed in the **PROJECT MANAGER**.

Creating a New Drawing

To create a new drawing, first select the node (For example: **P&ID Drawings**) from the **PROJECT MANAGER**. Next, choose the **New Drawing** button from the **Project** toolbar, as shown in Figure 2-7; the **New DWG** dialog box will be displayed, as shown in Figure 2-8. In this dialog box, enter the file name, author, and then select a dwg template by choosing the Browse button next to the **DWG template** edit box. Choose the **OK** button; a drawing file with the specified name will be created.

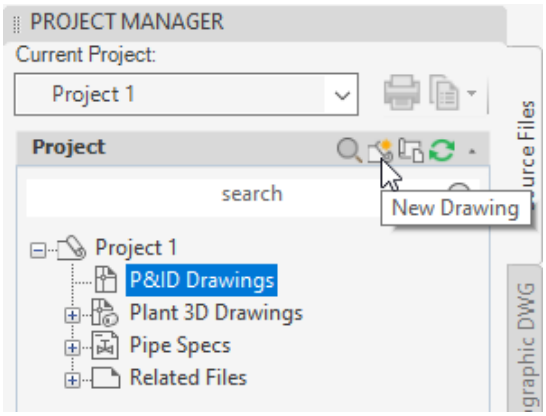

Figure 2-7 *Choosing the* ***New Drawing*** *button*

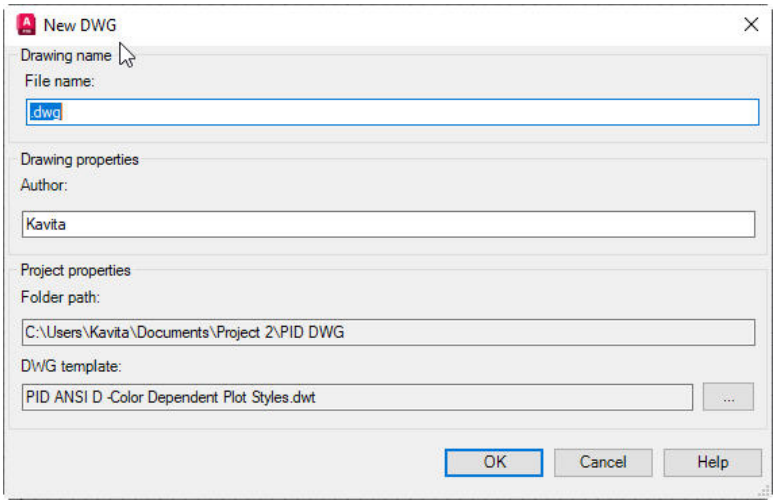

Figure 2-8 *The* ***New DWG*** *dialog box*

Grouping Project Files

You can group drawings into a folder. This ensures that the folder path retains the same folder hierarchy, even if the project files are moved to another computer. To do so, right-click on the required node (for example **P&ID Drawings** node) in the **PROJECT MANAGER** and choose the **New Folder** option from the shortcut menu displayed; the **New Folder** dialog box will be displayed, as shown in Figure 2-9. Next, enter a name in the **Folder name** edit box. Now, choose the **OK** button; the new folder will be added to the **P&ID Drawings**

node in the project tree. Click and drag the drawing file to the newly created folder to move the file, refer to Figure 2-10.

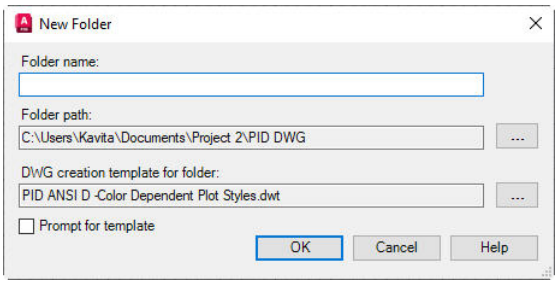

Figure 2-9 *The* ***New Folder*** *dialog box*

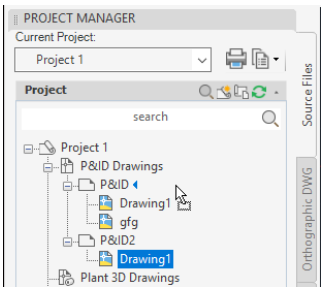

Figure 2-10 *Dragging the drawing file into the folder*

DESIGNING A P&ID

A P&ID is a graphical representation of a plant process and is created by combining various types of components, pipings, and instrumentations that are required to design, construct, and operate the plant. To design a P&ID, you need to create a new P&ID drawing file. The procedure to create a new drawing file is explained earlier. After creating a P&ID drawing file, the **3D Piping** environment will be displayed by default, refer to Figure 2-11.

The **TOOL PALETTES**, which is available at the right side of the window, is also loaded with modeling components. In order to display P&ID environment and P&ID components in the **TOOL PALETTES**, choose the **Workspace Switching** button available in the right side of the Status Bar; a flyout will be displayed. Choose the **PID PIP** option from the flyout, refer to Figure 2-12; the **P&ID PIP** environment will be displayed and the **TOOL PALETTES** will be loaded with P&ID components, as shown in Figure 2-13.

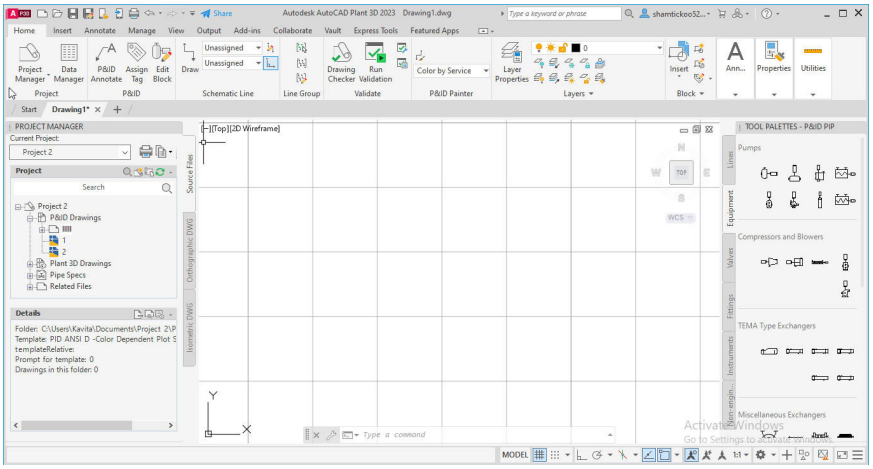

Figure 2-11 *The P&ID environment*

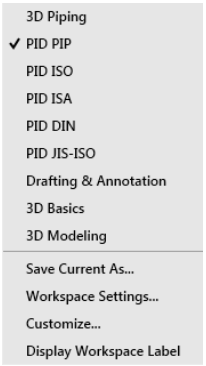

Figure 2-12 *Choosing the* ***PID PIP*** *option from the flyout*

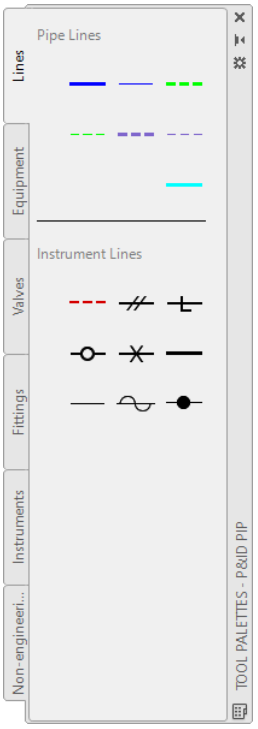

Figure 2-13 *The* ***TOOL PALETTES*** *loaded with P&ID components*

Adding Equipment to a P&ID

Equipment includes all the components that are associated with the process plant such as pumps, heat exchangers, compressors, blowers, tanks, vessels, and so on. To place an equipment in a P&ID, first you need to check whether the **TOOL PALETTES - P&ID PIP** is displayed or not. If it is not displayed, choose the **Tool Palettes** button from the **Palettes** panel in the **View** tab;

the **TOOL PALETTES - P&ID PIP** will be displayed on the right side of the window. In the **TOOL PALETTES - P&ID PIP**, choose the **Equipment** tab; the symbols of various equipments will be displayed in it. Choose the symbol of the desired equipment from the **TOOL PALETTES**; it will be attached to the cursor and you will be prompted to specify the insertion point. Click in the drawing area to place the symbol; the **Assign Tag** dialog box will be displayed, as shown in Figure 2-14.

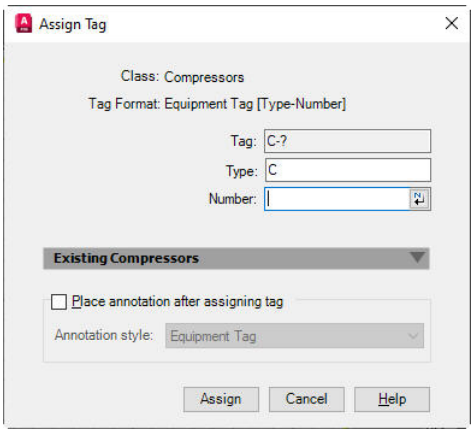

Figure 2-14 *The* ***Assign Tag*** *dialog box*

Note that in some equipments after clicking in the drawing area to place the symbol, you will be prompted to enter the XY scale factor. You can scale the equipment horizontally or vertically by dragging the cursor in the respective direction. Alternatively, you can enter a scale factor at the command prompt.

In the **Assign Tag** dialog box, enter a numeric value in the **Number** edit box and select the **Place annotation after assigning tag** check box. Next, choose the **Assign** button; the **Assign Tag** dialog box will be closed and you will be prompted to select the annotation position. Place the annotation below the equipment at an appropriate location.

Adding Pipe Lines

You can select a line from the **Pipe Lines** area in the **Lines** tab of the **TOOL PALETTES - P&ID PIP**. For example, to connect a vessel and a condenser with a primary line, choose the **Primary Line Segment** tool from the **Pipe Lines** area in the **Lines** tab of the **TOOL PALETTES - P&ID PIP**; you will be prompted to select the start point. Select a point on the top of the vessel. Next, connect the line to the top nozzle of the condenser, as shown in Figure 2-15; a nozzle will be created automatically on the vessel and an arrow will show the direction of flow. Note that the direction of flow is determined by the direction in which you move the cursor while creating the line.

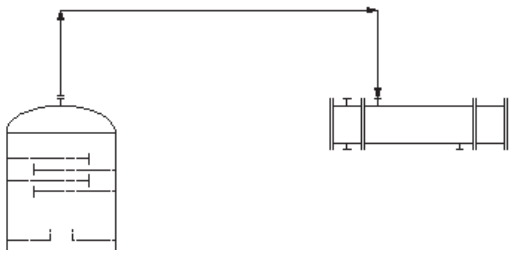

Figure 2-15 *Schematic line connecting the vessel and the condenser*

You can easily distinguish between a line connected to a component and a line which is not connected. On selecting the line that is connected to a component, a connection grip is displayed at the end of the line, as shown in Figure 2-16. But if the line is not connected to a component, an end grip is displayed at the end of the line, as shown in Figure 2-17.

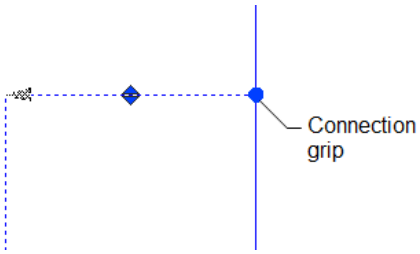

Figure 2-16 *A connected line showing the connection grip*

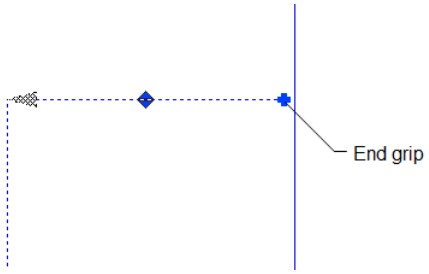

Figure 2-17 *A line not connected to any line or a component*

Note

After connecting two components with a pipe line, the 'From' and 'To' information is automatically added to the line. This information is displayed when you hover the cursor over the line. The 'From' field shows the component from which the line originates and the 'To' field indicates the destination component.

Assigning Tags to a Line

After creating a line, you need to assign a tag to it. The tag data consists of the information such as pipe size, specification, service, and line number; refer to Figure 2-18 for the representation of tag data on the line. In order to assign a tag to a line, choose the **Assign Tag** tool from the **P&ID** panel in the **Home** tab and select a line. Next, press ENTER; the **Assign Tag** dialog box will be displayed. Enter the data in the respective edit boxes and choose the **Assign** button; the tag data will be assigned to the line. Also, you can select the **Place annotation after assigning tag** check box from the **Assign Tag** dialog box in order to place the annotation near the line.

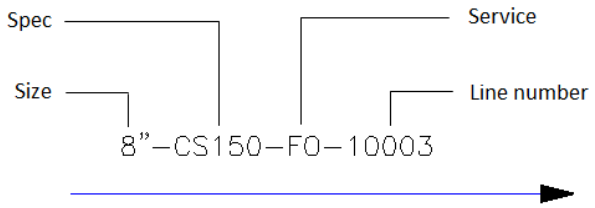

Figure 2-18 *Annotation of a pipeline tag*

Assigning Custom Service Category to a Line

As discussed earlier, after creating a line, you need to assign a tag to it. By default, you can assign pipe size, specification, service, and line number to a line. While assigning the service category to a line, the required service category might not be available in the **Pipe Line Group.Service** drop-down list of the **Assign Tag** dialog box. You can add the required service category to the **Pipe Line Group.Service** drop-down list using the **Project Setup** dialog box. Let us suppose you need to add Sludge Line service to the list. The procedure to add the Sludge Line service is given next.

Choose the **Project Setup** tool from the **Project Manager** drop-down of the **Project** panel in the **Home** tab; the **Project Setup** dialog box will be displayed. In this dialog box, expand the **P&ID DWG Settings** node. Next, expand the **P&ID Class Definitions** sub-node and then choose the **Pipe Line Group** option available under the **Non Engineering Items**; the corresponding options will be displayed in the **Properties** area of the dialog box, refer to Figure 2-18(a).

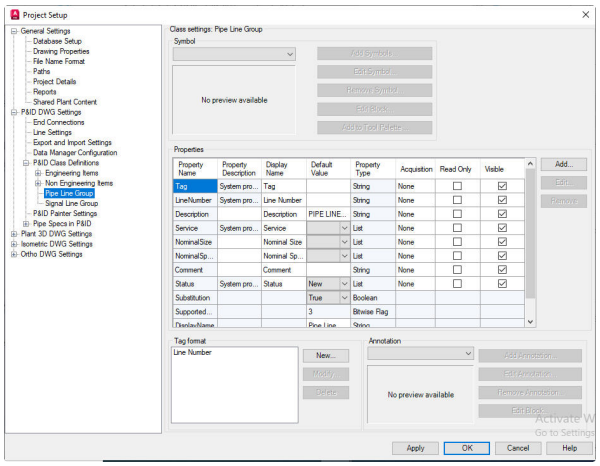

Figure 2-18(a) *The* ***Project Setup*** *dialog box with the* ***Pipe Line Group*** *option chosen*

In the **Properties** area, select the **Service** option available under the **Property Name** column. Next, choose the **Edit** button available at the right in the **Properties** area; the **Selection List Property** dialog box will be displayed, refer to Figure 2-18(b).

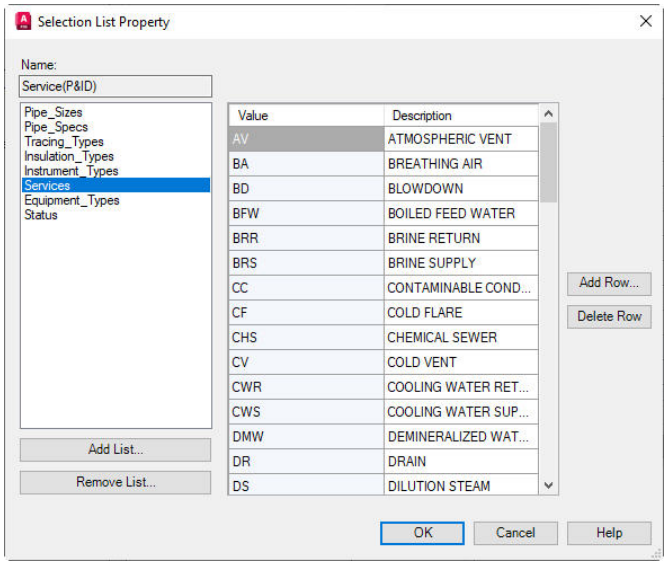

Figure 2-18(b) *The* ***Selection List Property*** *dialog box*

In this dialog box, the **Services** option is chosen by default, refer to Figure 2-18(b). Now, choose the **Add Row** button; the **Add Row** dialog box will be displayed. Enter **SL** in the **Value** edit box of the dialog box, refer to Figure 2-18(c) and then choosse the **OK** button; the new value **SL** will be added to the **Value** column of the **Selection List Property** dialog box. Select the newly added value **SL** from the **Value** column and then enter **SLUDGE LINE** in the respective **Description** edit box, refer to Figure 2-18(d) and then choose the **OK** button.

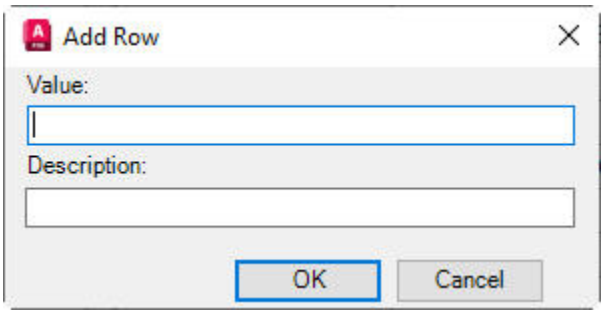

Figure 2-18(c) *The* ***Add Row*** *dialog box*

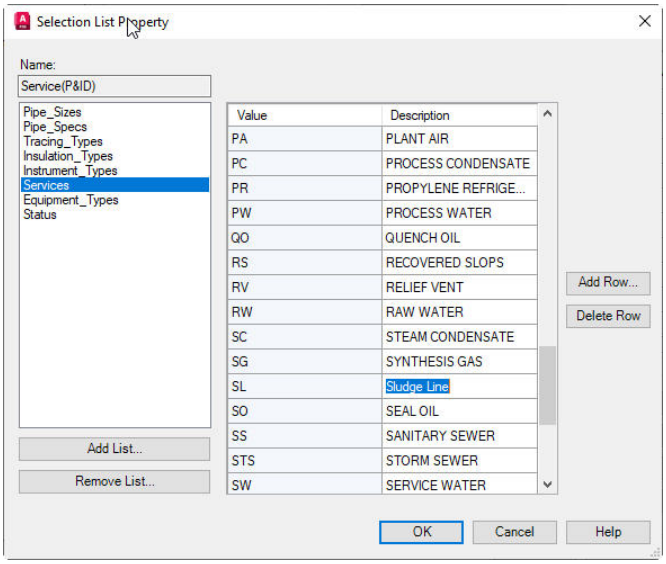

Figure 2-18(d) *The new value* ***SL*** *added to the dialog box*

Next, choose **Apply** and then the **OK** button to exit the **Project Setup** dialog box; the new service category **SL - SLUDGE LINE** will be added to the **Pipe Line Group.Service** drop-down list of the **Assign Tag** dialog box.

Creating and Adding Custom Pipe Line Segments to TOOL PALETTES

You can create custom pipe line segements and add them to **TOOL PALETTES**. To do so, choose the **Lines** tab in the **TOOL PALETTES**. Next, invoke the **Project Setup** dialog box. In this dialog box, expand the **P&ID DWG Settings** node. Next, expand **P&ID Class Definitions** > **Engineering Items** > **Lines** > **Pipe Line Segments** sub-nodes. Next, click on the **Pipe Line Segments** sub-node and right click on it; a shortcut menu will be displayed. Choose the New option from the shortcut menu; Create Class dialog box will be displayed, refer to Figure 2-18(e).

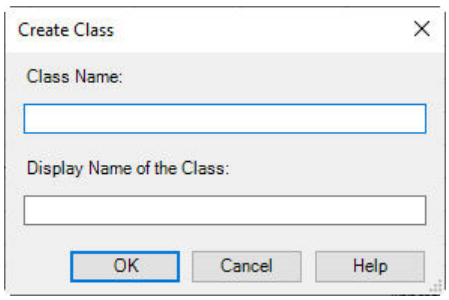

Figure 2-18(e) *The* ***Create Class*** *dialog box*

Enter **Sludgeline** in the **Class Name** edit box and **Sludge Line** in the **Display Name of the Class** edit box. Choose the OK button; the **Sludge Line** will be added and highlighted under the **Pipe**

Line Segments sub-node. Next, choose the **Edit Line** button available in the **Line** area of the **Project Setup** dialog box; the Line Settings dialog box will be displayed, refer to Figure 2-18(f).

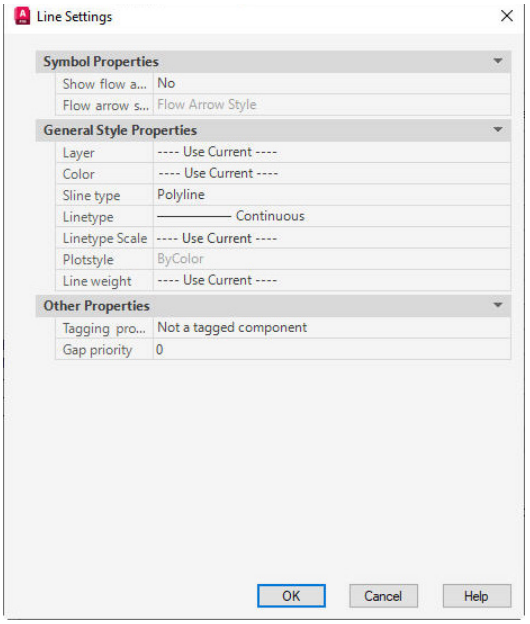

Figure 2-18(f) *The* ***Line Settings*** *dialog box*

Choose the **Yes** option from the **Show flow arrows** drop-down. Next, assign the Layer, Linetype, Color, Lineweight, Tagging prompt, Gap priority value and so on from the respective drop-downs. Choose the **OK** button to exit the dialog box. Next, choose the **Add to Tool Palette** button from the **Line** area of the **Project Setup** dialog box; the **Create Tool** message box will appear. Choose the **OK** button from the message box; the **Sludgeline** will be added to the **Line** tab of the **TOOL PALETTES**. Next, choose **Apply** and then the **OK** button to exit the **Project Setup** dialog box.

Adding Custom Tags to Pipe Line Segments

As discussed earlier, after creating a line, you need to assign tag to it. By default, you can assign pipe size, specification, service, and line number to a line. In some cases, you might want to assign other tag properties to the pipe segment like zone number, material of the pipeline, slope, and so on.

Let us assign the size, zone number, material of the pipeline, and slope to the **Primary Line Segment** available in the **Pipe Lines** area of the **Lines** tab in the **TOOL PALETTES**. To do so, invoke the **Project Setup** dialog box. Expand the nodes **P&ID DWG Settings** > **P&ID Class Definitions** > **Engineering Items** > **Lines** > **Pipe Line Segments**. Next, selectthe **Primary Line Segment** option; it will be highlighted and corresponding options will be displayed in the **Properties** area of the dialog box. Click on the **Add** button in this area; the **Add Property** dialog box will be displayed, refer to Figure 2-18(g).

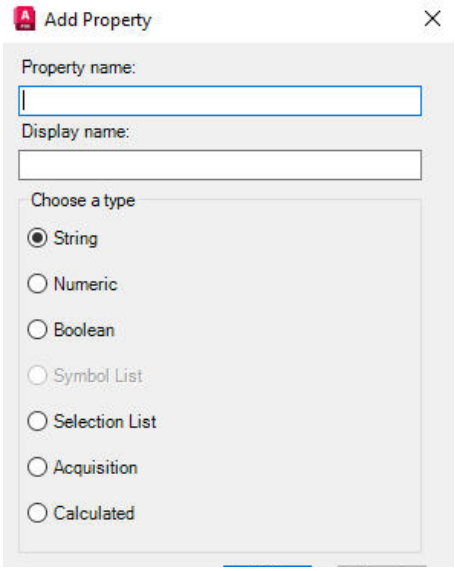

Figure 2-18(g) *The* ***Add Property*** *dialog box*

Enter **Zone_Number** in the **Property name** edit box and click on the **OK** button; the property will be added to the **Properties** area. Similarly add material and slope properties to the **Properties** area.

Choose the **New** button from the **Tag format** area of the dialog box; the **Tag Format Setup** dialog box will be displayed, refer to Figure 2-18(h).

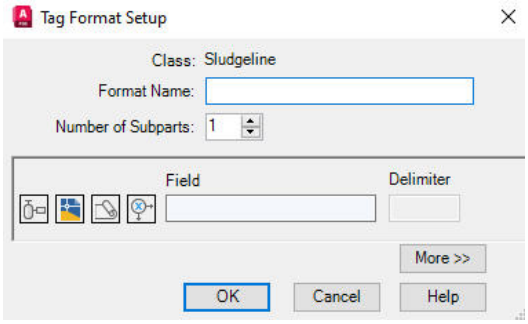

Figure 2-18(h) *The* ***Tag Format Setup*** *dialog box*

Enter **Pipeline Tag[Size- Zone Number- Material- Slope]** in the **Format Name** edit box and **4** in the **Number of Subparts** edit box; the **Tag Format** dialog box will be modified, refer to Figure 2-18(i).

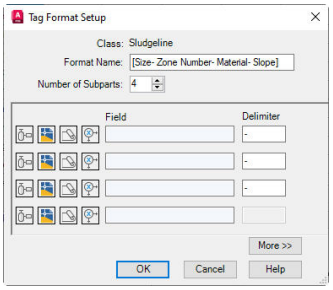

Figure 2-18(i) *The modified* ***Tag Format Setup*** *dialog box*

Click on the **Select Class Properties** button, the first button in the first row; the **Select Class Property** dialog box will be displayed, refer to Figure 2-18(j).

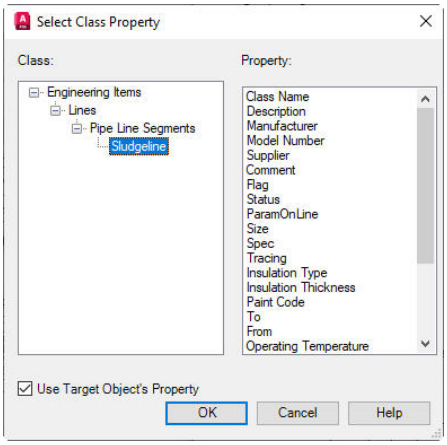

Figure 2-18(j) *The* ***Select Class Property*** *dialog box*

Choose the **Size** option from the **Property** list box and then choose the **OK** button. Similarly, add Zone_Number, Material, and Slope to the remaining rows of the **Tag Format Setup** dialog box, refer to Figure 2-18(k).

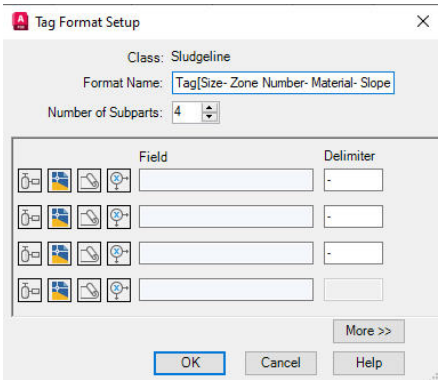

Figure 2-18(k) *The* ***Tag Format Setup*** *dialog box with class properties added*

Choose the **OK** button to exit the **Tag Format Setup** dialog box. Next, scroll down to the **TagFormatName** row of the **Properties** area and then choose the **Pipeline Tag[Size- Zone Number- Material- Slope]** option from the drop-down list in the **Default Value** column. Next, choose **Apply** and then the **OK** button to exit the **Project Setup** dialog box; the newly created tag format will be assigned to the Primary Line Segment.

Now, create a Primary Line Segment and then choose the **Assign Tag** tool to assign tag to it; the **Assign Tag** dialog box will be displayed with the new class properties listed in it, refer to Figure 2-18(l).

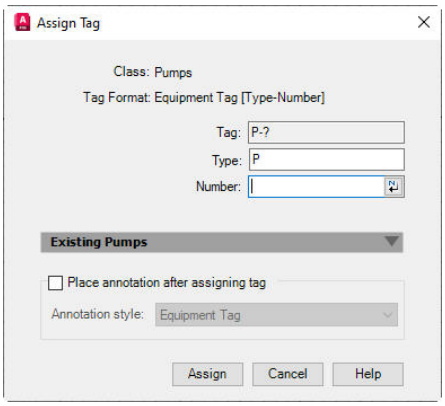

Figure 2-18(l) *The* ***Assign Tag*** *dialog box with new tag format*

Adding Valves

The **Valves** tab in the **TOOL PALETTES - P&ID PIP** contains a group of valve symbols. You can add any type of valve to a schematic line. For example, to place a gate valve on the schematic line, you need to choose the **Valves** tab from **TOOL PALETTES - P&ID PIP** and then choose the **Gate Valve** tool from the **Valves** area; the valve symbol will be attached to the cursor and you will be prompted to select the insertion point. Select an insertion point on the line; the valve will be placed on the specified point, as shown in Figure 2-19.

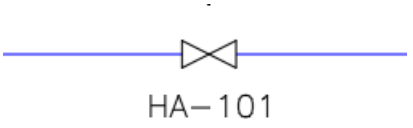

Figure 2-19 *A gate valve placed on the line*

Adding Instruments and Instrumentation Lines

Instruments play a major role in maintaining the safety and streamlining the process in the plant. The **Instruments** tab in the **TOOL PALETTES - P&ID PIP** contains **Control Valve**, **Relief Valves**, **Primary Element Symbols (Flow)**, **General Instruments**, and **Miscellaneous Instrument Symbols** areas. Figure 2-20 shows various instrument symbols available in the **Instruments** tab.

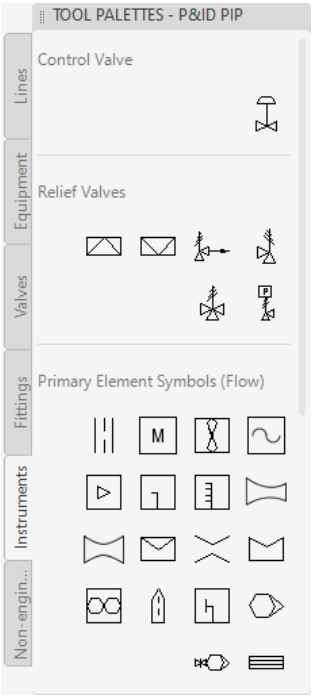

Figure 2-20 *Instrument symbols available in the* ***Instruments*** *tab*

For example, to add a control valve, choose the **Control Valve** tool from the **Instruments** tab; the **Control Valve Browser** dialog box will be displayed, if you are adding a control valve for the first time. Select the required valve body from the **Select Control Valve Body** tree view. Next, select the actuator type from the **Select Control Valve Actuator** tree view, refer to Figure 2-21 and choose the **OK** button; the dialog box will be closed and you will be prompted to select an insertion point. Select an insertion point on the line; the control valve will be added and you will be prompted to select annotation position.

Note

If the ***Control Valve Browser*** *dialog box is not displayed, choose the* ***Change body or actuator*** *option from the command bar to change the actuator of the valve body.*

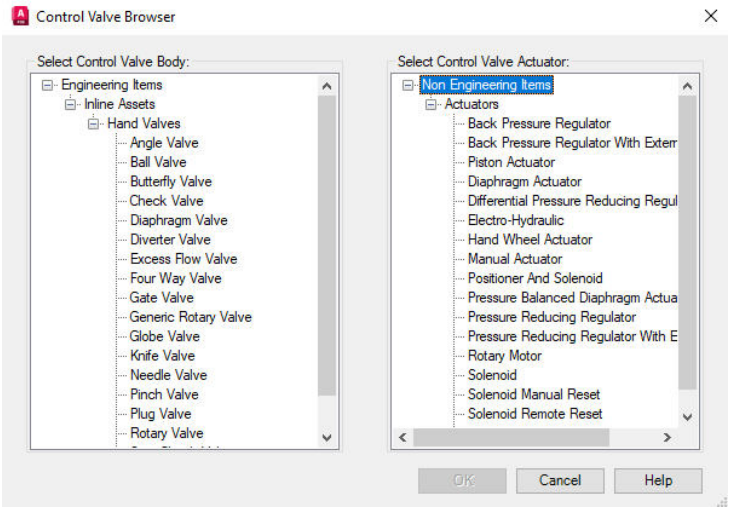

Figure 2-21 *The* ***Control Valve Browser*** *dialog box*

Move the cursor and click to position the annotation; the **Assign Tag** dialog box will be displayed. Enter values in the **Area**, **Type**, and **Loop Number** edit boxes, and clear the **Place annotation**

after assigning tag check box. Next, choose the **Assign** button from the **Assign Tag** dialog box; an annotation bubble will be placed at the specified location.

After adding the control valve, you need to add the signal lines connecting the instruments and the process line. Figure 2-22 shows various instrument lines used in a P&ID. For example, to add an electrical signal, choose the **Electric Signal** line from the **Instrument Lines** area in the **Lines** tab; you will be prompted to select the start point. Select the point on the process line; you will be prompted to select the next point. Move the cursor toward left and connect the line to the control valve.

Next, you need to place control instruments on the signal lines. For example, to add a temperature controller, choose the **Field Descrete Instrument** tool from the **General Instruments** area of the **Instruments** tab in the **TOOL PALETTES**; you will be prompted to specify the insertion point. Select a point on the signal line connecting the control valve; the instrument will be placed and the **Assign Tag** dialog box will be displayed.

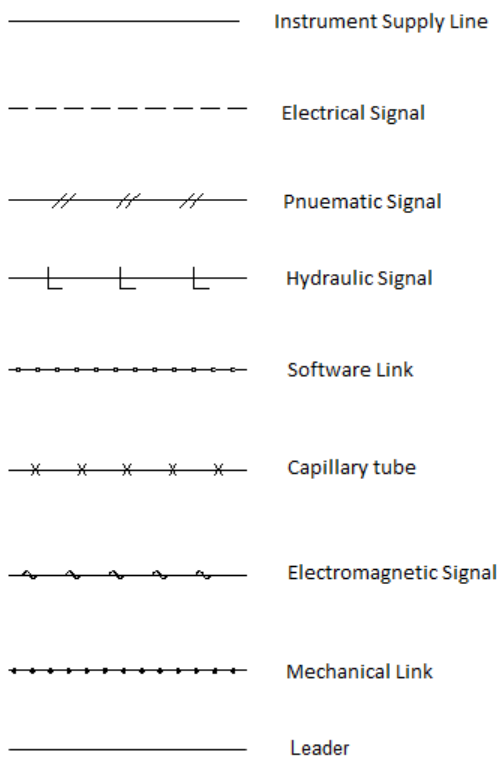

Figure 2-22 *The instrument line symbols*

In the **Assign Tag** dialog box, enter appropriate values in the **Area** and **Loop Number** edit boxes. Next, select the **TC - TEMPERATURE CONTROLLER** option from the **Type** drop-down list and choose the **Assign** button to close the dialog box. Figure 2-23 shows a typical instrumentation loop.

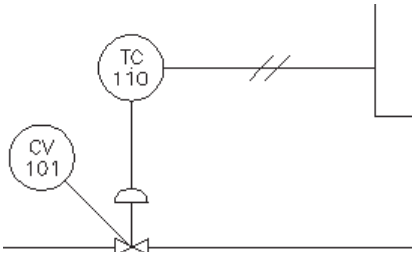

Figure 2-23 *A typical instrumentation loop*

Adding Fittings

Fittings are used to connect pipe lines that have different sizes or shapes and they are also used for regulating or measuring flow. You can add a fitting to a P&ID drawing from the **Fittings** tab in the **TOOL PALETTES - P&ID PIP**. This tab contains symbols of **Piping Fittings**, **Piping Specialty Items**, and **Nozzles**. For example, to add a concentric reducer, choose the **Concentric Reducer** tool from the **Piping Fittings** area in the **Fittings** tab; you will be prompted to specify the insertion point. Select a point on the line; the reducer will be placed at the specified position.

Adding the Off Page Connectors

The off page connectors are used to indicate the continuation of the process line from one drawing sheet to another. To add an off-page connector, choose the **Off Page Connector** tool from the **Off Page Connectors and Tie-In Symbol** area in the **Non-engineering** tab of **TOOL PALETTES - P&ID PIP**; you will be prompted to specify the insertion point. Select the endpoint of the line, as shown in Figure 2-24; the off page connector will be placed at the specified location.

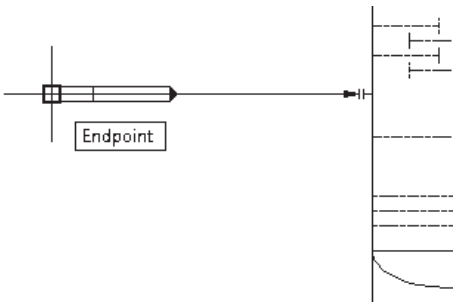

Figure 2-24 *Placing the off-page connector*

Connecting the Off Page Connectors

To connect two off page connectors, select any one of the off page connectors; a plus symbol will be displayed on it, refer to Figure 2-25. Select the plus symbol; the **Connect To** option will be displayed near the cursor. Choose the **Connect To** option, refer to Figure 2-26; the **Create Connection** dialog box will be displayed, as shown in Figure 2-27.

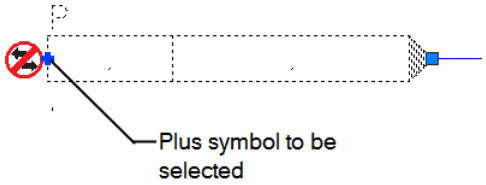

Figure 2-25 *The plus symbol displayed on the off page connector*

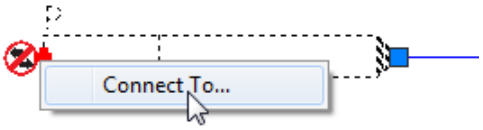

Figure 2-26 *Choosing the* ***Connect To*** *option*

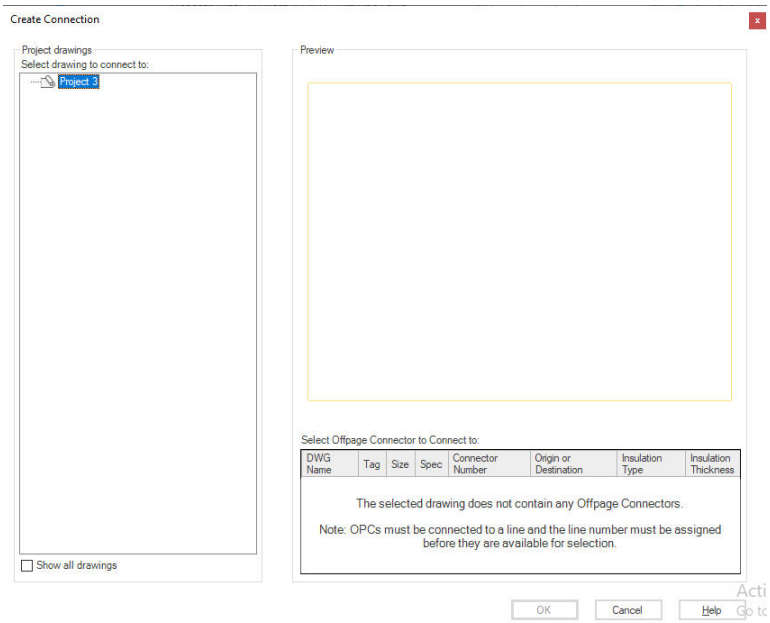

Figure 2-27 *The* ***Create Connection*** *dialog box*

In this dialog box, select the drawing to which the off page connector is to be connected from the **Project drawings** area. Next, select the off page connector to be connected from the **Select Offpage Connector to Connect to** table. Choose the **OK** button from the **Create Connection** dialog box; the off page connectors will be connected.

VALIDATING THE DRAWING

You need to validate the drawing to detect the errors and to correct them. To do so, first you need to select the conditions to validate a P&ID. Choose the **Validate Config** tool from the **Validate** panel in the **Home** tab; the **P&ID Validation Settings** dialog box will be displayed, as shown in Figure 2-28. Select the check boxes under the **P&ID objects** and the **Base AutoCAD objects** nodes and choose the **OK** button; the **P&ID Validation Settings** dialog box will be closed.

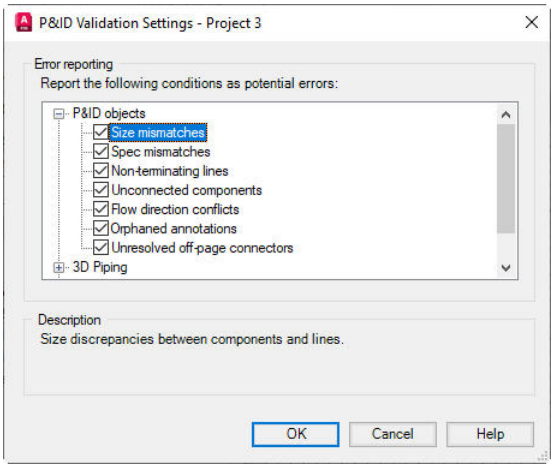

***Figure 2-28** The **P&ID Validation Settings** dialog box*

Checking for Errors

To run the checks for errors, choose the **Run Validation** tool from the **Validate** panel; the validation process will start and the errors will be checked. The list of errors detected will be displayed in the **VALIDATION SUMMARY** palette, as shown in Figure 2-29. Click on the error type in the **VALIDATION SUMMARY** palette; the drawing will zoom in where you can see the error location. Next, to correct the individual errors, select the respective drawing file node from the **VALIDATION SUMMARY** tree view. Now, choose the **Revalidate Selected Node** button in the **VALIDATION SUMMARY** palette; the **Validate Progress** message box will be displayed and errors will again be checked. You can also check for errors that are not corrected and close the **VALIDATION SUMMARY** palette. This different type of errors are discussed next.

The Base AutoCAD Object Errors

This error occurs when AutoCAD object or block is inserted in the drawing instead of AutoCAD P&ID component. You can ignore and erase a base AutoCAD object error. To do so, first you need to expand the **Base AutoCAD objects** error node. Next, click on the error; the error will zoom in the drawing.

Now, you can ignore the base AutoCAD object error. To do so, right-click on it in the **VALIDATION SUMMARY** palette; a shortcut menu will be displayed. Next, choose the **Ignore** option to ignore the error. You can also delete the object by choosing the **Erase** option.

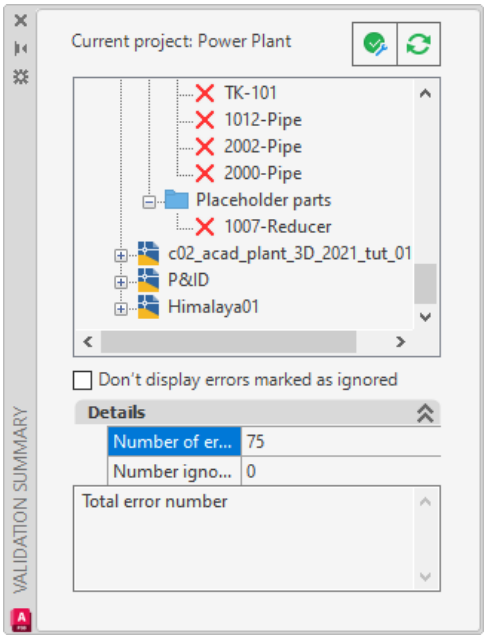

***Figure 2-29** The **VALIDATION SUMMARY** palette*

The Size mismatch Errors

This type of error occurs when size of a line and its associated component do not match. This condition is usually caused by manual changes in component properties. To correct the size mismatch error, expand the **Size mismatches** node in the **VALIDATION SUMMARY** palette and then click on the error; the error location will zoom-in in the drawing area. Next, manually change the size of the component or the size of the line connected to it.

The Spec mismatch Errors

This type of error occurs when specification properties of the connected components do not match. To correct the spec mismatch errors, zoom in the error location by clicking on the error in the **Spec mismatches** node. Next, manually change the specifications of the line by invoking the **Assign Tag** dialog box.

The Orphaned annotations Errors

This type of error occurs when the annotation tag of a component is moved away from the associated component to more than the acceptable distance. To correct the orphaned annotation error, expand the **Orphaned annotations** node in the **VALIDATION SUMMARY** palette. Next, select the error to zoom its location in the drawing area. Next, drag the annotation and place it nearer to the parent object. You can also right-click on the annotation and then choose the **Place from Parent** option from the shortcut menu displayed. Figure 2-30 shows an orphaned annotation and Figure 2-31 shows the annotation after correcting the error.

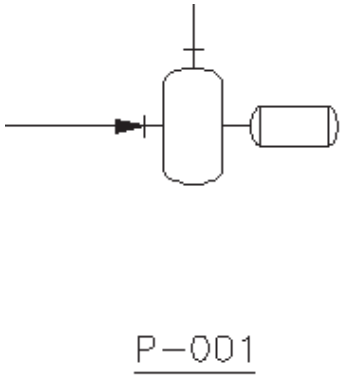

Figure 2-30 *Orphaned annotation*

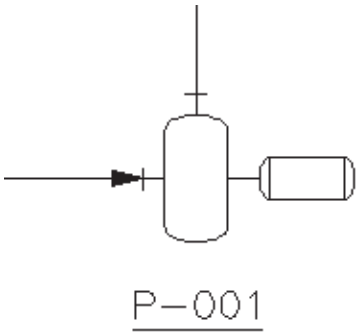

Figure 2-31 *Annotation after placing it close to the component*

The Unconnected Components Errors

This error occurs when the lines and components are not properly connected. To correct the unconnected component error, select the error from the **Unconnected components** node; the component in the drawing area will be zoomed in. Next, manually connect the component to the line near it.

The Unresolved Off Page Connectors Errors

This error occurs when off page connector in the drawing is not connected with the valid off page connector of the other drawing. Select the error from the **Unresolved off-page connectors** node in the **VALIDATION SUMMARY** palette; the off page connector in the drawing area will be zoomed in. Next, select and right-click on the off-page connector in the drawing and choose **Offpage Connector > Connect** from the shortcut menu displayed; the **Create Connection** dialog box will be displayed, refer to Figure 2-27. Next, select the drawing to which you want to connect the off page connector and then choose the **OK** button.

The Non-terminating lines Errors

This type of error occurs when the process line does not terminate with the valid terminator such as endline component or endline symbol. Select the error from the **Non-terminating lines** nodes to zoom it in the drawing area. Next, manually reconnect the line to the corresponding object by moving its endpoint. You can also recreate the connection.

The Flow Direction Errors

This error will occur when the direction of flow of process line is incorrect. To correct a flow direction error, click on the error under the **Flow direction conflicts** node; the error location will zoom in the drawing area. Next, click on the direction arrow; the **Flip Component** grip will be displayed. Click on this grip to flip the flow direction.

EDITING THE DRAWING

You can edit or modify a drawing while creating it or after it is created. The components of the drawing such as equipment, valves, instruments, lines, and so on can be modified as per the requirement. Various editing tasks are discussed next.

Moving an Equipment

You can move or change the location of an equipment. To do so, first you need to select the equipment by clicking on its border; the **Move Component** grip (square grip) will be displayed on it. Select it and drag the equipment and click to place it at a new location, as shown in Figure 2-32.

Moving a Valve

To move a valve, first select it to display the **Move Component** grip. Next, click on the grip, drag the valve along the horizontal or vertical line, and then click to place it at the new location. You can move the valve which is on the horizontal line to the vertical line or vice-versa, refer to Figure 2-33.

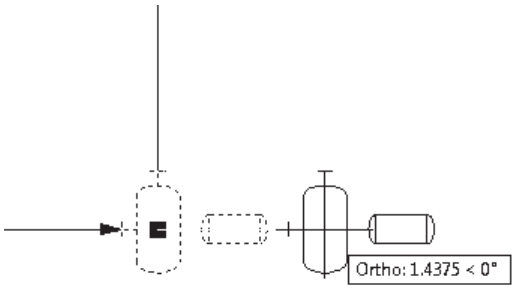

Figure 2-32 *Moving an equipment*

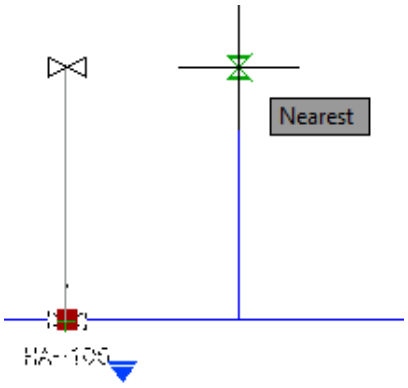

Figure 2-33 *Moving a valve from horizontal line to the vertical line*

Moving a Line

To move a line, first you need to select it; the stretch grip will be displayed on the line and the components connected to the line will be automatically selected. Select it from the middle of the line and drag it to the new location, as shown in Figure 2-34; the valves and the bubbles on the line will be moved. But the equipment connected to the line will not move.

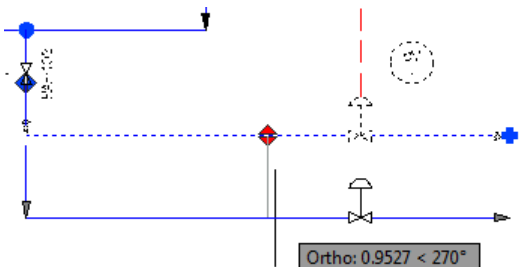

Figure 2-34 *Moving a line using the stretch grips*

Editing a Line

To edit a line, choose the **Edit** tool from the **Schematic Line** panel in the **Home** tab; you will be prompted to select a sline. Select a schematic line or a signal line from the drawing area; you will be prompted to enter an option at the command prompt. The options available at the command prompt are discussed next.

Attach

This option is used to attach the line to a component without physically connecting them. On invoking this option, you will be prompted to select a component to attach to the line. Select an equipment, valve, or any other P&ID component; you will be prompted to select an endpoint on the schematic line. Select an endpoint on the line and press ENTER; the component will be attached to the line.

Detach

This option is used to detach the attached line from the component. On invoking this option, you will be prompted to select the endpoint on the schematic line which has been attached to the source line. Select the attached endpoint on the line and press ENTER; the component will be detached from the line.

Gap

This option is used to create a gap on the line without breaking it. On invoking this option, you will be prompted to specify first gap point on the line. Specify the first gap point and move the cursor upto the required distance, and select the second gap point; a gap will be created on the line between the two specified points.

uNgap

This option removes the gap created on a line. On invoking this option, you will be prompted to select a schematic line segment with a gap or gap symbol. Select a line segment with a gap or gap symbol; the gap will be removed from the line.

Straighten

This option is used to straighten an inclined or a non-orthogonal line. On invoking this option, you will be prompted to select a line segment to be straightened. Select the line segment; you will be prompted to select an endpoint on the line to which the source line will be aligned. Select the endpoint on the line; the line will be straightened in alignment with the endpoint.

Corner

This option is used to create a corner by dividing the line into two sides. On invoking this option, you will be prompted to specify a point on the schematic line. Specify a point on the line; the line will be divided into two sides and you will be prompted to specify the second point of the corner. Move the cursor in a direction perpendicular to the line and select a point in the drawing area; you will be prompted to specify a point on the side of the line to move it. Select a point on one of the two sides; the selected side will be moved and aligned with the second point. As a result, a corner will be created.

Reverseflow
This option is used to reverse the direction of the schematic line. Invoke this option and press ENTER; the direction of flow of the line will be reversed.

Break
This option is used to break the line into two segments. On invoking this option, you will be prompted to select a break point. Select a point on the line; the line will be divided into two segments and you will be prompted to select an additional break point. Press ENTER to exit.

Join
This option is used to join two line segments. On invoking this option, you will be prompted to select one or more lines to join to the source line. Select a line segment that lies inline with the source line; the line will be joined with the source line.

Link
This option is used to link data of two line segments. On invoking this option, the following prompt will be displayed:

Select an sline segment to link to: *Select a line*

Sline segment data "?-?-?-?" will be deleted and segment will be linked to "?-?-?-?". Continue? [Yes/No]: *Enter 'Yes' to continue*

Note
*You can also choose the **Yes** option from the command prompt.*

Unlink
This option unlinks the data link created between two line segments. On invoking this option, the following prompt will be displayed:

Sline segment will be unlinked from "?-?-?-?". Continue? [Yes/No]: *Enter 'Yes' to continue*

Exit
This option is used to exit the command.

Grouping Lines
You can group schematic lines together and assign tag to the group. To do so, choose the **Make Group** tool from the **Line Group** panel in the **Home** tab; you will be prompted to select the source schematic line to group additional schematic lines to it. Select the source line; you will be prompted to select schematic lines to group. Select a single line or multiple lines and press ENTER; the lines will be grouped together.

Editing a P&ID Symbol

You can edit a P&ID symbol and also retain the original symbol by using the **Edit Block** tool. To do so, choose the **Edit Block** tool from the **P&ID** panel in the **Home** tab; you will be prompted to select a P&ID component to edit its block. Select an equipment, valve, or any other P&ID component; the **Block Editor** tab will be invoked. The drawing area of the **Block Editor** tab has a dull background and is called Authoring area. In this area, you can edit the existing entities or add new ones to the block of a P&ID component. In addition to the Authoring area, the **Block Editor** tab, **BLOCK AUTHORING PALETTES**, and **Edit P&ID Object's Block** dialog box will also be displayed. After editing the block, choose the **Save Changes and Exit Block Editor** button from the **Edit P&ID Object's Block** dialog box; the **Block Editor** will be closed and the edited P&ID component will be displayed in the drawing area.

Substituting Components

You can substitute a valve or any other component of a drawing with another similar component. For example, you can substitute a gate valve with a ball valve. To do so, first you need to select the component to display the grips on it. Next, select the substitution grip (down arrow); the **Substitute with another Component** palette containing valves will be displayed, as shown in Figure 2-35. Select the ball valve symbol from the palette; it will replace the existing gate valve.

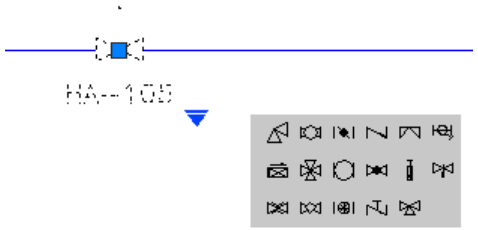

Figure 2-35 *The* ***Substitute with another Component*** *palette containing valves*

Converting AutoCAD Components into P&ID Symbols

You can add new symbols which are not available in **TOOL PALETTES - P&ID PIP** by creating a block and converting it into a P&ID symbol. To convert a block into a P&ID symbol, first you need to create a block by using the AutoCAD drawing tools. Next, select the component, right-click on it and choose **Convert to P&ID Object** from the shortcut menu displayed; the **Convert to P&ID Object** dialog box will be displayed, as shown in Figure 2-36. The tree view in the dialog box shows a list of components arranged in groups. Expand the tree view by clicking on the + sign adjacent to the required group and select the object from it. Next, choose the **OK** button; the component will be converted into the selected P&ID object.

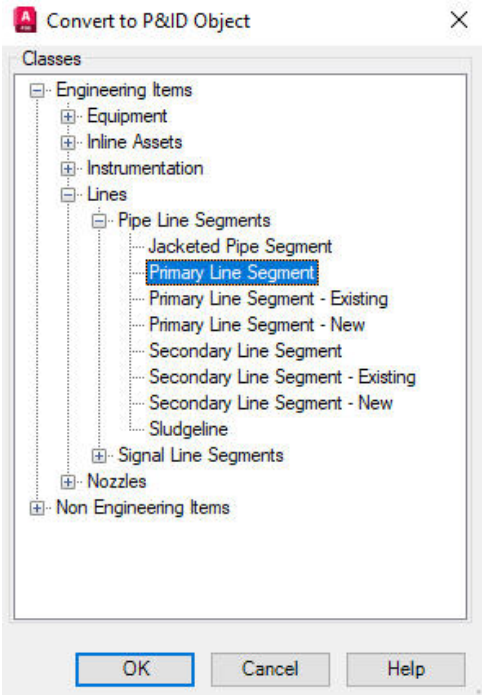

***Figure 2-36** The **Convert to P&ID Object** dialog box*

To add the converted component to the **TOOL PALETTES - P&ID PIP**, first you need to save the current file. Next, open the tab in the **TOOL PALETTES** to which you want to add the symbol. Choose the **Design Center** tool from the **Palettes** panel of the **View** tab. Choose the **Load** button at the top left corner of the **DESIGN CENTER** palette; the **Load** window will be displayed. Browse to the saved current file and choose on the **Open** button. Now, double-click on the **Blocks** icon in the **DESIGN CENTER** palette; the saved block is displayed. Now, click and drag the object and place it in the desired group in the **TOOL PALETTES**; the symbol will be displayed in the **TOOL PALETTES**.

Adding Intelligence to the Custom P&ID Symbols

You can add more intelligence to the custom P&ID symbols that you want to add to the **TOOL PALETTES**. The procedure to do so is illustrated below. Figure 2-37 shows the block of a control valve which is to be added to the TOOL PALETTES.

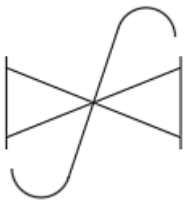

Figure 2-37 *The valve symbol block to be added to the* ***TOOL PALETTES***

To add the symbol shown in the Figure 2-37 to the **TOOL PALETTES**, make sure that the **P&ID PIP** workspace is activated and the tool palette is loaded with **P&ID PIP** symbols.

Create the shape of the valve symbol, as shown in Figure 2-37 and convert it into a block with the name **control valve 1**. Save the drawing by choosing the **Save** tool from the Quick Access Toolbar. Convert this shape of the valve into P&ID symbol as discussed earlier. Next, click on the **Valves** tab in the **TOOL PALETTES - P&ID PIP** to ensure that the custom symbol which is a valve here gets added to the **Valves** tab of the **TOOL PALETTES**. Choose the **Project Setup** tool from the **Project Manager** drop-down of the **Project** panel in the **Home** tab; the **Project Setup** dialog box will be displayed, refer to Figure 2-38.

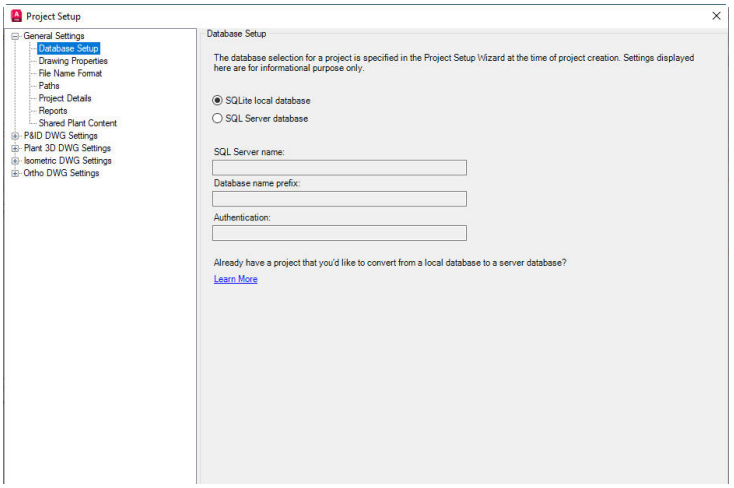

Figure 2-38 *The* ***Project Setup*** *dialog box*

You can also invoke this dialog box by entering **PROJECTSETUP** in the command window or by right-clicking on the project name node in the **Project** area of the **PROJECT MANAGER** and, then selecting the **Project Setup** option from the flyout displayed.

In the **Project Setup** dialog box, expand the **P&ID DWG Settings** node by clicking on the + sign and then choose, **P&ID Class Definitions > Engineering Items > Inline Assets > Hand Valves**. Click on the **Hand Valves** sub-node to highlight it. Next, right-click to display a shortcut menu and choose the **New** option; the **Create Class** dialog box will be displayed, refer to Figure 2-39.

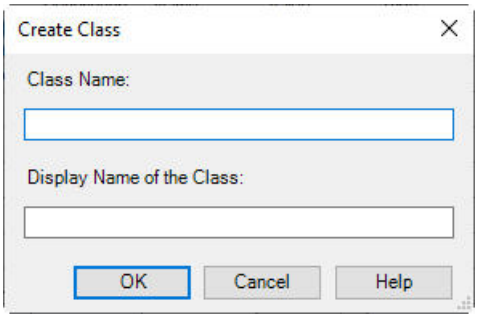

Figure 2-39 *The* ***Create Class*** *dialog box*

Enter **controlvalve1** in the **Class Name** edit box; the specified name is also displayed in the **Display Name of the Class** edit box (Note that the class name entered in the **Class Name** edit box should not have any spaces in between the alphabets). Next, choose the **OK** button to exit the dialog box; the specified class name will be listed and highlighted under the **Hand Valves** sub-node. Also, the class name (controlvalve1) will be displayed next to the **Class settings** area. Next, choose the **Add Symbols** button from the **Symbol** area; the **Add Symbols - Select Symbols** dialog box will be displayed, refer to Figure 2-40.

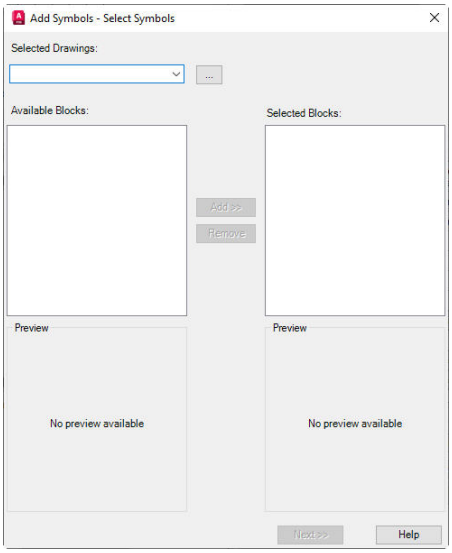

Figure 2-40 *The* ***Add Symbols - Select Symbols*** *dialog box*

In this dialog box, choose the browse button next to the drop-down in the **Selected Drawings** area; the **Select Block Drawing** dialog box will be displayed. In this dialog box, browse to the file location and open it; the **Add Symbols - Select Symbols** will be displayed again with the list of blocks contained in the drawing file in the **Available Blocks** list box. Select **control valve 1** from the **Available Blocks** list box; it will be highlighted. Also a preview of the valve block will be displayed in the **Preview** window available below the **Available Blocks** list box.

Next, choose the **Add** button; the block name will be displayed in the **Selected Blocks** list box of the dialog box. Choose the **Next** button; the **Add Symbols - Edit Symbol Settings** dialog box

will be displayed. Enter **control valve 1** in the **Symbol Name** edit box of the **Symbol Properties** area. Choose the **Yes** option from the **Auto Nozzle** drop-down list and **Flanged Nozzle Style** from the **Auto Nozzle Style** drop-down list of the **Other Properties** area. Next, choose the **Finish** button; the **Add Symbols - Edit Symbol Settings** dialog box will be closed and the **Project Setup** dialog box will be displayed again. Next, choose the **Add to Tool Palette** button from the **Project Setup** dialog box; the **Create Tool** message box will be displayed with a message that the control valve 1 tool has been added to the current tool palette. Choose the **OK** button to exit the message box. Next, choose the **Apply** and then the **OK** button to exit the **Project Setup** dialog box and add the control valve 1 symbol to the **Valves** area of the **Valves** tab.

Editing the Properties of the Custom P&ID Symbol

Using the **Project Setup** dialog box, you can also edit the symbol settings, block settings, properties like tag format, annotation style and so on. Consider that the newly created **control valve 1** P&ID symbol needs some editing as per the requirement. The steps to do various editing operations on it are listed below.

Invoke the **Project Setup** dialog box and follow the path, **P&ID DWG Settings > P&ID Class Definitions > Engineering Items > Inline**

Assets > Hand Valves > controlvalve1. On doing so, the **controlvalve1** will be displayed in the **Class settings** area and its preview will be displayed in the Preview window in the **Symbol** area. Also, various properties related to the symbol will be listed in the table in the **Properties** area of the dialog box. Choose the **Edit Symbol** button in the **Symbol** area; the **Symbol Settings** dialog box will be displayed, refer to Figure 2-41.

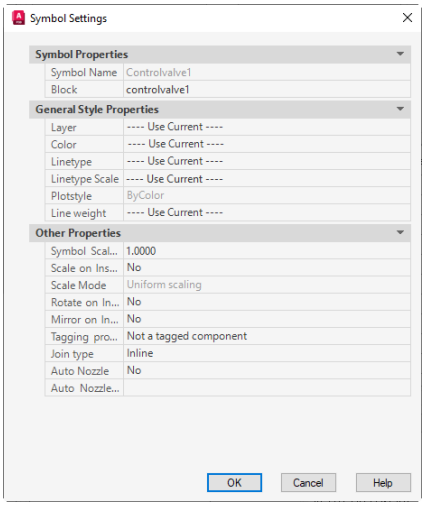

Figure 2-41 *The* ***Symbol Settings*** *dialog box*

You can change various properties such as layer, color, linetype, symbol scale, tagging prompt, join type by using the areas of this dialog box. Choose the **OK** button to exit the dialog box. Choose the **Edit Block** button in the **Symbol** area; the **Block Editor** will be invoked displaying the symbol of the custom block. You can use various tools of the **Block Editor** to make changes in the shape, size and so on of the block and then exit the **Block Editor** by choosing the **Close**

Block Editor button from the **Close** panel of the **Block Editor** tab. In the **Properties** area of the dialog box, you can set various properties related to the valve such as class name, model number, description, size, spec. The name of the property will be listed in the **Property Name** column of the table in the **Properties** area. You can also add a new property to the **Property Name** list. To do so, choose the **Add** button from the **Properties** area; the **Add Property** dialog box will be displayed, refer to Figure 2-42.

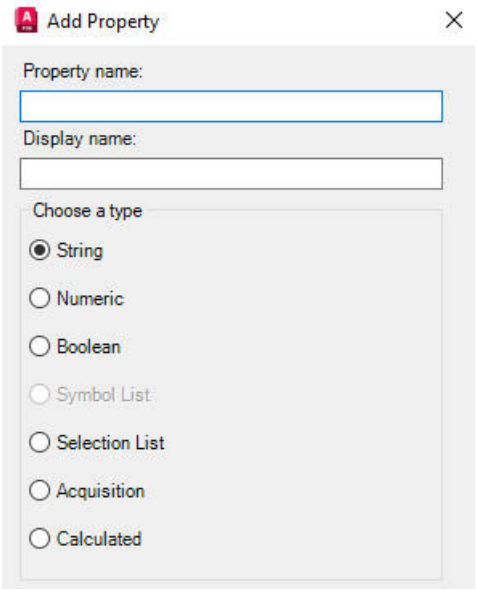

Figure 2-42 *The **Add Property** dialog box*

Enter the property name in the **Property name** edit box; the specified name will also be displayed in the **Display name** edit box. Next, choose a property type from the **Choose a type** area by selecting the respective radio button. Next, choose the **OK** button; the dialog box is closed and the property will be added to the **Property Name** column of the table. In the **Tag format** area of the dialog box, a list box will be available displaying the **Hand Valve Tag [Code-Number]** by default. You can add a new tag format to the list or modify the existing one. To add a new tag format, choose the **New** button from the **Tag format** area; the **Tag Format Setup** dialog box will be displayed, refer to Figure 2-43.

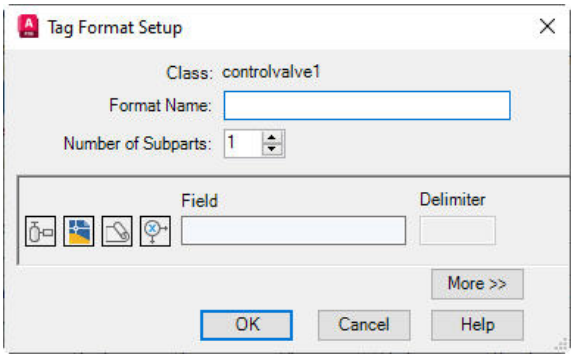

Figure 2-43 *The* ***Tag Format Setup*** *dialog box*

In this dialog box, enter the format name in the **Format Name** edit box. You can add subparts to the tag format by entering the desired value in the **Number of Subparts** edit box either manually or by using the spinner. The default value in the **Number of Subparts** edit box is **1**. The information that a tag format will be carrying can be controlled by using the buttons available in the list box of the dialog box, refer to Figure 2-43. The buttons in this list box are: **Select Class Properties**, **Select Drawing Properties**, **Select Project Properties**, and **Define Expression**. Using these buttons, you can set a new tag format for a class. After making all the necessary changes, choose the **OK** button; the dialog box will be closed and the newly created tag format will be listed and highlighted in the list box in the **Tag format** area of the **Project Setup** dialog box. You can modify or delete the newly created tag format by choosing the **Modify** or **Delete** button, respectively. You can also add, modify and change the annotation styles using the options available in the **Annotation** area of the **Project Setup** dialog box. After making all the necessary changes, exit the **Project Setup** dialog box by choosing **Apply** and then the **OK** button.

TUTORIAL

Tutorial 1

In this tutorial, you will create a P&ID, shown in Figure 2-44. You will create it by placing equipments, instruments, and inline components and then connecting them with lines.

(Expected time: 2hr)

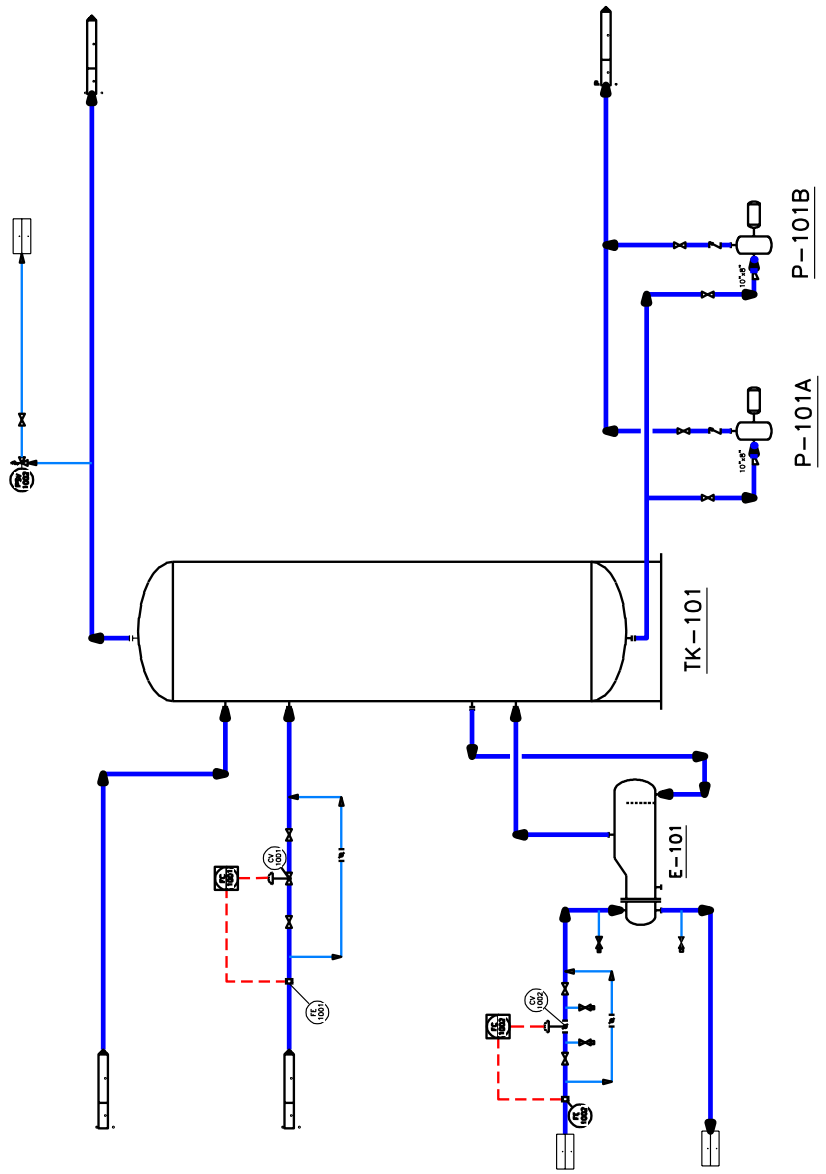

Figure 2-44 *P&ID for Tutorial 1*

The following steps are required to complete this tutorial:

a. Start AutoCAD Plant 3D and then create a new project.
b. Create a new P&ID drawing.
c. Place equipments into the drawing.
d. Connect equipments using schematic lines.
e. Place valves on the lines connecting the components.
f. Add off-page connectors to the drawing.
g. Add tags to schematic lines.
h. Validate the drawing.
i. Save and close the drawing file.

Starting AutoCAD Plant 3D and Creating a New Project

1. Double-click on the **AutoCAD Plant 3D 2023- English** icon from the desktop of your computer to start AutoCAD Plant 3D 2023.

2. In the **PROJECT MANAGER**, select the **New Project** option from the drop-down list available in the **Current Project** area; the **Project Setup Wizard** is displayed.

3. Enter **CADCIM** in the **Enter a name for this project** edit box and choose the **Next** button; the **Specify unit settings** page is displayed.

4. Select the **Imperial** radio button, if not selected by default and then choose the **Next** button; the **Specify P&ID settings** page is displayed.

5. Select the **PIP** option from the **Select the P&ID symbology standard to be used** list box, if not selected by default and choose the **Next** button; the **Specify Plant 3D directory settings** page is displayed.

6. Accept the default directory settings and choose the **Next** button; the **Specify database settings** page is displayed.

7. Make sure the **Single User - SQLite local database** radio button is selected and choose the **Next** button; the **Finish** page is displayed.

8. Choose the **Finish** button; you will notice that the CADCIM project is displayed in the drop-down list available in the **Current Project** area of the **PROJECT MANAGER**. Also, a node named CADCIM is created in the **Project** area.

Creating a New Drawing

1. In the **PROJECT MANAGER**, right-click on the **P&ID Drawings** node in the project tree and then choose the **New Drawing** option; the **New DWG** dialog box is displayed.

2. Enter **P&ID1.dwg** in the **File name** edit box and then specify the **PID ANSI D -Color Dependent Plot Styles.dwt** template in the **DWG template** edit box.

3. Choose the **OK** button from the **New DWG** dialog box; the new P&ID drawing file is created with the **TOOL PALETTES** displayed on the right side of the screen.

4. Choose the **Workspace Switching** button on the right-side of the Status Bar; a flyout is displayed. Choose the **PID PIP** option from the flyout; the **P&ID PIP** workspace is invoked and the **TOOL PALETTES** is loaded with the P&ID symbols. Note that, if **Tool Palette** is not displayed, then choose the **Tool Palettes** button from the **Palettes** panel in the **View** tab.

Placing Equipment in the Drawing

1. Choose the **Vessel** tool from the **Vessel and Miscellaneous Vessel Details** area in the **Equipment** tab of the **TOOL PALETTES - P&ID PIP**; you are prompted to specify an insertion point. Next, specify **(13,5)** as the insertion point of the vessel; you are prompted to specify the scale factor.

2. Enter **1.5** as the scale factor; the **Assign Tag** dialog box is displayed. Enter **101** in the **Number** edit box and make sure that the **Place annotation after assigning tag** check box is selected. Next, choose the **Assign** button and specify the position of the annotation tag near the vessel, as shown in Figure 2-45.

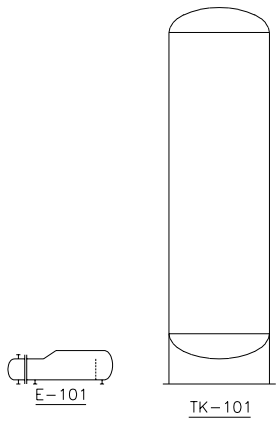

Figure 2-45 *P&ID after placing the vessel and the heat exchanger*

3. Choose the **TEMA type BKU Exchanger** from the **TEMA Type Exchangers** area in the **Equipment** tab of the **TOOL PALETTES - P&ID PIP** and place it at the point **(7,5)**. Next, assign tag **E-101** to the heat exchanger. Figure 2-45 shows the P&ID after placing the vessel and the heat exchanger.

4. Choose **Horizontal Centrifugal pump** from the **Pumps** area in the **Equipment** tab of the **TOOL PALETTES - P&ID PIP** and place at the point **(17,3)**. Next, assign tag **P-101A** to the pump.

5. Similarly, place another horizontal centrifugal pump at the point **(21,3)**. Next, assign the tag **P-101B** to the pump. Figure 2-46 shows the P&ID after placing the centrifugal pumps.

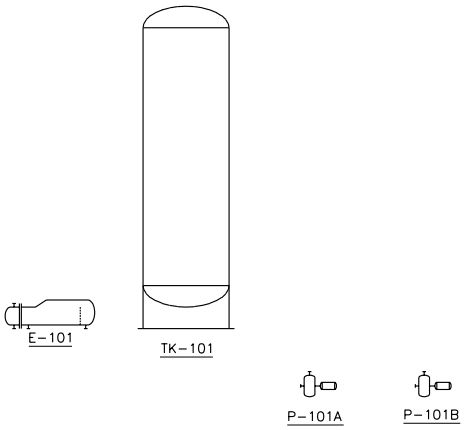

Figure 2-46 *P&ID after placing two centrifugal pumps*

Connecting the Heat Exchanger and the Vessel

Now, you need to create lines connecting the equipment. Before doing that, you need to place some nozzles at the required locations on the equipment.

1. Choose **Single Line Nozzle** from the **Nozzles** area in the **Fittings** tab of the **TOOL PALETTES - P&ID PIP**; you are prompted to select the asset to place nozzle.

2. Select the heat exchanger from the drawing sheet; the nozzle is attached to the cursor and you are prompted to specify the insertion point.

3. Specify the insertion point, refer to Figure 2-47, and then specify the rotational angle as 90-degrees.

   Next, you need to connect the heat exchanger and the vessel by drawing pipe lines. To do so, you need to first make sure that the **ORTHOMODE** is turned on to draw straight lines. Also, the **Object Snap** should be turned on for easy selection of the points.

4. Choose the **Lines** tab from the **TOOL PALETTES** and choose the **Primary Line Segment** line type from the **Pipe Lines** area; you are prompted to select the start point.

5. Specify the start point on the newly created nozzle of the heat exchanger. Next, move the cursor upward and enter **2** at the command prompt. Next, press ENTER.

6. Move the cursor horizontally toward right and specify the endpoint on the vessel; the line connecting the vessel and the heat exchanger is created, refer to Figure 2-47.

   Next, you need to assign a tag to the line.

7. Choose the **Assign Tag** tool from the **P&ID** panel in the **Home** tab and select the previously created line.

8. Press the ENTER key; the **Assign Tag** dialog box is displayed. Specify the following values in the dialog box:

Size	**8”**
Spec	**CS150**
Pipe Line Group.Service	**P-GENERAL PROCESS**
Pipe Line Group.Line Number	**1007**

9. Clear the **Place annotation after assigning tag** check box. Choose the **Assign** button; the tag is assigned to the line.

Note

*You can also annotate the line with the assigned tag. To do so, you need to select the **Place annotation after assigning tag** check box and then select the **Pipeline Tag** option from the **Annotation style** drop-down list in the **Assign Tag** dialog box.*

10. Invoke the **Primary Line Segment** tool from the **Lines** tab of the **TOOL PALETTES** and connect the vessel to the nozzle located at the bottom of the heat exchanger. The line created should be similar to the one shown in Figure 2-48.

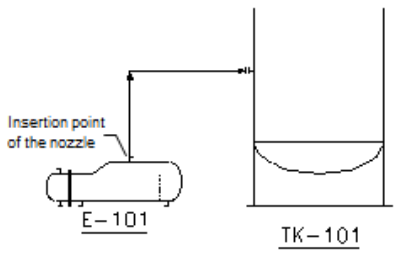

Figure 2-47 *Insertion point of the nozzle, and line connecting the vessel and the heat exchanger*

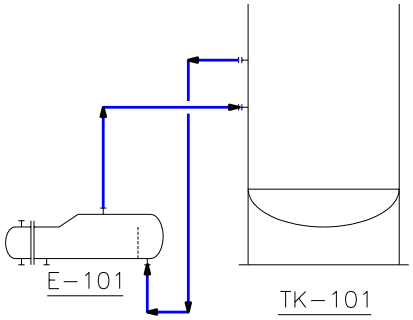

Figure 2-48 *Line connecting the vessel and the bottom nozzle of the heat exchanger*

11.Assign the tag **6”-CS150-P-1006** to the line.

12. Similarly, create lines connecting the other two nozzles (steam inlet and outlet nozzles) of the heat exchanger, as shown in Figure 2-49. Next, assign tags **6”-CS150-P-2000** and **3”-CS150-SC-2002** to steam inlet line and condensate lines, respectively.

13. Choose the **Secondary Line Segment** tool from the **Lines** tab in the **TOOL PALETTES - P&ID PIP** and create a loop on the line connecting the steam inlet nozzle of the heat exchanger, as shown in Figure 2-50.

Note that in this tutorial, the newly created line is referred as outlet line of the pump.

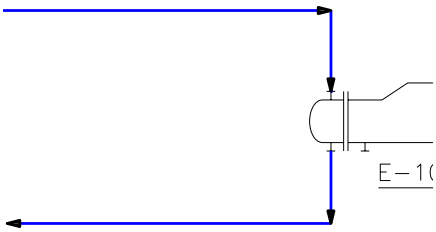

Figure 2-49 The steam inlet line and condensate line of the heat exchanger

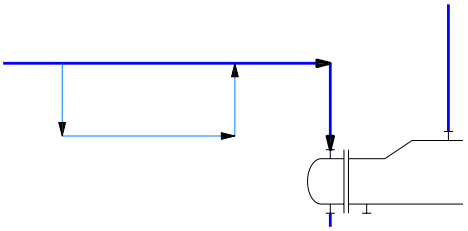

Figure 2-50 Loop created on line connecting the steam inlet nozzle

Connecting the Vessel to Pumps

Next, you need to create pipe lines connecting the vessel and pumps.

1. Invoke the **Primary Line Segment** tool from the **Lines** tab in the **TOOL PALETTES - P&ID PIP** and specify the start point at the bottom of the vessel, as shown in Figure 2-51.

2. Connect the line to the horizontal nozzle of the pump tagged **P-101B**. The line created should be similar to the one shown in Figure 2-52. In this tutorial, this line is referred as inlet line of the pump.

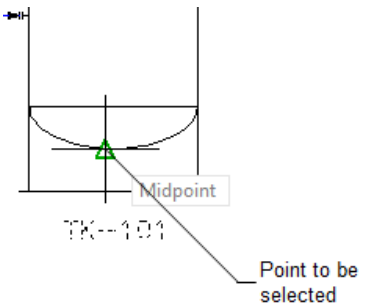

Figure 2-51 Point to be selected on the vessel

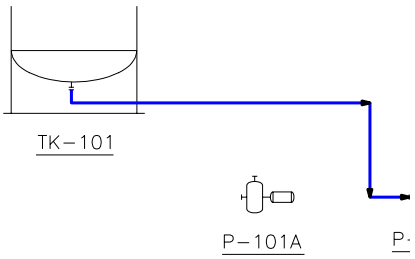

Figure 2-52 Line connecting the vessel and the pump

3. Assign tag **10”-CS150-P-1004** to the line.

4. Create a line connecting the previously created line to the horizontal nozzle of the pump tagged **P-101A**, refer to Figure 2-53. Assign the tag **10”-CS150-P-1004** to the line.

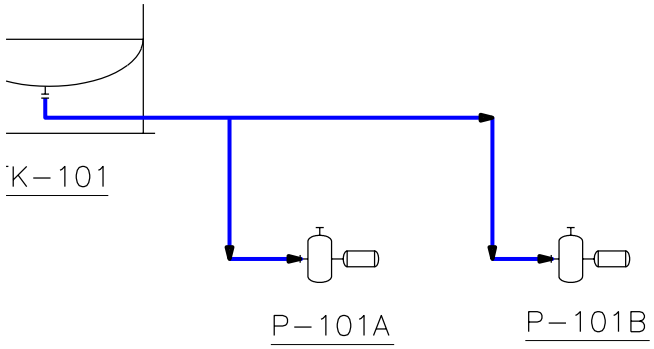

Figure 2-53 *Line connecting the horizontal nozzle of the pump tagged* ***P-101A***

5. Invoke the **Draw** tool from the **Schematic Line** panel in the **Home** tab; you are prompted to specify the start point of the line.

6. Specify the start point on the vertical nozzle of the pump tagged **P-101A**, and then create a line, as shown in Figure 2-54.

7. Assign tag **8"-CS150-P-1012A** to the line.

8. Next, connect the vertical nozzle of the other pump to the previously created line, refer to Figure 2-55. Assign the tag **8"-CS150-P-1012B** to the line.

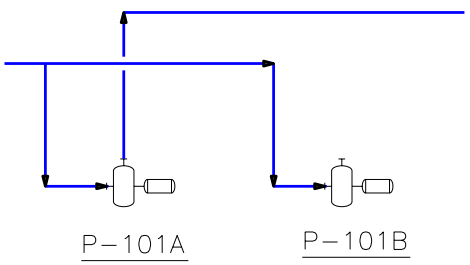

Figure 2-54 *Line connecting the vertical nozzle of the pump*

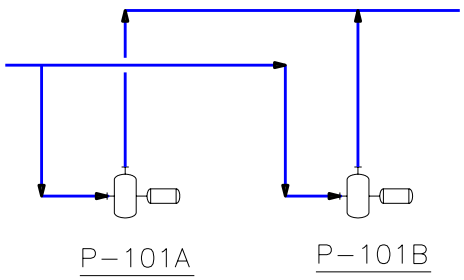

Figure 2-55 *Line connecting another pump and previously created line*

Note that in this tutorial, the newly created line is referred as outlet line of the pump.

Creating the Remaining Lines Connecting the Vessel

1. Invoke the **Primary Line Segment** tool and specify the start point as (4,13). Next, move the cursor horizontally toward right and specify the endpoint on the vessel; the line is created, as shown in Figure 2-56. Note that this line will be referred as feed line in this tutorial.

2. Next, assign tag **12”-CS150-P-1001** to the line.

3. Choose **Secondary Line Segment** from the **Lines** tab in the **TOOL PALETTES - P&ID PIP** and create the loop, as shown in Figure 2-57.

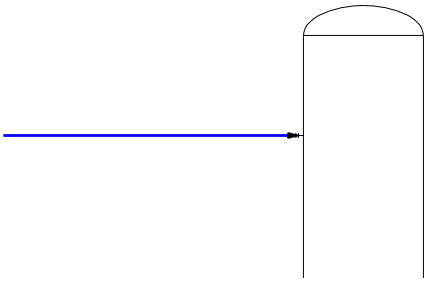

Figure 2-56 *Line connected to the vessel*

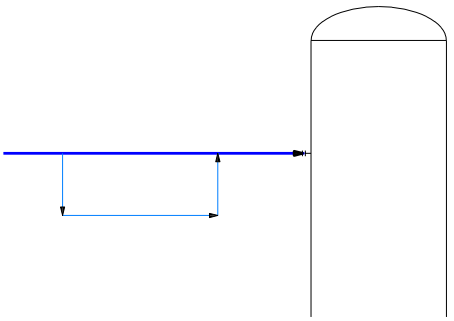

Figure 2-57 *Loop created on the previous line*

4. Create another primary line by specifying the start point at 4,17. It should be similar to the line shown in Figure 2-58. Assign tag **4”-CS150-P-1000** to the line.

   This line is referred as reflux line.

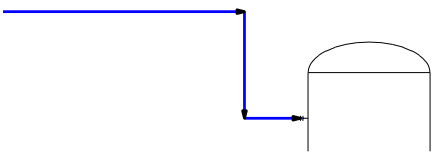

Figure 2-58 *Reflux line connected to the vessel*

   Next, you need to create a line originating from the top of the vessel.

5. Invoke the **Primary Line Segment** tool and specify the start point on the top of the vessel.

6. Move the cursor upward and enter **1** at the command prompt. Next, press ENTER.

7. Move the cursor horizontally toward right and create a line, as shown in Figure 2-59. Assign the tag **12”-CS150-P-1006T** to the line.

8. Invoke the **Secondary Line Segment** tool and create a line, as shown in Figure 2-60.

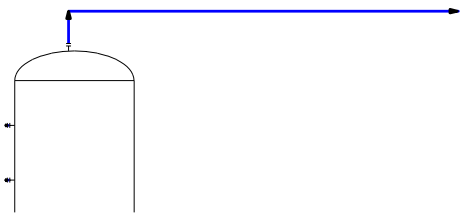

Figure 2-59 *Line drawn from the top of the vessel*

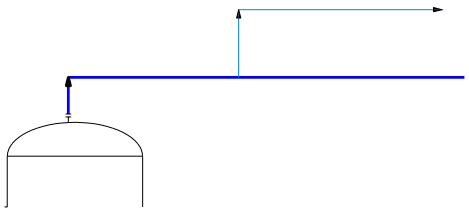

Figure 2-60 *Drawing the secondary line connecting the previous line*

Adding Valves to the P&ID

1. Choose the **Control Valve** tool from the **Control Valve** area of the **Valves** tab of the **TOOL PALETTES**; you are prompted to pick the insertion point.

2. Choose the **Change body or actuator** option from the command prompt to invoke the **Control Valve Browser** dialog box. Note that if you are adding a control valve for the first time, the **Control Valve Browser** dialog box will be displayed by default.

3. Select the **Globe Valve** option from the **Select Control Valve Body** tree view and **Diaphragm Actuator** from the **Select Control Valve Actuator** tree view and then choose the **OK** button.

4. Insert the control valve on the feed line, as shown in Figure 2-61.

5. Specify the position of the annotation balloon near the control valve; the **Assign Tag** dialog box is displayed.

6. Enter the values given next in this dialog box and then choose the **Assign** button.

Area	**01**
Type	**CV**
Loop Number	**1001**

7. Similarly, place a control valve on the steam inlet pipe of the heat exchanger, as shown in Figure 2-62. Note that you need to specify **Butterfly Valve** and **Diaphragm Actuator** as the valve body and actuator, respectively.

8. Enter the following values in the **Assign Tag** dialog box:

Area	**01**
Type	**CV**
Loop Number	**1002**

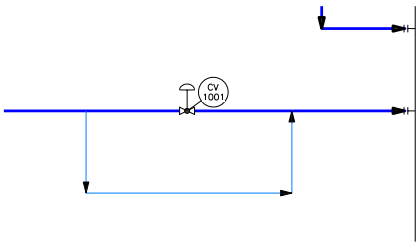

Figure 2-61 Location of the control valve

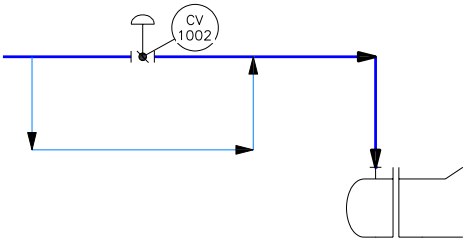

Figure 2-62 Location of the control valve on the steam inlet line

9. Choose **Gate Valve** from the **Valves** area in the **Valves** tab of the **TOOL PALETTES - P&ID PIP**, and place it at two locations, as shown in Figure 2-63.

Note

On inserting a valve, an annotation is displayed by default next to it. To avoid this, you need to hide objects. To do so, right-click on the annotation and choose ***Isolate > Hide Objects****.*

10. Next, choose **Butterfly Valve** and place it at the location shown in Figure 2-63.

11. Similarly, place two gate valves and a butterfly valve on the pipe which is connected to the heat exchanger, as shown in Figure 2-64.

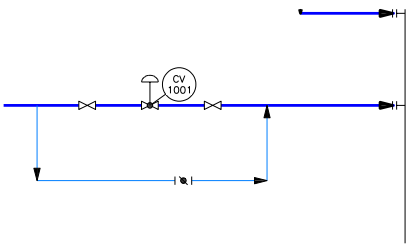

Figure 2-63 Location of the gate valve and butterfly valve on the line connected to the vessel

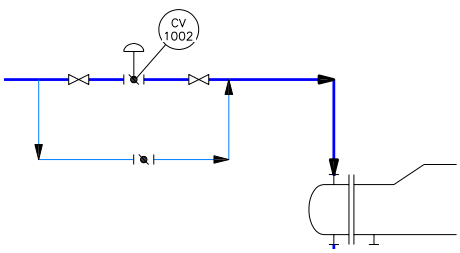

Figure 2-64 Location of gate valves and the butterfly valve

12. Next, create two secondary lines connecting the steam inlet pipe, as shown in Figure 2-65.

13. Choose **Plug** from the **Piping Fittings** area in the **Fittings** tab of the **TOOL PALETTES - P&ID PIP**, and then place it at the endpoints of the secondary lines, refer to Figure 2-65.

14. Next, delete the arrows on the secondary lines and place gate valves, as shown in Figure 2-66.

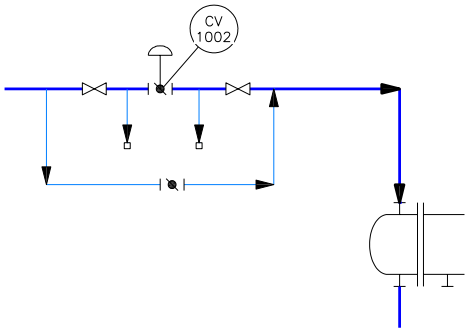

Figure 2-65 *Secondary lines with plugs placed at their endpoints*

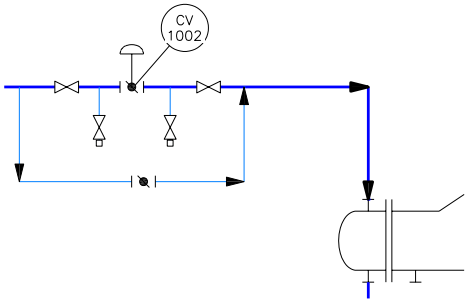

Figure 2-66 *Gate valves placed on the secondary lines*

15. Invoke the **PROPERTIES** palette of the gate valves by double-clicking on them.

16. Select the **Gate Valve Closed Style** option from the **Graphical style** drop-down list of the **Styles** area, refer to Figure 2-67; the gate valve is closed, as shown in Figure 2-68.

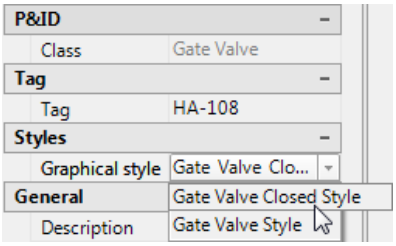

Figure 2-67 *Selecting the **Gate Valve Closed Style** option from the **Graphical style** drop-down list*

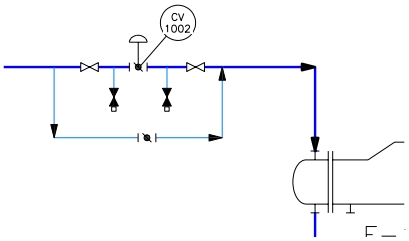

Figure 2-68 *The graphical style of gate valves changed to the closed type*

17. Similarly, create secondary lines and place the plugs and gate valves at the locations shown in Figure 2-69.

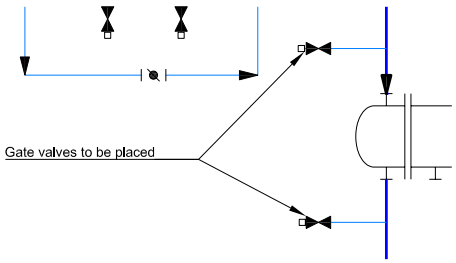

Figure 2-69 *Locations of the secondary lines and gate valves*

Note

*If required, you can change the attachment point of the **Plug** by choosing the **Point** option from the command prompt.*

Adding Instruments to the P&ID

Next, you need to add instruments to the P&ID.

1. Choose the **Restriction Orifice** tool from the **Primary Element Symbols (Flow)** area of the **Instruments** tab in the **TOOL PALETTES - P&ID PIP**; you are prompted to specify the insertion point.

2. Place the restriction orifice on the pipe which is connected to the vessel, as shown in Figure 2-70.

3. Enter the values given next in the **Assign Tag** dialog box and place the annotation near the orifice.

Area	**01**
Type	**FE-FLOW ELEMENT**
Loop Number	**1001**

4. Similarly, place another restriction orifice on the steam inlet pipe of the heat exchanger, refer to Figure 2-71. Next, enter the following values in the **Assign Tag** dialog box:

Area	**01**
Type	**FE-FLOW ELEMENT**
Loop Number	**1002**

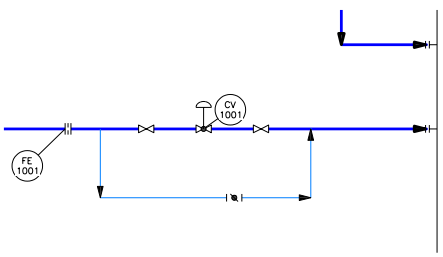

Figure 2-70 *Location of the orifice*

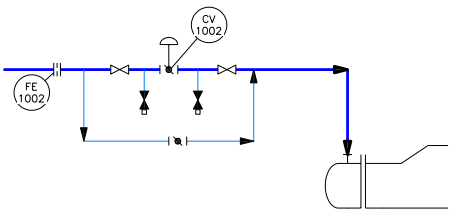

Figure 2-71 *Location of the orifice on the steam inlet line of the heat exchanger*

Next, you need to create instrumentation line connecting the orifice and the control valve.

5. Choose the **Electric Signal** tool from the **Instrument Lines** area in the **Lines** tab of the **TOOL PALETTES - P&ID PIP**.

6. Specify the start point on the orifice located on the pipe connected to the heat exchanger and move the cursor upward upto a distance of 1.5. Next, click to specify the endpoint.

You need to make sure that the **Object Snap** and **Object Snap Tracking** options are activated in the Status Bar.

7. Move the cursor toward right and click when the cursor snaps to the mid point of the control valve, as shown in Figure 2-72.

8. Next, move the cursor downward and specify the endpoint on the control valve, refer to Figure 2-73.

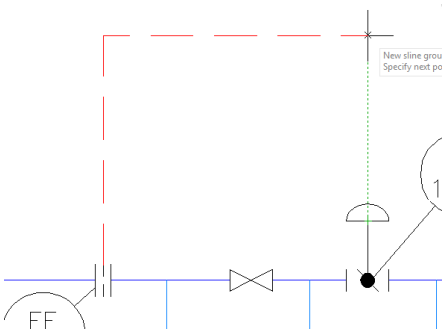

Figure 2-72 *Snapping to the midpoint of the control valve*

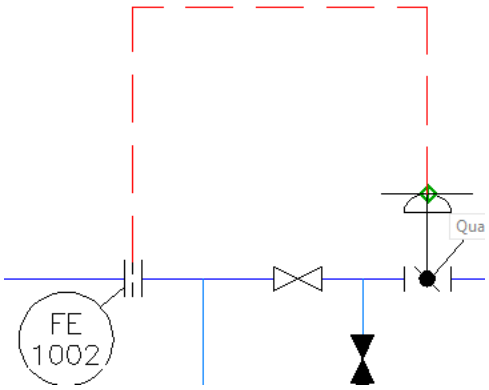

Figure 2-73 *Specifying the endpoint of the electric signal line*

9. Similarly, create an electrical signal on the pipe connecting the vessel, as shown in Figure 2-74.

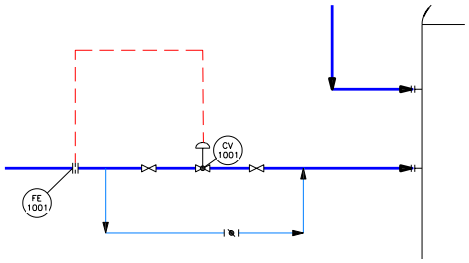

Figure 2-74 *Electric signal created on the feed line*

10. Choose **Primary Accessible DCS** from the **General Instruments** area of the **Instruments** tab in the **TOOL PALETTES - P&ID PIP**.

11. Place the instrument symbol on the electric signal line, as shown in Figure 2-75; the **Assign Tag** dialog box is displayed.

12. Enter the values given next in the **Assign Tag** dialog box and choose the **Assign** button.

Area	**01**
Type	**FC - FLOW CONTROLLER**
Loop Number	**1002**

13. Similarly, place another **Primary Accessible DCS** on the electric signal connected to the feed pipe, refer to Figure 2-76.

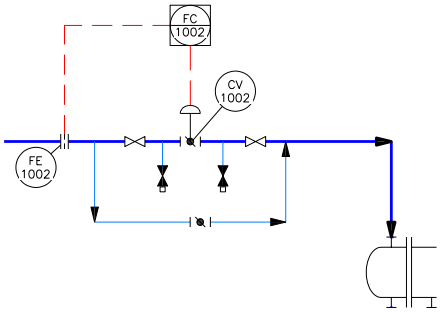

Figure 2-75 *Position of the* ***Primary Accessible DCS***

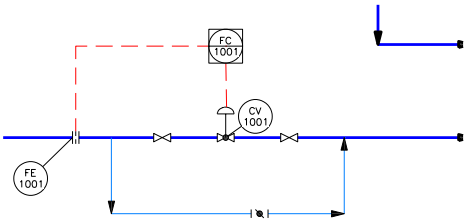

Figure 2-76 *Position of another* ***Primary Accessible DCS*** *on the electric signal line of the feed line*

14. Assign tag **01-FC-1001** to the instrument.

Placing Valves and Fittings on the Lines Connecting the Pumps

Next, you need to place valves and fittings on the lines connecting the pumps.

1. Choose **Eccentric Reducer** from the **Piping Fittings** area in the **Fittings** tab of the **TOOL PALETTES - P&ID PIP** and place it on the line connecting the horizontal nozzle of the pump, as shown in Figure 2-77.

2. Place a gate valve on the same line, refer to Figure 2-78.

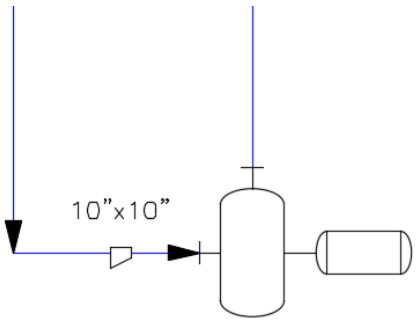

Figure 2-77 *An eccentric reducer placed on the line connecting the first pump*

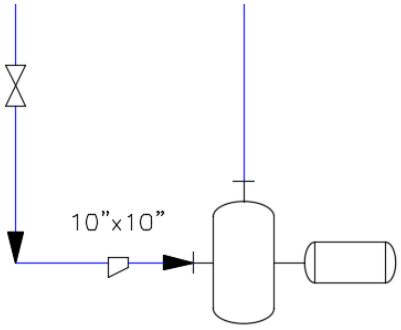

Figure 2-78 *A gate valve placed on the line connecting the first pump*

3. Choose the **Assign Tag** button from the **P&ID** panel and select the line connected to the reducing end of the eccentric reducer and press ENTER; the **Assign Tag** dialog box is invoked.

4. Modify the size of the line to **8”**, refer to Figure 2-79 and choose the **Assign** button from the dialog box.

5. Similarly, place an eccentric reducer and a gate valve on the pipe connecting the other pump, as shown in Figure 2-80.

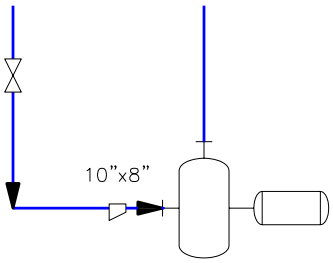

Figure 2-79 *Modified size of a line*

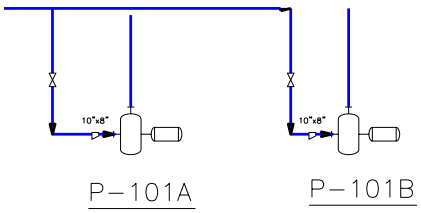

Figure 2-80 *A gate valve and an eccentric reducer placed on the line connecting the second pump*

6. Change the size of the pipe line connecting the reducing end of the eccentric reducer to 8”.

7. Place Check Valves and Gate Valves on the outlet lines of the two pumps, refer to Figures 2-81 and 2-82.

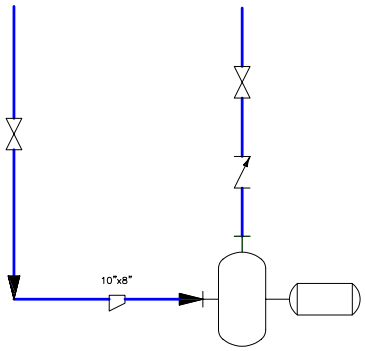

Figure 2-81 *Check valve and gate valve placed on the outlet line of the first pump*

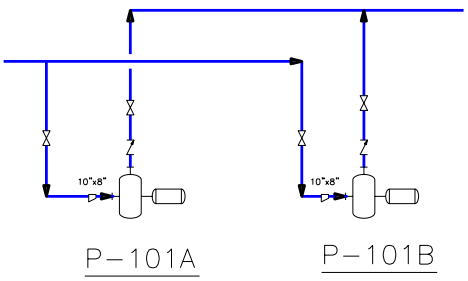

Figure 2-82 *Check valves and gate valves placed on outlet lines of both the pumps*

Next, you need to place a pressure relief valve on the pipe connecting the top nozzle of the vessel.

8. Choose **Pressure Relief Valve** from the **Relief Valves** area in the **Instruments** tab of the **TOOL PALETTES - P&ID PIP**.

9. Place the pressure relief valve on the secondary line of the line connecting the top nozzle of the vessel, as shown in Figure 2-83, and give the required parameter in the **Assign Tag** dialog box.

10. Place a gate valve on the same line, as shown in Figure 2-84.

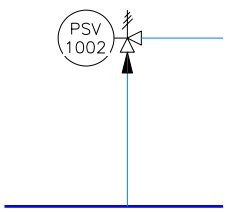

Figure 2-83 *Location of the pressure relief valve*

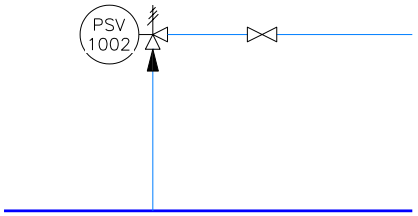

Figure 2-84 *Location of the gate valve*

Adding Off Page Connectors

1. Choose the **Off Page Connector** tool from the **Off Page Connectors and Tie-In Symbol** area of the **Non-engineering** tab of the **TOOL PALETTES - P&ID PIP**; you are prompted to specify the insertion point.

2. Place the off page connector at the endpoint of the line connecting the pumps, as shown in Figure 2-85.

3. Similarly, place off page connectors at the locations shown in Figures 2-86 and 2-87.

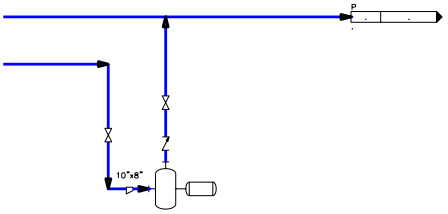

Figure 2-85 *Off page connector placed at the endpoint of the pump outlet line*

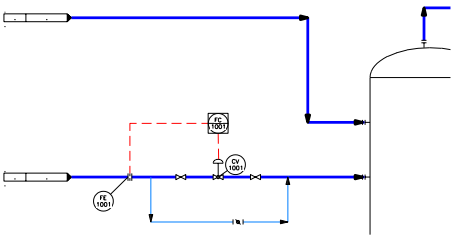

Figure 2-86 *Off page connectors placed at the endpoints of the feed line and reflux line*

4. Choose the **Utility Connector** tool from the **Off Page Connectors and Tie-In Symbol** area of the **Non-engineering** tab of the **TOOL PALETTES - P&ID PIP** and place then at the locations shown in Figures 2-87 and 2-88.

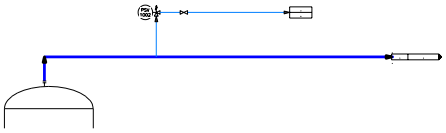

Figure 2-87 Location of utility connector and off page connector

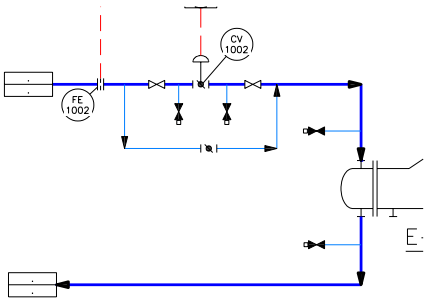

Figure 2-88 Utility connectors placed at the endpoints of the steam inlet line and the condensate line

Validating the Drawing

1. Choose the **Validate Config** button from the **Validate** panel in the **Home** tab; the **P&ID Validation Settings** dialog box is displayed.

2. In this dialog box, expand the **P&ID objects** node and clear the **Unresolved off-page connectors** check box. Similarly, expand the **3D Model to P&ID checks** node and clear all the check boxes under it. Next, choose the **OK** button to close the dialog box.

Note

In this tutorial, the off page connectors are not validated because they are not connected to any other P&ID.

3. Run validation process by choosing the **Run Validation** tool from the **Validate** panel; the **VALIDATION SUMMARY** palette is displayed with a tree list of errors in the drawing.

4. Right-click on any error in the **VALIDATION SUMMARY** palette and choose **Ignore** to ignore the error. Similarly, ignore all the errors and exit the **VALIDATION SUMMARY** palette.

Saving the Drawing

1. Choose the **Save** option from the **Application menu** or choose **File > Save** in the menu bar to save the drawing file *c02tut01.dwg*.

2. Choose **Close > Current Drawing** from the **Application Menu** to close the drawing file.

Self-Evaluation Test

Answer the following questions and then compare them to those given at the end of this chapter:

1. You can substitute a component by invoking the _____.

2. You need to use _____ to indicate the continuation of the process line from one drawing sheet to the another.

3. You can specify the control valve body and the actuator in _____.

4. To convert an AutoCAD component into a P&ID symbol, you need to choose the _____ option.

5. You should select the **P&ID Drawings** node in the Project tree and then choose the **New Drawing** button to create a new P&ID file. (T/F)

6. When you move a line, the equipment connected to the line also moves with the line. (T/F)

7. When you move a line, the inline components such as valves and balloons also move with the line. (T/F)

8. If the diameter of the line on either side of the reducer is changed, the reducer will be reoriented. (T/F)

9. You can add converted AutoCAD component to the **TOOL PALETTE - P&ID PIP** by clicking and dragging it into the **TOOL PALETTE**. (T/F)

10. A nozzle will be placed automatically when you connect a line to an equipment. (T/F)

Review Questions

Answer the following questions:

1. The _____ dialog box is displayed if you choose the **Control Valve** tool for the first time.

2. A project file is a _____ file.

3. You can edit a P&ID symbol using the _____ tool.

4. The _____ option in the **Edit** tool is used to attach a line to a component without physically connecting to it.

5. The _____ option in the **Edit** tool is used to divide a line into two.

6. The **Make Group** tool is used to group _____.

7. The _____ button in the **VALIDATION SUMMARY** palette is used to run validation on selected node.

8. You can place a symbol from the PID ISO Tool palette even while working in PIP standard file. (T/F)

9. The **PROJECT MANAGER** is used to manage the project files only. (T/F)

10. You can activate more than one project at a time.

EXERCISE

Exercise 1

In this exercise, you will create the P&ID shown in Figure 2-89.

(Expected time: 30 min)

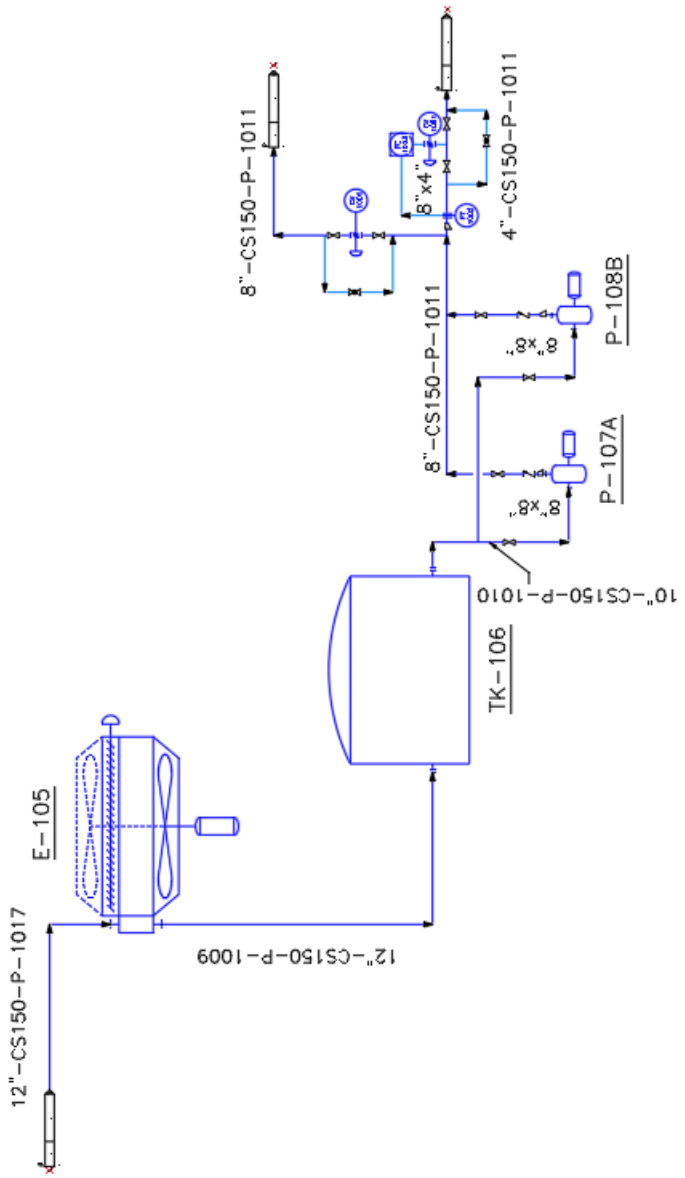

Figure 2-89 *P&ID for Exercise 1*

Answers to Self-Evaluation Test

1. Substitution palette, **2.** Off-Page Connector, **3. Control Valve Browser**, **4. Convert to P&ID object**, **5.** T, **6.** F, **7.** T, **8.** T, **9.** T, **10.** T