Conceptual Engineering Product™ 6.2

Heat Integration Guide

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1 Heat Integration Manager

1.1 Introduction

Heat integration in HX-Net is designed for analysing and improving the performance of heat exchanger networks (HEN). HX-Net focus on analysing the networks from operations' as well as design's point of view.

HEN operations features are designed to provide you with an understanding of current plant operation and related issues such as fouling. Furthermore fouling mitigation strategies can be studied and simulated in HX-Net.

HEN design features assist the designer in understanding the gap between current operation and the thermodynamic optimum operation. Furthermore, the designer can use HX-Net to identify and compare options to improve the performance and reduce the gap between current and thermodynamic optimum operations.

To perform any heat integration study from a design or operations perspective, HX-Net need the process requirements and the HEN that achieves the process requirements. The terminology that is used in HX-Net is "scenario" for process requirements and "design" for the HEN.

HX-Net exposes the heat integration functionality through the HI Case and HI Project operations:

- HI Case limits you to working with one scenario and one design. Thus HI Case is suitable for users who want to perform a quick energy analysis or for users who wan to study current plant operation.
- HI Project enables you to work with multiple scenarios and each scenario could have multiple designs. Thus HI Project is more suitable for users who want to make structured modifications and compare those modifications. HI Project is also suitable for performing revamp studies.

1.1.1 Heat Integration Case

The Heat Integration Case (HI Case) operation is a tool used to design heat exchanger network (HEN) and perform simulation analysis on the HEN. HI Case contains one scenario/one set of input parameters and one design/one Grid Diagram that displays one HEN.

General Procedure

The following is a general procedure to setup the HI Case operation:

1. Open the HI Case operation view.
2. Go to the **Process Streams** tab, and enter the following minimum information:
   - Name, inlet temperature, outlet temperature, and MCp or enthalpy of the process stream.
3. Go to the **Utility Streams** tab, and enter the following minimum information:
   - If you are specifying your own utility: name, inlet temperature, and outlet temperature of the utility stream.
     If you want HX-Net to calculate the operating cost of the utility you have to supply a cost per energy value.
   - If you are using the utilities from HX-Net utility database: click the down arrow in the **Name** cell to open the drop-down list, and select the utility you want from the list.

If the utility in the Name cell is a hot utility, you cannot replace that hot utility with a cold utility, until after you click on the Name cell and press **DELETE**.

Once the previous utility occupying the row has been deleted, you can select a different type of utility to be added in that row.

4. If any of the streams in the HEN has large varying values for the specific heat capacity, you can segment the streams. Click once in the **Segm** cell to access the Process Stream view. The Process Stream view contains options to segment the stream. Refer to **Section 6.2 - Segmenting Streams** for more information.
5. Go to the **Economics** tab to manipulate the cost calculations of the operation.
6. Click the **Open HEN Grid Diagram** icon to access the HEN Design view.

Open HEN Grid Diagram icon

7. On the HEN Design view, add heat exchangers and stream splitters to generate the HEN design.

1.1.2 Heat Integration Project

The Heat Integration Project (HI Project) operation is a tool used to design heat exchanger network (HEN). The HI Project is similar to the HI Case operation except for the following differences:

- The operation can contain multiple scenarios and designs.
- The operation can be switched to retrofit mode.
- The operation cannot perform simulation analysis.

General Procedure

The following is a general procedure to setup the HI Project operation:

1. Open the HI Project operation view.
2. Select a scenario from the Viewer group and go to the **Data** tab.
3. Go to the **Process Streams** page, and enter the following information:
   - Name, inlet temperature, outlet temperature, and MCp or enthalpy of the process stream.
4. Go to the **Utility Streams** page, and enter the following information:
   - If you are specifying your own utility: name, inlet temperature, and outlet temperature of the utility stream.
     If you want HX-Net to calculate the operating cost of the utility you have to supply a cost per energy value.
   - If you are using the utilities from HX-Net utility database: click the down arrow in the **Name** cell to open the drop-down list, and select the utility you want from the list.

If the utility in the Name cell is a hot utility, you cannot replace that hot utility with a cold utility, until after you click on the Name cell and press **DELETE**.

Once the previous utility occupying the row has been deleted, you can select a different type of utility to be added in that row.

5. If any of the streams in the HEN has large varying values for the specific heat capacity, you can segment the streams. Click once in the **Segm** cell to access the Process Stream view. The Process Stream view contains options to segment the stream. Refer to **Section 6.2 - Segmenting Streams** for more information.
6. Go to the **Economics** page to manipulate the cost calculations of the operation.
7. Select the design associated to the selected scenario in the Viewer group. The Main pane will now display the Grid Diagram.
8. On the Grid Diagram, add heat exchangers and stream splitters to generate the HEN design.

1.2 Heat Integration Manager View

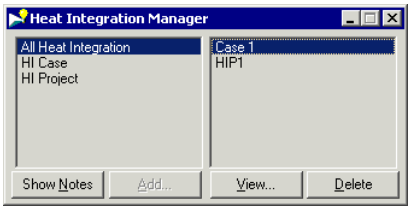
The Heat Integration Manager view is used to access, create, or delete two operations: Heat Integration Case and Heat Integration Project.

There are two methods of accessing the Heat Integration Manager view:

Heat Integration Manager icon

- Click on the **Heat Integration Manager** icon in the toolbar.
- Select the **Managers-Heat Integration Manager** command from the menu bar.

Figure 1.1



The Heat Integration Manager view contains four buttons used to manipulate the operations:

Button	Description
Show/Hide Notes	Allows you to access the notes associated to the operations.
Add	Allows you to add the operations.
View	Allows you to access existing operations in the case.
Delete	Allows you to delete existing operations in the case.

1.2.1 Adding an Operation

To add an operation:

Heat Integration Manager icon

1. Open the Heat Integration Manager view by clicking the **Heat Integration Manager** icon.
2. In the list on the left, select the type of operation you want to add. For example to add a HI Case operation, select **HeatIntegrationCase** from the left list.
3. Click the **Add** button, and the selected type of operation property view appears.

1.2.2 Editing an Operation

Heat Integration Manager icon

To edit an existing operation:

1. Open the Heat Integration Manager view by clicking the **Heat Integration Manager** icon.
2. In the list on the left, select the type of operation you want to edit. To see all the existing operation available, select **All Heat Integration** from the left list.
3. Select the operation you want to edit from the list on the right.
4. Click the **View** button, and the selected operation property view appears.

1.2.3 Deleting an Operation

Heat Integration Manager icon

To delete an existing operation:

1. Open the Heat Integration Manager view by clicking the **Heat Integration Manager** icon.
2. In the list on the left, select the type of operation you want to edit. To see all the existing operation available, select **All Heat Integration** from the left list.
3. Select the operation you want to delete from the list on the right.
4. Click the **Delete** button.
5. HX-Net will prompt you for a confirmation to delete the selected operation.
   Click the **Yes** button to delete the selected operation, or click the **No** button to not delete the selected operation.

1.2.4 Editing Operation Notes

Heat Integration Manager icon

To edit the notes associated to the operation:

1. Open the Heat Integration Manager view by clicking the **Heat Integration Manager** icon.
2. In the list on the left, select the type of operation you want.
   To see all the existing operation available, select **All Heat Integration** from the left list.
3. Select the operation you want from the list on the right.
4. Click the **Show Notes** button, to open the text editor at the bottom of the Heat Integration Manager view.
5. You can edit the notes associated to the selected operation in the text editor.
   If there has been no previous notes entered to the selected operation, the text editor will appear blank.

The text editor associated to the selected operation is connected to the Notes text editor of the selected operation. In other words, any changes made to the information in the text editor of an operation, will also appear in the Notes text editor of the operation, and vice versa.

6. Once you have completed editing the notes, you can hide the text editor by clicking the **Hide Notes** button.

1.3 HTC Database

The default heat transfer coefficient values are based on the assumption that there is no fouling on the surface of the heat exchanger.

HX-Net provides a default set of heat transfer coefficients in a heat transfer coefficient (HTC) database file. The default heat transfer coefficient values are listed on the HTC Database view.

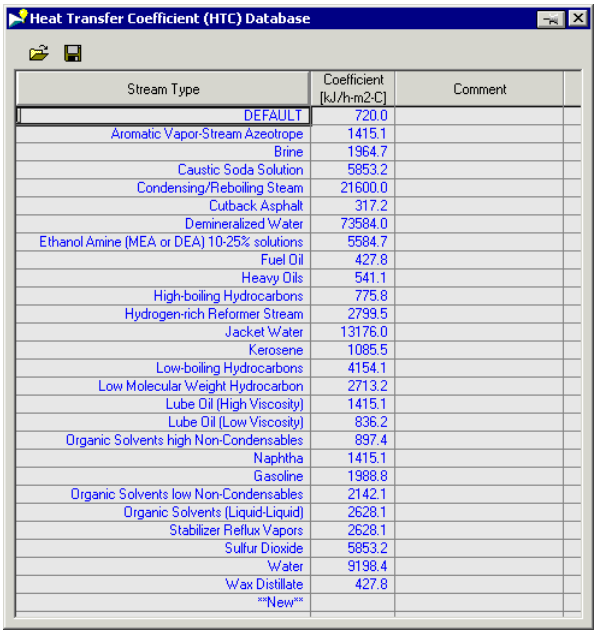
The default location and name for the HTC database file can be set in the Session Preferences view, Files tab, on the Locations page. For information about default location and name of files, refer to Section 5.4 - Preferences in the **User Guide**.

To access the HTC Database view:

1. Open the HI Case or HI Project view.
2. Locate and go to the **Options** tab/page.
3. Click the **HTC Database** button, and the HTC Database view will appear.

The HTC Database view is a modal view. Refer to Section **2.3.4 - Modal vs. Non-Modal** Views in the **User Guide** for information.

Figure 1.2



Stream Type	Coefficient [kJ/h-m2-C]	Comment
DEFAULT	720.0	
Aromatic Vapor-Stream Azeotrope	1415.1	
Brine	1964.7	
Caustic Soda Solution	5853.2	
Condensing/Reboiling Steam	21600.0	
Cutback Asphalt	317.2	
Demineralized Water	73584.0	
Ethanol Amine (MEA or DEA) 10-25% solutions	5584.7	
Fuel Oil	427.8	
Heavy Oils	541.1	
High-boiling Hydrocarbons	775.8	
Hydrogen-rich Reformer Stream	2799.5	
Jacket Water	13176.0	
Kerosene	1085.5	
Low-boiling Hydrocarbons	4154.1	
Low Molecular Weight Hydrocarbon	2713.2	
Lube Oil (High Viscosity)	1415.1	
Lube Oil (Low Viscosity)	836.2	
Organic Solvents high Non-Condensables	897.4	
Naphtha	1415.1	
Gasoline	1988.8	
Organic Solvents low Non-Condensables	2142.1	
Organic Solvents (Liquid-Liquid)	2628.1	
Stabilizer Reflux Vapors	2628.1	
Sulfur Dioxide	5853.2	
Water	9198.4	
Wax Distillate	427.8	
New		

The HTC Database view allows you to do the following options:

- View the entire list of default heat transfer coefficient values available in HX-Net.
- Modify the name, heat transfer coefficient, and/or notes of the default HTC variables.
- Add new HTC variables, with their heat transfer coefficient values and notes to the database.
- Save the modified HTC database as a ***.htc** file.
- Recall a previously saved HTC database file.

It is recommended that you do not save over the HX-Net default HTC database file.

1.3.1 Adding HTC Variable into HTC Database

To add new types of HTC variables into the HTC database:

1. Access the HTC Database view.
2. Under the **Stream Type** column, select the cell containing ****New**** and enter a name for the new HTC variable.
3. Under the **Coefficient** column, select the cell beside the new HTC variable and enter the new HTC value.
4. Under the **Comment** column, select the cell within the row of the new HTC variable and enter information regarding the new HTC variable.
5. Click the **Close** icon when you are done adding new HTC variables to close the HTC Database view.

Close icon

1.3.2 Modifying HTC variables in HTC Database

To modify HTC values in the HTC database:

1. Access the HTC Database view.
2. Select the appropriate cell that contains the value/parameter you want to modify and enter the new information.
3. Click the **Close** icon when you are done modifying the HTC variables to close the HTC Database view.

Close icon

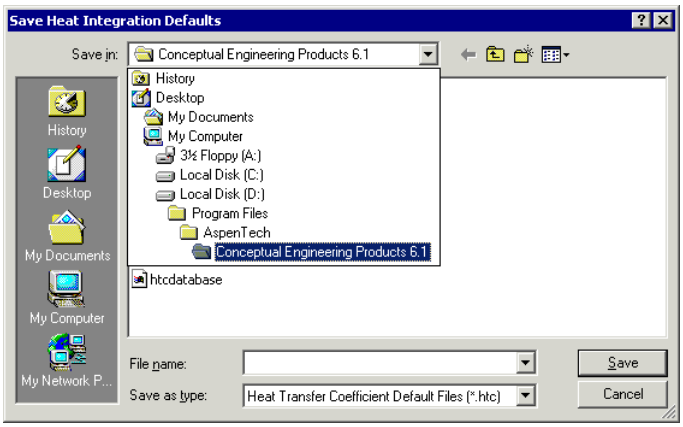
1.3.3 Saving HTC Database into a File

To save the HTC database into a *.htc file:

1. Access the HTC Database view.
2. Click the **Save Heat Transfer Coefficient Data to File** icon and the Save Heat Integration Defaults view appears.

Save Heat Transfer Coefficient Data to File icon

Figure 1.3



3. Select the location/folder to save the HTC database file using the **Save in** drop-down list.
4. Enter the HTC database file name in the **File name** field.
5. Click the **Save** button.

1.3.4 Accessing Saved HTC Database File

To access previous saved HTC database file:

1. Access the HTC Database view.
2. Click the **Open Saved Heat Transfer Coefficient Database** icon and the Open Heat Integration Defaults view appears.
   The Open Heat Integration Defaults view is similar to the Save Heat Integration Defaults view.
3. Locate the HTC database file you want to access using the **Look in** drop-down list.
4. Select the HTC database file you want and click the **Open** button.

Open Saved Heat Transfer Coefficient Database icon

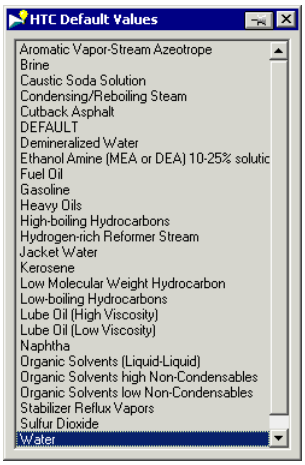
1.3.5 Selecting HTC from HTC Database

You can modify the list of HTC values available in the HTC database.

To select from the list of default HTC values:

1. Open the HI Case or HI Project view, and go to the **Process Streams** or **Utility Streams** tab/page.
2. Double-click the **HTC** cell in the process or utility stream row which you want to modify.
3. The HTC Default Values view will appear.

Figure 1.4



4. Select the type of HTC characteristic you want from the list by clicking on the name within the list.
5. Click the **Close** icon when you have selected the HTC value that you want.

Close icon

1.4 Matchwise Economic View

In calculating the cost of the HEN, you can specify unique cost sets for different types of heat exchangers you have in your simulation.

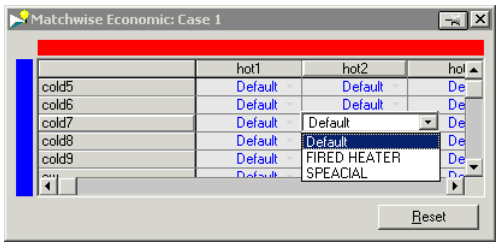
These unique cost sets can be specified in the Heat Exchanger Capital Cost Index Parameters group of the HI Case or HI Project views, and the Matchwise Economic view allows you to apply the unique cost laws to certain hot-cold stream pairs in the HEN.

To access the Matchwise Economic view:

1. Open the HI Case/HI Project views, and go to the **Economics** tab/page.
2. Click the **Matchwise Economics** button, and the Matchwise Economic view appears.

The Matchwise Economics view will appear blank, if you have not specified any process or utility stream.

Figure 1.5



The following table lists and describes the objects available in the Matchwise Economic view:

Object	Description
Top/First row	Displays the names of all the hot process and hot utility streams available in the operation.
Left/First column	Displays the names of all the cold process and cold utility streams available in the operation.
Rest of the cells	Allows you to select the type of cost set to be associated to the possible heat exchanger that is connected to the two intersecting streams. For example, a cell located in the *h1* column and *c2* row represents a possible heat exchanger that has process streams *h1* and *c2* flowing through it.
Reset button	Allows you to reset the cost set of all the possible heat exchangers to the HX-Net default cost set

You cannot delete the HX-Net default cost set.

By default HX-Net supplies one cost set. This default cost set is used for all stream pairings unless otherwise specified in the Matchwise Economics view.

Changing the Cost Set of a Heat Exchanger

To change the cost set for a heat exchanger:

1. Open the Matchwise Economics view.
2. Locate the column of the hot stream for the specific heat exchanger, for example heat exchanger *A*.
3. Locate the row of the cold stream for the heat exchanger *A*.
4. The cell where both column and row intersect, is the cell that controls the heat exchanger *A*'s capital cost calculation.

Refer to the **Material of Construction** section in **Section 6.2.6 - Economic Parameters** from the **Reference Guide** for more information on specifying cost sets.

5. Click the down arrow in the cell to open the drop-down list containing all the cost sets you had specified.
6. Select the cost set you want for the heat exchanger *A* from the list.
7. Click the **Close** icon when you have finish applying different cost sets to the heat exchangers.

1.5 Forbidden Matches View

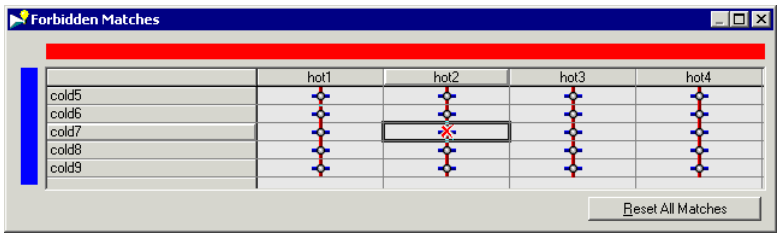
The Forbidden Matches view allows you to specify which two process streams cannot exchange heat with each other. The process streams may not be able to exchange heat due to plant layout, corrosion, or available material for construction.

To access the Forbidden Matches view:

1. Open the HI Case or HI Project view.
2. Go to the **Process Streams** tab/page of the operation view.
3. Click the **Open Forbidden Matches View** icon located at the bottom left corner of the operation view, and the Forbidden Matches view appears.

Open Forbidden Matches View icon

Figure 1.6



The Forbidden Matches view displays a matrix of hot and cold process streams. Cold process streams are positioned as rows in the Forbidden Matches matrix while hot process streams are positioned as columns.

You can toggle between forbidding or allowing hot and cold process stream pairs by clicking once on the cell that intersects both streams.

Forbid icon

Allow icon

- A cell that displays an icon with a red **X** indicates that the two process streams cannot exchange heat.
- A cell that displays an icon with a heat exchanger indicates that the two process streams can exchange heat.
- The **Reset All Matches** button allows you to remove all forbidden matches in the matrix. So all the process streams are allowed to exchange heat.

Refer to **Section 6.2.11 - Forbidden Matches** from the **Reference Guide** for more information.

When you specify a forbidden match, the area target method will automatically switch from the *Bath Formula* to *LP formulation*. Similarly, the utility allocation method changes to *GCC Based*.

2 Heat Integration Case

2.1 Introduction

The Heat Integration Case (HI Case) is the simplest of the three available operations used to design heat exchanger network (HEN). HI Case contains one scenario/one set of input parameters and one design/one Grid Diagram that displays one heat exchanger network.

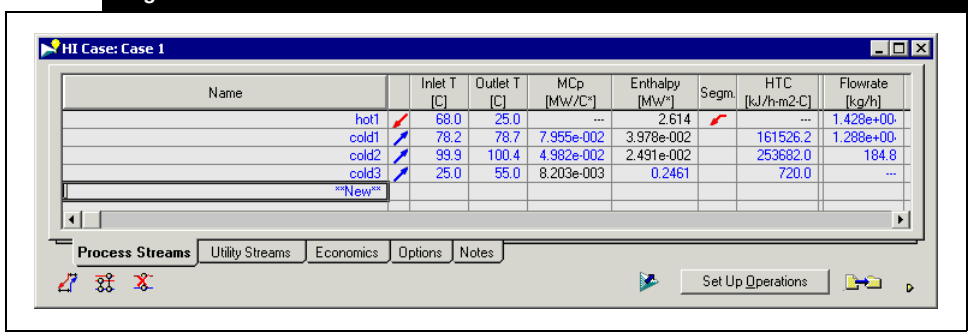
2.2 Heat Integration Case View

To access previously created HI Case operation, refer to **Section 1.2.2 - Editing an Operation**.

There are two ways to create a HI Case operation:

- Select the **Features-HI Case** command from the menu bar.
- Select the **Managers-Heat Integration Manager** command from the menu bar, to open the Heat Integration Manager view. In the Heat Integration Manager view select **HeatIntegrationCase** in the left list and click the **Add** button.

Figure 2.1



The HI Case view contains five tabs and nine objects at the bottom of the view. The number of objects at the bottom of the view varies depending on which tab is selected.

The following table lists and describes all the objects available in the HI Case view:

Object	Icon	Description
Open Targets View icon		Allows you to access the Targets view. This view contains calculated information regarding HEN design. Refer to **Section 2.3 - Targets View** for more information
Open HEN Grid Diagram icon		Allows you to access the HEN Design view. This view allows you to generate the HEN design. Refer to **Section 2.4 - Heat Exchanger Network View** for more information.
Open Forbidden Matches View icon		Allows you to access the Forbidden Matches view. This view allows you to forbid certain streams from interacting. Refer to **Section 1.5 - Forbidden Matches View** for more information.
Cold and Hot status bars		Displays whether or not there is sufficient cold /hot utilities in the HEN design for the process streams being cooled/heated to achieve the specified outlet temperature. Refer to **Section 6.2.3 - Hot and Cold Status Bars** from the **Reference Guide** for more information.
Process Stream Data Extraction From Simulation icon		Allows you to extract the stream information from a simulation file and placed them in the HI Case operation for a HEN design. Refer to **Chapter 8 - Data Extraction** for more information.
Set Up Operations button		Allows you to access the Operation Mode Data Set Up view. Refer to **Chapter 3 - Operations Mode** for more information.
Converts Case to Project icon		Allows you to convert the current HI Case operation to a HI Project operation. Refer to **Section 2.6 - Converting Case to Project** for more information.
Opens Current Page in Separate Window icon		Allows you to open the active tab into a separate view.

The Open Forbidden Matches View icon is only available when the *Process Streams* tab is active.

The Hot and Cold status bars are only available when the *Utility Streams* tab is active.

The Process Stream Data Extraction From Simulation icon is only available when the *Process Streams* tab is active.

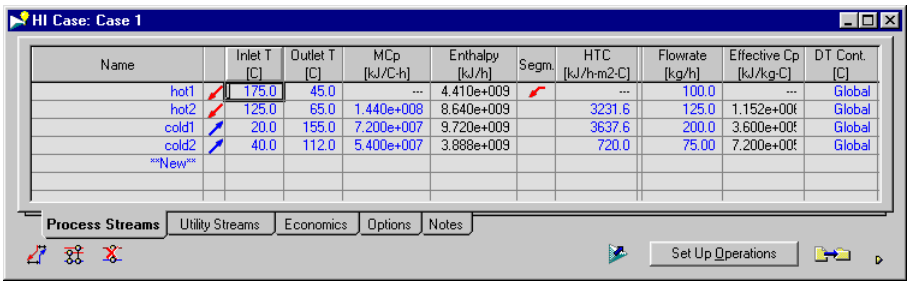
Once a HI Case has been converted to a HI Project, the HI Case no longer exist in the file and the HI Project cannot be converted back into a HI Case.

The following sections explain each tab in the HI Case view in greater detail.

2.2.1 Process Streams Tab

The Process Streams tab allows you to specify information about the process streams in the HEN.

Figure 2.2



You must enter the following information for the process stream: name, inlet temperature, outlet temperature, and MCp or Enthalpy of the process stream.

The following table lists and describes the objects in the Process Streams tab:

Object	Description
Name column	Allows you to specify the name of the process stream.
Stream Type column	Displays an icon to indicate the type of stream for the process stream. There are two types of stream: Hot and Cold. The cell in this column will appear blank until you specify the inlet and outlet temperature. Refer to **Section 6.2.1 - Process Streams** from the **Reference Guide** for more information.
Inlet T column	Allows you to specify the supply or inlet temperature of the process stream.
Outlet T column	Allows you to specify the target or outlet temperature of the process stream.
MCp column	Allows you to specify the heat capacity flow rate value of the process stream. • This cell displays a value only if the specific heat of the stream is assumed to be temperature independent. • If the stream contains piece wise linearized temperature (i.e., enthalpy curve), then this cell will contain this symbol (**---**).

Hot and Cold Stream icon

Refer to **Section 6.2.1 - Process Streams** from the **Reference Guide** for more information.

If the stream contains multiple segments, the Segm. cell will display one of the following two icons:

Segmented Hot Stream icon

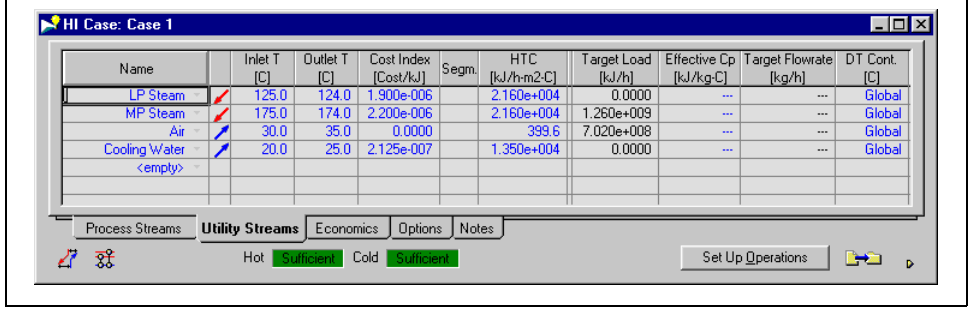
Segmented Cold Stream icon

Object	Description
Enthalpy column	Allows you to specify the enthalpy of the process stream. Refer to **Section 6.2.1 - Process Streams** from the **Reference Guide** for more information.
Segm. column	Allows you access to the Segment Data tab. This tab allows you to model changes in MCp over the temperature range of the hot or cold process stream. For more information on segmenting process streams, refer to **Section 6.1.1 - Segment Data Tab**.
HTC column	Allows you to specify the local heat transfer coefficient associated with the stream. HX-Net provides a default value of 720 kJ/hm^{2}C (35.22 Btu/hft^{2}F). If the stream contains segments, then this cell will contain this symbol (**---**). Refer to **Section 1.3.5 - Selecting HTC from HTC Database** for more information.
Flowrate column	Allows you to specify the mass flowrate of the stream.
Effective Cp column	Displays the specific heat capacity of the stream. This value is calculated only when a value for the flow rate has been specified. If the stream contains segments, then this cell will contain this symbol (**---**).
DT Cont. column	Allows you to specify the minimal approach temperature associated with the stream for calculating the target values. HX-Net provides a default global ΔT_{min} value of 10°C, which is represented by the word **Global** in the cell.

2.2.2 Utility Streams Tab

The Utility Streams tab allows you to specify the utilities used in the HEN to cool or heat the process streams.

Figure 2.3



If you have entered a hot stream in a cell, you have to delete the information in that cell, before you can replace the information in that cell with a cold stream.

There are two methods to adding utilities to the HEN:

- You can select a utility from the HX-Net Utility Database by clicking the down arrow in the **Name** cell and selecting the utility you want from the drop-down list.
- You can specify your own utility by entering the utility information in the appropriate cells.

If you are entering your own utility, you must enter the following information: name, inlet temperature, and outlet temperature of the utility stream.

If you want to calculate the operating cost of the utility you must enter the cost per energy value in the Cost Index cell. The operating cost of the utility is the Heat Load requirement of the utility multiplied by the Cost Index value.

HX-Net has two different capital cost calculation: an equation for general heat exchangers and an equation for Fired Heater. Refer to Section 2.2.3 - Economics Tab for more information.

The following table lists and describes the objects in the Utility Streams tab:

Hot and Cold Stream icon

If there is more than one segment in the stream and depending on the stream type, the Segm. cell will display one of the following two icons:

Segmented Hot Stream icon

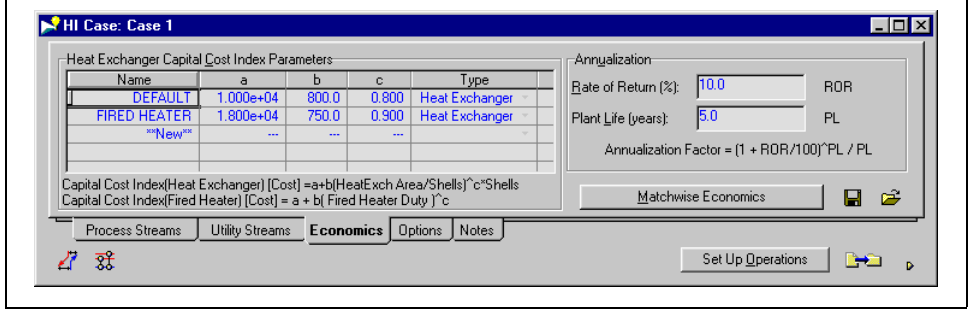
Segmented Cold Stream icon

Object	Description
Name column	Allows you to specify the name of utility stream or select a utility from the HX-Net Utility Database.
Utility Type column	Displays an icon to indicate the type of stream for the utility stream. There are two types of stream: Hot and Cold. The cell in this column will appear blank until you specify the inlet and outlet temperature or select a utility stream. Refer to **Section 6.2.2 - Utility Streams** from the **Reference Guide** for more information.
Inlet T column	Allows you to specify the supply or inlet temperature of the utility stream.
Outlet T column	Allows you to specify the target or outlet temperature of the utility stream.
Cost Index column	Allows you to specify the utility cost rate. Utility cost rate is based on dollars per unit heat load.
Segm. column	Allows you access to the Utility Stream view. For more information the Utility Stream view, refer to **Chapter 6 - Stream View**.
HTC column	Allows you to specify the heat transfer coefficient for the stream. HX-Net also provide a list of default heat transfer coefficient (HTC) values that you can select from. Refer to **Section 1.3.5 - Selecting HTC from HTC Database** for more information.
Target Load column	Displays the calculated Target Load value of the utility stream that satisfies the process stream temperature requirements in the heat exchanger network. The Target Load value is the total enthalpy change of the utility stream.
Effective Cp column	Allows you to specify the effective or overall heat capacity of the stream.
Target Flowrate column	Displays the calculated target flow rate when the value for effective heat capacity has been entered.
DT Cont. column	Allows you to specify the minimal approach temperature associated with the stream. HX-Net provides a default global ΔT_{min} value of 10°C, which is represented by the word **Global** in the cell.

2.2.3 Economics Tab

The Economics tab allows you to modify the cost calculations. There are two groups in the Economic tab: Heat Exchanger Capital Cost Index Parameters (HECCIP) and Annualization.

Figure 2.4



- The HECCIP group contains a set of parameter values for calculating the capital cost of the heat exchangers. You can have more than one set of parameter values.
  HX-Net has an economic database file, which contains one set of economic parameter values. By default, this set of parameter values always appears in the HECCIP group.
- The Annualization group contains parameter values for calculating the Annualization Factor.

You cannot delete the HX-Net default cost set.

Refer to **Section 6.2.6 - Economic Parameters** from the **Reference Guide** for more information about cost calculations.

The following table lists and describes the objects in the Economics tab:

Object	Description
Name column	Allows you to specify a name for a set of economic parameter values.
a column	Allows you to specify the installation cost of the heat exchanger. HX-Net default value for “a” is 10000.
b column	Allows you to specify the area/duty-related cost set coefficients of the heat exchanger. HX-Net default value for “b” is 800.
c column	Allows you to specify the area/duty-related cost set coefficients of the heat exchanger. HX-Net default value for “c” is 0.8.
Type column	Allows you to select the type of heat transfer configuration to be associated to the capital cost calculation. There are two selections: Heat Exchanger and Fired Heater.
Rate of Return field	Allows you to specify the rate of return percentage on the heat exchanger. HX-Net default value is 10%.

For more information about calculating capital cost, refer to **Section 6.2.6 - Economic Parameters** from the **Reference Guide**.

Object	Description
Plant Life field	Allows you to specify the length of time the plant will be operating. HX-Net default value is 5 years.
Matchwise Economics button	Allows you access to the Matches Economics view. This view allows you to specify different cost sets to certain heat exchangers. Refer to **Section 1.4 - Matchwise Economic View** for more information.
Save Heat Exchanger Capital Cost Parameters to File icon	Allows you to save the capital cost parameter data as an economic database/*.hcc file.
Open Saved Heat Exchanger Capital Cost Parameters icon	Allows you to open a previously saved economic database file with the extension *.hcc.

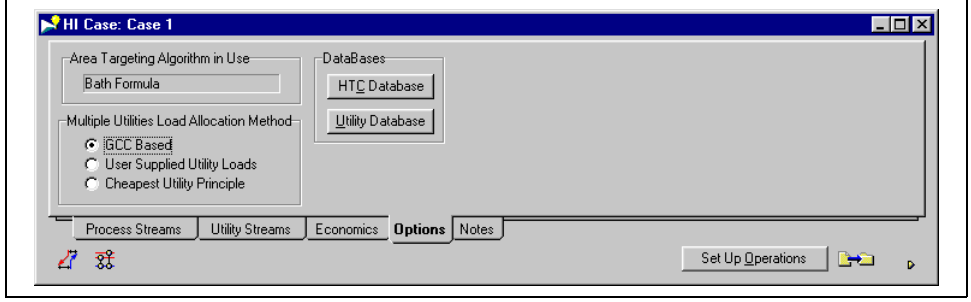
Save Heat Exchanger Capital Cost Parameters to File icon

Open Saved Heat Exchanger Capital Cost Parameters icon

2.2.4 Options Tab

The Options tab allows you to select the allocation for the utility load when there are multiple utilities. The area targeting algorithm currently in use is also displayed on the Options tab.

Figure 2.5



The following table lists and describes the objects available in the Options tab:

For more information about area targeting method, refer to **Section 6.3.3 - Area Targets** from the **Reference Guide**.

For more information about utilities load allocation method, refer to **Section 6.3.2 - Utility Load Allocation Methods** from the **Reference Guide**.

Object	Description
Area Targeting Algorithm in Use group	Displays the current method being used for the area targeting calculation. • If there are no forbidden matches, Bath Formula method is used. • If there are any forbidden matches, LP Formulation method is used.
Multiple Utilities Load Allocation Method group	Allows you to select one of the three different methods used to allocate utilities in the heat exchanger network. The three methods are: • GCC Based (HX-Net default selection) • User Supplied Utility Load • Cheapest Utility Principle
HTC Database button	Allows you to access the HTC Database view. This view allows you to modify the heat transfer coefficients in the database. Refer to **Section 1.3 - HTC Database** for more information.
Utility Database button	Allows you to access the Utility Database view. This view allows you to modify the utilities available in the database. Refer to **Section 10.2 - Utility Database View** from the **User Guide** for more information.

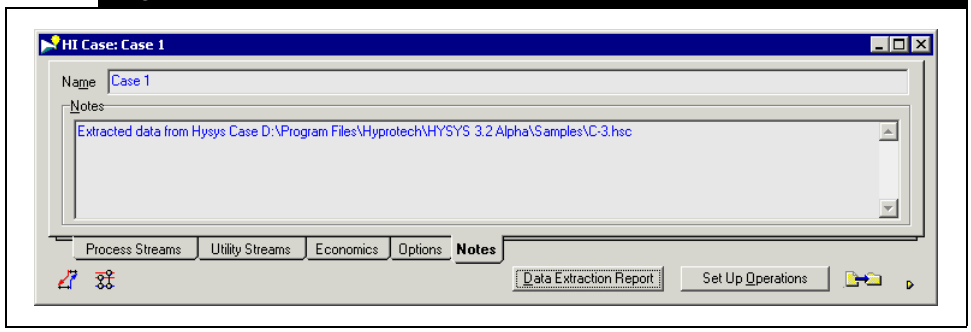
2.2.5 Notes Tab

The Notes tab allows you to:

- Change the name of the operation by entering a new name in the **Name** field.
- Enter information regarding the operation by entering the information in the **Notes** text editor.
- Observe the data extraction report, by clicking the **Data Extraction Report** button to open the Data Extraction Report view. The **Data Extraction Report** button only appears if data extraction has occurred for the operation. Refer to **Chapter 8 - Data Extraction** for more information.

Any changes made to the information in the Notes text editor, will appear in the text editor located at the bottom of the Heat Integration Manager view when the Show Notes button has been clicked.

Figure 2.6



2.3 Targets View

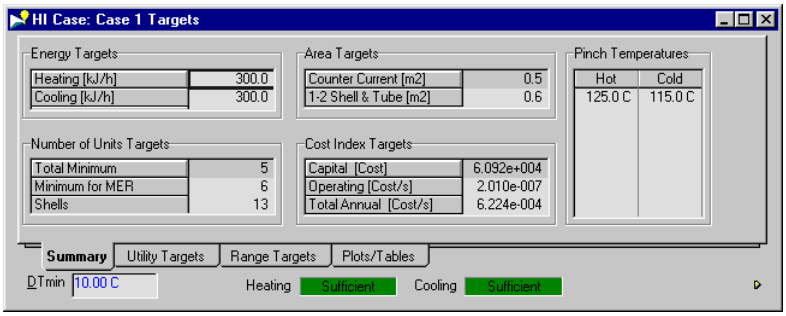
The Targets view allows you to observe all the target values for the values specified on the HI Case view.

To access the Targets view:

1. Open the HI Case view.
2. Click the **Open Targets View** icon located at the bottom left corner of the HI Case view, and the Targets view appears.

Open Targets View icon

Figure 2.7



The Targets view contains four tabs and six objects at the bottom of the view. The following table lists and displays all six objects that may be available in the view:

Object	Description
DTmin field	Allows you to specify the global minimum approach temperature for the heat exchangers in the HEN.
Heating and Cooling status bars	Displays whether or not there is sufficient cold /hot utilities in the HEN design for the process streams being cooled/heated to achieve the specified outlet temperature. Refer to **Section 6.2.3 - Hot and Cold Status Bars** from the **Reference Guide** for more information.
Insert DTmin button	Allows you to insert a DTmin value to be calculated in the Range Targeting calculations. Refer to **Section 2.3.3 - Range Targets Tab** for more information.
DTmin Range button	Allows you to access the Range Target view. This view allows you to specify a range of DTmin values. Refer to **Section 2.3.3 - Range Targets Tab** for more information.

The status bars are available for all tabs, except *Range Targets* tab.

The Insert DTmin, DTmin Range, Calculate, and Clear Calculate buttons are only available when *Range Targets* tab is active.

Object	Description
Calculate button	Allows you to begin calculation of a selected dependant variable over a range of a selected independent variable. Refer to **Section 2.3.3 - Range Targets Tab** for more information.
Clear Calculation button	Allows you to clear the previous calculated values from the plot and table on the Range Targets tab. Refer to **Section 2.3.3 - Range Targets Tab** for more information.
Opens Current Page in Separate Window icon	Allows you to open the active tab into a separate view.

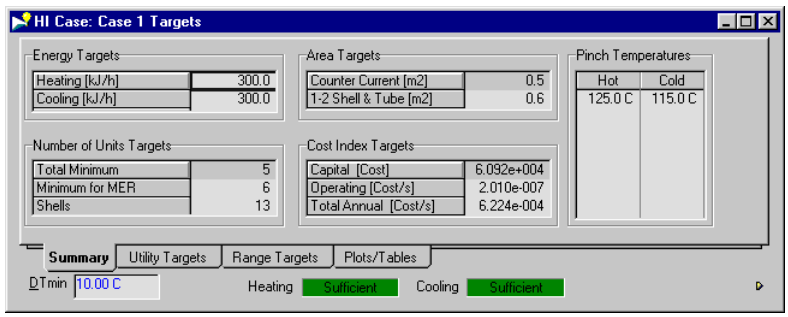
Opens Current Page in Separate Window icon

The following sections explain in detail each tab in the Targets view.

2.3.1 Summary Tab

The Summary tab displays all of the targets in four groups, and the pinch temperatures for the operation in the fifth group.

Figure 2.8



For more information regarding the target values, refer to **Section 6.3 - Targets** from the **Reference Guide.**

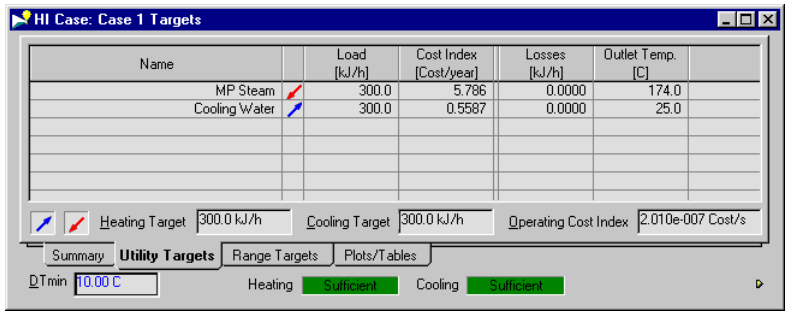
The following table lists and describes the groups available in the Summary tab:

Group	Description
Energy Targets	Displays the following target variables: • **Heating**. The minimum hot utility load required for the process streams in the heat exchanger network (HEN) to achieve their final values, after the energy available in the hot process streams have been transferred to cold process streams. • **Cooling**. The minimum cold utility load required for the process streams in the heat exchanger network (HEN) to achieve their final values, after the energy available in the hot process streams have been transferred to cold process streams.
Number of Units Targets	Displays the following target variables: • **Total Minimum**. The minimum total number of units required for the HEN system. • **Minimum for MER**. The minimum number of units required for the HEN system for MER design. The MER (Minimum Energy Requirement) design takes info account the pinch temperature. • **Shells**. The total minimum number of shells required for the HEN system. The minimum number of shells do not necessary equal the minimum total number of heat exchangers due to restriction on maximum heat transfer area for a shell.
Area Targets	Displays the following target variables: • **Counter Current**. The minimum amount of heat transfer area required when all exchangers are counter current. • **1-2 Shell & Tube**.The minimum amount of heat transfer area required when all exchangers are shell and tube.
Cost Index Targets	Displays the following target variables: • **Capital**. The minimum capital cost of the heat exchangers, based on area targets. • **Operating**. The minimum operating cost of the utilities, based on energy targets. • **Total Annual**. The minimum annualized cost of the heat exchanger network, based on capital and operating targets.
Pinch Temperature	Displays the hot and cold pinch temperatures in the HEN of the operation.

2.3.2 Utility Tab

The Utility tab contains a table that displays the targets for the individual utility stream.

Figure 2.9



The following table lists and describes the objects available on the Utility tab:

Hot and Cold Stream icon

Displays cold stream, hide hot stream.

Hide cold stream, displays hot stream.

Object	Description
Name column	Displays the name of the utility stream.
Utility Type column	Displays an icon to indicate the utility stream type. Refer to **Section 6.2.2 - Utility Streams** from the **Reference Guide** for more information.
Load column	Displays the calculated Target Load of the utility stream which satisfies the process stream temperature requirements in the heat exchanger network. The Target Load is the total enthalpy change of the utility stream.
Cost Index column	Displays the utility cost rate specified in the HI Case view, Utility Streams tab. Utility cost is based in dollars per unit heat load.
Losses column	Displays the target heat loss of the utility stream. Energy losses occur when the hot utility's outlet temperature is lower than the hot stream pinch temperature or the cold utility's outlet temperature is higher than the cold stream pinch temperature.
Outlet Temp. column	Displays the target or outlet temperature of the stream.
Displays Cold Utility Stream icon	Allows you to toggle between hiding and displaying the cold utility stream in the Utility Targets table. The default setting for this icon is active.
Displays Hot Utility Stream icon	Allows you to toggle between hiding and displaying the hot utility stream in the Utility Targets table. The default setting for this icon is active.

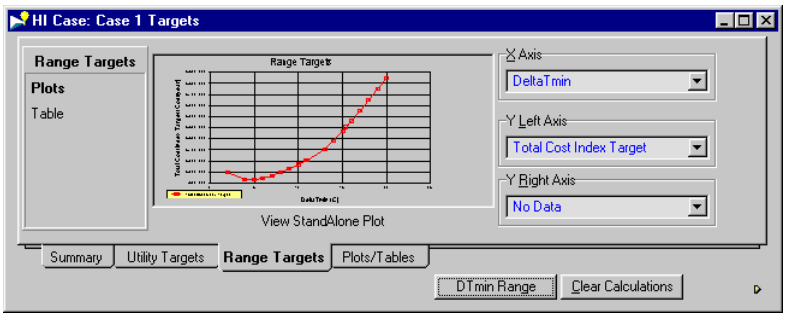
Object	Description
Heating Target field	Displays the total heat load for the hot utility stream.
Cooling Target field	Displays the total heat load for the cold utility stream.
Operating Cost Index field	Displays the total operating cost of the utilities in the HEN.

2.3.3 Range Targets Tab

For more information on Range Targets, refer to **Section 6.3.6 - Range Targeting** from the **Reference Guide**.

The Range Targets tab is split into two pages: Plots and Table. Both pages contain Range Targeting information pertinent to the optimization of the minimum approach temperature.

Figure 2.10



The plot and table in the Range Targets tab will appear empty until you click the *Calculate* button.

Underneath the Range Targets tab are two or three buttons: Insert DTmin, DTmin Range, Calculate, or Clear Calculations.

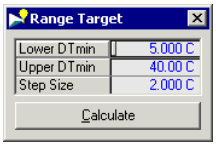
The following table lists and describes each button in detail:

Button	Description
Insert DTmin	Allows you to insertion of a specific DTmin value into the Range Targeting calculation. Available only when *Table* page is active.
DTmin Range	Allows you to access the Range Target view. This view allows you to specify the interval over which the Range Targeting calculation is performed.
Calculate	Allows you to begin the Range Targeting calculations. The calculated values are displayed on the table and plot. Available only when the plot or table is empty.
Clear Calculations	Allows you to clear the values that have been previously calculated from the plot and table. Available only when the plot and table contains calculated values.

Refer to the **Range Target View** section for more information.

Range Target View

To access the Range Target view: open the Targets view, go to the *Range Targets* tab, and click the *DTmin Range* button.



The Range Target view allows you to specify the range of values to be calculated in the Range Target calculations.

The following table lists and describes in objects available in the Range Target view:

Object	Description
Lower DTmin cell	Allows you to enter the minimum value in the range calculation.
Upper DTmin cell	Allows you to enter the maximum value in the range calculation.
Interval Size cell	Allows you to specify the interval or step size to be taken during the calculations.
Calculate button	Allows you to begin the Range Targeting calculations. The range of values to be calculated are based on the values entered in the *Lower DTmin* and *Upper DTmin* cells.

Performing a Range Target Calculation

After entering all the process streams, utility streams, and economic data you want, a range target calculation can be performed.

1. Open the Targets view and go to the **Range Targets** tab.
2. From either the **Plots** or **Table** page, click the **DTmin Range** button.
3. On the Range Target view, enter the following three information:
   - **Lower DTmin.** The minimum value for the range over which the calculations will occur.
   - **Upper DTmin.** The maximum value for the range over which the calculations will occur.
   - **Interval.** The step size to be taken when iterating over the range.
4. Click the **Calculate** button in the Range Target view.

To perform another calculation, click the *Clear Calculation* button at the bottom of the Range Targets tab to delete the current values.

Inserting a Value for Calculation

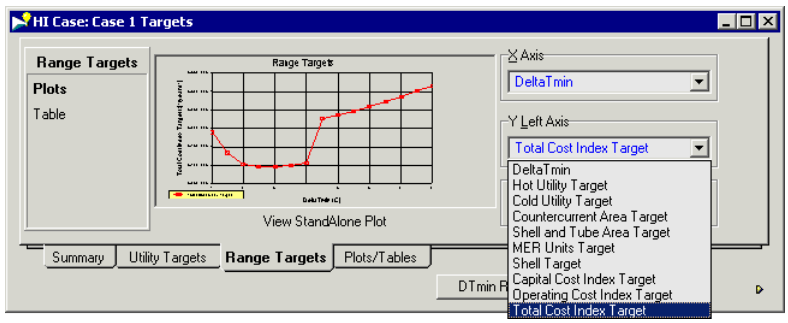
To add a specific DTmin value in the Range Target calculation:

1. Open the Targets view and go to the **Range Targets** tab.
2. Go to the **Table** page, and click the **Insert DTmin** button.
3. Click on the empty cell in the table and enter the DTmin value you want.

Plots Page

The Plots page displays all the optimization information of the Range Target table in graphical format. The information displayed on the plot depends on which variables you select for the X and Y axis of the plot.

Figure 2.11



The following table lists and describes the objects available in the Plots page:

Object	Description
Plot	Displays the Range Targeting calculated values in a plot.
View StandAlone Plot button	Allows you to display the plot in a separate view.
X Axis drop-down list	Allows you to select which variable you want to appear in the x axis of the plot.
Y Left Axis drop-down list	Allows you to select which variable you want to appear in the y axis on the left side of the plot.
Y Right Axis drop-down list	Allows you to select which variable you want to appear in the y axis on the right side of the plot.

The drop-down list for the x and y axes contains the following list of options:

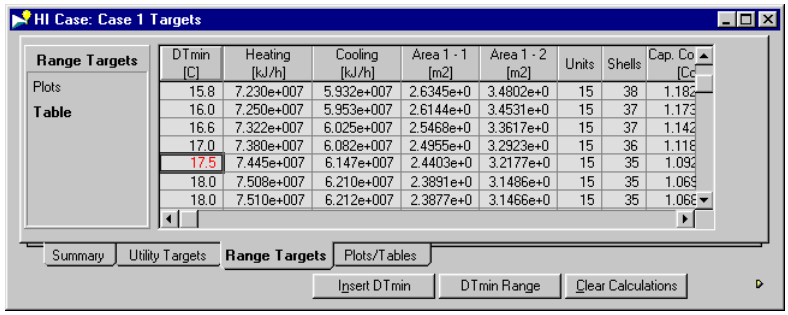
- Delta T Min
- Hot Utility Target
- Cold Utility Target
- Countercurrent Area Target
- Shell and Tube Area Target
- MER Units Target
- Shell Target
- Capital Cost Target
- Operating Cost Target
- Total Cost Target
- No Data. This option is available only for the right y axis.

Table Page

To perform another calculation, click the *Clear Calculation* button at the bottom of the Range Targets tab to delete the current values.

The Table page displays all cost data as a function of the Minimum Approach Temperature in a tabular format.

Figure 2.12



In order for HX-Net to calculate the Total Annual Cost of the heat exchanger network the following information must be provided:

- values for each of the utility cost
- cost law for the heat exchanger network
- values for the annualization factor parameters: Rate of Return (ROR) of the plant and the plant life (PL)

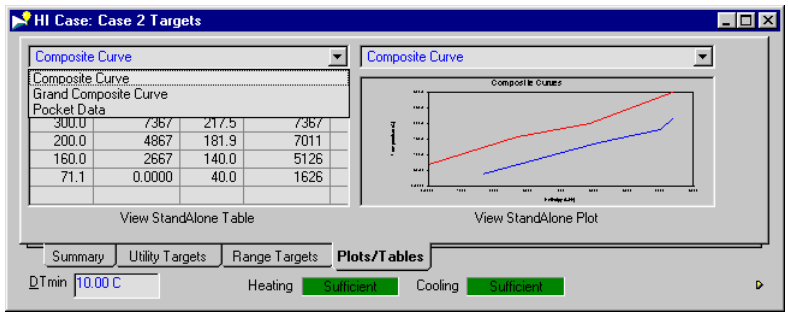
If no range values for ΔT_{min} is provided, HX-Net calculates the cost data for all ΔT_{min} values ranging from 0 to the calculated maximum ΔT_{min}. The default intervals for which the ΔT_{min} range is divided is determined using the Golden Search method.

2.3.4 Plots/Tables

For more details on the information contained within these curves, refer to **Section 6.3.7 - Plots** from the **Reference Guide**.

The Plots/Tables tab contains a table and a plot that displays curve information. The type of information displayed in the table and plot depends on the curve selected in the drop-down list above the table and plot respectively.

Figure 2.13



The following table lists and describes the objects available in the Plots/Tables tab:

Object	Description
Table drop-down list	Allows you to select which information you want to observe in the table. There are three selections to choose from: • **Composite Curve**. This table contains the inlet and outlet temperature of both hot and cold stream and the enthalpies that correspond to each temperature. • **Grand Composite Curve**. This table contains the shifted temperature between each temperature interval and the corresponding ethalpies. • **Pocket Data**. This table provides information about pockets on the grand composite curve. A pocket is a portion of the grand composite curve that can be satisfied completely with process-process heat transfer.
Table	Displays the information based on the option you selected in the drop-down list above the table.
View StandAlone Table button	Allows you to display the table in a separate view.

Object	Description
Plot drop-down list	Allows you to select which information you want to observe in the table. There are nine selections to choose from: • **Composite Curve**. This plot displays the graphical combination (or composite) of all hot or cold process streams in a heat exchange network. • **Grand Composite Curve.** This plot shows the heat available in various temperature intervals and the net heat flow in the process (which is zero at the pinch). • **Balanced Composite Curve**. This plot is similar to the Composite Curve, except both process and utility streams' information are combined. • **Utility Composite Curve**. This plot is similar to the Grand Composite Curve, except the utility composite curve (plot that contains information from the utility streams) is added. • **Shifted Composite Curve**. This plot is similar to the Composition Curve plot, except the hot composite curve is shifted down by $\Delta T_{min}/2$ and the cold composite curve is shifted up by $\Delta T_{min}/2$. • **Shifted Balanced Composite Curve**. This plot is similar to the Balanced Composition Curve, except the hot composite curve is shifted down by $\Delta T_{min}/2$ and the cold composite curve is shifted up by $\Delta T_{min}/2$. • **User Supplied Utility Load**. This plot is similar to the Composite Curve, except the plot contains the information from the utility streams instead of process streams. • **Hot Driving Force Curve**. This plot displays the temperature difference (driving force) between the hot and cold composite curves for the hot stream. • **Cold Driving Force Curve**. This plot displays the temperature difference (driving force) between the hot and cold composite curves for the cold stream.
Plot	Displays the information based on the option you selected in the drop-down list above the plot.
View StandAlone Plot button	Allows you to display the plot in a separate view.

Refer to **Section 7.4 - Plot Area** and **Chapter 8 - Plot Properties** from the **User Guide** for information on manipulating plots.

2.4 Heat Exchanger Network View

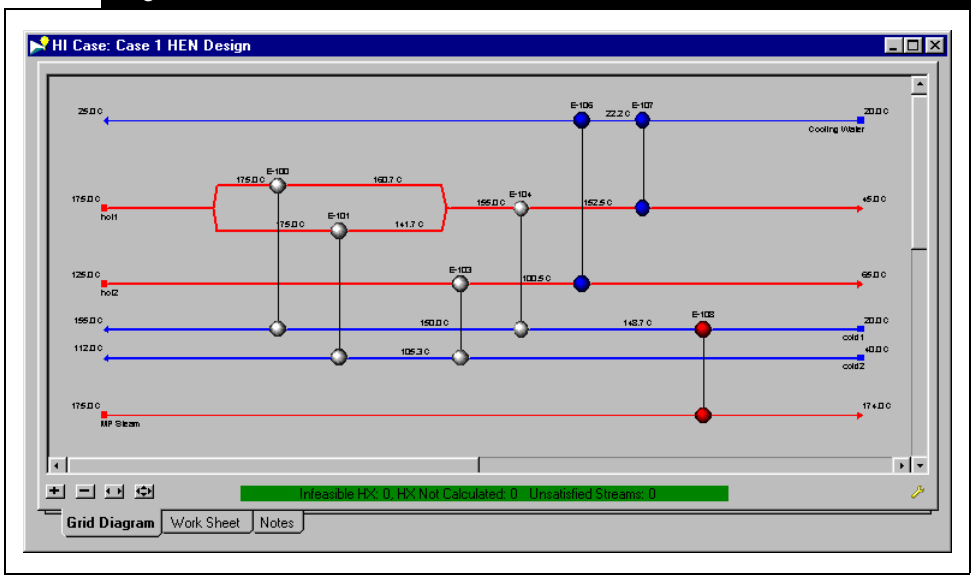
The HEN view allows you to build the network based on all of the parameters entered in the main view. The network can be manipulated through the Grid Diagram or the Worksheet.

To access the HEN view:

1. Open the HI Case view.
2. Click the **Open HEN Grid Diagram** icon located at the bottom left corner of the HI Case view, and the HEN view appears.

Open HEN Grid Diagram icon

Figure 2.14



The HEN view contains three tabs: Grid Diagram, Work Sheet, and Notes. The following sections describe each tab in detail.

2.4.1 Grid Diagram Tab

For detailed information on the Grid Diagram, refer to **Chapter 7 - Grid Diagram**.

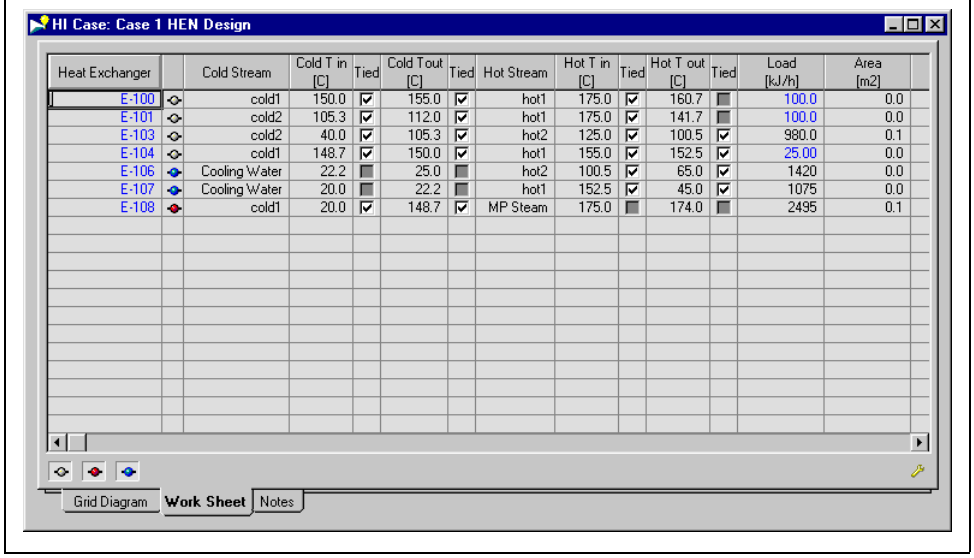
The Grid Diagram tab displays the heat exchanger network in a visual format. Heat exchanger, splitters, and mixers can be added via the Design Tools palette.

2.4.2 Worksheet Tab

For detailed information on the Worksheet, see **Section 7.7 - Worksheet Tab**.

The Worksheet tab is a tabular representation of the information found on the Grid Diagram. You can manipulation of existing heat exchangers through this tab.

Figure 2.15



Heat Exchanger	Cold Stream	Cold T in [C]	Tied	Cold Tout [C]	Tied	Hot Stream	Hot T in [C]	Tied	Hot T out [C]	Tied	Load [kJ/h]	Area [m2]
E-100	cold1	150.0	☑	155.0	☑	hot1	175.0	☑	160.7	☐	100.0	0.0
E-101	cold2	105.3	☑	112.0	☑	hot1	175.0	☑	141.7	☐	100.0	0.0
E-103	cold2	40.0	☑	105.3	☑	hot2	125.0	☑	100.5	☑	980.0	0.1
E-104	cold1	148.7	☑	150.0	☑	hot1	155.0	☑	152.5	☑	25.00	0.0
E-106	Cooling Water	22.2	☐	25.0	☐	hot2	100.5	☑	65.0	☑	1420	0.0
E-107	Cooling Water	20.0	☐	22.2	☐	hot1	152.5	☑	45.0	☑	1075	0.0
E-108	cold1	20.0	☑	148.7	☑	MP Steam	175.0	☐	174.0	☐	2495	0.1

2.4.3 Notes Tab

The Notes tab allows you to specify information regarding the HEN design by entering the information in the **Notes** text editor.

2.5 Operation Mode Data Set Up View

You can only switch from design mode to operation mode if the HEN design is complete.

The Operation Mode Data Set Up view allows you to specify/modify the assumptions/conditions of the heat exchangers at base case. Refer to **Section 3.2 - Op. Mode Data Set Up View** for more information.

Difference between Design and Operation Mode

The difference between design mode and operation mode are:

- In Design mode, you design/configure the heat exchanger network (HEN) based on simple assumptions. You do not worry about fouling occurring in the exchangers.
  In Operation mode, you analyse the performance of the heat exchanger in the HEN as changes occur in the plant. These changes can be from fouling in the exchanger to removing the exchanger for service repairs. In other words, you put the HEN through different simulation scenarios.
- The HI Case view only contains the following objects: **Open HEN Grid Diagram** icon, **Go to Design Mod**e button, and **Open Page** icon.
- The HI Case view, **Process Streams** tab only contains the following information on the process streams: name, type of process stream, inlet temperature, outlet temperature, enthalpy, and flowrate.
- The HI Case view, **Utility Streams** tab only contains the following information on the utility streams: name, type of utility stream, inlet temperature, outlet temperature, and cost index.

2.6 Converting Case to Project

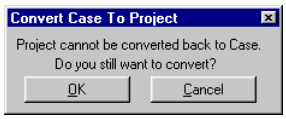
HX-Net allows you to convert a completed HI Case operation to a HI Project operation. By converting a HI Case into a HI Project, you have the same basic information (e.g., process streams and utility streams) from the HI Case operation, except in HI Project operation you can have multiple HEN designs.

Once the HI Case is converted to a HI Project, you cannot convert the HI Project back into a HI Case.

To convert a HI Case into a HI Project:

1. Open a HI Case operation with the HEN design completed.
2. Click the **Converts Case to Project** icon.
3. A warning view will appear, asking you to confirm the conversion:

Figure 2.16



- Click the **OK** button to continue with the conversion.
- Click the **Cancel** button to stop converting the case into a project.

4. If you click the **OK** button, HX-Net automatically deletes the HI Case operation creates a new HI Project operation containing all the specifications from previous the HI Case operation.

Refer to **Chapter 4 - Heat Integration Project** for more information about the HI Project operation.

3 Operations Mode

3.1 Introduction

For more information about the Operations mode, refer to **Chapter 7 - Heat Integration - Operations Mode** from the **Reference Guide**.

The HI Case offers two different settings for a heat exchanger network (HEN) design. The first setting is the Design mode where you specify and design a HEN, or extract a HEN from a HYSYS simulation. The other setting is the Operations mode where you run/simulate a fix HEN design with events (which are sets of tasks) to evaluate how the changes affect the performance of the HEN. A task is the value change of an operating variable. The simulation of events can be done at a point in time or during a period of time.

Differences between Design mode and Operations mode:

Design mode	Operations mode
• Modify the HEN	• HEN is fixed
• Designing/changing a HEN structure	• Studying how changes in the plant operating variables will affect the HEN
• Use in design phase	• Use in analysis/simulation phase

3.1.1 Entering Operations Mode

There are some restrictions before you can enter the Operations mode. One of the restrictions is that the process stream, utility stream, and economic parameters must contain some data. There must also exist a feasible design. You can enter all the required process and utility stream information and create the existing heat exchanger network (HEN) in HI Case operation, or you can extract a completed HEN.

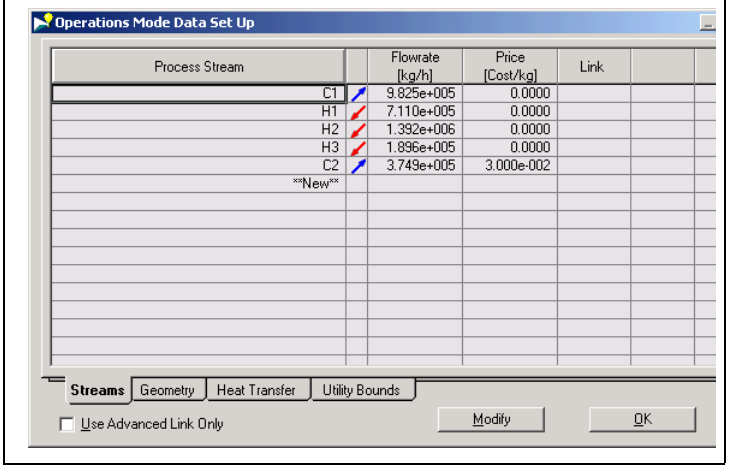
To enter the Operations mode:

1. Open a HI Case operation with a complete HEN design.
2. In the HI Case view, click the **Set Up Operations** button. The button is located in the lower right corner of the view.

Refer to **Section 3.2 - Op. Mode Data Set Up View** for more information.

3. The Operations mode Data Set Up (OMDSU) view will appear.

Figure 3.1



The base case is the starting point of the existing heat exchanger network (HEN) before you simulate any events in the HEN.

Unless specified, HX-Net will use a default base case, which assumes clean heat exchangers in the HEN.

4. You can modify the following variables of the heat exchanger network at base case before entering the Operations mode:
   - Flow rate and price of the process streams.
   - Geometry of the heat exchangers: area and number of shells in series.
   - Overall observed heat transfer coefficient of the heat exchangers.
   - Shell diameter of the heat exchanger.
   - Number of tubes and number of passes in the tube side.
   - Maximum amount of heat/energy provided by the utility streams.
5. Click the **Set Up** button when you are ready to enter the Operations mode.

3.2 Op. Mode Data Set Up View

The Operations Mode Data Set Up (OMDSU) view pops up before you enter Operations mode. The OMDSU view allows you to set up and modify the conditions of the heat exchangers and streams in the HEN. There are four tabs in the OMDSU view: Streams, Geometry, Heat Transfer, and Utility Bounds.

You can also access the OMDSU view from the HEN Design view, after entering the Operations mode. The OMDSU view will display the information in black text to signify that the values cannot be modify.

Any events executed before clicking the Modify button will return to not executed state, and a new base case will be generated based on the revised/updated values in the OMDSU view.

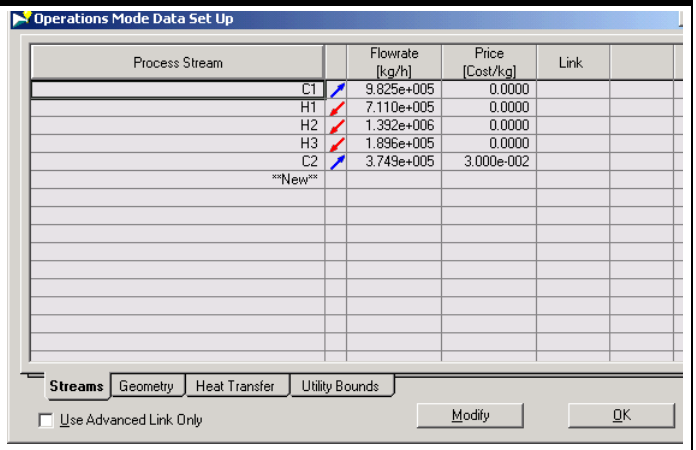
You can change the values in the OMDSU view by clicking the Modify button located at the bottom right corner of the OMDSU view.

3.2.1 Streams Tab

The Streams tab allows you to manipulate the mass flow rate of the process streams and assign prices for calculating the profit index for the heat exchanger network.

Notice some of the values in the table are blue colour text. This indicates that you can change the values.

Figure 3.2



The values for the stream flow rates in the table are based on the calculated values from the Design mode.

Use the **Streams** tab of the **Operations Mode Data Set Up** view to:

- Edit mass flowrates and prices to reflect current conditions.
- Enter and modify Simple Links and Advanced Links between streams.

To edit the flowrate and price of the process streams at base case for the Operation mode:

1. Access the Operations Mode Data Set Up view.
2. Click the **Streams** tab.
3. In the appropriate cell in the **Flowrate** column, enter the new flowrate of the process stream
4. In the appropriate cell in the **Price** column, enter the price of the process stream. To determine a profit index to be assigned to a stream, enter its cost (negative number) or profit (positive number).
5. When you have finished modifying the assumptions/conditions for the base case, click **Set Up**.

The **HI Case** operation is now in **Operation** mode.

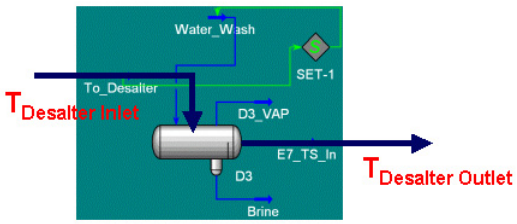
About Stream Links

The Linking Streams feature of HX-Net adds process stream inlet temperature and/or flowrate linking. The feature addresses the problem of linking unit operation outlet streams with the same unit operation inlet streams.

HX-Net lets you input the derivatives of unit operations temperatures and flowrates to link process streams that are outlets with the streams that are inlets.

In the Desalter example below, the issue is linking the inlet and outlet streams by temperature. In other unit operations, for example, Pre-Flash, flowrate is also important.

Figure 3.3



$$T_{\text{Desalter Outlet}} = T_{\text{Desalter Inlet}} + \Delta T_{\text{ Desalter}}$$

usually

$$\Delta T_{\text{Desalter}} < 0$$

General Equations for Linking

The general equations for linking by temperature and flowrate are shown below.

Link the outlet temperature of a process stream

$$T_{Outlet} = A + \Sigma\, B_i\, T_{(Inlet,\, i)} + \Sigma\, C_i\, mf_i$$

Link the flowrate of a process stream

$$mf = A + \Sigma\, B_i\, T_{(Inlet,\, i)} + \Sigma\, C_i\, mf_i$$

Note: Using the RefSYS Delta base utility it is possible to calculate the derivatives and obtain the coefficients.

The Linking Streams feature lets you establish two types of links

between streams:

These links	do this
Simple Links	link the inlet temperature of a process stream with the outlet temperature of another single process stream
Advanced Links	• link the inlet temperature of a process stream with multiple temperatures of other process streams and/or flowrates of other process streams • link the flowrate of a process stream with multiple temperatures of other process streams and/or flowrates of other process streams

Viewing All Links

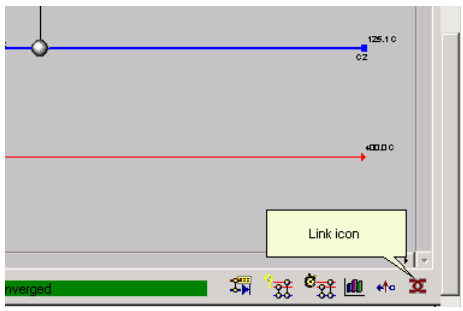
You can view the links in your simulation. If a simulation contains links, the **link** icon appears at the lower right corner of the Grid Diagram.

To view all links

1. Open the HEN Grid Diagram view.
2. Click the **Grid Diagram** tab.

The **Grid Diagram** view appears, showing the **link** icon .

Figure 3.4



3. Left click the **link** icon .

The **Streams Links Connections** view appears.

On the **Streams Links Connections** view, you can view:

- Temperature Links

- Flowrate Links

To view temperature links

- Click the **Temperature** tab.

To view flowrate links

- Click the **Flowrate** tab.

4. When you have finished viewing links, click **Close**.

Temperature Tab - Stream Links Connections View

Use the **Temperature** tab of the **Stream Links Connections** view to view **Temperature** links in the simulation.

To view Flowrate links

- Click the **Flowrate** tab.

To exit the Temperature tab and return to the Grid Diagram

- Click **Close**.

Flowrate Tab - Stream Links Connections View

Use the **Flowrate** tab of the **Stream Links Connections** view to view **Flowrate** links in the simulation.

To view temperature links

- Click the **Temperature** tab.

To exit the Flowrate tab and return to the Grid Diagram

- Click **Close**.

Adding Simple Links

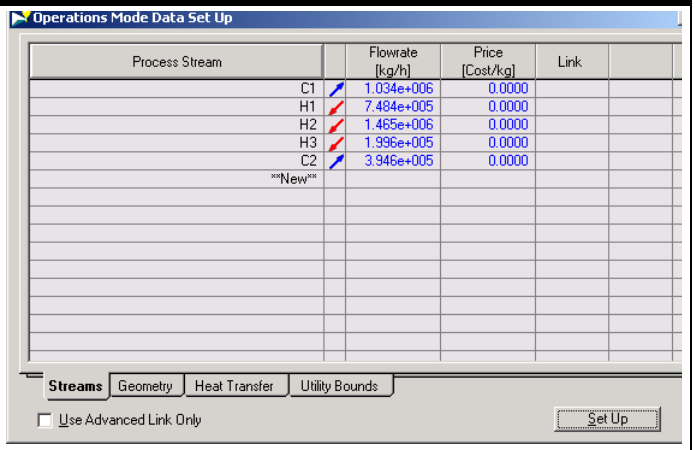
You can add Simple Links to the simulation.

To add simple links

1. Access the Operations Mode Data Set Up view.
2. Click the **Streams** tab.

The **Streams** tab appears.

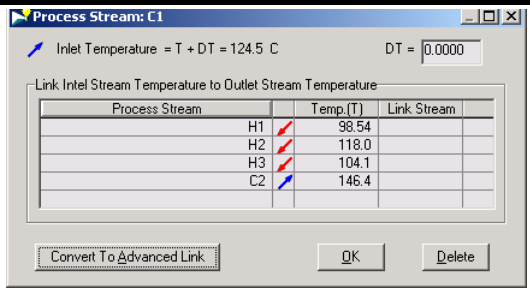
Figure 3.5



3. Clear the **Use Advanced Link Only** check box if it is selected.
4. Left-click in the **Link** column for the stream for which you want to add a **Simple** Link.

The **Simple Link** view appears.

Figure 3.6



The **Simple Link** view shows the Process Stream to which you are creating a **Simple** Link and the available process streams to which you can link it.

5. Left-click in the **Link Stream** column of the process stream you want to link to.

The **link** icon appears in the **Link Stream** column and the **DT** = field

displays the DT value.

6. Click **OK** to save your changes. execute the link, and return to the **Streams** view.
   -or-
   Click **Delete** to delete this link.

Editing Simple Links

You can edit the parameters of simple links. You can:

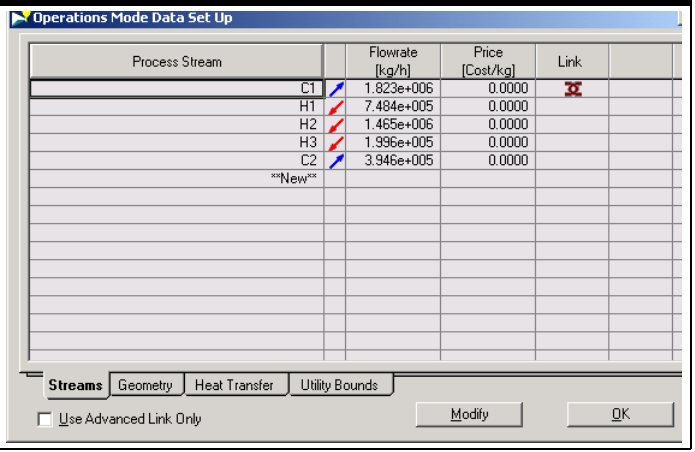
- Change the **DT =** value.
- Link the process stream to a different process stream
- Convert the Simple Link to an Advanced Link.

To edit simple links

1. Access the Operations Mode Data Set Up view.
2. Click the **Streams** tab.

The **Streams** tab appears.

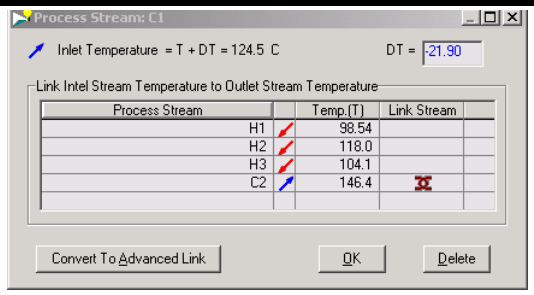
Figure 3.7



3. On the **Streams** tab, click **Modify**.
4. On the **Streams** tab in the **Link** column, double left-click the **link** icon for the link you want to edit.

The **Simple Link** view appears.

Figure 3.8



5. Perform the edits you want.

You can:

- Change the **DT =** value.
- Link the process stream to a different stream by left-clicking in the **Link Stream** column of the stream to which you want to link.
- Convert the Simple Link to an Advanced Link by clicking **Convert To Advanced Link**.

6. When you have finished editing the Simple Link, click **OK** to execute the Simple Link, and return to the **Streams** tab.

Deleting Simple Links

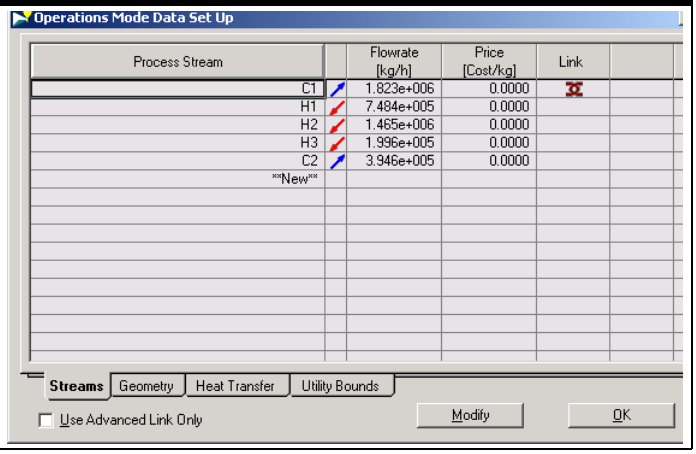
You can delete a Simple Link.

To delete simple links

1. Access the Operations Mode Data Set Up view.
2. Click the **Streams** tab.

The **Streams** tab appears.

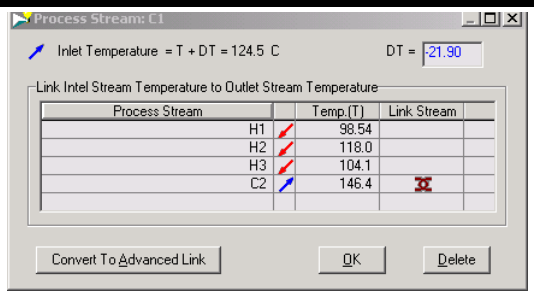
Figure 3.9



3. On the **Streams** tab, click **Modify**.
4. On the **Streams** tab in the **Link** column, double left-click the **link** con for the link you want to edit.

The **Simple Link** view appears.

Figure 3.10



5. Click **Delete**.

You are returned to the **Streams** tab. The **Simple Link** is deleted and the **link** icon is absent from the **Link** column.

Converting Simple Links to Advanced Links

You can convert a Simple Link to an Advanced Link. You might want to

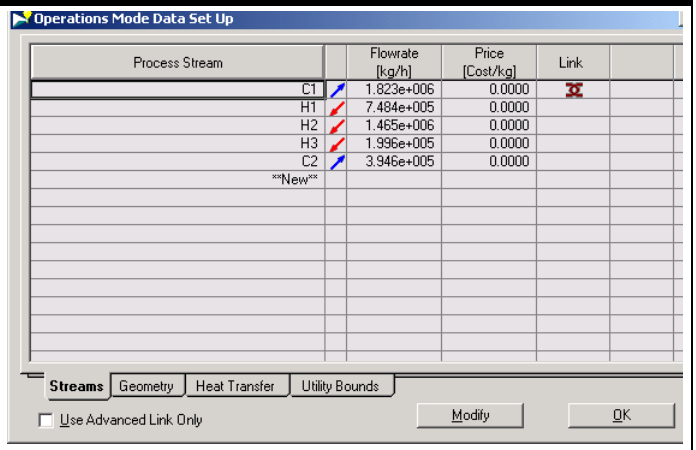
do this if you want to add more details or more streams to a Simple Link.

To convert a Simple Link to an Advanced Link

1. Access the Operations Mode Data Set Up view.
2. Click the **Streams** tab.

The **Streams** tab appears. The **link** icon appears in the **Link** column.

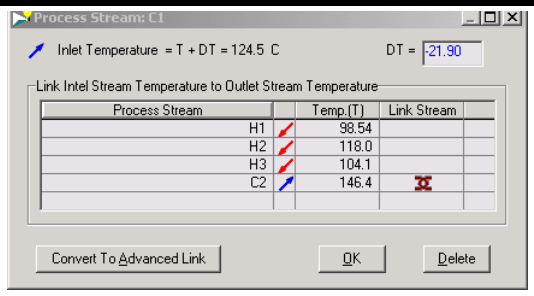
Figure 3.11



3. Clear the **Use Advanced Link Only** check box if it is selected.
4. Left-click the **link** icon for the link you want to convert to an Advanced Link.

The **Simple Link** view appears. The **link** icon appears in the **Link Stream** column.

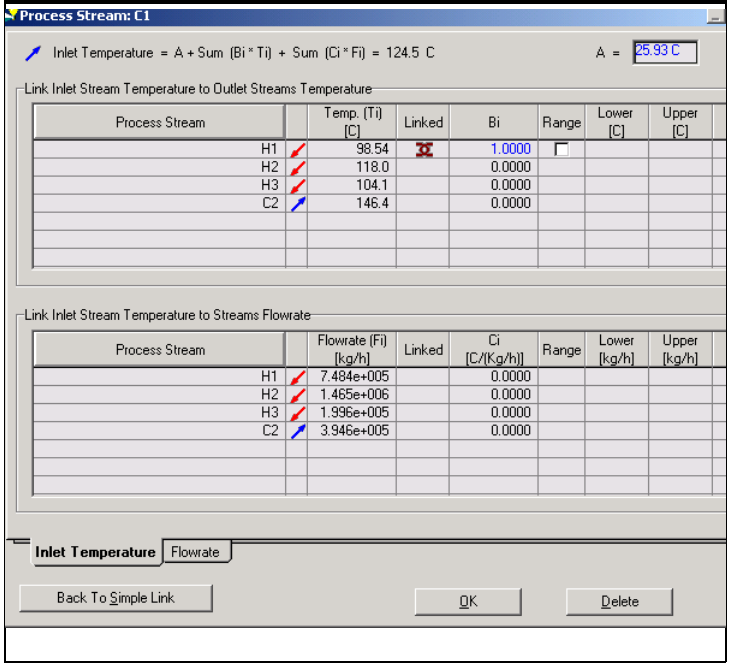
Figure 3.12



5. On the **Simple Link** view, click **Convert to Advanced Link.**

The **Advanced Link** view appears, with the **link** icon displayed from the **Simple Link** view.

Figure 3.13



6. Use the **Advanced Link** view to add or edit links.
7. When you have finished converting the Simple Link to an Advanced Link,
   Click **OK** to save your changes. execute the link, and return to the **Streams** view.
   -or-
   Use the **Advanced Link** view to add another Advanced Link.

Types of Advanced Links

There are two types of Advanced Links: **Temperature** linking and **Flowrate** linking.

Use this link	to
Temperature Link	link a stream's inlet temperature to outlet temperatures and/or flowrates of the other process streams.
Flowrate Link	link a stream's flowrate to outlet temperatures and/or flowrates of other process streams.

Linking Inlet Stream Temperature to Outlet Streams Temperatures

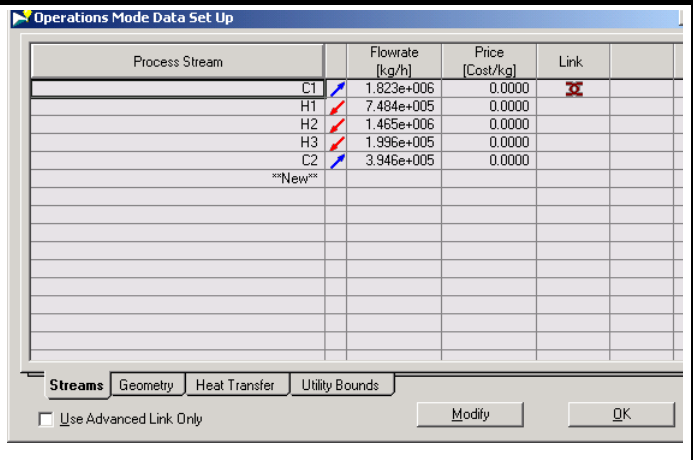
You can link the Inlet Stream Temperature to the Temperature(s) of one or more Outlet Streams.

To link the Inlet Stream Temperature to the Temperature(s) of one or more Outlet Streams

1. Access the Operations Mode Data Set Up view.
2. Click the **Streams** tab.

The **Streams** tab appears.

Figure 3.14

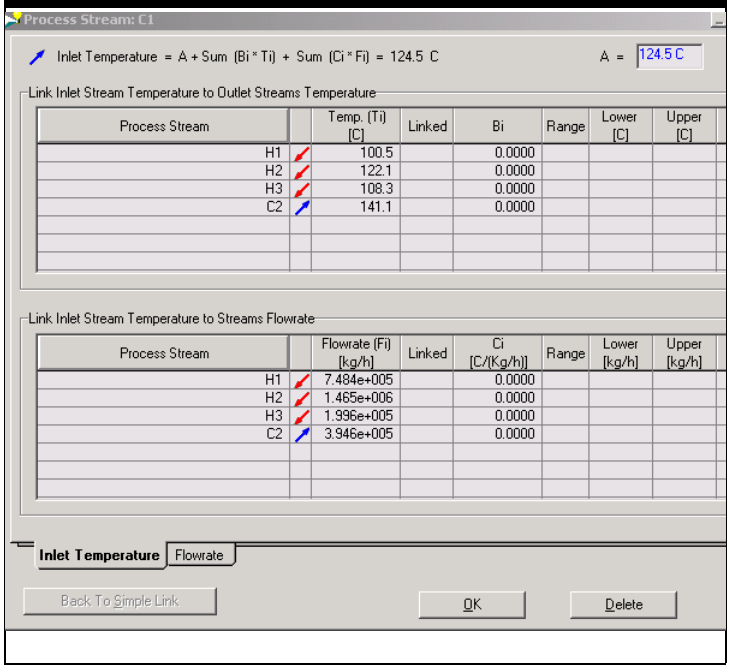


3. Select the **Use Advanced Link Only** check box if it is not selected.

4. Left-click in the **Link** column for the stream for which you want to add an Advanced Link.

The **Advanced Link** view appears.

Figure 3.15



5. Click **Inlet Temperature**.

The **Inlet Temperature** tab appears.

6. On the Inlet Temperature Tab, in the **Link Inlet Stream Temperature to Outlet Streams Temperature** group, left-click in the **Linked** column beside the stream to which you want to link the process stream.
7. If you do not want to use a temperature bounds range (either default or one you customize), clear the **Range** check box for the stream if it is selected.
8. If you want to use the default temperature bounds (specified on **Tools | Preferences | Temperature Bound**), select the **Range** check box if it is not selected.
9. If you want to change the temperature bounds for the stream, select the **Range** check box if it is not selected. Then change:

- the lower temperature bound.

-or-

- the upper temperature bound.

-or-

- both temperature bounds.

Note: If you change a bound so that it is outside of the range you set on the **Tools | Preferences** dialog, HX-Net generates an error message in the **Trace** window when you click **Set Up**. The error message is in this format:

The Outlet Temperature of Stream H1 is outside its bounds

Although HX-Net generates this warning message, it calculates the link(s) using the values you input in the bound(s).

10. Follow steps 6-9 above to link the process stream to another stream by temperature.
11. When you are finished linking to streams by temperature
    Click **OK** to save your changes. execute the link, and return to the **Streams** view.
    -or-
    Use the **Advanced Link** view to add another Advanced Link.

Linking Inlet Stream Temperature to Streams Flowrate

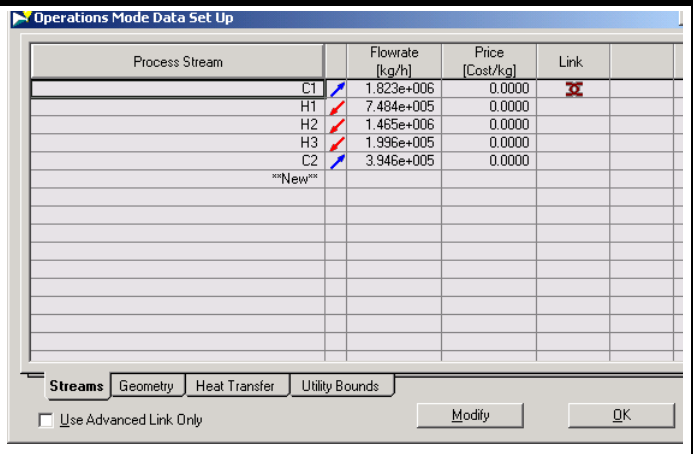
You can link the Stream Flowrate to the Temperature(s) of one or more Outlet Streams.

To link the Stream Flowrate to the Temperature(s) of one or more Outlet Streams

1. Access the Operations Mode Data Set Up view.
2. Click the **Streams** tab.

The **Streams** tab appears.

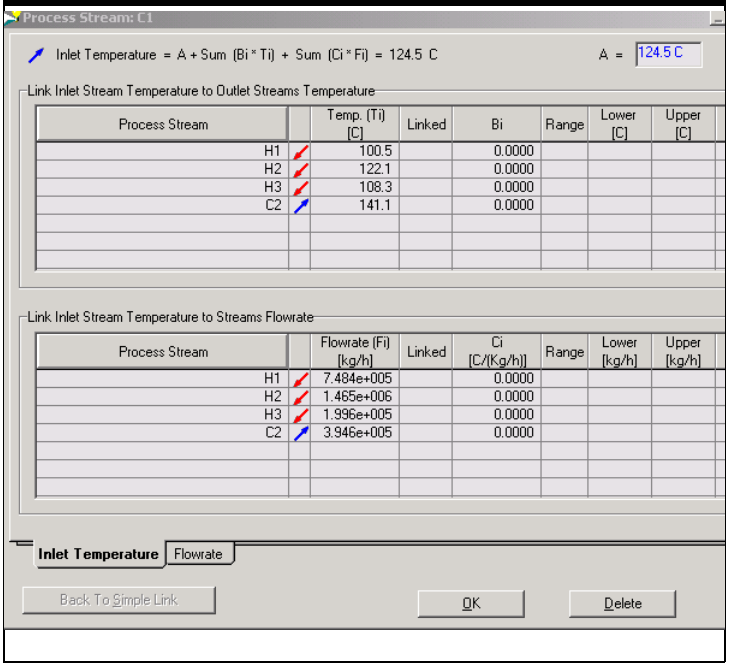
Figure 3.16



3. Select the **Use Advanced Link Only** check box if it is not selected.
4. Left-click in the **Link** column for the stream for which you want to add an Advanced Link.

The **Advanced Link** view appears.

Figure 3.17



5. Click **Flowrate**.

The **Flowrate**. tab appears.

6. On the **Flowrate** tab, in the **Link Stream Flowrate to Outlet Streams Temperature** group, left-click in the **Linked** column beside the stream to which you want to link the process stream.
7. If you do not want to use a temperature bounds range (either default or one you customize), clear the **Range** check box for the stream if it is selected.
8. If you want to use the default temperature bounds (specified on **Tools | Preferences | Temperature Bound**), select the **Range** check box if it is not selected.
9. If you want to change the temperature bounds for the stream, select the **Range** check box if it is not selected. Then change:
   - the lower temperature bound.

   -or-
   - the upper temperature bound.

-or-

- both temperature bounds.

Note: If you change a bound so that it is outside of the range you set on the **Tools | Preferences** dialog, HX-Net generates an error message in the **Trace** window when you click **Set Up**. The error message is in this format:

The Outlet Temperature of Stream H1 is outside its bounds

Although HX-Net generates this warning message, it calculates the link(s) using the values you input in the bound(s).

10. Follow steps 6-9 above to link the process stream to another stream by temperature.
11. When you are finished linking to streams by temperature
    Click **OK** to save your changes. execute the link, and return to the **Streams** view.
    -or-
    Use the **Advanced Link** view to add another Advanced Link.

Linking Stream Flowrate to Streams Flowrate

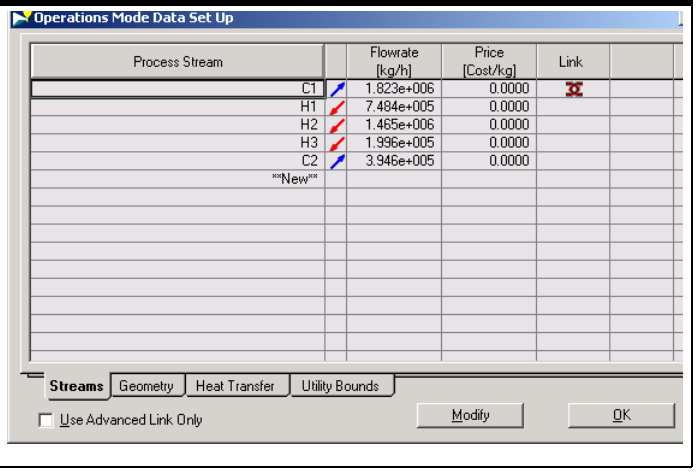
You can link the Stream Flowrate to the Flowrate(s) of one or more Streams.

To link the Stream Flowrate to the Stream Flowrate to the Flowrate(s) of one or more Streams

1. Access the Operations Mode Data Set Up view.
2. Click the **Streams** tab.

The **Streams** tab appears.

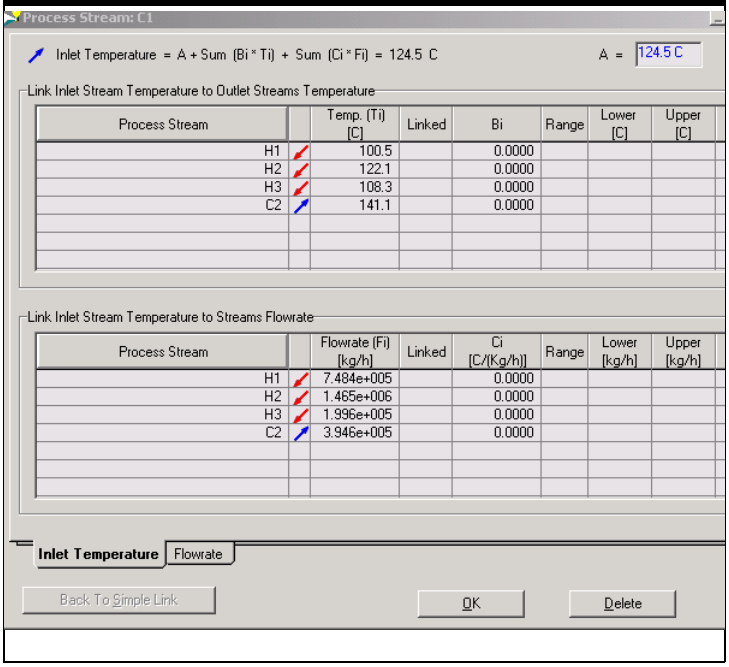
Figure 3.18



3. Select the **Use Advanced Link Only** check box if it is not selected.
4. Left-click in the **Link** column for the stream for which you want to add an Advanced Link.

The **Advanced Link** view appears.

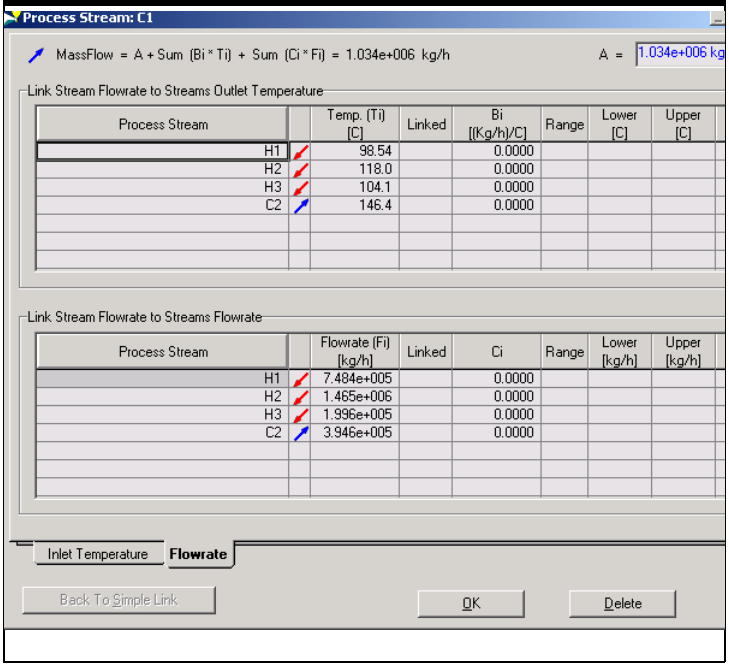
Figure 3.19



5. Click **Flowrate**.

The **Flowrate**. tab appears.

Figure 3.20



6. On the **Flowrate** tab, in the **Link Stream Flowrate to Streams Flowrate** group, left-click in the **Linked** column beside the stream to which you want to link the process stream.
7. If you do not want to use a flowrate bounds range (either default or one you customize), clear the **Range** check box for the stream if it is selected.
8. If you want to use the default flowrate bounds (specified on **Tools | Preferences | Flowrate Bound**), select the **Range** check box if it is not selected.
9. If you want to change the flowrate bounds for the stream, select the **Range** check box if it is not selected. Then change:
   - the lower flowrate bound.

   -or-
   - the upper flowrate bound.

   -or-
   - both flowrate bounds.

Note: If you change a bound so that it is outside of the range you set on the **Tools | Preferences** dialog, HX-Net generates an error message in the **Trace** window when you click **Set Up**. The error message is in this format:

The Outlet Temperature of Stream H1 is outside its bounds

Although HX-Net generates this warning message, it calculates the link(s) using the values you input in the bound(s).

10. Follow steps 6-9 above to link the process stream to another stream by flowrate.
11. When you are finished linking to streams by flowrate,
    Click **OK** to save your changes. execute the link, and return to the **Streams** view.
    -or-
    Use the **Advanced Link** view to add another Advanced Link.

Editing Advanced Links

You can edit the parameters of Advanced Links. You can:

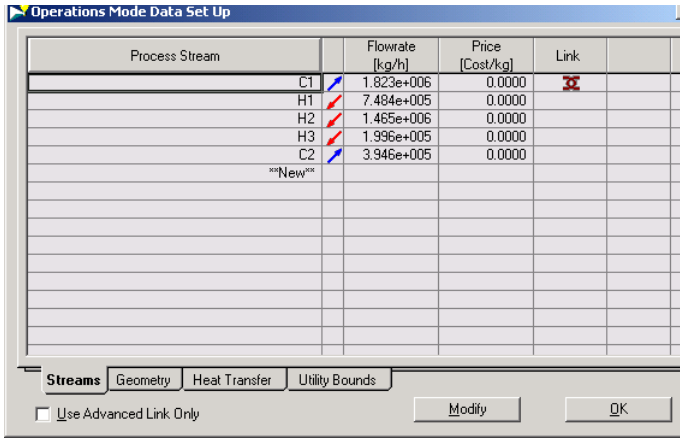
- Change the **A =** value.
- Link the Inlet Stream Temperature to Outlet Streams Temperatures.
- Link the Inlet Stream Temperature to Streams Flowrates.
- Link the Stream Flowrate to Outlet Streams Temperatures.
- Link the Stream Flowrate to Streams Flowrates.
- Change the lower or upper bounds of a stream's range.
- Return to the **Simple Link** view by clicking **Back to Simple Link**.

To edit advanced links

1. Access the Operations Mode Data Set Up view.
2. Click the **Streams** tab.

The **Streams** tab appears.

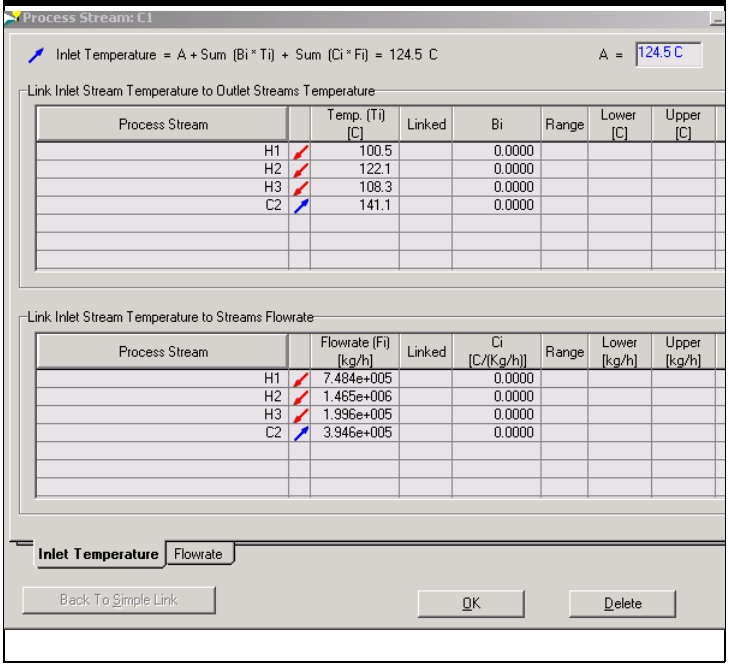
Figure 3.21



3. On the **Streams** tab, click **Modify**.
4. On the **Streams** tab in the **Link** column, left-click the **link** icon for the link you want to edit.

The **Advanced Link** view appears.

Figure 3.22



5. Perform the edits you want.
6. When you have finished editing the Advanced Link, click **OK**.

Editing Details of Advanced Steps

To change the A value

1. In the **A =** field, enter the correct value.
2. Click **OK** to save your changes and execute the link.

To link to one or more streams by temperature

1. In the **Link Inlet Stream Temperature to Outlet Streams Temperature** group, left-click in the **Linked** column beside the stream to which you want to link the process stream.
2. If you do not want to use a temperature bounds range (either default or one you customize), clear the **Range** check box for the stream if it is selected.

3. If you want to use the default temperature bounds (specified on **Tools | Preferences | Temperature Bound**), select the **Range** check box if it is not selected.
4. If you want to change the temperature bounds for the stream, select the **Range** check box if it is not selected. Then change:
   - the lower temperature bound.

   -or-
   - the upper temperature bound.

   -or-
   - both temperature bounds.

Note: If you change a bound so that it is outside of the range you set on the **Tools | Preferences** dialog, HX-Net generates an error message in the **Trace** window when you click **Set Up**. The error message is in this format:

The Outlet Temperature of Stream H1 is outside its bounds

Although HX-Net generates this warning message, it calculates the link(s) using the values you input in the bound(s).

5. Follow steps 1-4 above to link the process stream to another stream by temperature.
6. When you are finished linking to streams by temperature
   Click **OK** to save your changes. execute the link, and return to the **Streams** view.
   -or-
   Proceed to link the process stream to one or more streams by flowrate on the **Advanced Link** view.

To link to one or more streams by flowrate

1. In the **Link Inlet Stream Temperature to Outlet Streams Temperature** group, left-click in the **Linked** column beside the stream to which you want to link the process stream.
2. If you do not want to use a temperature bounds range (either default or one you customize), clear the **Range** check box for the stream if it is selected.
3. If you want to use the default temperature bounds (specified on **Tools | Preferences | Temperature Bound**), select the **Range** check box if it is not selected.
4. If you want to change the temperature bounds for the stream, select the **Range** check box if it is not selected. Then change:

- the lower temperature bound.

-or-

- the upper temperature bound.

-or-

- both temperature bounds.

Note: If you change a bound so that it is outside of the range you set on the **Tools | Preferences** dialog, HX-Net generates an error message in the **Trace** window when you click **Set Up**. The error message is in this format:

The Outlet Temperature of Stream H1 is outside its bounds

Although HX-Net generates this warning message, it calculates the link(s) using the values you input in the bound(s).

5. Follow steps 1-4 above to link the process stream to another stream by temperature.
6. When you are finished linking to streams by temperature
   Click **OK** to save your changes. execute the link, and return to the **Streams** view.
   -or-
   Use the **Advanced Link** view to add another Advanced Link.

Deleting Advanced Links

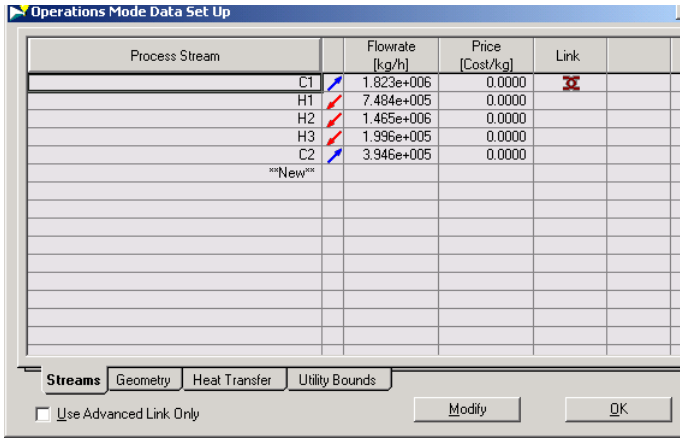
You can delete an Advanced Link Deleting an Advanced Link deletes all the links within that Advanced Link.

To delete advanced links

1. Access the Operations Mode Data Set Up view.
2. Click the **Streams** tab.

The **Streams** tab appears.

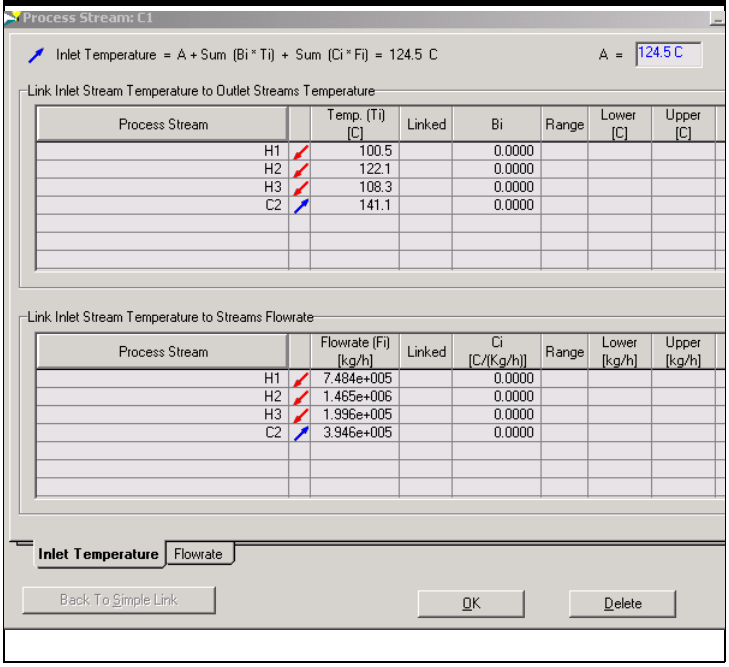
Figure 3.23



3. On the **Streams** tab, click **Modify**.
4. On the **Streams** tab in the **Link** column, left-click the **link** icon for the link you want to delete.

The **Advanced Link** view appears.

Figure 3.24



5. Click **Delete**.

You are returned to the **Streams** tab. The **Advanced Link** is deleted and the **link** icon is absent from the **Link** column.

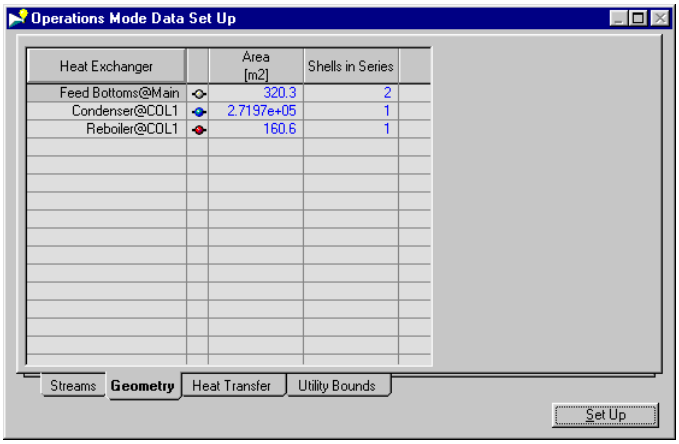
3.2.2 Geometry Tab

Notice some of the values in the table are blue colour text. This indicates that you can change the values.

The Geometry tab allows you to manipulate the geometry of the heat exchangers like area and number of shells in series for each exchanger

listed.

Figure 3.25



The calculated values in the table are based on the calculated values from the Design mode.

3.2.3 Heat Transfer Tab

The Heat Transfer tab allows you to manipulate the heat transfer properties of each heat exchanger. These properties are grouped into three pages: Observed, Shell Side, and Tube Side.

Observed Page

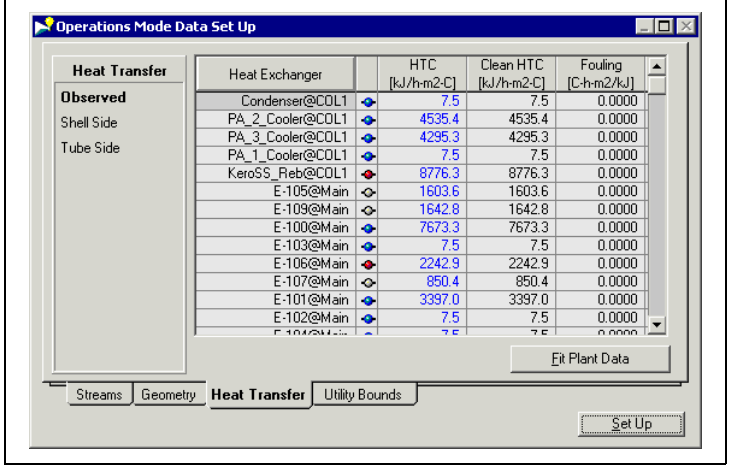
The default heat transfer coefficient (HTC) values in the table are known as the *clean* overall HTC values.

Clean HTC values are based on heat transfer of the exchangers without considering fouling.

Fouling values are based on the fouling value you specified in the **Process Strems** tab for each stream.

The Observed page allows you to change the overall observed heat transfer coefficient value of the heat exchangers.

Figure 3.26



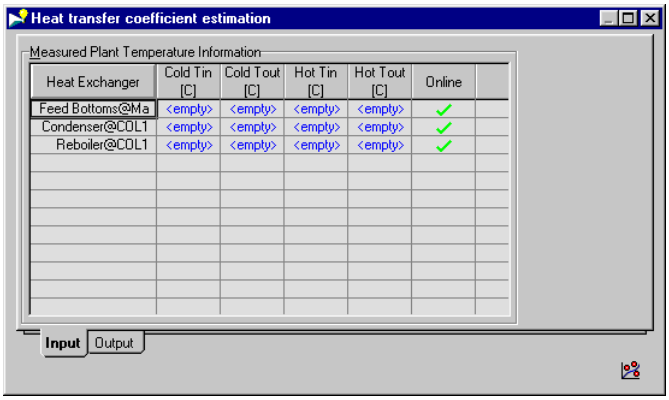
There are two ways to manipulate the overall heat transfer coefficient (HTC) value:

- You can enter the overall HTC value in the appropriate cell under the **HTC** column.
- You can click the **Fit Plant Data** to access the Heat transfer coefficient estimation view.

HTCE View

The Heat transfer coefficient estimation (HTCE) view allows you to generate an overall HTC value based on the measured hot and cold stream temperatures flowing through the heat exchanger.

Figure 3.27



The HTCE view contains two tabs (Input and Output) and the Fit heat transfer coefficient to plant data icon.

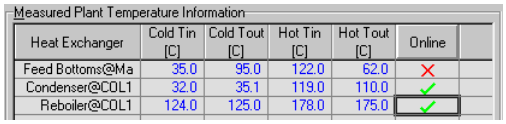
- **Input** tab allows you to enter the inlet and outlet stream temperatures for both hot and cold streams flowing through the heat exchanger. The overall HTC value will be calculated based on those specified values.

  The **Online** column allows you to specify which exchangers are in operation (Green checkmark icon) and which are not in operation (Red X icon), when the specified stream temperatures were measured.

Green checkmark icon

Red X icon

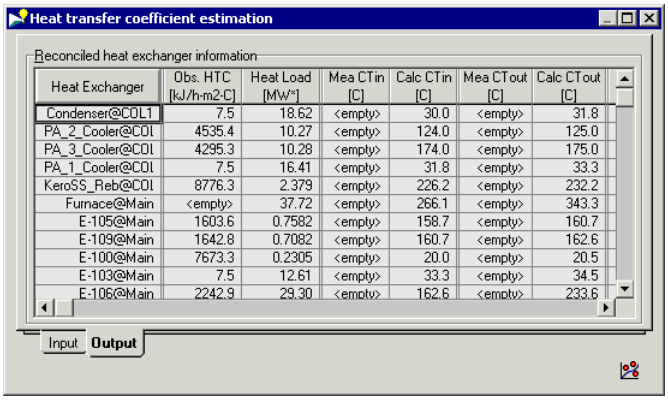
Figure 3.28



Fit heat transfer coefficient to plant data icon

- **Fit heat transfer coefficient to plant data** icon allows HX-Net to go ahead and estimate the values for the heat transfer coefficients by minimizing the summation of the squares of the differences between the measure temperatures (in the **Input** tab) and the calculated temperatures.
- **Output** tab displays the generated values taken from the Design mode and (if any) the specified values from the **Input** tab. So you can compare the values you specified with the values generated by HX-Net.

Figure 3.29

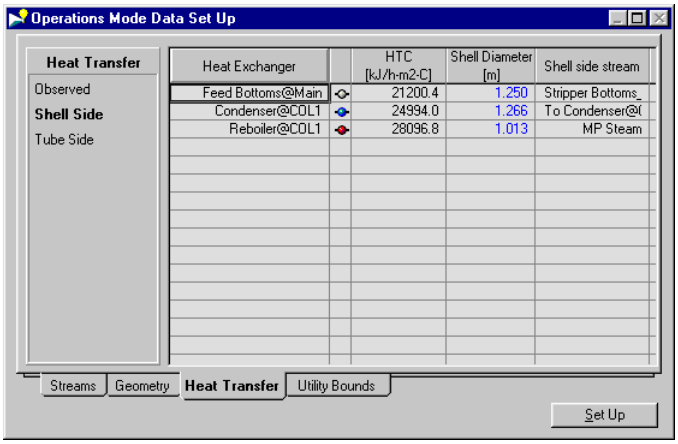


Shell Side Page

The default shell diameter is the calculated optimum diameter based on the clean HTC value.

The Shell Side page displays the clean heat transfer coefficient (HTC) on the shell side, diameter of the shell, and stream flowing in the shell each heat exchanger. You can change the shell diameter to modify the calculated clean shell side HTC.

Figure 3.30

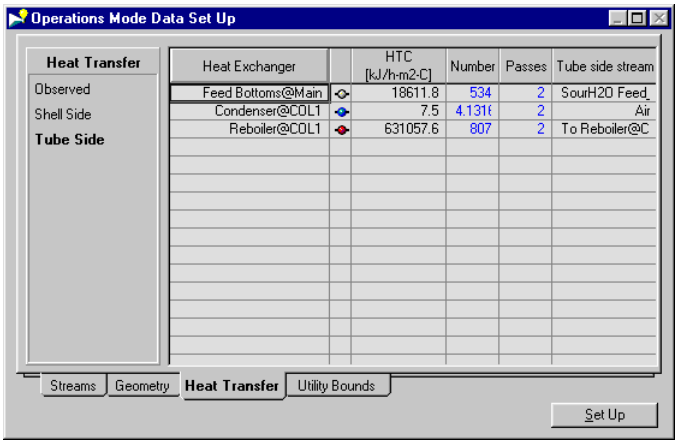


Tube Side Page

The default number of tubes and tube passes are the calculated optimum values based on the clean HTC value.

The Tube Side page displays the clean heat transfer coefficient (HTC) on the tube side, number of tubes, number of passes made by the tubes, and the stream flowing through the tube for each heat exchanger. You can manipulate the number of tubes and number of passes values to change the value of the calculated clean tube side HTC.

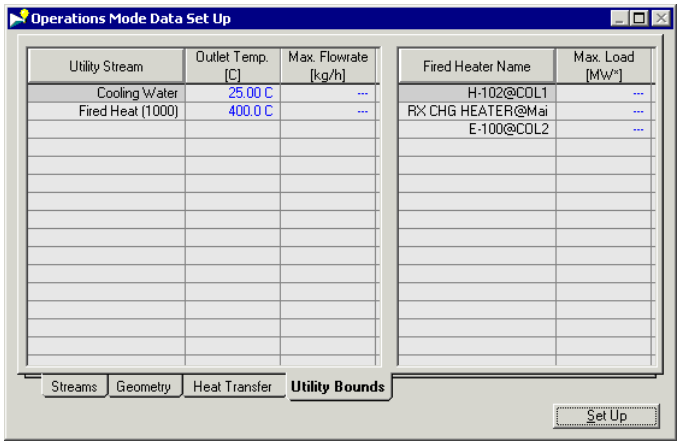
Figure 3.31



3.2.4 Utility Bounds Tab

The Utility Bounds tab allows you to specify the outlet temperature and maximum flow rate for the utility stream(s), and the maximum energy/ load for the fired heat exchanger (s).

Figure 3.32



No bounds are considered for the cells that are left empty.

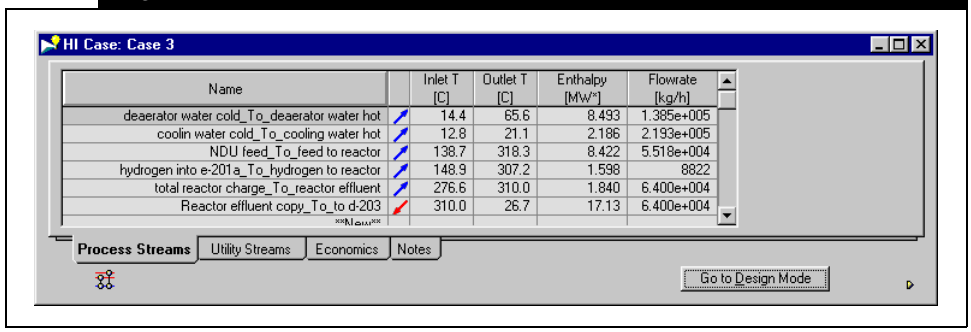
The Operations Mode Data Set Up view allows you to modify the geometry and heat transfer parameters of the heat exchangers to improve the consistency of the simulation with your plant data.

3.3 HI Case View

For more information on the general setup of the Heat Integration Project, refer to **Chapter 4 - Heat Integration Project**.

In Operations mode, the HI Case view is slightly different. There are only four tabs in the HI Case view and only three objects located at the bottom of the view.

Figure 3.33



The following table lists and describes the objects located at the bottom of the HI Case view:

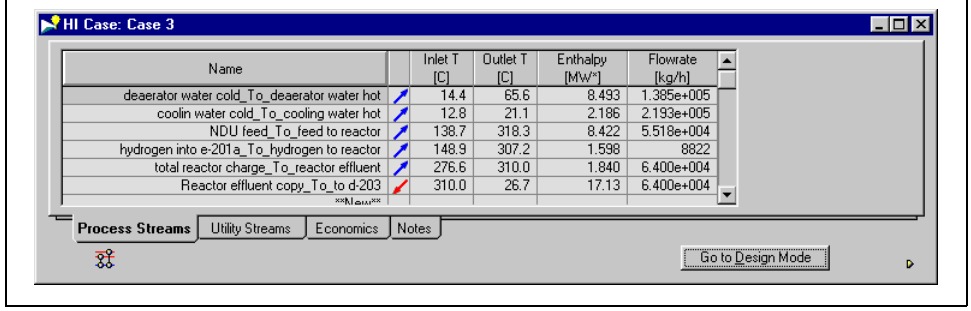
Object	Icon	Description
Open HEN Grid Diagram icon		Allows you to access the HEN Design view. Refer to **Section 3.4 - HEN Design View** for more information.
Go to Design Mode button		Allows you to return the settings back to Design mode.
Opens Current Page in Separate Window icon		Allows you to open the active tab into a separate view.

The following sections describe the difference in the tabs between Design mode and Operations mode for the HI Case view.

3.3.1 Process Streams Tab

The Process Streams tab displays information about the process streams in the HEN.

Figure 3.34

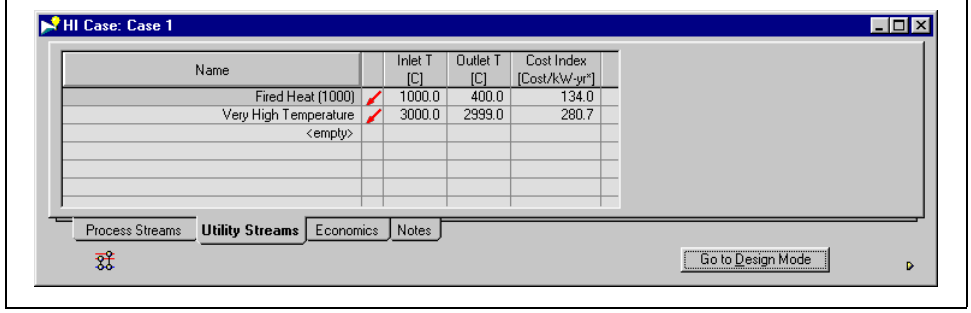


In Operations mode, you cannot modify any information on this tab. Refer to **Section 2.2.1 - Process Streams Tab** for more information.

3.3.2 Utility Streams Tab

The Utility Streams tab in Operations mode displays information about the utility streams in the HEN.

Figure 3.35

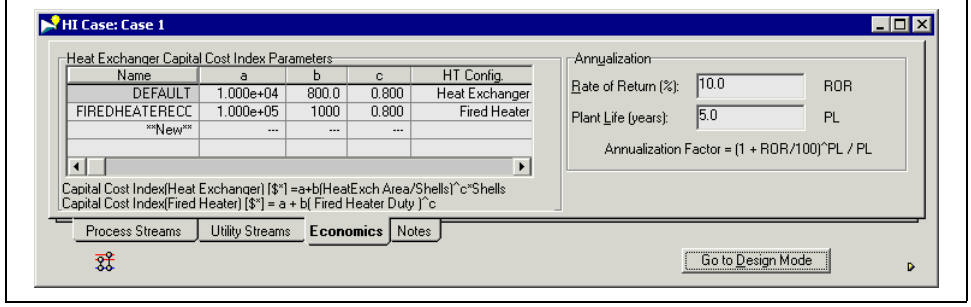


In operations mode, you cannot modify any information on this tab. Refer to **Section 2.2.2 - Utility Streams Tab** for more information.

3.3.3 Economics Tab

The Economics tab displays the cost set and economic parameter values used to calculate the capital cost of the exchangers.

Figure 3.36



In operation mode, you cannot modify any information on this tab. Refer to **Section 2.2.3 - Economics Tab** for more information.

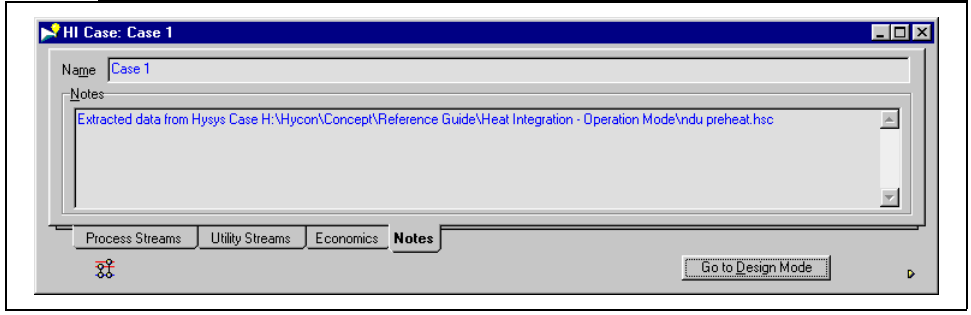
3.3.4 Notes Tab

The Notes tab allows you to:

- Change the name of the operation by entering a new name in the **Name** field.
- Enter information regarding the operation by entering the information in the **Notes** text editor.
- If the HEN design was extracted from a simulation file (like HYSYS), the **Notes** text editor will display a note indicating where the extracted file is located.

Any changes made to the information in the Notes text editor, will appear in the text editor located at the bottom of the Heat Integration Manager view when the Show Notes button has been clicked.

Figure 3.37



3.4 HEN Design View

The HEN Design view in Operations mode and Design mode are similar. The major differences in Operations mode are:

- The **Open Palette View** icon has been removed from the **Grid Diagram** tab
- Five new icons have been added to the **Grid Diagram** tab.
- You cannot modify any variable values in the Process Stream, Utility Stream, Heat Exchanger, and Split Editor views.
- The information in the **Worksheet** tab remains the same, however, you cannot edit any values/information displayed.

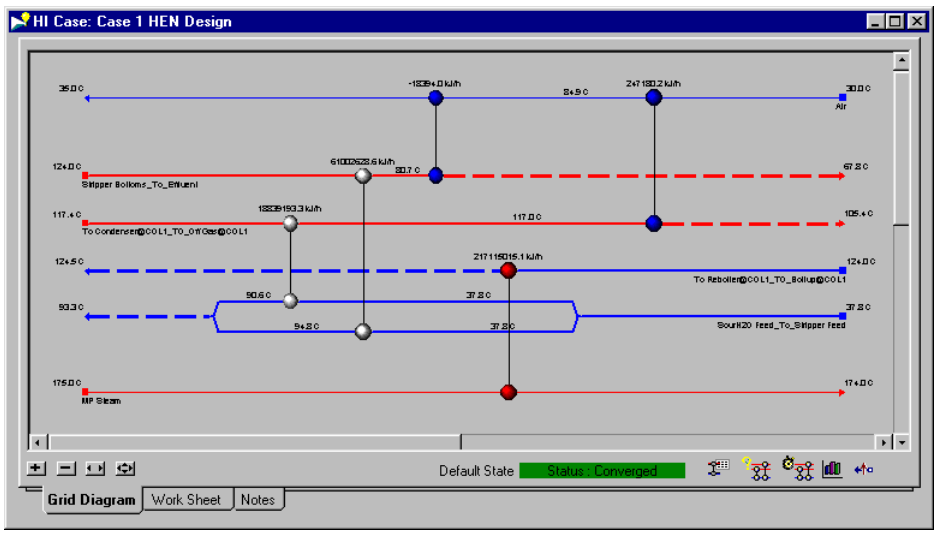
Open Palette View icon

Refer to **Section 7.7 - Worksheet Tab** for more information.

3.4.1 Grid Diagram Tab

The Grid Diagram tab contains the HEN design. Refer to **Section 7.2 - Grid Diagram Tools** for more information about the options available in the Grid Diagram.

Figure 3.38



The information/values displayed on the Grid Diagram will either be from the base case or the last executed event.

The following table lists and describes the five new icons available in Operation mode:

Name	Icon	Description
Operation Mode Data Set Up		Allows you to access the Operation Mode Data Set Up view. Refer to **Section 3.2 - Op. Mode Data Set Up View** for more information.
What If Analysis		Allows you to add events to the heat exchanger network (HEN) design. These events consist of a set of tasks (for example: cleaning exchanger, increasing exchanger's area, etc.). These events are considered to take place at a point in time. .
Trend Analysis		Allows you to study the extent of fouling in a set of heat exchangers over a period of time. The cleaning of these exchangers can be added as events to evaluate savings in operating costs. The trend analysis also allows you to add changes in the process stream flow rates as events. Refer to **Section 3.6 - Trend Analysis Wizard** on how to perform this type of analysis.
View bar chart		Allows you to access the Bar Chart view. Refer to **Section 7.2.6 - Bar Chart View** for more information.
Open HEN Diagram Properties View		Allows you to access the Property Presets view. Refer to **Section 7.2.11 - Property Presets View** for more information.

Status Bar

The status bar located in the Grid Diagram tab indicates both the status of the heat exchanger network in the tab and the last study/event that was executed. There are three possible status for the heat exchanger network:

- **Not Converged**. This status indicates that the executed study/event has generated process stream outlet temperature(s) that fall outside the specified range of outlet temperature(s).
- **Not Executed**. This status indicates that the previous executed study/event has changed. So the current results in the heat exchanger network is not associated to the indicated study/event.
- **Status Converged**. This status indicates that the executed study/event has generated process stream outlet temperatures that fall within the specified range of outlet temperatures.

3.5 What If Analysis View

For more information about What If analysis, refer to **Section 7.3 - What If Analysis** from the **Reference Guide**.

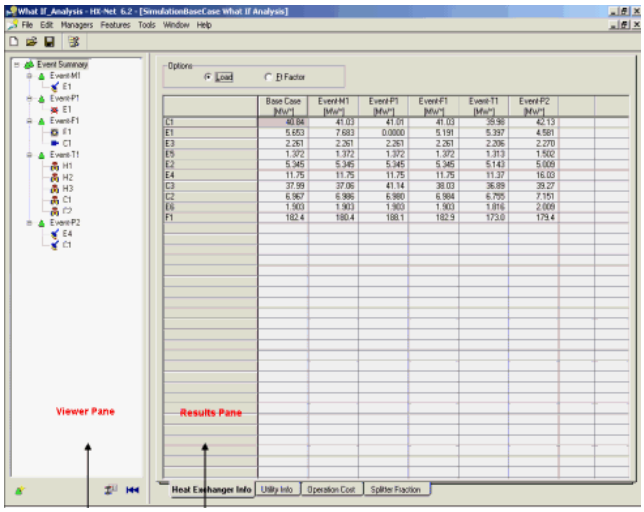
The What If Analysis (WIA) view allows you to perform multiple changes to the heat exchanger network (HEN) operating variables. These changes are considered to take place at a point in time.

To access the WIA view:

1. Open a HI Case operation with a complete HEN design.
2. Enter the Operations mode by clicking the **Go to Operations mode** button.
3. Open the HEN Design view of the HI Case in Operations mode.
4. Click the **What If Analysis** icon located at the bottom right corner of the **Grid Diagram** tab.

What If Analysis icon

Figure 3.39



Viewer pane

Refer to **Section 2.3.5 - Project View** from the **User Guide** for more information.

The WIA view is similar to a project view. There are two levels (Event and Task) and two panes (Viewer and Results) in the WIA view.

Levels

Like the project view, there are three different hierarchical levels in the WIA view. Each level has a specific set of tabs associated with it and the tabs are displayed in the Results pane. Each level also has a certain number of icons/options associated with it. You can access all three levels from the tree browser in the Viewer pane.

The three levels in the WIA view are:

Refer to **Section 7.3.1 - Event** from the **Reference Guide** for more information about event and event types.

- **Event**. This level lets you create and generate events. You can assign tasks to an event at this level. Each event can have multiple tasks.
  This level also contains and displays the history of the calculated results for each event executed.

Refer to **Section 7.3.2 - Task** from the **Reference Guide** for more information about task.

- **Task**. This level lets you manipulate the selected task. You can only change one variable value for each task.

Panes

The two panes in the WIA view are:

- **Viewer** pane. This pane is located on the left side of the WIA view. This pane allows you to manipulate the events/changes you want to perform on the HEN design, contains the list of levels available in the WIA view, and does not change at different levels.
- **Results** pane. This pane is located on the right side of the WIA view.
  Depending on which level you have selected, this pane will display the basic information of the variables from the base case and the events, detailed information of the exchangers in an event, or detail information of each task performed in an event. So the types of tabs and information displayed in this pane change at different levels.

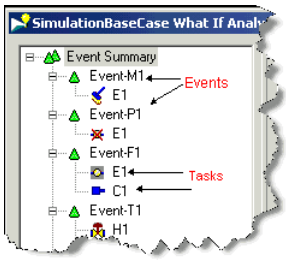
The base case is the status of the HEN design when you first enter the Operations mode. Refer to **Section 7.2.5 - Base Case** from the **Reference Guide** for more information.

The following sections describe each pane in more detail.

3.5.1 Viewer Pane

The Viewer pane allows you to manipulate the events and tasks to perform changes taking place at a point in time.

Figure 3.40



The following table lists and describes all the objects available in the Viewer pane. Depending on the active level, some objects may not be available.

Object	Icon	Description
Status Legend group		Displays the icons of the three possible status for the events. • Yellow icon indicates that the event has not been executed. • Green icon indicates that the event has been successfully executed. • Red icon indicates that the event has been executed, but there was a calculation error or the calculated temperature results did not converged to the Target values.
Display an Event or Task	+	Lets you display events or tasks.
Hide an Event or Task	-	Lets you hide events or tasks.
Create New Event icon		Lets you create a new event.
Create New Task icon		Lets you create a new task.
Delete Selected Event icon		Lets you delete the selected event.

Object	Icon	Description
Execute Selected Event icon		Lets you execute the selected event and its task(s).
Press to Open a Summary of Base Case icon		Allows you to access the Base Case view. Refer to **Section 3.5.2 - Base Case View** for more information.
Reset Default State icon		Allows you to reset the values in the HEN design (displayed on the Grid Diagram tab of the HEN Design view) back to the base case status.

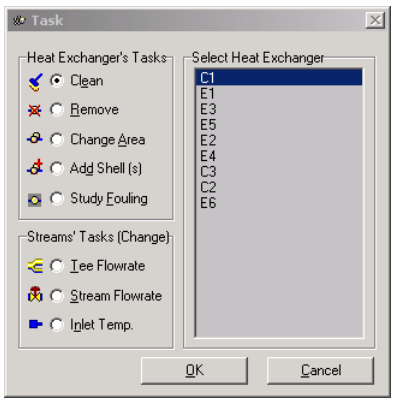
Adding an Event

To add an event:

1. Open the What If Analysis view.
2. Below the **Viewer** pane, click the **Create New Event** icon .

The **Task** view appears.

Figure 3.41



3. On the **Task** view, select the type of task you want to add.

Heat Exchanger Tasks

Select this option	to
Clean	analyze the effect of cleaning an exchanger
Remove	analyze the effect of removing an exchanger from service
Change Area	analyze the effect of changing the area of an exchanger
Add Shell(s)	analyze the effect of adding one or more shells to an exchanger
Study Fouling	analyze the effect of changing the observed heat exchange coefficient of an exchanger

Stream Tasks

Select this option	to
Tee Flowrate	analyze the effect of changing the flowrate through a splitter
Stream Flowrate	analyze the effect of changing the flowrate of a stream
Inlet Temp.	analyze the effect of changing the inlet temperature of a stream

Note:

- If you select a **Heat Exchanger** task, the **Task** view displays a list of available heat exchangers.
- If you select a **Stream** task, the **Task** view displays a list of available streams.

4. Continue adding tasks to the event you are creating.
5. Click **OK** to add the tasks to the event.
   -or
   Click **Cancel** to exit the **Task** view without saving the event.

HX-Net automatically creates a new Event and displays it in the Viewer pane. The task is displayed below the Event. The task displays the icon 

showing the type of task and the exchanger or stream to which it applies For example, a task labeled **Clean E1** would indicate that the task is to clean Heat Exchanger E1 .

This icon	means
	clean heat exchanger
	remove heat exchanger from service
	change heat exchanger's area
	add shell(s) to heat exchanger
	study the effect of heat exchanger fouling
	change splitter flow
	change stream flowrate
	change the inlet flow temperature

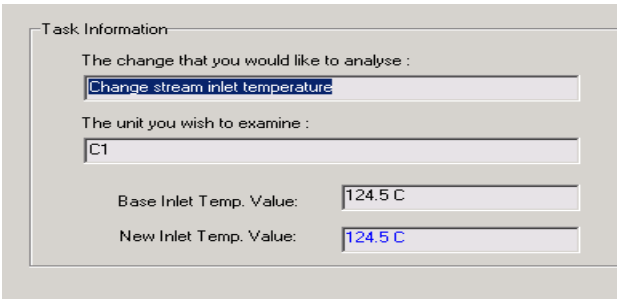
You can now specify information for a task or tasks.

To Specify the Details for a Task:

1. On the **Viewer** pane, left-click the task for which you want to specify details.

The **Task Information** view appears.

Figure 3.43



2. In the appropriate field (which varies depending on the type of task you are working with), enter the new value.
3. Press ENTER.

Adding a Task to an Existing Event

An event can have multiple tasks.

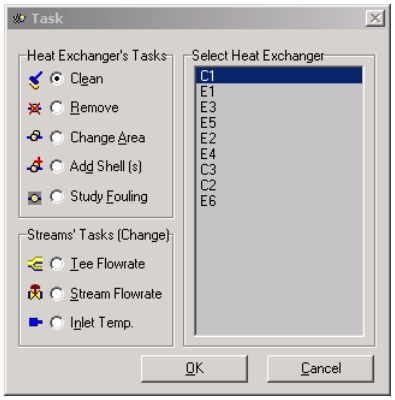
To add a task:

1. Open the What If Analysis view.
2. In the Viewer pane, select the Event to which you want to add a Task.
3. Click the **Create New Task** icon.

Create New Task icon

The **Task** view appears.

Figure 3.44



4. On the **Task** view, select the type of task you want to add.

Heat Exchanger Tasks

Select this option	to
Clean	analyze the effect of cleaning an exchanger
Remove	analyze the effect of removing an exchanger from service
Change Area	analyze the effect of changing the area of an exchanger
Add Shell(s)	analyze the effect of adding one or more shells to an exchanger
Study Fouling	analyze the effect of changing the observed heat exchange coefficient of an exchanger

Stream Tasks

Select this option	to
Tee Flowrate	analyze the effect of changing the flowrate through a splitter
Stream Flowrate	analyze the effect of changing the flowrate of a stream
Inlet Temp.	analyze the effect of changing the inlet temperature of a stream

Note:

- If you select a **Heat Exchanger** task, the **Task** view displays a list of available heat exchangers.
- If you select a **Stream** task, the **Task** view displays a list of available streams.

5. Continue adding tasks to the event you are creating.
6. Click **OK** to add the tasks to the event.
   -or-
   Click **Cancel** to exit the **Task** view without saving the event.

HX-Net automatically places the new Task under the selected Event.

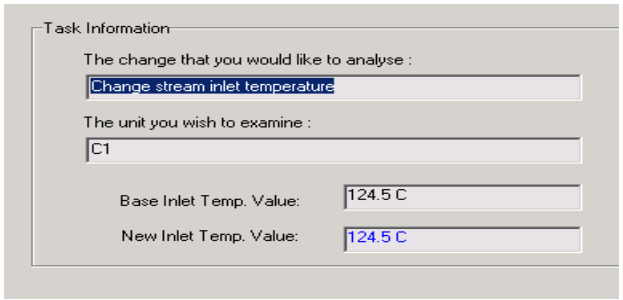
You can now specify the details of the Task(s) you have added.

To Specify the Details for a Task:

1. On the **Viewer** pane, left-click the task for which you want to specify details.

The **Task Information** view appears.

Figure 3.46



2. In the appropriate field (which varies depending on the type of task you are working with), enter the new value.
3. Press ENTER.

Note: The icon beside the Event that contains the new Task turns yellow to indicate that the Event has not been executed.

Renaming an Event

When you add events, the program automatically assigns numbers and letters to the new event. You may want to rename the event to something more meaningful.

To Rename an Event:

1. Open the **What If Analysis** view.
2. In the **Viewer** pane, select the event you want to rename.
3. Right-click the event you want to rename.

A menu of options appears.

4. On this menu, click **Rename Event**.

The Rename Event dialog appears.

5. In the New Name field, enter the new name for the event; then press ENTER.

The new name appears in the **Viewer** pane.

Deleting an Event

When you delete an event, the tasks in the event are also deleted.

Delete Event icon

To delete an Event:

1. Open the What If Analysis view.
2. In the **Viewer** pane, select the event that you want to delete.
3. At the bottom of the **Viewer** pane, click the delete an event icon.

A Warning dialog appears, asking you to confirm that you want to delete the event.

4. Click **Yes** to delete the event.

Note: When you delete an Event, all Tasks within the Event are also deleted.

Deleting a Task

You can delete a Task from an Event.

To delete a Task:

1. Open the What If Analysis view.
2. In the **Viewer** pane, select the Event that contains the Task you want to delete.
3. Expand the Event by clicking the + to show the Tasks associated with the Event.
4. Select the task you want to delete.
5. At the bottom of the **Viewer** pane, click the **Delete a Task** icon.

Delete Task icon

A Warning dialog appears, asking you to confirm that you want to delete the Task.

6. Click **Yes** to delete the Task.

Note: If you delete a task of an event that has been executed, the event status changes to not executed .

Renaming an Event

When you add events, the program automatically assigns numbers and letters to the new event. You may want to rename the event to something more meaningful.

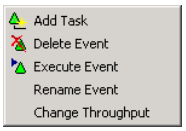
You can only rename the events.

To rename an event:

1. Open the What If Analysis view.
2. In the Viewer pane, select the event you want to rename.
3. Right-click the event you want to rename.

A menu of options appears.mand..

Figure 3.47



4. On this menu, click **Rename Event**.

The **Rename Event** dialog appears..

Figure 3.48

5. In the **New Name** field, enter the new name for the event; then press ENTER.

Executing an Event

You can only execute events that have not already been executed.

Execute Selected Event icon

To execute an event:

1. Open the What If Analysis view.
2. In the Viewer pane, select the event that you want to execute.
3. Click the **Execute Selected Event** icon.

The icon beside an event changes from yellow to green or red after you execute the event.

Notes:

- You cannot execute an event that has already been executed..
- When executing an event, the program always applies the event's task to the base case.

The name of the last executed event is displayed beside the status bar of the **Grid** Diagram in the HEN Design view.

When an event is executed, HX-Net does not take the variable values from the last executed event and apply the new specified values to the calculation. Instead HX-Net takes the variable values from the base case and applies the new specified values to the calculation.

For example, you want to execute *EVENT-M1* and *EVENT-M2*:

1. You start off with the base case.
2. Execute **EVENT - M1** which cleans exchanger E-101 and adds area to exchanger E-102.
3. HX-Net recalculates the HEN design based on the existing base case values and the specified values from the tasks in **EVENT - M1**.
4. Now execute **EVENT - M2** which cleans E-102 and adds area to E-103.

The Grid Diagram will display the calculated values from EVENT - M2 only.

5. HX-Net recalculates the HEN design based on the existing base case values and the specified values from the tasks in **EVENT - M2**.

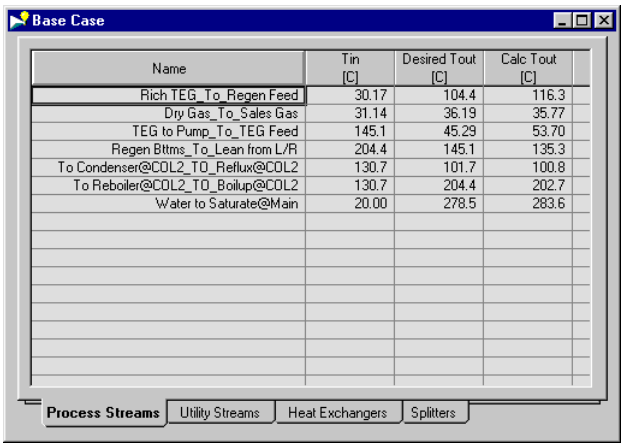
3.5.2 Base Case View

Refer to **Section 3.5.5 - Results Pane - Event Level** for more information.

You cannot modify any values in the Base Case view.

The Base Case view contains four tabs. The four tabs in the Base Case view is similar to the four tabs in the **Results** pane for a selected event. The difference is the variable information displayed in the tabs are base case values.

Figure 3.49



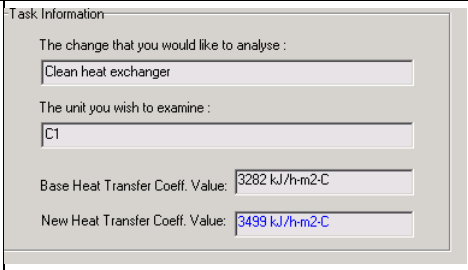
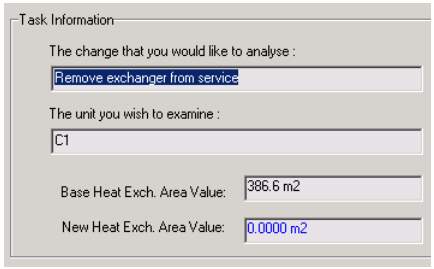
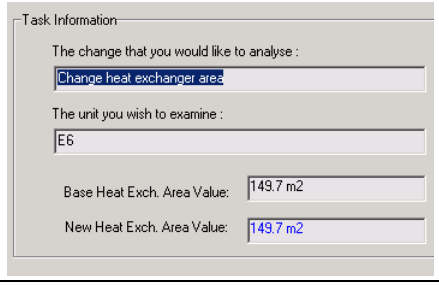
3.5.3 Task View

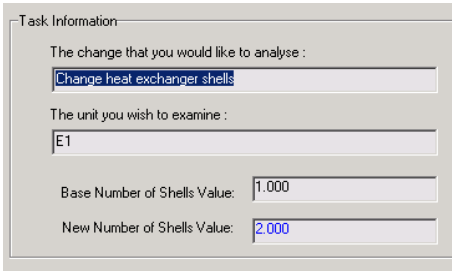
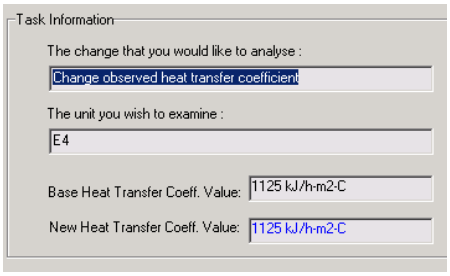
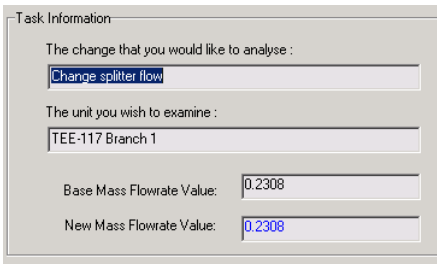
The Task view only appears when you add a task to an event.

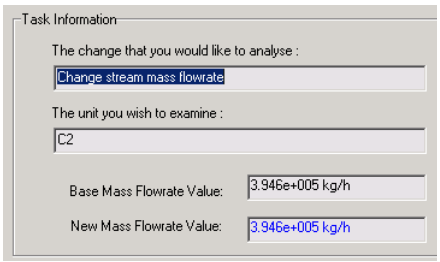
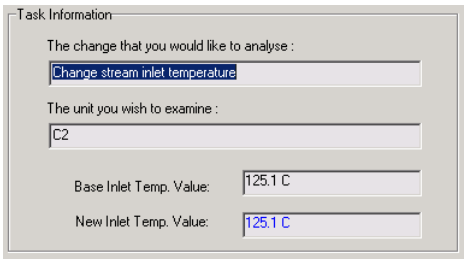
- The options and objects in the Task view changes with each selection you make on the type of task and the object to be modified.

Refer to **Section 7.3.2 - Task** from the **Reference Guide** for a detail description of each type of task from all the events.

The following table describes and displays the Task view for specific tasks.

Task Type	View
Clean	
Remove Exchanger from Service	
Change Area of an Exchanger	

Task Type	View
Add Shell(s) to an Exchanger	
Study Effect of Fouling of an Exchanger	
Change Flowrate through a Splitter	

Task Type	View
Change Stream Flowrate	
Change Stream Inlet Temperature	

Changing Throughput

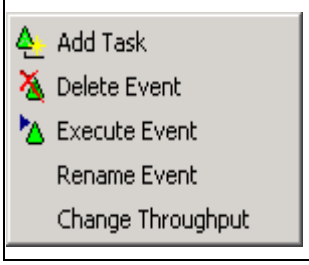
You can modify the flow rate of all the process streams in the heat exchanger network (HEN).

To change throughput:

1. Open the What If Analysis view.
2. In the Viewer pane, right-click the event to which you want to attach a change of throughput.

The **Event Tasks** menu appears..

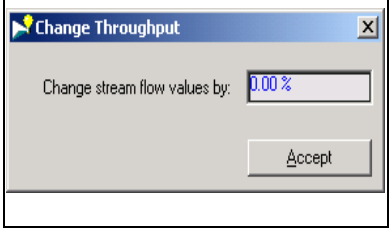
Figure 3.50



3. On the **Event Tasks** menu, click **Change Throughput**.

The **Change Throughput** view appears..

Figure 3.51



4. In the **Change stream flow values by** field, specify the change of flow rate by entering the change in percentage value relative to the flow rate of the base case process stream.
   - o increase the flow rate of the process streams, enter a positive percentage value.
   - To decrease the flow rate of the process streams, enter a negative percentage value.
5. Click **Accept**.

The program generates a change flow rate task for every process stream in the HEN.

3.5.4 Results Pane - Event Level

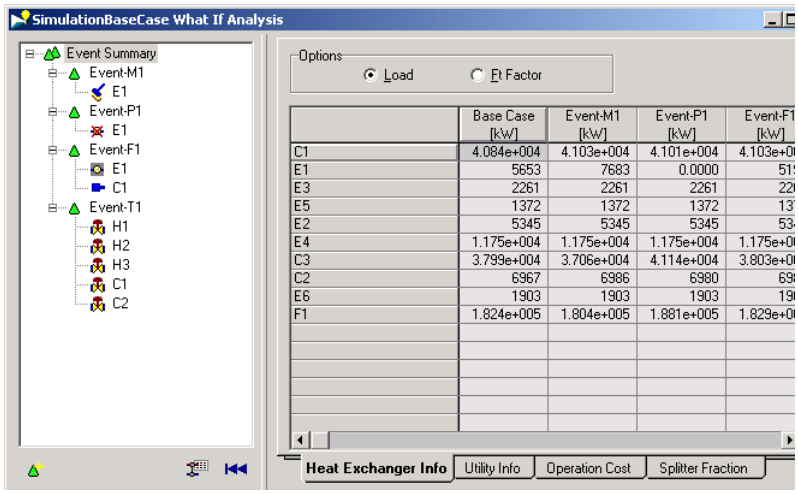
At the Event level, the Results pane displays the general information regarding the HEN design for the base case and any tasks under the event.

The general information is split into four tabs: Heat Exchanger Info, Utility Info, Operation Cost, and Splitter Fraction.

Heat Exchanger Info Tab

The Heat Exchanger Info tab displays the heat load and F_t factor for all the exchangers in the HEN design.

Figure 3.52



The following table lists and describes the objects available on the Heat Exchanger Info tab:

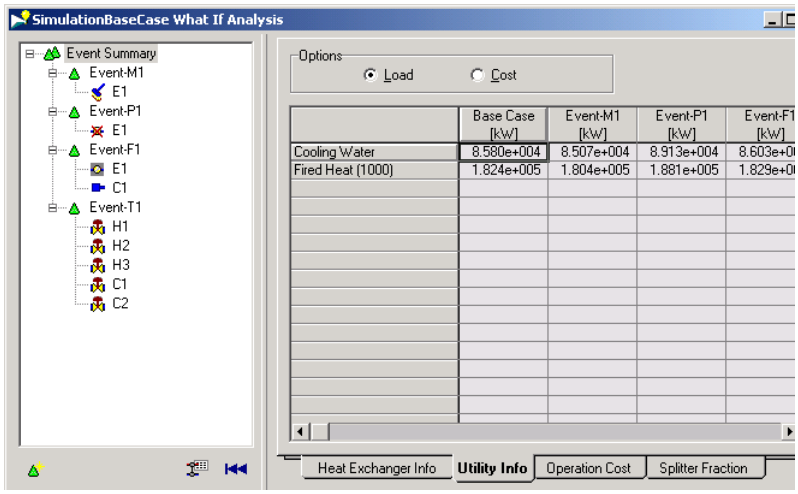
Object	Description
Load radio button	Allows you to display the heat/duty load of all the exchangers from the HEN design in the table below the Options group.
Ft Factor radio button	Allows you to display the F_t factor of all the exchangers from the HEN design in the table below the Options group.
First column in the table	Displays the names of all the heat exchangers.
Second column in the table	Displays the load/F_t factor values for all the exchangers at the base case.
Remaining columns in the table	Displays the load/F_t factor values for all the exchangers at each event in the selected event type.

F_t is the correction factor that accounts for non-counter current flow in the exchanger.

Utility Info Tab

The Utility Info tab displays the total heat load and operating cost for all the utilities in the HEN design.

Figure 3.53



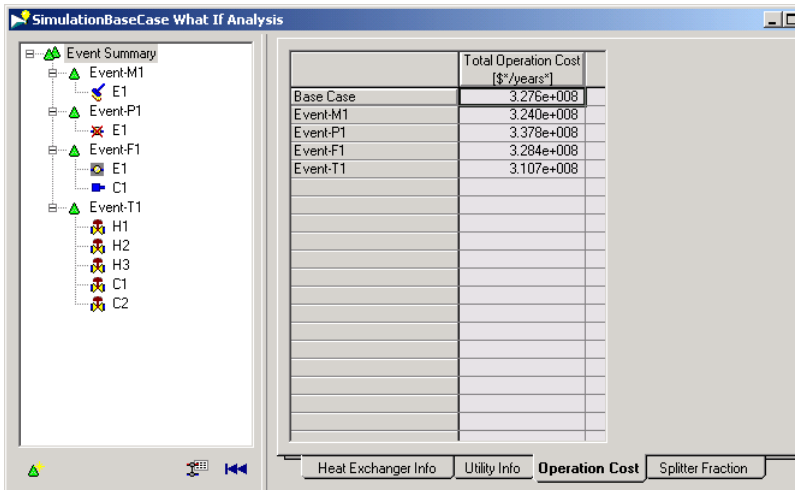
The following table lists and describes the objects available on the Utility Info tab:

Object	Description
Load radio button	Allows you to display the total heat/duty load of all the utilities from the HEN design in the table below the Options group.
Cost	Allows you to display the operating cost of all the utilities from the HEN design in the table below the Options group.
First column in the table	Displays the names of all the available hot and cold utilities.
Second column in the table	Displays the total load/operating cost values for all the utilities at base case.
Remaining columns in the table	Displays the total load/operating cost values for all the utilities at each event in the selected event type.

Operation Cost Tab

The Operation Cost tab displays the total operating cost for the base case and all the events under the selected event type.

Figure 3.54



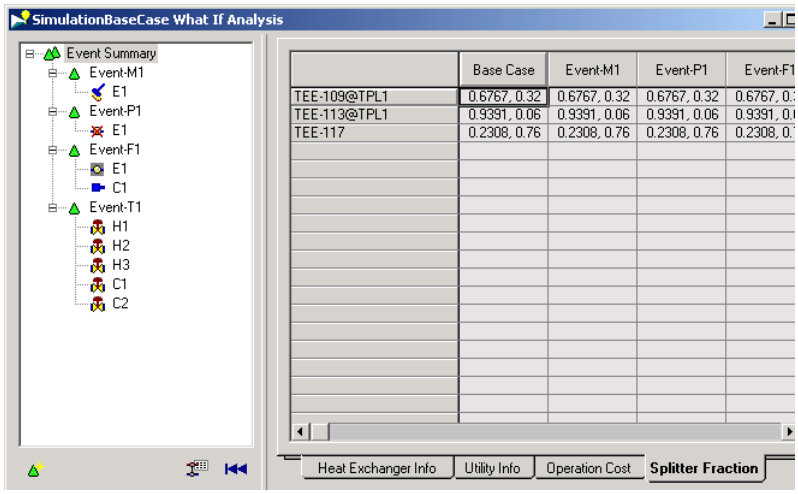
The following table lists and describes the objects available on the Operation Cost tab:

Object	Description
First column in the table	Displays the base case name and the names of all the events in the selected event type.
Second column in the table	Displays the total operation cost values for the base case and all the events in the selected event type.

Splitter Fraction Tab

The Splitter Fraction tab displays the split fractions of all the splitters in the HEN design.

Figure 3.55



The following table lists and describes the objects available on the Splitter Fraction tab:

Object	Description
First column in the table	Displays the names of all the splitters.
Second column in the table	Displays the split ratio for all the splitters at base case.
Remaining columns in the table	Displays the split ratio for all the splitters at each event in the selected event type.

3.5.5 Results Pane - Event Level

If the event has not been executed, the information displayed for this event will be exactly the same as the information displayed in the base case.

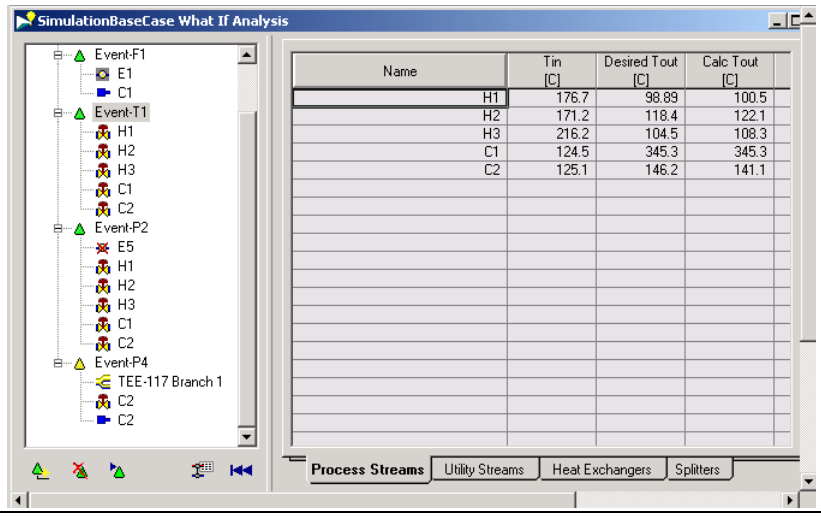
At the Event level, the Results pane displays detail information regarding the HEN design for the selected event.

The information is split into four tabs: Process Streams, Utility Streams, Heat Exchangers, and Splitters. The following sections describe each tab in detail.

Process Streams Tab

The Process Streams tab displays information for all the process streams in the HEN design.

Figure 3.56



The following table lists and describes the objects available on the Process Streams tab:

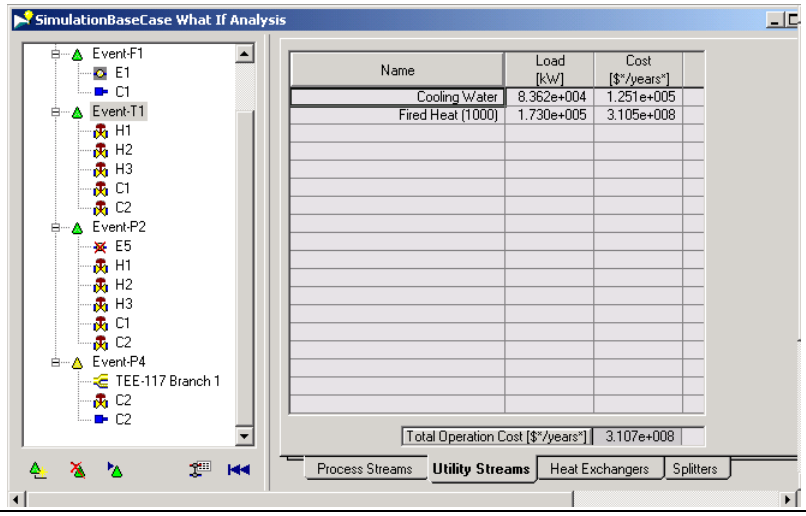
Object	Description
Name column	Displays the names of the process streams.
Tin column	Displays the inlet temperature of the process streams.

Object	Description
Desired Tout	Displays the Target outlet temperature of the process streams
Calc Tout	Displays the calculated outlet temperature of the process streams.

Utility Streams Tab

The Utility Streams tab displays information about the utilities in the HEN design.

Figure 3.57



The following table lists and describes the objects available on the Utility Streams tab:

Object	Description
Name column	Displays the name of the utilities.
Load column	Displays the total heat/duty load of each utilities.
Cost column	Displays the operating cost of each utilities.
Total Operation Cost cell	Displays the total operating cost of all the utilities.

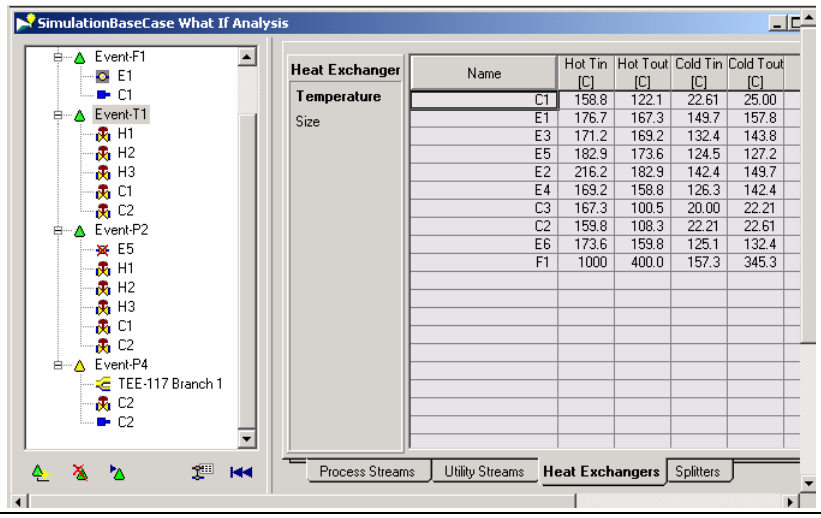
Heat Exchangers Tab

The Heat Exchangers tab displays information regarding all the heat exchangers in the HEN design. The information is split into two pages: Temperature and Size.

Temperature Page

The Temperature page displays the inlet and outlet temperature of the hot and cold streams flowing through the heat exchangers.

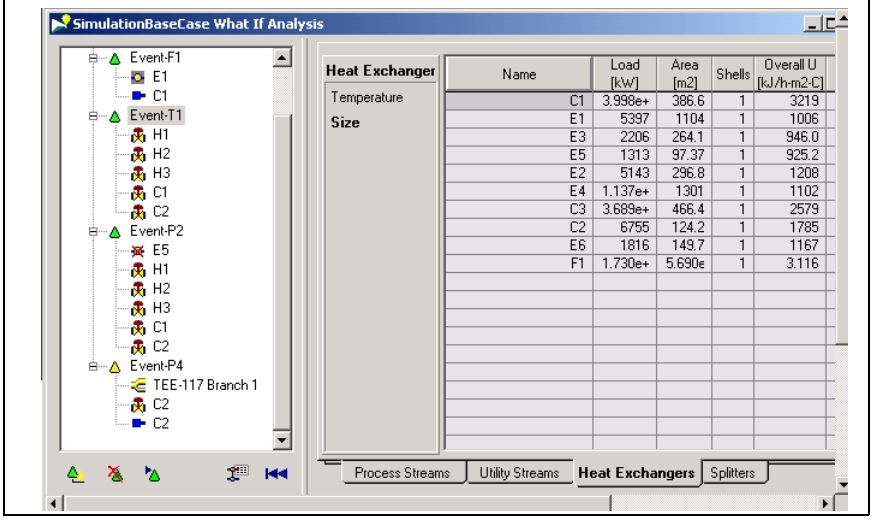
Figure 3.58



Size Page

The Size page displays the heat/duty load, heat transfer area, number of shells in series, and overall heat transfer coefficient values of the heat exchangers.

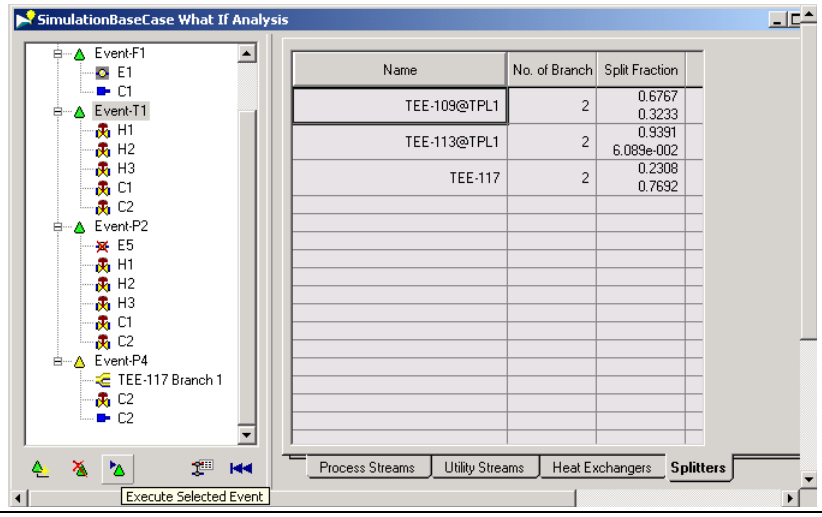
Figure 3.59



Splitters Tab

The Splitters tab displays information about all the splitters in the HEN design.

Figure 3.60



The following table lists and describes the objects available on the Splitters tab:

Object	Description
Name column	Displays the names of the splitters.
No. of Branch column	Displays the number of branches in the splitters.
Split Fraction column	Displays the split fractions in the splitters.

3.5.6 Results Pane - Task Level

At the Task level, the Results pane displays the information about the selected task.

Refer to **Section 3.5.3 - Task View** for more information.

The objects and information in the Task Information group is the same as the objects and information in the Task view after clicking the Add Task button.

3.6 Trend Analysis Wizard

For more information about Trend analysis, refer to **Section 7.4 - Trend Analysis** from the **Reference Guide**.

The Trend Analysis Wizard (TAW) allows you to enter the information for the performance (how the exchangers are getting fouled) of the HEN design over the Trend analysis period.

When performing Trend analysis, the starting point should be the clean case (that is, make sure the values in the Grid DIagram are the values for a clean design).

To access the TAW:

1. Open a HI Case operation with a complete HEN design.
2. Enter the Operations mode by clicking the **Set Up Operations** button.
3. Open the HEN Design view of the HI Case in Operations mode.
4. Click the **Trend Analysis** icon located at the bottom right corner of the **Grid Diagram** tab.

Trend Analysis icon

The TAW consist of one view with many pages. Each page represents a step you have to follow through to set up the base case trends information. You can only move from page to page after supplying the required amount of information in each page.

There are two common buttons located at the bottom of the TAW for all the pages:

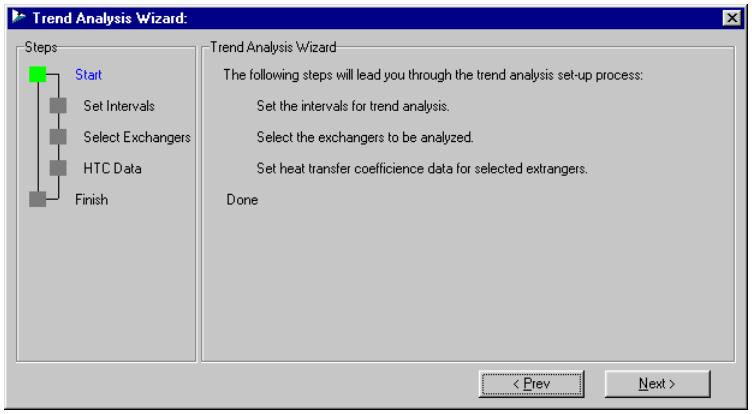
- **Prev** button allows you to go back to the previous step/page if you want to change something in the previous step. This button is only available if there is a previous step from your current page position.
- **Next** button allows you to move to the next step/page. This button is only available if there is another step following your current page position and/or you have entered the required information in the current page.

The following sections will describe each page in detail.

3.6.1 Start Page

The Start page displays the steps that TAW will lead you through to generate the base case trends.

Figure 3.61

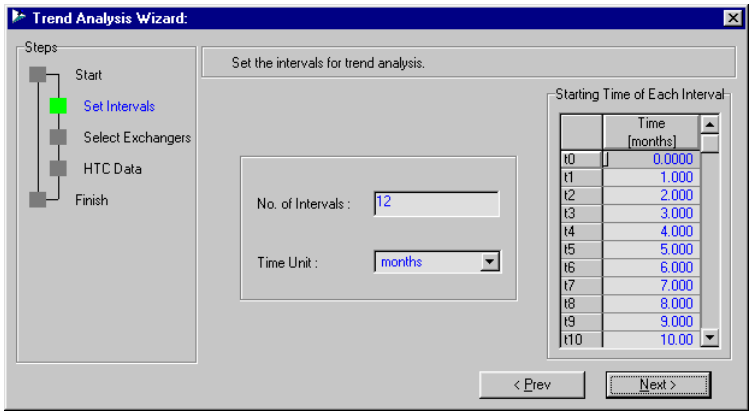


3.6.2 Set Intervals Page

HX-Net provides a default number of 12 months interval over a one year period.

The Set Intervals page allows you to specify the number of intervals, the time unit for the intervals, and the starting time for each interval.

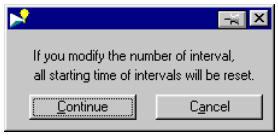
Figure 3.62



To set up the trend period:

1. Enter the number of intervals that occur during the trend analysis in the **No. of Intervals** field.
2. The following view will appear to inform you how the change in the number of intervals will impact the values in the Starting Time of Each Interval group.

Figure 3.63



In the Starting Time of Each Interval table, the number of intervals and the starting time for each interval will change to the number of intervals you specified and the HX-Net default starting time values.

- Click the **Continue** button to continue with the changes to the number of intervals.
- Click the **Cancel** button to disregard the changes to the number of intervals.

3. Click the down arrow in the **Time Unit** field and select the time unit you want from the drop-down list.
4. Specify the starting time of each interval in the Starting Time of Each Interval table.

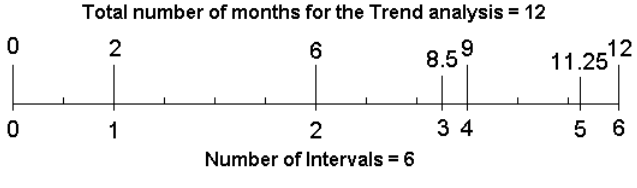
For example, you want to perform a trend analysis containing *six* intervals and the start time for the intervals are: second month, sixth month, middle of the eighth month, ninth month, quarter into the eleventh month, and twelfth month.

- Enter **6** in the No. of Intervals field.
- Select **months** from the Time Unit drop-down list.
- Enter the following values in the Time column of the Starting Time of Each Interval table: 0, 2, 6, 8.5, 9, 11.25, and 12.

In this example, the time between intervals are: the first interval last *2 months*, the second interval last *4 months*, the third interval last *2.5 months*, the fourth interval last *0.5 month*, the fifth interval last *2.25 months*, and the last interval last *0.75 month*.

The time line of the example trend analysis is shown in the figure below:

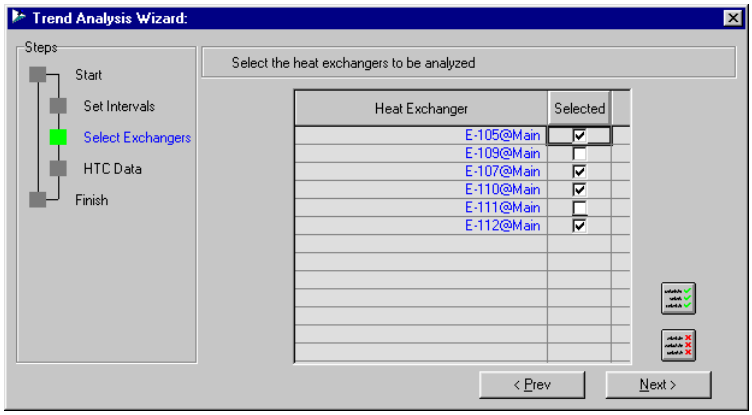
Figure 3.64



3.6.3 Select Exchangers Page

The Select Exchangers page allows you to select which heat exchangers will be considered for the Trend analysis.

Figure 3.65



The following table lists and describes the objects available in the Select Exchangers page:

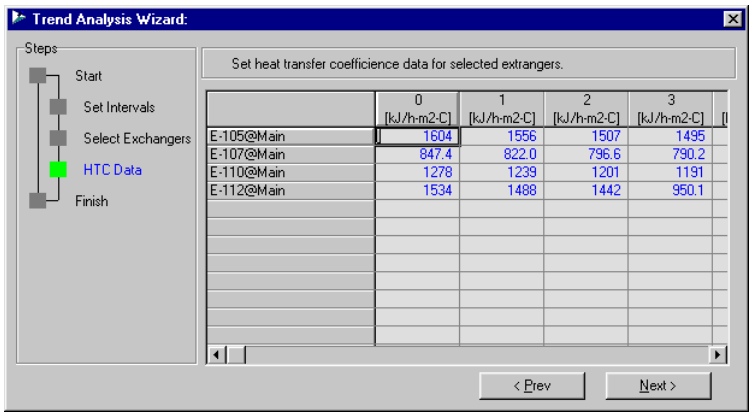
Object	Icon	Description
Heat Exchanger column		Displays the name of all the heat exchangers in the heat exchanger network.
Selected column		Allows you to toggle between accepting or rejecting the exchangers for modification during the Trend analysis. • Checked checkbox indicates the exchanger will change. • Unchecked checkbox indicates the exchanger will remain unchanged.
Select All icon		Allows you to select all the heat exchangers in the table.
Unselect All icon		Allows you to unselect all the heat exchangers in the table.

3.6.4 HTC Data Page

HX-Net sets the clean overall heat transfer coefficient value for all the intervals as the default.

The HTC Data page allows you to specify the amount of fouling (by reducing the heat transfer coefficient value from the initial clean value) that will be present in each of the selected heat exchangers for each of the intervals of the Trend analysis period.

Figure 3.66



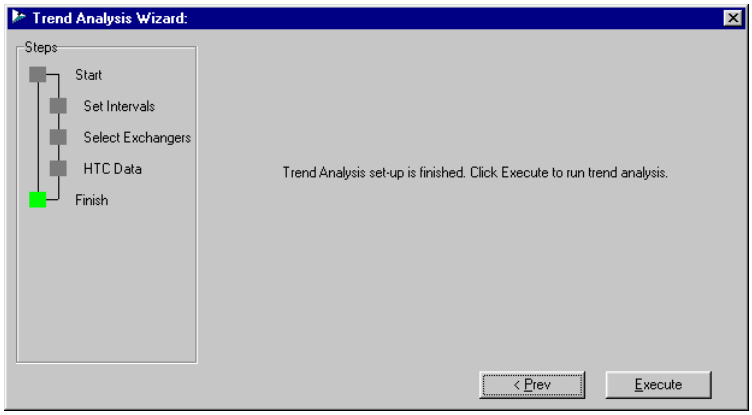
3.6.5 Finish Page

The TAW view will automatically close and the Trend Analysis view will open when you click the Execute button.

The base case trends is also known as the Default Study.

The Finish page allows you to generate the base case trends.

Figure 3.67



3.7 Trend Analysis View

The Trend Analysis view allows you to perform multiple long term analysis.

Refer to **Section 3.6 - Trend Analysis Wizard** for more information about TAW.

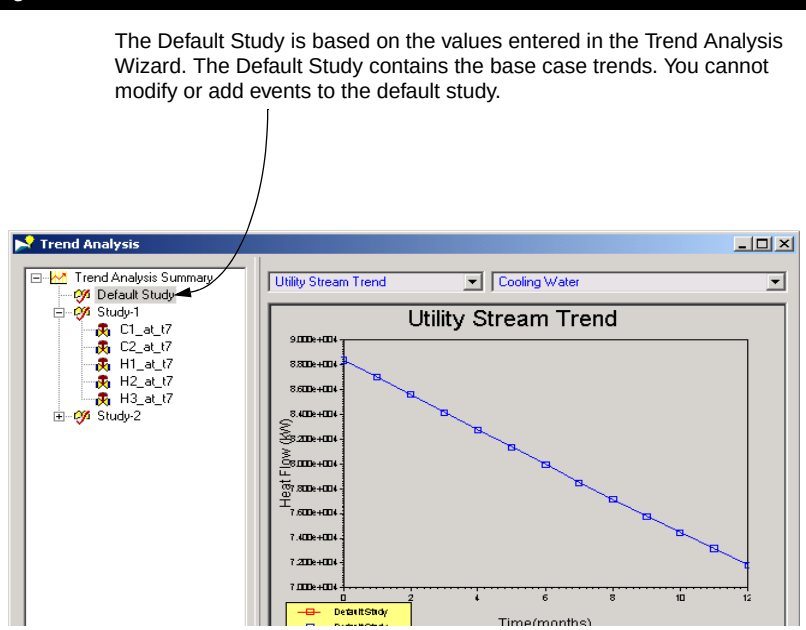
When you click the Trend Analysis icon for the first time, the Trend Analysis Wizard (TAW) view will appear. The TAW allows the set up of the base case/default study and trend information.

After you have specified the default study of the Trend analysis, you can access the Trend Analysis view by:

1. Opening the HEN Design view of the HI Case in Operations mode.
2. Clicking the **Trend Analysis** icon located at the bottom right corner of the **Grid Diagram** tab.

Trend Analysis icon

Figure 3.68



Refer to **Section 2.3.5 - Project View** from the **User Guide** for more information.

The Trend Analysis view is similar to the project view. There are three levels (Summary, Study, and Event) and two panes (Viewer and Results) in the Trend Analysis view.

Levels

Like the project view, there are three different hierarchical levels in the Trend Analysis view. Each level has certain tables or graphs associated with it and these objects are displayed in the Results pane. Each level also has a certain icons/options associated with it. You can access all three levels from the tree browser in the **Viewer** pane.

The three levels in the WIA view are:

Refer to **Section 7.4.2 - Study** from the **Reference Guide** for more information about study.

- **Summary**. This level allows you to generate studies and compare the base performance with the calculated values from the executed studies. A study is a performance analysis over the specified Trend analysis period.
- **Study**. This level allows you to assign events to a study. There are two type of events and a study can have multiple events.
  This level also contains and displays the trend plots for each executed study.

Refer to **Section 7.4.3 - Event** from the **Reference Guide** for more information about event.

- **Event**. This level allows you to manipulate the event.

Panes

The two panes in the Trend Analysis view are:

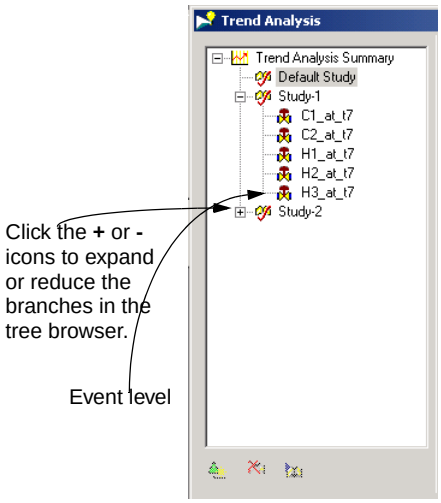
- **Viewer** pane. This pane is located on the left side of the Trend Analysis view.
  This pane allows you to manipulate the changes you want to perform on the HEN design, contains the list of levels available in the Trend Analysis view, and does not change at different levels.
- **Results** pane. This pane is located on the right side of the Trend Analysis view.
  Depending on which level you have selected, this pane will display the information of the selected variables from the base performance and the studies, plots of variable changes in the selected study, or information about the selected event. So the objects displayed in this pane change at different levels.

The following sections describe each pane in more detail.

3.7.1 Viewer Pane

The Viewer pane allows you to manipulate the studies and events in the Trend analysis.

Figure 3.69



The following table lists and describes all the objects available in the Viewer pane. Depending on the active level, some objects may not be available.

Object	Icon	Description
Status Legend group		Displays the icons of the three possible states for the studies. • Yellow icon indicates that the study has not been executed. • Green icon indicates that the study has been successfully executed. • Red icon indicates that the study has been executed, but there was a calculation error or the end results are not close to the Target value.
Create New Study icon		Lets you create a new study Refer to the **Adding a Study** section for more information.
Delete Selected Study icon		Lets you delete the selected study. You cannot delete the Summary.

Available only at Summary level.

Available only at Study level.

Object	Icon	Description
Execute Selected Study icon		Lets you execute the event(s) in the selected study.
Add a Task icon		Lets you add a task to a study.

Adding a Study

To add a study:

1. Open the Trend Analysis view.
2. In the Viewer pane, select the Summary level.
3. Click the **Create New Study** icon.

Create New Study icon

HX-Net automatically creates a new study under the Trend Analysis folder, and names the study "*Study -*" followed by an integer number that increases for each new study added.

Renaming a Study

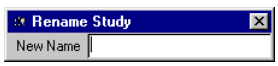
You can only rename the studies.

To rename a study:

1. Open the Trend Analysis view.
2. In the Viewer pane, expand the Trend Analysis folder to find the study you want to rename by clicking the + icon.
3. Select the study you want by clicking its name.
4. Right-click to open the Object Inspect menu and select the **Rename Study** command.

The **Rename Study** view appears.

Figure 3.70



Close icon

5. Enter the new name for the study in the **New Name** field and click the **Close** icon.

HX-Net automatically places the renamed study under the Trend Analysis folder in descending alphabetical order.

Adding Tasks to Studies

A study can have multiple events.

To add a Task to a Study:

1. Open the Trend Analysis view.
2. In the Viewer pane, select the Study that will contain the new Task.

There are three types of Tasks you can assign to a Study. Click the link for the Task below for information on how to add that Task to a Study.

- Change the throughput of the process stream
- Clean an exchanger
- Modify the massflow of a stream

Adding a Change Throughput Task

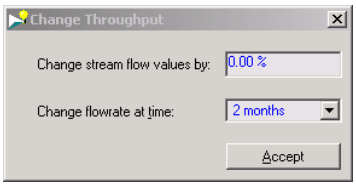
You can add a Task that changes the flow rates of all the process streams.

To add a Change Throughput Task to a Study

1. In the Viewer pane, right-click the Study to which you want to add a **Change Throughput** Task.
2. On the **Object Inspect** menu that appears, click **Change Throughput**.

The **Change Throughput** view appears.

Figure 3.71



3. In the **Change stream flow values by** field, enter the percentage of stream flow change.
4. In the **Change flowrate at time** box, select the interval when the change in flowrate occurs.
5. Click **Accept**.

The **Change Throughput** view closes, and the **Change Throughput** Task is assigned to the Study.The **Change Throughput** view appears.

Adding a Clean Exchanger Task

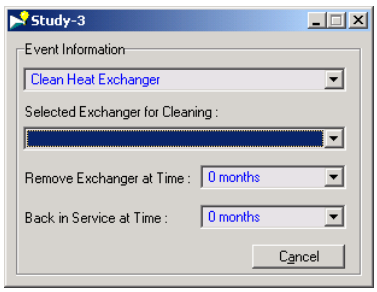
You can add a Task that cleans a heat exchanger.

To add a Clean Exchanger Task to a Study

1. In the Viewer pane, right-click the Study to which you want to add a **Clean Exchanger** Task.
2. On the **Object Inspect** menu that appears, click **Clean Exchanger / Change MassFlow**.

The **Event Information** view for the Study appears.

Figure 3.72



3. In the top box, select **Clean Heat Exchanger** if it is not already selected.
4. In the **Selected Exchanger for Cleaning** box, select the exchanger to be changed by this Task.
5. In the **Remove Exchanger at Time** box, select the interval when the exchanger will be removed from service.
6. In the **Back in Service at Time** box, select the interval when the exchanger will be returned to service.
7. When you have finished specifying information for the **Clean Exchanger** Task,
   Click **Create** to add the **Clean Exchanger** Task to the Study.
   -or-
   Click **Cancel** to abort adding the **Clean Exchanger** Task to the Study**.**

Adding a Change MassFlow Task

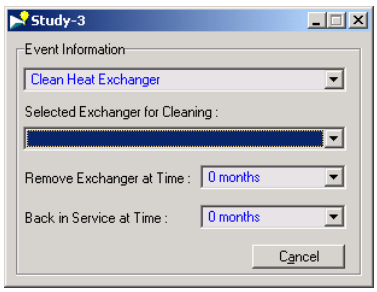
You can add a Task that changes the massflow of a stream.

To add a Change MassFlow Task to a Study

1. In the Viewer pane, right-click the Study to which you want to add a **Change MassFlow** Task.
2. On the **Object Inspect** menu that appears, click **Clean Exchanger / Change MassFlow**.

The **Event Information** view for the Study appears.

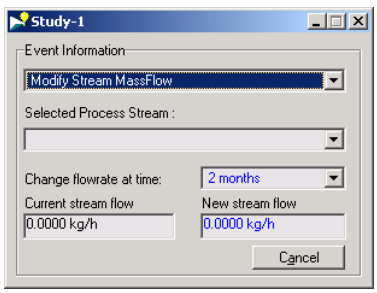
Figure 3.73



3. In the top box, select **Modify Stream Massflow**.

The **Modify Stream Massflow** view appears.

Figure 3.74



4. In the **Selected Process Stream** box, select the process stream whose massflow this task will change.

5. In the **Change flowrate at time** box, select the interval at which the flowrate change will occur.
6. In the **New stream flow** box, enter the new flowrate.
7. When you have finished specifying information for the **Change MassFlow** Task,
   Click **Create** to add the **Change MassFlow** Task to the Study.
   -or-
   Click **Cancel** to abort adding the **Change MassFlow** Task to the Study**.**

Modifying a Clean Exchanger Task

You can modify the specifications of a **Clean Exchanger** Task by changing:

- The time the exchanger is to come out of service.

-and/or-

- The time the exchanger is to be returned to service.

To modify a Clean Exchanger Task:

1. Open the Trend Analysis view.
2. In the Viewer pane, left-click the Study on which you want to modify a **Clean Exchanger** Task.
3. If the **Clean Exchanger** Task you want to modify is not visible under the Study, click the PLUS SIGN to the left of the Study to display the Tasks associated with the Study.
4. Left-click the **Clean Exchanger** Task you want to modify.

The **Results** pane displays the detail information for the **Clean Exchanger** Task.

5. If you want to change the time at which the exchanger is to removed from service, in the **Remove Exchanger at Time** box, select the new time.
6. If you want to change the time at which the exchanger is to returned to service, in the **Back in Service at Time** box, select the new time.
7. When you have finished modifying the **Clean Exchanger** Task, press ENTER**.**

Executing a Study

To execute a Study for trend analysis:

1. Open the Trend Analysis view.
2. In the Viewer pane, select the Study for trend analysis.
3. At the bottom of the **Viewer** pane, click the **Execute Selected Study** icon  .

Notes:

You cannot execute a Study that has already been executed. If a Study has been executed, it displays the **Executed** icon  .

When executing a Study, the program always applies the Study's Tasks to the **default** Study.

When a study is executed, HX-Net always takes the variable values from the default study and the new specified values from the selected study to calculate the new trend performance of the HEN design.

Deleting a Study

You can delete a Study from the **Trend Analysis Viewer** pane. You cannot delete the default study.

To delete a Study:

1. Open the Trend Analysis view.
2. In the Viewer pane, left-click the Study you want to delete.
3. At the bottom of the **Viewer** pane, click the **Delete Selected Study** icon  .

A warning view appears asking you to confirm the deletion of the Study.

4. Click **Yes** to delete the Study.
   -or-
   Click **No** to abort the deletion of the Study.

Note: When you delete a Study, all the Tasks within the Study are also deleted.

Deleting a Task from a Study

You can delete a Task from a Study.

To delete a Task:

1. Open the Trend Analysis view.
2. In the Viewer pane, left-click the Study from which you want to delete a Task.
3. If the Task you want to delete is not visible under the Study, click the PLUS SIGN to the left of the Study to display the Tasks associated with the Study.
4. Left-click the Task you want to delete.
5. At the bottom of the **Viewer** pane, click the **Delete Selected Task** icon  .

A warning view appears asking you to confirm the deletion of the Task.

6. Click **Yes** to delete the Task.
   -or-
   Click **No** to abort the deletion of the Task.

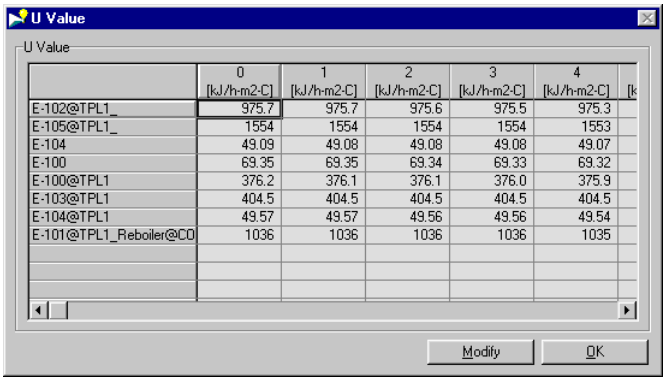
Note: When you delete a Task from an executed Study, the Study's status changes to **Unexecuted**.

3.7.2 U Value View

The U Value view allows you to modify the overall heat transfer

coefficient (HTC) values for the heat exchangers in the Default Study.

Figure 3.75



The following table lists and describes the objects available in the U Value view:

Object	Description
U Value table	Displays the overall HTC value for the exchanger at each interval. • If the values in the table are black in colour, you cannot modify the values. • If the values in the table are blue in colour, you can modify the values
Modify button	Allows you to remove the lock/freeze on the current overall HTC values in the U Value table and modify/change the values in the U Value table. Only available when the text in the U Value table are black.
Lock button	Allows you to lock/freeze and keep the current overall HTC values in the U Value table for the Default Study. Only available when the text in the U Value table are blue.
OK button	Allows you to close the current U Value view.

If you change the values in the U Value view, any studies previously generated before the modification will be deleted.

3.7.3 Study View

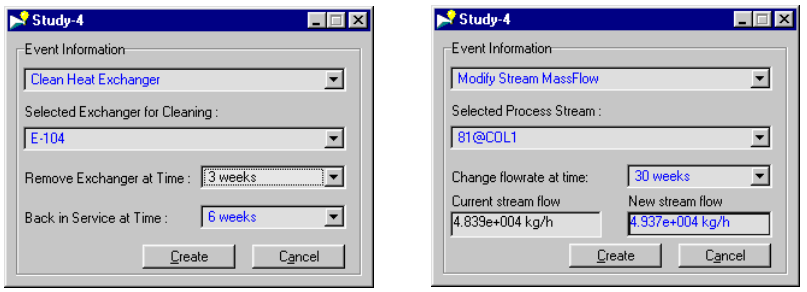
The Study view only appears when you add an event to a study. HX-Net contains three type of events for the Trend analysis. The events are:

- The change of throughput values for all the process streams.
- The off-service cleaning of the heat exchangers.

The change of throughput event has its own type of view. Refer to the **Change Throughput View** section for more information.

- The change in flow rate of the process stream.

Figure 3.76



The following table lists and describes the objects available in the Study view:

Object	Description
First drop-down list	Allows you to select the type of event you want to generate.
The following three drop-down list are only available when the Clean Heat Exchanger event is selected.	
Selected Exchanger for Cleaning drop-down list	Allows you to select the heat exchanger you are going to clean.
Remove Exchanger at Time drop-down list	Allows you to select which interval the selected exchanger will be removed/off service for cleaning.
Back in Service at Time drop-down list	Allows you to select which interval the selected exchanger will be cleaned and returned to service.
The following two drop-down lists and two fields are only available when the Modify Stream MassFlow event is selected.	
Selected Process Stream drop-down list	Allows you to select the process stream whose flow rate will change.
Change flowrate at time drop-down list	Allows you to select which interval the selected process stream's flow rate will begin to change.
Current stream flow field	Displays the selected process stream's flow rate before the change takes place.
New stream flow field	Allows you to specify the new flow rate of the selected process stream.
Create button	Allows you to add the event to the selected study.
Cancel button	Allows you to exit the Study view and removes the event.

The *Create* button appears only after you have selected an object.

Change Throughput View

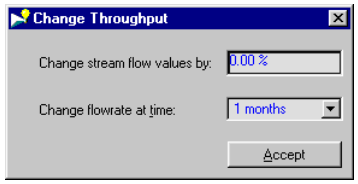
The Change Throughput view allows you to quickly add events that will

change the flow rates of all the process streams in the heat exchanger network (HEN) design.

To add the Throughput event for all the process streams:

1. Select the study that will contain the Throughput event.
2. Right-click to open the Object Inspect menu and select the **Change Throughput** command.
3. The Change Throughput view appears.

Figure 3.77



4. Enter the percentage value of the change in process stream flow rate in the **Change stream flow values by** field.
5. Use the drop-down list in the **Change flowrate at time** field to select at which interval the change in flow rates take place.
6. Click the **Accept** button.
7. HX-Net automatically generates and assigns the flow-rate-change event to each process stream in the heat exchanger network design. The flow rate change values are based on the percentage value entered in the Change Throughput view.

3.7.4 Results Pane - Summary Level

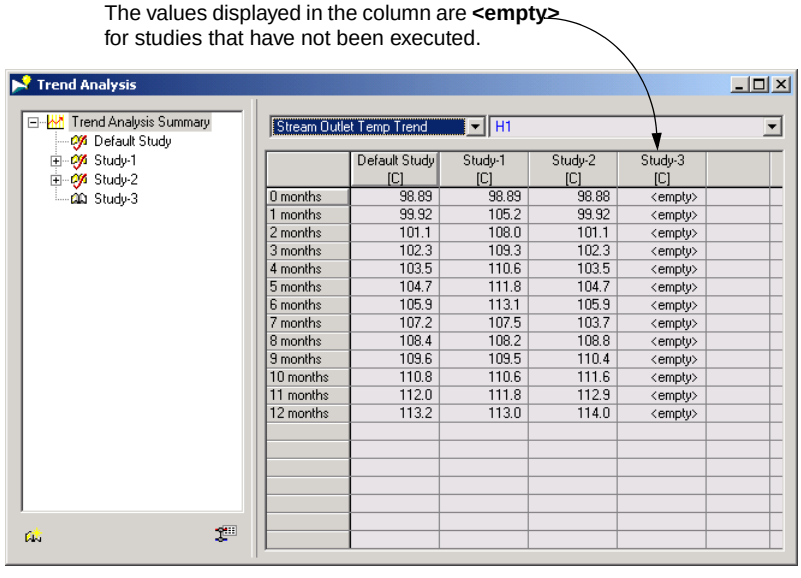
At the Summary level, the Results pane displays the following information for all the studies in the Trend Analysis folder in a tabular format:

- **Utility Stream Trend**. The amount of load/duty supplied by the utility streams as it varies from interval to interval.
- **Cumulative Profit Index**. The amount of cumulated profit for each study (i.e., the area under the profit index trend curve).
- **Stream Outlet Temp Trend**. The process streams outlet temperature value as it varies from interval to interval.
- **Profit Index Trend**. The amount of profit at each interval.

If you had specified the price indexes for the process streams, the values in the Cumulative Profit Index and Profit Index Trend may be positive.

If you had not specified the price indexes for the process streams, the values in the Cumulative Profit Index and Profit Index Trend will be negative, because only the operating cost is accounted.

Figure 3.78



The following table lists and describes the objects available in the Results pane:

Object	Description
First drop-down list	Allows you to select and display the trend performance values for the utility load, cumulative profit, process stream outlet temperature, or profit index.
Second drop-down list	Allows you to select the utility or process stream you want to see in the table.

The second drop-down list is not available when Cumulative Profit Index or Profit Index Trend is the selected variable.

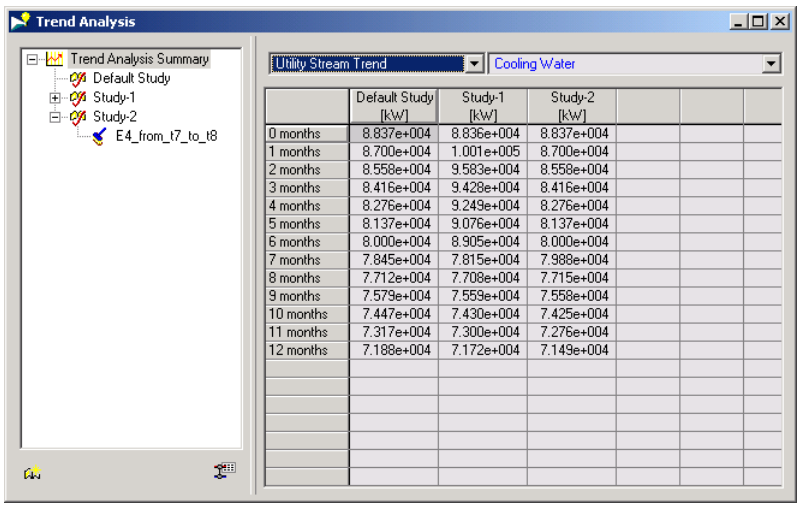
Object	Description
First column	Displays the interval/stage number.
Second column	Displays the selected variable values for the default study at each interval/stage.
Remaining columns	Displays the selected variable values for the studies at each interval/stage.

3.7.5 Results Pane - Study Level

At the Study level, the Results pane displays the following information for the selected study in a graph format:

- **Utility Stream Trend**. The amount of load/duty supplied by the utility streams vs. time.
- **Stream Outlet Temp Trend**. The process streams outlet temperature values vs. time.
- **Profit Index Trend**. The amount of profit at each interval for the entire study.

Figure 3.79



The following table lists and describes the objects available in the Results pane:

Object	Description
First drop-down list	Allows you to select and display the trend performance values for the utility load, process stream outlet temperature, or profit index.
Second drop-down list	Allows you to select the utility or process stream you want to see in the table.
Default Study field	Displays the cumulative profit for the default study.
This Study field	Displays the cumulative profit for the selected study.
Plot	Displays the selected variable values as plot lines for both default and selected studies. Refer to **Section 7.4 - Plot Area** and **Chapter 8 - Plot Properties** from **User Guide** for information about manipulating the plot appearance.

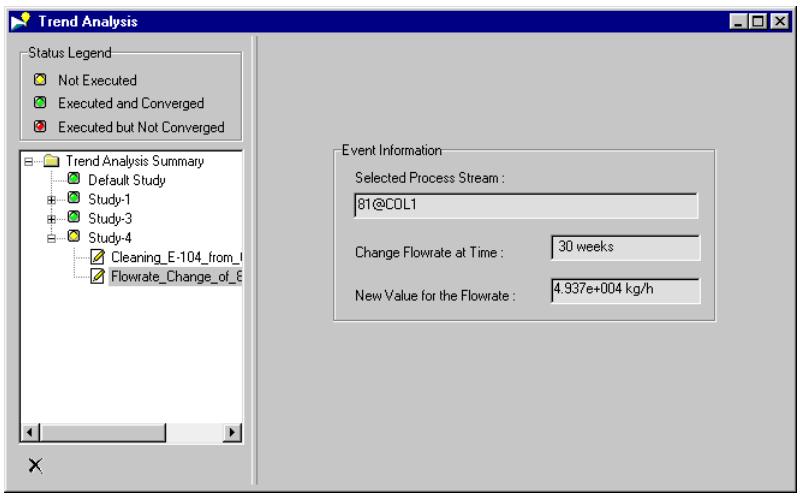
The second drop-down list is not available when the Profit Index Trend is selected.

The fields are available only when Profit Index Trend is selected.

3.7.6 Results Pane - Event Level

At the Event level, the Results pane displays information regarding the selected event.

Figure 3.80



The following table lists and describes the objects available in the Results pane:

Object	Description
The following field and two drop-down lists are only available when you select the cleaning exchanger type event.	
Selected Exchanger for Cleaning field	Displays the selected exchanger's name in the selected event.
Remove exchanger at interval drop-down list	Allows you to select/change the interval when the selected exchanger is off-service for cleaning.
Put back service at interval drop-down list	Allows you to select/change the interval when the selected exchanger is back in service.
The following three fields are only available when you select the modifying process stream type event or the events generated by the Change Throughput event type.	
Selected Process Stream field	Displays the selected process stream's name in the selected event.
Change Flowrate at Time field	Displays the time interval when the process stream's flow rate is modified.
New Value for the Flowrate field	Displays the new flow rate of the process stream in the selected event.

You cannot change the selected exchanger in an event at the Event level.

You cannot change an existing Modify Stream MassFlow event.

If you want to make modifications, you have to delete the event you want to change.

4 Heat Integration Project

4.1 Introduction

The Heat Integration Project (HI Project) is an operation used to design heat exchanger network (HEN). The HI Project is similar to the HI Case operation except for the two following differences:

- The operation can contain multiple scenarios and designs.
- The operation can be switched to retrofit mode.

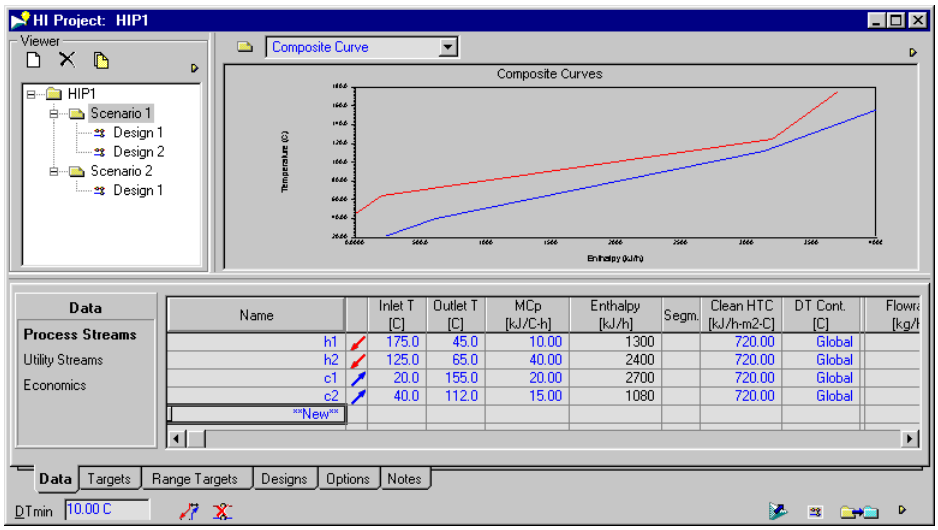
4.2 Heat Integration Project View

To access previously created HI Project operation, refer to **Section 1.2.2 - Editing an Operation**.

There are two ways to create a HI Project operation:

- Select the **Managers-HI Project** command from the menu bar.
- Select the **Managers-Heat Integration Manager** command from the menu bar, to open the Heat Integration Manager view. In the Heat Integration Manager view select **HeatIntegrationProject** in the left list and click the **Add** button.

Figure 4.1



For more information about the Project views, refer to **Section 2.3.5 - Project View** from the **User Guide**.

The HI Project operation view is a project view and contains the following:

- Three levels: Project, Scenario, and Design. Refer to **Section 8.2.2 - Heat Integration Levels and Panes** from the **Reference Guide**.
- Three panes: Viewer, Main, and Worksheet. Refer to **Section 8.2.4 - Scenario Level** from the **Reference Guide**.

Viewer Pane

The Viewer pane is located at the top left corner of the HI Project view. This pane is used to navigate between levels in the HI Project view, so it does not change at different levels.

The following table lists and describes the objects available in the Viewer pane:

Object	Icon	Description
Viewer group		Contains the tree browser that is used to navigate from level to level.
Add icon		Allows you to add a scenario or design.
Delete icon		Allows you to delete the selected scenario and/or design(s).
Close icon		Allows you to clone the selected scenario and/or design(s).
Open Viewer as Separate Window icon		Allows you to open the Viewer pane into a separate view.

Main Pane

The Main pane is located at the top right side of the HI Project view. The information/objects displayed on this pane depends on the selected/active level in the Viewer pane.

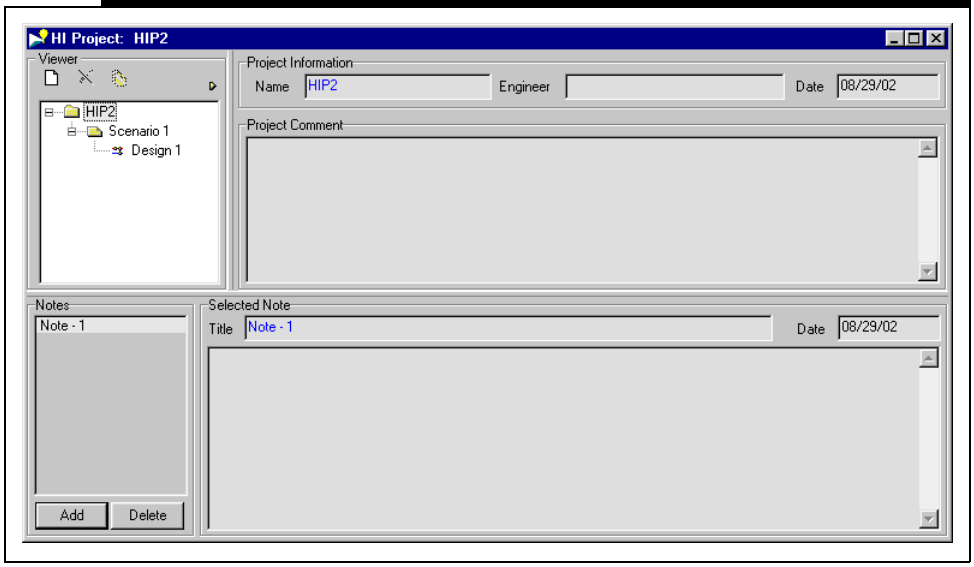
Worksheet Pane

The Worksheet pane is located at the center bottom of the HI Project view. The information/objects displayed on this pane depends on the selected/active level in the Viewer pane.

4.3 Project Level

The project level allows you to specify general information about the system/plant you are about to analyse. The information specified at this level will not affect any of the scenarios or designs created/generated in the HI Project operation.

Figure 4.2



Main Pane

Refer to **Section 2.3.5 - Project View** from the **User Guide** for more information.

At this level, the Main pane allows you to enter and/or modify the HI Project view's name, the name of the engineer/author who worked or created the HI Project operation, and general information about the system being analysed in the HI Project operation.

Worksheet Pane

Refer to **Section 2.3.5 - Project View** from the **User Guide** for more information.

At this level, the Worksheet pane allows you to enter multiple notes about the HI Project operation. HX-Net also automatically records the date of when you last entered/modified information in each note.

4.4 Scenario Level

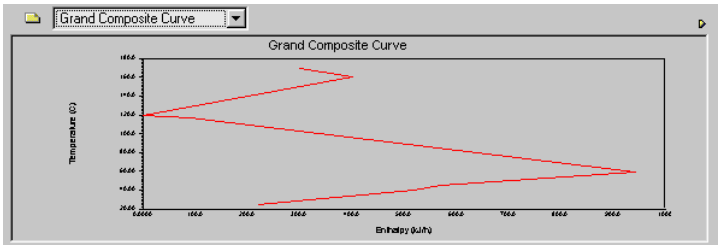
The Scenario level can be accessed by clicking any scenario on the tree browser in the Viewer group.

Main Pane

For information about the plots, refer to the **Target Values** section of **Section 8.2.4 - Scenario Level** from the **Reference Guide**.

At this level, the Main pane displays one of four different plots: Composite Curves, Grand Composite Curve, Alpha Plot, and General Plot.

Figure 4.3



The following table lists and describes the possible objects available in the Main pane:

Object	Description
Folder icon	Indicates the mode of the active scenario by displaying yellow colour for design mode and blue colour for retrofit mode. For more information about modes, refer to **Section 8.2.6 - Operation Modes** from the **Reference Guide**.
Drop-down list	Allows you to select one of the four possible plots to be displayed in the pane.
Open Page icon	Allows you to open the plot into a separate view.
Plot	Displays the type of plot selected from the drop-down list.
Calculate button	Allows you to display the calculated default range targets in the Alpha Plot and General Plot. This button is only available when the Alpha Plot is selected.
The objects below are only available when the General Plot is selected.	
Show all design points checkbox	Allows you to toggle between displaying or hiding data points of all the designs in the plot.

Folder icon

Open Page icon

Object	Description
Show target line checkbox	Allows you to toggle between displaying or hiding the target line in the plot.
X Axis drop-down list	Allows you to select the property for the x-axis of the plot.
Left drop-down list	Allows you to select the property for the left side y-axis of the plot.
Right drop-down list	Allows you to select the property for the right side y-axis of the plot.

Worksheet Pane

At the Scenario level, the Worksheet pane contains six tabs and several objects below the tabs. The number and type of objects available below the tabs varies, depending on which tab is active.

The following table lists and describes all the objects available in the Worksheet pane:

Object	Icon	Description
DTmin field		Allows you to specify the minimum temperature difference for all the heat exchangers in the heat exchanger network (HEN) design.
Open Targets View icon		Allows you access to the Targets view. Refer to the **Targets View** section for more information.
Open Forbidden Matches icon		Allows you to access the Forbidden Matches view. This view allows you to forbid certain streams from interacting. Refer to **Section 1.5 - Forbidden Matches View** for more information.
Hot and Cold status bar		Displays whether or not there is sufficient cold /hot utilities in the HEN design for the process streams being cooled/heated to achieve the specified outlet temperature. Refer to **Section 6.2.3 - Hot and Cold Status Bars** from the **Reference Guide** for more information.
Calculate button		Allows you to begin the Range Targeting calculations. The calculated values are displayed on the table and plot. Available only when the plot or table is empty.
DTmin Range button		Allows you to access the Range Target view. This view allows you to specify the interval over which the Range Targeting calculation is performed.
Clear button		Allows you to clear the values that have been previously calculated from the plot and table. Available only when the plot and table contains calculated values.

The Hot and Cold status bars are only available when the *Utility Streams* tab is active.

The Calculate, DTmin Range, Clear, and Insert buttons are available when the *Range Targets* tab is active.

Refer to the **Range Target View** section for more information.

Object	Icon	Description
Insert button		Allows you to insertion of a specific DTmin value into the Range Targeting calculation. Available only when *Table* page is active.
Complete designs only checkbox		Allows you to toggle between displaying only completed designs or all designs associated to the selected scenario.
Relative to target checkbox		Allows you to toggle between displaying the actual design values or the design values as a percentage of the calculated target values in the *Designs* tab.
Data Extraction Report button		Allows you to open the Data Extraction Report view. This view contains a summary of the data extraction. The button only appears when the **Notes** tab is active and the HEN design is based on data extracted from a HYSYS case or Column Sequencing operation.
Data Extraction From Simulation icon		Allows you to extract the stream information from HYSYS and placed them in the HI Case operation for a HEN design.
Recommend Designs icon		Allows you access to the Recommend Designs view. Refer to **Section 4.5 - Automatic Recommend Designs Feature** for more information.
Enter Retrofit Environment icon		Allows you to enter the selected design/scenario into retrofit mode.
Opens Current Page in Separate Window icon		Allows you to open the active tab/page into a separate view.

The two checkboxes are only available when the *Designs* tab is active.

Refer to **Section 8.3 - Summary View** for more information.

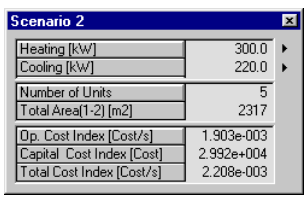
Refer to **Chapter 8 - Data Extraction** for more information.

For more information on HI Project-Retrofit Environment, see **Chapter 5 - Retrofit Mode**.

Targets View

The Targets view contains a summary information of the target values from the Targets tab.

Figure 4.4



Open Targets View icon

To access the Targets view, clicking the **Open Targets View** icon (which appears at the bottom of every tab and page in the scenario level).

The Targets view displays following target information:

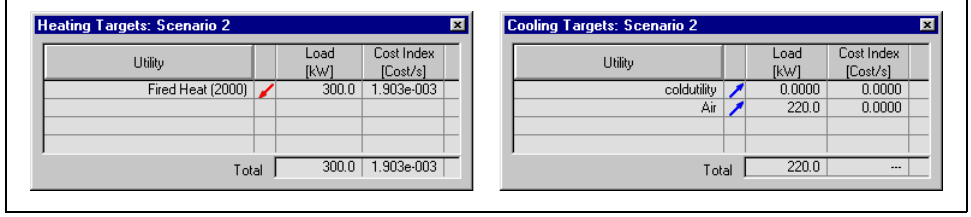
Variable	Description
Heating cell	Displays the minimum hot utility load required.
Cooling cell	Displays the minimum cold utility load required.
Number of Units cell	Displays the minimum total number of heat exchanger units.
Total Area (1-2) cell	Displays the minimum total area when all exchangers are shell and tube type.
Op. Cost Index cell	Displays the minimum operating cost, based on energy targets.
Capital Cost Index cell	Displays the minimum capital cost, based on area targets.
Total Cost Index cell	Displays the minimum annualized cost, based on capital and operating targets.

Click the **Open () Utilities Target** icon beside the Heating or Cooling cell to observe more information about the hot or cold utility targets respectively.

Hot/Cold Utility Targets Views

Click the **Open Heating Utilities Target** or **Open Cold Utilities Target** icon to open the Heating Targets or Cooling Targets view.

Figure 4.5

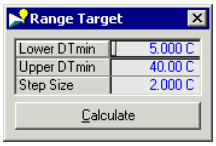


Each view displays the same information for either heating or cooling utilities:

Object	Description
Utility column	Displays the name of the utility.
Load column	Displays the target load for the individual utility. The last cell of the Load column displays the total load on all utilities.
Cost Index column	Displays the cost of the individual utility. The last cell of the Cost Index column displays the sum of the cost indexes.

Range Target View

To access the Range Target view: open the Targets view, go to the **Range Targets** tab, and click the **DTmin Range** button.



The Range Target view allows you to specify the range of values to be calculated in the Range Target calculations. The following table lists and describes in objects available in the Range Target view:

Object	Description
Lower DTmin cell	Allows you to enter the minimum value in the range calculation.
Upper DTmin cell	Allows you to enter the maximum value in the range calculation.
Interval Size cell	Allows you to specify the interval or step size to be taken during the calculations.
Calculate button	Allows you to begin the Range Targeting calculations. The range of values to be calculated are based on the values entered in the **Lower DTmin** and **Upper DTmin** cells.

The following sections describe each tab in the Worksheet pane for Scenario level in detail.

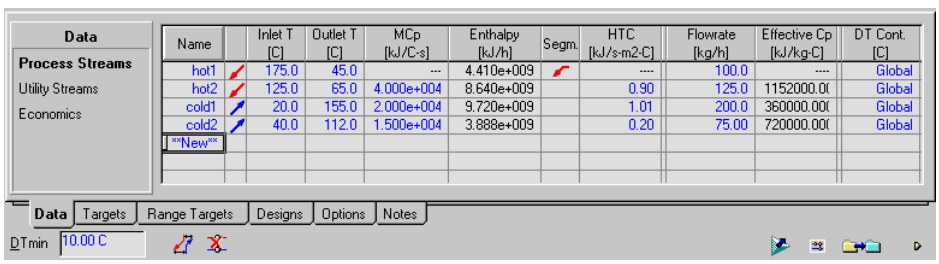
4.4.1 Data Tab

The Data tab contains three pages: Process Streams, Utility Streams, and Economics.

Process Streams Page

The Process Streams page allows you to specify the basic information regarding the process streams in the heat exchanger network.

Figure 4.6



You must enter the following information for the process stream: name, inlet temperature, outlet temperature, and MCp or Enthalpy of the process stream.

The following table lists and describes the objects in the Process Streams tab:

Object	Description
Name column	Allows you to specify the name of the process stream.
Stream Type column	Displays an icon to indicate the type of stream for the process stream. There are two types of stream: Hot and Cold. The cell in this column will appear blank until you specify the inlet and outlet temperature. Refer to **Section 6.2.1 - Process Streams** from the **Reference Guide** for more information.
Inlet T column	Allows you to specify the supply or inlet temperature of the process stream.
Outlet T column	Allows you to specify the target or outlet temperature of the process stream.
MCp column	Allows you to specify the heat capacity flow rate value of the process stream. • This cell displays a value only if the specific heat of the stream is assumed to be temperature independent. • If the stream contains piece wise linearized temperature (i.e., enthalpy curve), then this cell will contain this symbol (**---**).
Enthalpy column	Allows you to specify the enthalpy of the process stream. Refer to **Section 6.2.1 - Process Streams** from the **Reference Guide** for more information.
Segm. column	Allows you access to the Segment Data tab. This tab allows you to model changes in MCp over the temperature range of the hot or cold process stream. For more information on segmenting process streams, refer to **Section 6.1.1 - Segment Data Tab**.
HTC column	Allows you to specify the local heat transfer coefficient associated with the stream. HX-Net provides a default value of 720 kJ/hm^{2}C (35.22 Btu/hft^{2}F). If the stream contains segments, then this cell will contain this symbol (**---**). Refer to **Section 1.3.5 - Selecting HTC from HTC Database** for more information.
Flowrate column	Allows you to specify the mass flowrate of the stream.

Hot and Cold Stream icon

Refer to **Section 6.2.1 - Process Streams** from the **Reference Guide** for more information.

If the stream contains multiple segments, the Segm. cell will display one of the following two icons:

Segmented Hot Stream icon

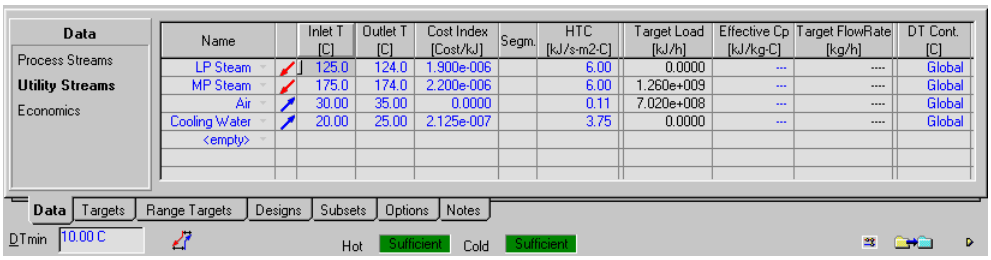
Segmented Cold Stream icon

Object	Description
Effective Cp column	Displays the specific heat capacity of the stream. This value is calculated only when a value for the flow rate has been specified. If the stream contains segments, then this cell will contain this symbol (**---**).
DT Cont. column	Allows you to specify the minimal approach temperature associated with the stream. HX-Net provides a default global ΔT_{min} value of 10°C, which is represented by the word **Global** in the cell.

Utility Streams Page

The Utility Streams page allows you to select the hot and cold utility for the heat exchanger network. Utility streams are used to satisfy heating and cooling requirements of the process streams.

Figure 4.7



If you have entered a hot stream in a cell, you have to delete the information in that cell, before you can replace the information in that cell with a cold stream.

There are two methods to adding utilities to the HEN:

- You can select a utility from the HX-Net Utility Database by clicking the down arrow in the **Name** cell and selecting the utility you want from the drop-down list.
- You can specify your own utility by entering the utility information in the appropriate cells.

If you are entering your own utility, you must enter the following information: name, inlet temperature, and outlet temperature of the utility stream.

If you want to calculate the operating cost of the utility you must enter the cost per energy value in the Cost Index cell. The operating cost of the utility is the Heat Load requirement of the utility multiplied by the Cost Index value.

The following table lists and describes the objects in the Utility Streams tab:

Object	Description
Name column	Allows you to specify the name of utility stream or select a utility from the HX-Net Utility Database.
Utility Type column	Displays an icon to indicate the type of stream for the utility stream. There are two types of stream: Hot and Cold. The cell in this column will appear blank until you specify the inlet and outlet temperature or select a utility stream. Refer to **Section 6.2.2 - Utility Streams** from the **Reference Guide** for more information.
Inlet T column	Allows you to specify the supply or inlet temperature of the utility stream.
Outlet T column	Allows you to specify the target or outlet temperature of the utility stream.
Cost Index column	Allows you to specify the utility cost rate. Utility cost rate is based on dollars per unit heat load.
Segm. column	Allows you access to the Process Stream view. This view allows you to model changes in Cp over the temperature range of the hot or cold utility stream. HX-Net will back calculate the mass flow of the utility stream, to satisfy the heat balance of the entire network. For more information on segmenting process streams, refer to **Section 6.2 - Segmenting Streams**.
HTC column	Allows you to specify the heat transfer coefficient for the stream. HX-Net also provide a list of default heat transfer coefficient (HTC) values that you can select from. Refer to **Section 1.3.5 - Selecting HTC from HTC Database** for more information.
Target Load column	Displays the calculated Target Load value of the utility stream that satisfies the process stream temperature requirements in the heat exchanger network. The Target Load value is the total enthalpy change of the utility stream.
Effective Cp column	Allows you to specify the effective or overall heat capacity of the stream.
Target Flowrate column	Displays the calculated target flow rate when the value for effective heat capacity has been entered.
DT Cont. column	Allows you to specify the minimal approach temperature associated with the stream. HX-Net provides a default global ΔT_{min} value of 10°C, which is represented by the word **Global** in the cell.

Hot and Cold Stream icon

If there is more than one segment in the stream and depending on the stream type, the Segm. cell will display one of the following two icons:

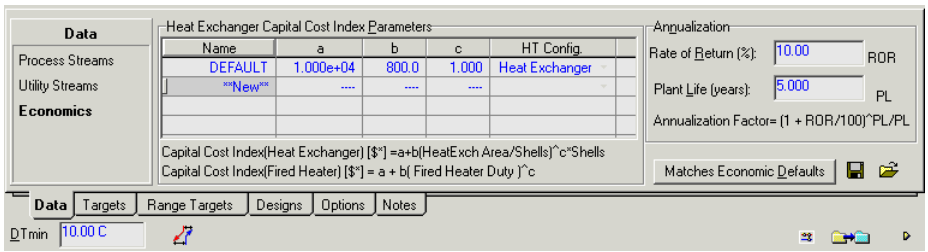
Segmented Hot Stream icon

Segmented Cold Stream icon

Economics Page

The Economics page allows you to modify the cost calculations. There are two groups in the Economic tab: Heat Exchanger Capital Cost Index Parameters (HECCIP) and Annualization.

Figure 4.8



Refer to **Section 6.2.6 - Economic Parameters** from the **Reference Guide** for more information about cost calculations.

You cannot delete the HX-Net default cost law.

- The HECCIP group contains a set of parameter values for calculating the capital cost of the heat exchangers. You can have more than one set of parameter values.
  HX-Net has an economic database file, which contains one set of economic parameter values. By default, this set of parameter values always appears in the HECCIP group.
- The Annualization group contains parameter values for calculating the Annualization Factor.

The following table lists and describes the objects in the Economics tab:

Object	Description
Name column	Allows you to specify a name for a set of economic parameter values.
a column	Allows you to specify the installation cost of the heat exchanger. HX-Net default value for “a” is 10000.
b column	Allows you to specify the area-related cost law coefficients of the heat exchanger. HX-Net default value for “b” is 800.
c column	Allows you to specify the area-related cost law coefficients of the heat exchanger. HX-Net default value for “c” is 0.8.
HT Config column	Allows you to select the type of heat transfer configuration to be associated to the capital cost calculation. There are two selections: Heat Exchanger and Fired Heater.
Rate of Return field	Allows you to specify the rate of return percentage on the heat exchanger. HX-Net default value is 10%.
Plant Life field	Allows you to specify the length of time the plant will be operating. HX-Net default value is 5 years.

For more information about calculating capital cost, refer to **Section 6.2.6 - Economic Parameters** from the **Reference Guide**.

Object	Description
Matches Economic Defaults button	Allows you access to the Matches Economics view. This view allows you to specify different cost sets to certain heat exchangers. Refer to **Section 1.4 - Matchwise Economic View** for more information.
Save Heat Exchanger Capital Cost Parameters to File icon	Allows you to save the capital cost parameter data as an economic database/*.hcc file.
Open Saved Heat Exchanger Capital Cost Parameters icon	Allows you to open a previously saved economic database file with the extension *.hcc.

Save Heat Exchanger Capital Cost Parameters to File icon

Open Saved Heat Exchanger Capital Cost Parameters icon

4.4.2 Targets Tab

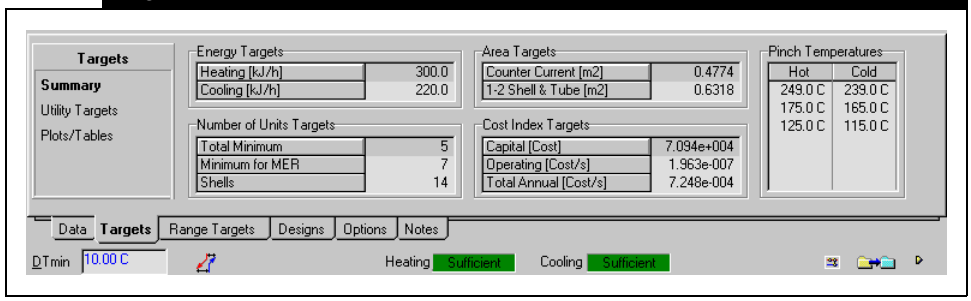
The Targets tab contains three pages: Summary, Utility Targets, and Plots/Tables. You cannot specify any information in the Targets tab.

Summary Page

For more information regarding the target values, refer to **Section 6.3 - Targets** from the **Reference Guide.**

The Summary page displays all target information calculated by HX-Net.

Figure 4.9



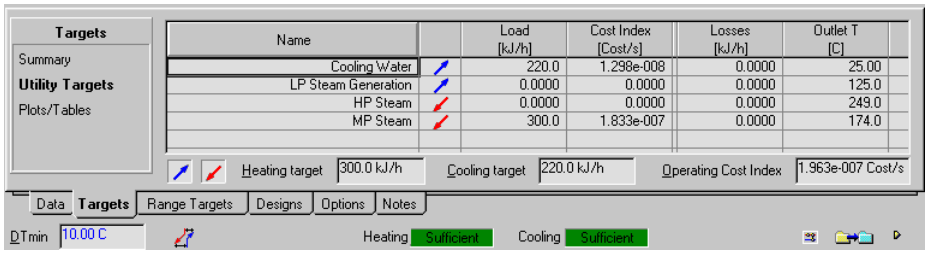
There are five groups in the Summary page. The groups name and description of their contents is described in the following table:

Group	Description
Energy Targets	Displays the following target variables: • **Heating**. The minimum hot utility load required for the process streams in the heat exchanger network (HEN) to achieve their final values, after the energy available in the hot process streams have been transferred to cold process streams. • **Cooling**. The minimum cold utility load required for the process streams in the heat exchanger network (HEN) to achieve their final values, after the energy available in the hot process streams have been transferred to cold process streams.
Number of Units Targets	Displays the following target variables: • **Total Minimum**. The minimum total number of units required for the HEN system. • **Minimum for MER**. The minimum number of units required for the HEN system for MER design. The MER (Minimum Energy Requirement) design takes info account the pinch temperature. • **Shells**. The total minimum number of shells required for the HEN system. The minimum number of shells do not necessary equal the minimum total number of heat exchangers due to restriction on maximum heat transfer area for a shell.
Area Targets	Displays the following target variables: • **Counter Current**. The minimum amount of heat transfer area required when all exchangers are counter current. • **1-2 Shell & Tube**.The minimum amount of heat transfer area required when all exchangers are shell and tube.
Cost Index Targets	Displays the following target variables: • **Capital**. The minimum capital cost of the heat exchangers, based on area targets. • **Operating**. The minimum operating cost of the utilities, based on energy targets. • **Total Annual**. The minimum annualized cost of the heat exchanger network, based on capital and operating targets.
Pinch Temperature	Displays the hot and cold pinch temperatures in the HEN of the operation.

Utility Targets Page

The Utility Targets page displays the targets for the individual utility streams.

Figure 4.10



The following table lists and describes the objects available on the Utility Targets page:

Hot and Cold Stream icon

Object	Description
Name column	Displays the name of the utility stream.
Utility Type column	Displays whether the utility is hot or cold using one of two icons.
Load column	Displays the calculated Target Load of the utility stream which satisfies the process stream temperature requirements in the heat exchanger network. The Target Load is the total enthalpy change of the utility stream.
Cost Index column	Displays the utility cost rate specified in the HI Case view, Utility Streams tab. Utility cost is based in dollars per unit heat load.
Losses column	Displays the target heat loss of the utility stream. Energy losses occur when the hot utility's outlet temperature is lower than the hot stream pinch temperature or the cold utility's outlet temperature is higher than the cold stream pinch temperature.
Outlet Temp. column	Displays the target or outlet temperature of the stream.
Displays Cold Utility Stream icon	Allows you to toggle between hiding and displaying the cold utility stream in the Utility Targets table. The default setting for this icon is active.
Displays Hot Utility Stream icon	Allows you to toggle between hiding and displaying the hot utility stream in the Utility Targets table. The default setting for this icon is active.
Heating Target field	Displays the total heat load for the hot utility stream.

Displays cold stream, hide hot stream.

Hide cold stream, displays hot stream.

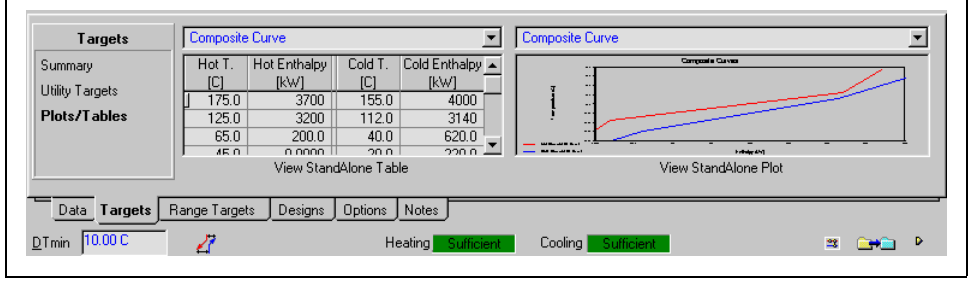
Object	Description
Cooling Target field	Displays the total heat load for the cold utility stream.
Operating Cost Index field	Displays the total operating cost of the utilities in the HEN.

Plots/Tables Page

For more details on the information contained within these curves, refer to **Section 6.3.7 - Plots** from the **Reference Guide**.

The Plots/Tables page contains a table and a plot that displays curve information. The type of information displayed in the table and plot depends on the curve selected in the drop-down list above the table and plot respectively

Figure 4.11



The following table lists and describes the objects available in the Plots/Tables page:

Object	Description
Table drop-down list	Allows you to select which information you want to observe in the table. There are three selections to choose from: • **Composite Curve**. This table contains the inlet and outlet temperature of both hot and cold stream and the enthalpies that correspond to each temperature. • **Grand Composite Curve**. This table contains the shifted temperature between each temperature interval and the corresponding ethalpies. • **Pocket Data**. This table provides information about pockets on the grand composite curve. A pocket is a portion of the grand composite curve that can be satisfied completely with process-process heat transfer.
Table	Displays the information based on the option you selected in the drop-down list above the table.
View StandAlone Table button	Allows you to display the table in a separate view.

Object	Description
Plot drop-down list	Allows you to select which information you want to observe in the table. There are nine selections to choose from: • **Composite Curve**. This plot displays the graphical combination (or composite) of all hot or cold process streams in a heat exchange network. • **Grand Composite Curve.** This plot shows the heat available in various temperature intervals and the net heat flow in the process (which is zero at the pinch). • **Balanced Composite Curve**. This plot is similar to the Composite Curve, except both process and utility streams' information are combined. • **Utility Composite Curve**. This plot is similar to the Grand Composite Curve, except the utility composite curve (plot that contains information from the utility streams) is added. • **Shifted Composite Curve**. This plot is similar to the Composition Curve plot, except the hot composite curve is shifted down by $\Delta T_{min}/2$ and the cold composite curve is shifted up by $\Delta T_{min}/2$. • **Shifted Balanced Composite Curve**. This plot is similar to the Balanced Composition Curve, except the hot composite curve is shifted down by $\Delta T_{min}/2$ and the cold composite curve is shifted up by $\Delta T_{min}/2$. • **User Supplied Utility Load**. This plot is similar to the Composite Curve, except the plot contains the information from the utility streams instead of process streams. • **Hot Driving Force Curve**. This plot displays the temperature difference (driving force) between the hot and cold composite curves for the hot stream. • **Cold Driving Force Curve**. This plot displays the temperature difference (driving force) between the hot and cold composite curves for the cold stream.
Plot	Displays the information based on the option you selected in the drop-down list above the plot.
View StandAlone Plot button	Allows you to display the plot in a separate view.

Refer to **Section 7.4 - Plot Area** and **Chapter 8 - Plot Properties** from the **User Guide** for information on manipulating plots.

Accessing a Plot type

To access the plot type in a table or plot format:

1. At Scenario level, access the **Targets** tab, **Plots/Tables** page.
2. Click the drop arrow in the drop-down list above the table or plot.
3. Select a plot type from the drop-down list, and the selected plot type will appear on the table or plot.

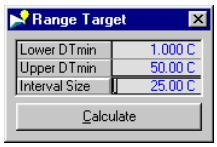
4.4.3 Range Targets Tab

The Range Targets tab contains two pages: Plot and Table. Both pages contain information pertinent to the optimization of the minimum approach temperature.

Performing a Range Target Calculation

After entering information for all process streams, utility streams, and economic data, a range target calculation can be performed.

1. Go to the **Range Targets** tab.
2. On either the **Plots** or **Table** page, click the **DTmin Range** button.
3. In the Range Target view, enter the following information:
   - **Lower DTmin.** The minimum value for the range over which the calculations will occur.
   - **Upper DTmin.** The maximum value for the range over which the calculations will occur.
   - **Interval**. The step size taken when iterating over the range.
4. Click the **Calculate** button.



Range Target view

To perform another calculation, click the Clear button at the bottom of the Range Targets tab to delete the current values.

Inserting a Value for Calculation

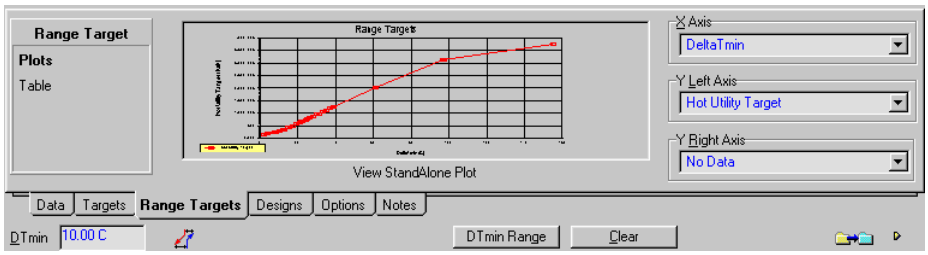
To add a specific DTmin value:

1. Go to the **Range Targets** tab, **Table** page.
2. Click the **Insert** button and the a blank row will appear in the table.
3. Click in the empty cell in the table and enter the new DTmin value. HX-Net will automatically calculate the values for the variables based on the new DTmin value.

Plots Page

The Plots page displays range targeting information in a graphical format. The three drop-down lists located on the right side of the plot controls the type of variables being displayed on the plot's axes.

Figure 4.12



The following table lists and describes the objects available in the Plots page:

Object	Description
Plot	Displays the Range Targeting calculated values in a plot.
View StandAlone Plot button	Allows you to display the plot in a separate view.
X Axis drop-down list	Allows you to select which variable you want to appear in the x axis of the plot.
Y Left Axis drop-down list	Allows you to select which variable you want to appear in the y axis on the left side of the plot.
Y Right Axis drop-down list	Allows you to select which variable you want to appear in the y axis on the right side of the plot.

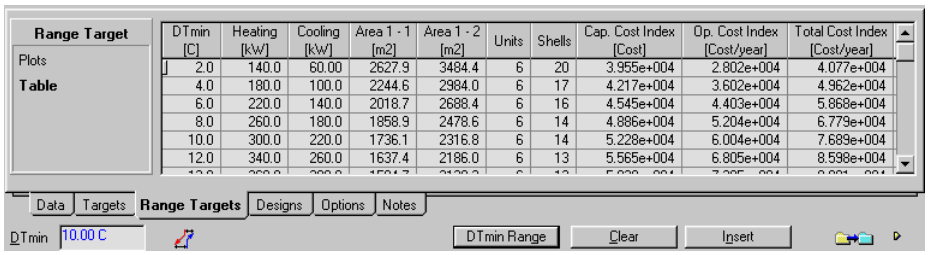
The drop-down list for the x and y axes contains the following list of options:

- Delta T Min
- Hot Utility Target
- Cold Utility Target
- Countercurrent Area Target
- Shell and Tube Area Target
- MER Units Target
- Shell Target
- Capital Cost Target
- Operating Cost Target
- Total Cost Target
- No Data. This option is available only for the right y axis.

Table Page

The Table page displays the Range Targeting information in tabular format.

Figure 4.13



In order for HX-Net to calculate the Total Annual Cost of the heat exchanger network the following information must be provided:

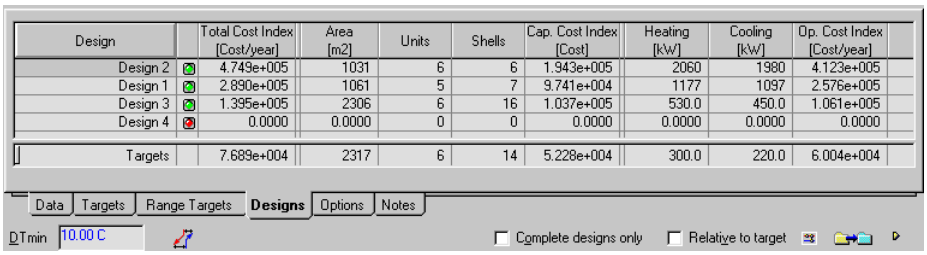
- values for each of the utility cost
- cost law for the heat exchanger network
- values for the annualization factor parameters: Rate of Return (ROR) of the plant and the plant life (PL)

If no range values for ΔT_{min} is provided, HX-Net calculates the cost data for all ΔT_{min} values ranging from 0 to the calculated maximum ΔT_{min}. The default intervals for which the ΔT_{min} range is divided is determined using the Golden Search method.

4.4.4 Designs Tab

The Designs tab provides a table that list some information regarding all the designs available for the selected scenario. This table is a tool for comparing the numerous designs that can exist under one scenario. The last row in the table contains the calculated target values.

Figure 4.14



The following table lists and describes all the objects available in the Design tab:

Object	Description
Design column	Displays the name of the design.
Design Status column	Displays an icon that indicates the status of the design. The design can be one of the following two statuses: • **Complete**. Designs do not have any unsatisfied streams, or infeasible heat exchangers. A green light icon appears for this status. • **Incomplete**. Designs can have unsatisfied streams, infeasible heat exchangers, or uncalculated heat exchangers. A red light icon appears for this status.
Total Cost Index column	Displays the total annualized cost of the design.
Area column	Displays the total area of all heat exchangers in the design.
Units column	Displays the total number of heat exchangers in the design.
Shells column	Displays the total number of shells in the design.
Capital Cost Index column	Displays the total capital cost of the design, based on the total area and the economic parameters entered on the **Data** tab, **Economics** page.
Heating column	Displays the total load on hot utilities in design.
Cooling column	Displays the total load on cold utilities in design.
Op. Cost Index column	Displays the total operating cost of the design, based on the heating and cooling loads and the cost index of the utilities.

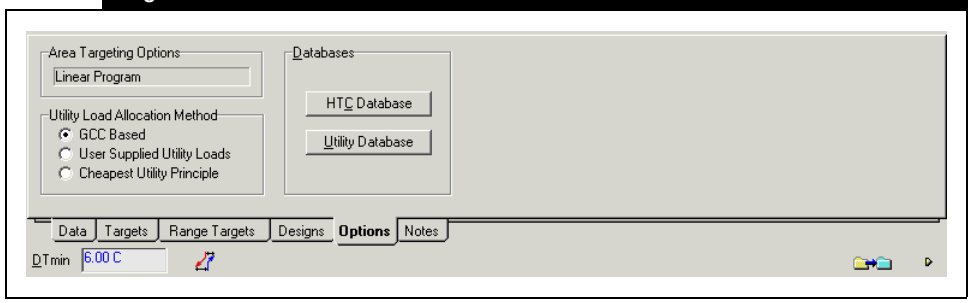
Green Light icon indicates a complete design

Red Light icon indicates an incomplete design

4.4.5 Options Tab

The Options tab allows you to select the allocation for the utility load when there are multiple utilities. The area targeting algorithm currently in use is also displayed.

Figure 4.15



For more details on these two calculations, see **Section 1.5 - Forbidden Matches View**

For more information on these three allocation methods, see **Section 6.3.2 - Utility Load Allocation Methods** from the **Reference Guide**.

The Area Targeting Options group displays the current method being used for the area targeting calculation. If there are no forbidden matches, it will display Bath Formula. Otherwise, it will display LP formulation.

The Utility Load Allocation Method group contains three radio buttons corresponding to the three methods available:

- GCC Based
- User Supplied Utility Load
- Cheapest Utility Principle

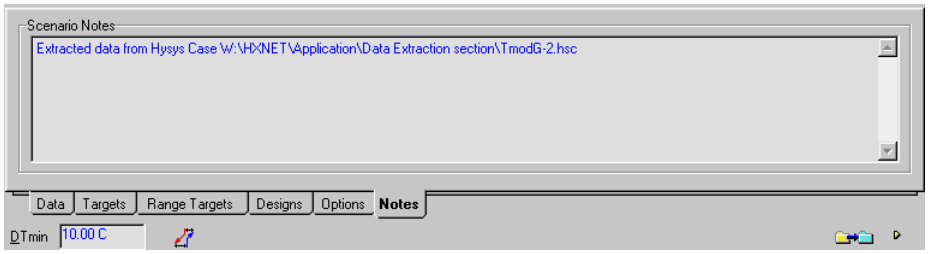
The Databases group, contains the two buttons described below.

- HTC Database button allows you to open the Heat Transfer Coefficient view. Refer to **Section 1.3 - HTC Database** for more information.
- Utility Database button allows you to open the Utility Database view. Refer to **Section 10.2 - Utility Database View** from the **User Guide** for more information.

4.4.6 Notes Tab

The Notes tab allows you to supply a description of the Project at the Scenario level.

Figure 4.16



The Scenario Notes group contains a text editor, where you can specify how one Scenario is different from the other, and document the assumptions made to completely specify the problem.

4.5 Automatic Recommend Designs Feature

The Automatic Recommend Designs feature in HX-Net allows user to generate several near optimal heat exchanger networks (HENs). For the underlying theory and algorithm that support this feature, refer to the **Theory and Algorithm** section of **Section 8.3.1 - Automated New Designs** from the **Reference Guide**.

4.5.1 Recommend Designs View

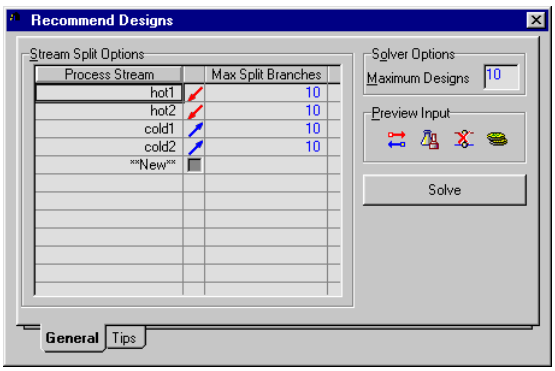
The Recommend Designs view allows you to specify limitations to the Automatic Recommend Designs feature and displays hints on the required information before attempting to use the Automatic Recommend Designs feature.

There are two tabs in the Recommend Designs view: General and Tips.

General Tab

The options to manipulate the Recommend Designs calculation are located in the **General** tab.

Figure 4.17



The following table lists and describes the objects in the General tab:

Object	Icon	Description
Process Stream column		Displays the name of all the process streams in the scenario
Stream Type icon		Displays an icon that indicates whether the process stream is a hot or cold stream.
Max Split Branches column		Allows you to specify the maximum number of splits/ branches allowed in the process stream.
Maximum Designs field		Allows you to specify the maximum number of optimum designs to be generated.
Preview Process Streams icon		Opens the *Process Streams* page in a separate view and allows you to modify the process streams information.
Preview Utility Streams icon		Opens the *Utility Streams* page in a separate view and allows you to modify the utility streams information.
Preview Forbidden Matches icon		Allows you to access the Forbidden Matches view. This view allows you to forbid certain streams from interacting. Refer to **Section 1.5 - Forbidden Matches View** for more information.
Preview Economic Information icon		Opens the *Economics* page in a separate view and allows you to modify the economic parameter information.
Solve button		Allows you to start the Automatic Recommend Designs calculations.

Refer to **Section 6.2.1 - Process Streams** from the **Reference Guide** for more information.

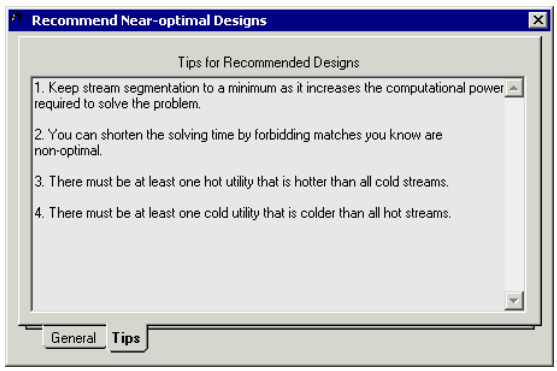
Refer to **Section 4.4.1 - Data Tab** for information about the *Process Streams* page and the *Utility Streams* page.

Refer to **Section 4.4.1 - Data Tab** for information about the *Economics* page.

Tips Tab

The hints in obtaining a near optimum HEN are located in the **Tips** tab.

Figure 4.18



4.6 Design Level

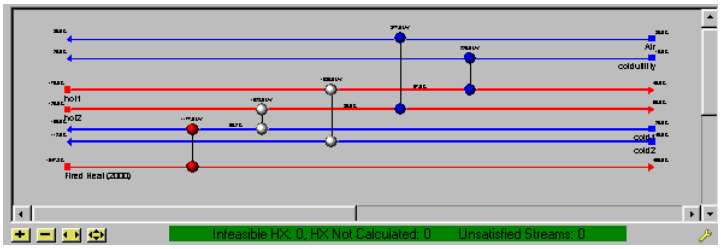
The Design level can be accessed by clicking any design in the tree browser in the Viewer group.

Main Pane

For more information regarding the construction of a heat exchanger network, refer to **Chapter 7 - Grid Diagram**.

At the Design level, the Main pane contains the Grid Diagram and a set of manipulation tools to manually generate a heat exchanger network design.

Figure 4.19



You can create, modify, and remove heat exchangers in the Grid Diagram using the manipulation tools provided.have been provided.

Worksheet Pane

At the Design level, the Worksheet contains five tabs and two icons below the tabs.

Enter Retrofit Mode icon

Opens Current Page in Separate Window icon

- **Enter Retrofit Mode** icon allows you to take the selected design and scenario and placed them in Retrofit mode.
  For more information on HI Project-Retrofit Environment, see **Chapter 5 - Retrofit Mode**.
- **Opens Current Page in Separate Window** icon allows you to open the active tab/page into a separate view.

The following sections describe each tabs from the Worksheet pane in detail.

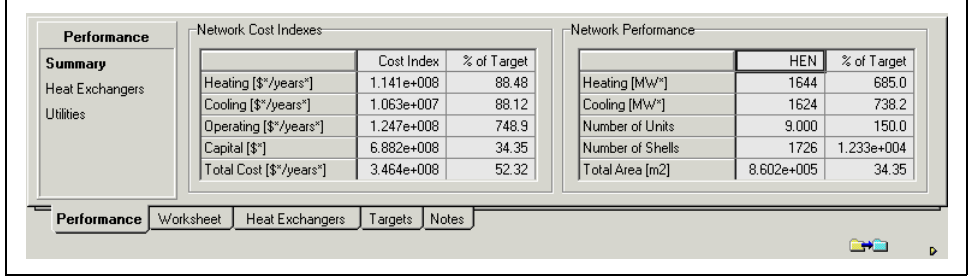
4.6.1 Performance Tab

The Performance tab contains three pages: Summary, Heat Exchangers, and Utilities. The three pages display the capital and operating costs of the Design, as well as a summary of important performance variables.

Summary Page

The Summary page displays the calculated values for a number of key variables for the design, and displays them along with the value as a percentage of the target value.

Figure 4.20



There are two groups on the Summary page: Network Cost Indexes, and Network Performance.

The following table lists and describes the variables in both groups:

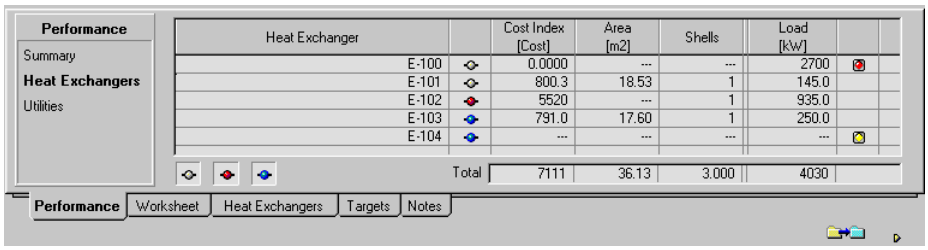
Variable	Description
Network Cost Indexes group	
Heating	Displays the actual cost of the hot utilities used in the design.
Cooling	Displays the actual cost of the cold utilities used in the design.
Operating	Displays the calculated operating cost, using the actual heating and cooling costs.
Capital	Displays the calculated capital cost of the design, using the area of the heat exchangers placed in the design.
Total Cost	Displays the calculated annualized total cost.

Variable	Description
Network Performance group	
Heating	Displays the sum of the loads on the hot utilities in the design.
Cooling	Displays the sum of the loads on the cold utilities in the design.
Number of Units	Displays the number of heat exchangers used in the design.
Number of Shells	Displays the number of shells used in the design.
Total Area	Displays the sum of all the heat exchanger areas in the design.

Heat Exchangers Page

The Heat Exchangers page displays the key variable values of the heat exchangers in the current design.

Figure 4.21



The following table lists and describes the objects available in the Heat Exchanger page:

Object	Description
Heat Exchanger column	Displays the name of the heat exchangers in the Grid Diagram.
Heat Exchanger Type column	Displays an icon that indicates the heat exchanger type. There are three types of heat exchanger: • **Process-Process.** The heat exchanger is attached to two process streams. • **Cooler**. A cold utility stream is being used in the heat exchanger to cool a process stream. • **Heater**. A hot utility stream is being used in the heat exchanger to heat a process stream.
Cost Index column	Displays the capital cost of the individual heat exchanger.
Area column	Displays the area of the individual heat exchanger.


Process streams


Cooler


Heater

Object	Description
Shells column	Displays the number of shells in the individual heat exchanger.
Load column	Displays the heat load placed on the heat exchanger
Status column	Displays the status of the heat exchanger calculations. The following statuses are available: • **OK Status.** The specifications are OK and the heat exchanger is feasible. No icon is displayed. • **Partially Calculated.** There is insufficient information about the conditions to complete the calculations. Yellow icon is displayed. • **Under Specified**. When some of the conditions are specified and some of the conditions are not specified, for either the heat exchanger or the stream. Yellow icon is displayed. • **Over Specified**. There are too many conditions specified. Yellow icon is displayed. • **Infeasible.** The specifications provided will not make a feasible heat exchanger. Red icon is displayed. • **Failed to Calculate.** There was a problem with the calculations. Red icon is displayed.
Displays Process-Process Exchangers icon	Allows you to toggle between showing or hiding the Process-Process heat exchangers data in the Heat Exchanger view.
Displays Heater icon	Allows you to toggle between showing or hiding the Heaters data in the Heat Exchanger view.
Displays Cooler icon	Allows you to toggle between showing or hiding the Coolers data in the Heat Exchanger view.
Total row	Displays the total values for the cost index, area, shells, and load for the entire design.

Yellow icon represents: Partially Calculated, Under Specified, and Over Specified status.

Red icon represents: Infeasible and Failed to Calculate status.

Show and Hide Process-Process Exchangers icons

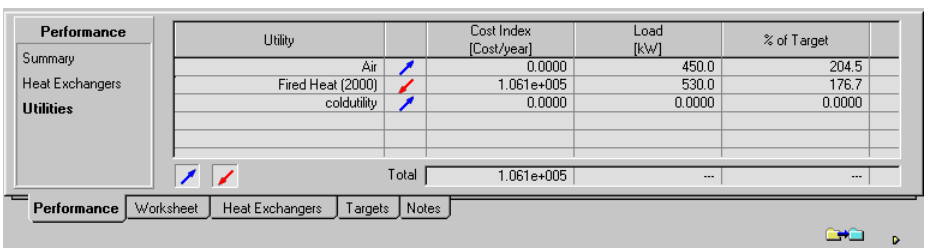
Show and Hide Heaters icons

Show and Hide Coolers icons

Utilities Page

The Utilities page contains a summary of the operating costs associated with the heat exchanger network design.

Figure 4.22



The following table lists and describes the objects available in the Utilities page:

Object	Description
Utility column	Displays the name of the utility.
Utility Type column	Displays an icon to indicate the type of stream for the utility stream. There are two types of stream: Hot and Cold. Refer to **Section 6.2.2 - Utility Streams** from the **Reference Guide** for more information.
Cost Index column	Displays the operating cost associated with the utility in the heat exchanger network.
Load column	Displays the load on the utility in the heat exchanger network.
% of Target column	Displays the heat load on the utility as a percentage of the target heat load.
Displays Cold Utility Stream icon	Allows you to toggle between hiding and displaying the cold utility stream in the Utility Targets table. The default setting for this icon is active.
Displays Hot Utility Stream icon	Allows you to toggle between hiding and displaying the hot utility stream in the Utility Targets table. The default setting for this icon is active.
Total row	Displays the sum of the operating costs of the entire network.

Hot and Cold Stream icon

Displays cold stream, hide hot stream.

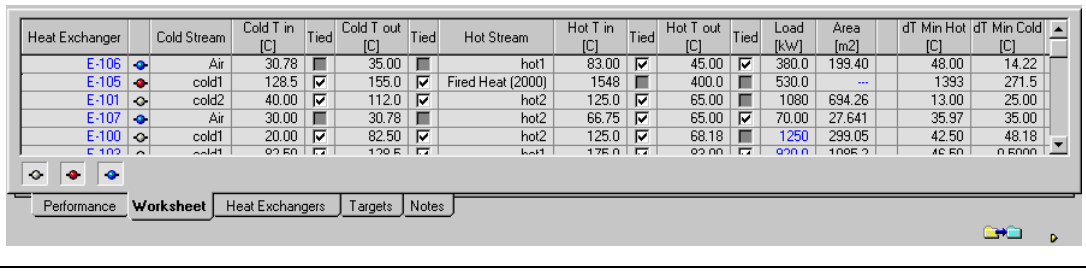
Hide cold stream, displays hot stream.

4.6.2 Worksheet Tab

For more information on the Worksheet tab, see **Section 7.7 - Worksheet Tab**.

The Worksheet tab is a tabular representation of the information found in the Grid Diagram. Manipulation of existing heat exchangers is possible through this tab.

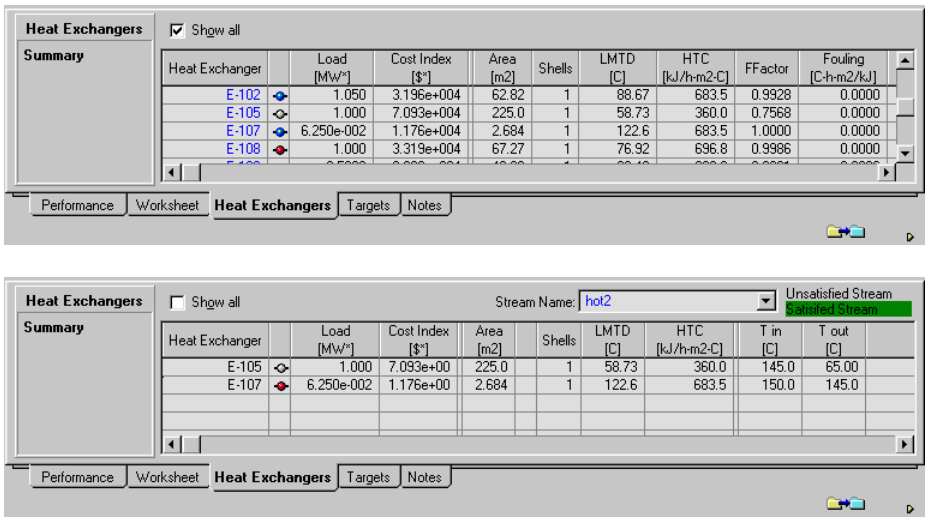
Figure 4.23



4.6.3 Heat Exchangers Tab

The Heat Exchangers tab displays specific information about each heat exchanger in the HEN view.

Figure 4.24



The following table lists and describes all the objects available in the Heat Exchanger tab:

Object	Description
Show all checkbox	Allows you to toggle between displaying all heat exchangers in the table or displaying specific heat exchangers in the table based on the stream you select. • When the **Show all** checkbox is checked the following objects are available: Driving Force button, Bar Chart button, Displays Process-Process Exchangers icon, Displays Heater icon, Displays Cooler icon, and table. • When the **Show all** checkbox is unchecked the following objects are available: Stream Name drop-down list, Stream status bar, and table.
Stream Name drop-down list	Allows you to select a stream available from the current scenario, and displays any heat exchangers associated to the selected stream in the table.

Object	Description
Stream status bar	Displays the status of the stream. There are two status: • **Unsatisfied Stream**. This status bar is red in colour and indicates that the streams product/outlet temperature was not achieved. • **Satisfied Stream**. This status bar is green in colour and indicates that the streams product/outlet temperature was achieved.
Heat Exchanger column	Displays the name of the heat exchanger.
Heat Exchanger Type column	Displays an icon to indicate the heat exchanger type. There are three types of heat exchangers. HX-Net automatically determines the type of exchanger based on the following information: • **Process-Process.** The heat exchanger is attached to two process streams. • **Cooler.** A cold utility stream is being used in the heat exchanger to cool a process stream. • **Heater**. A hot utility stream is being used in the heat exchanger to heat a process stream.
Load column	Displays the total heat load of the heat exchanger.
Cost Index column	Displays the capital cost associated with the individual heat exchanger. The capital cost is calculated using the *Economic Parameters* entered in the Scenario level.
Area column	Displays the heat exchanger area.
Shells column	Displays the number of shells associated with the heat exchanger.
LMTD column	Displays the Log Mean Temperature difference. The LMTD is calculated in terms of the hot and cold stream inlet and exit temperatures.
HTC (Heat Transfer Coefficient) column	Displays the overall heat transfer coefficient. The overall heat transfer coefficient, U, is calculated from the local heat transfer coefficients. The relationship is as follows: $\frac{1}{U} = \frac{1}{h_C} + \frac{1}{h_H}$ *where:* h_C = *the local heat transfer coefficient for cold streams* h_H = *the local heat transfer coefficient for hot streams*
FFactor column	Displays Ft, the LMTD correction factor, which is calculated from the geometry and configuration of the heat exchanger.
Fouling column	Displays the specified fouling factor of the streams in the heat exchanger.

Process streams

Cooler

Heater

The equation used to calculate LMTD is as follows:

$$\Delta T_{LM} = \frac{\Delta T_1 - \Delta T_2}{\ln(\Delta T_1 / \Delta T_2)}$$

where:

$$\Delta T_1 = T_{\text{hot out}} - T_{\text{cold in}}$$

$$\Delta T_2 = T_{\text{hot in}} - T_{\text{cold out}}$$

Yellow icon represents: Partially Calculated, Under Specified, and Over Specified status.

Red icon represents: Infeasible and Failed to Calculate status.

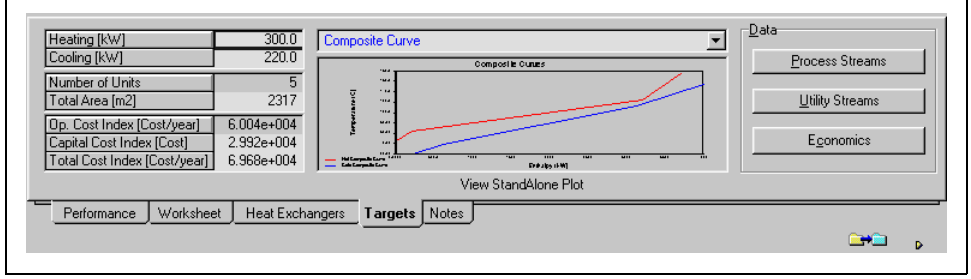
Object	Description
Status column	This column displays information about the status of the heat exchanger calculations. The following statuses are available: • **OK Status.** The specifications are OK and the heat exchanger is feasible. No icon is displayed. • **Partially Calculated.** There is insufficient information about the conditions to complete the calculations. Yellow icon is displayed. • **Under Specified**. When some of the conditions are specified and some of the conditions are not specified, for either the heat exchanger or the stream. Yellow icon is displayed. • **Over Specified.** There are too many conditions specified. Yellow icon is displayed. • **Infeasible.** The specifications provided will not make a feasible heat exchanger. Red icon is displayed. • **Failed to Calculate**. There was a problem with the calculations. Red icon is displayed.
Hot Stream column	Displays the name of the hot stream attached to the heat exchanger.
Hot T in column	Displays the inlet temperature of the hot stream.
Hot T out column	Displays the outlet temperature of the hot stream.
Cold Stream column	Displays the name of the cold stream attached to the heat exchanger.
Cold T in column	Displays the inlet temperature of the cold stream.
Cold T out column	Displays the outlet temperature of the cold stream.
dT Min Hot column	Displays the temperature difference between the inlet hot stream and the outlet cold stream of the heat exchanger.
dT Min Cold column	Displays the temperature difference between the outlet hot stream and the inlet cold stream of the heat exchanger.
Matched With column	Displays the streams that are connected to the heat exchangers of the selected stream.

This column is only available when the *Show all* checkbox is unchecked.

4.6.4 Targets Tab

The Targets tab provides a location for all targets to be displayed for reference at the Design level.

Figure 4.25



On the left side of the Targets tab is a table. The table contains the following target variable/information:

Variable	Description
Heating	Minimum hot utility load required for the heat exchanger network.
Cooling	Minimum cold utility load required for the heat exchanger network.
Number of Units	Minimum total number of heat exchanger units for the heat exchanger network.
Total Area	Minimum total area when all exchangers are shell and tube type for the heat exchanger network.
Operating Cost Index	Minimum operating cost, based on energy targets.
Capital Cost Index	Minimum capital cost, based on area targets.
Total Cost Index	Minimum annualized cost, based on capital and operating targets.

In the middle of the Targets tab is a graph region. you can select the type of plot you want to display by opening the drop-down list above the plot and selecting the plot type.

For more information about the plot types, refer to **Section 6.3.7 - Plots** from the **Reference Guide**.

The plot can display the following plot types:

- Composite Curve
- Grand Composite Curve
- Balanced Composite Curve
- Utility Composite Curve

- Shifted Composite Curve
- Shifted Balanced Composite Curve
- User Supplied Utility Load
- Hot Driving Force Curve
- Cold Driving Force Curve

Information regarding these pages are found in **Section 4.4.1 - Data Tab**.

On the right side of the Targets tab is the Data group. The Data group contains three buttons which will open the information contained on the **Data** tab of the Scenario level.

- **Process Streams** button will open the information on the Process Streams page.
- **Utility Streams** button will open the information on Utility Streams page.
- **Economics** button will open the information on the Economics page.

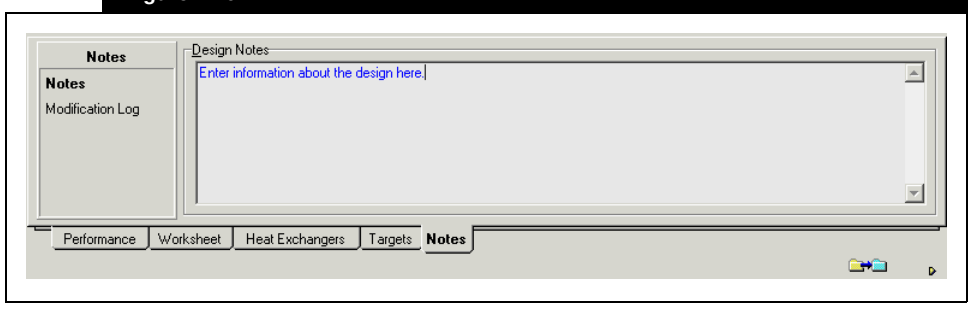
4.6.5 Notes Tab

The Notes tab contains two pages: Notes and Modification Log.

Notes Page

On the Notes page, you can supply a description of the Project at the Design level. You are able to specify how one Design is different from the other. You can also document the assumptions made to completely build or modify the heat exchanger design.

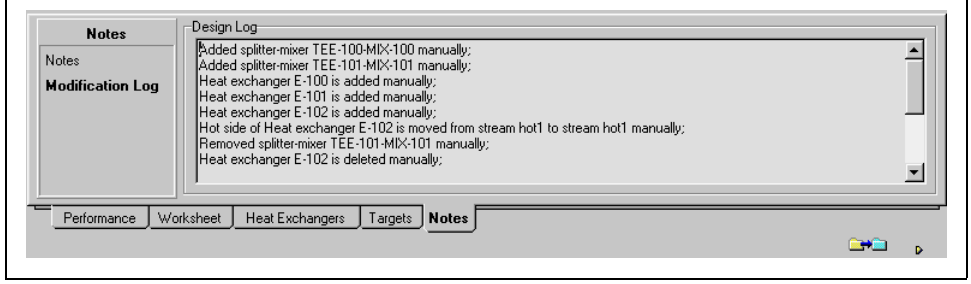
Figure 4.26



Modification Log

The Modification Log page, shown in the figure above records all actions performed on the Grid Diagram. It records when heat exchangers, splitters and mixers are added and deleted. It indicates if the actions were performed manually by the user, or automatically, as is the case in of a data extraction from a simulation case file.

Figure 4.27



5 Retrofit Mode

5.1 Introduction to Retrofit

The design produced through HEN retrofit is limited by the existing HEN design and operation set up.

The day to day operation of a plant is usually subject to change. The average heat exchanger network (HEN) designs are flexible enough to handle these changes. In some cases, like rising energy costs, problems arise and cannot be resolved with the original HEN. The purpose of retrofit is to modify the existing HEN so that it satisfies the new operating conditions and keeps energy costs low.

For more information about the Automatic Retrofit's theory and algorithm, refer to **Section 8.3.2 - Automated Retrofit Capabilities** from the **Reference Guide**.

HX-Net has a feature called the Automatic Retrofit. This feature allows you to perform step-by-step retrofit options on an existing HEN design.

5.1.1 Entering the Retrofit Mode

Before entering the retrofit mode, there are three restrictions that must be met/satisfied:

1. The process stream, utility stream, and economic parameters must contain some data.
2. A feasible heat exchanger network design must be available/exist.
3. The example problem must exist in HI Project operation.

There are three ways to satisfy the above restrictions:

Converts Case to Project icon

- If all the required process and utility stream information and feasible heat exchanger network (HEN) design already exist in a HI Case operation. You can convert the HI Case operation into a HI Project operation by clicking the **Converts Case to Project** icon.
- You can enter all the required process and utility stream information and create the existing heat exchanger network (HEN) in a HI Project operation.

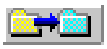
Data Extraction From Simulation icon

- If the plant simulation you want to retrofit already exist in HYSYS, you can import the simulation into the HI Project operation by clicking the **Data Extraction From Simulation** icon.

Once the HEN is completely solved and all of the streams are satisfied, HEN Automatic Retrofit feature can be activated.

To enter the retrofit mode:

1. In the Viewer pane, do one of the following:
   - Select the **scenario** that contains the information that you want to work on and click the **Enter Retrofit Mode** icon.
   - Select the **design** that contains the information you want to work on and click the **Enter Retrofit Mode** icon.



Enter Retrofit Mode icon

2. If you have selected a **scenario** to enter the retrofit mode, the Enter Retrofit Environment view appears. Refer to the **Enter Retrofit Environment View** section for more information.
   - If you have multiple designs for the selected scenario, you need to choose which design you want to retrofit.

All the modifications performed by Automatic Retrofit feature are compared to the selected design.

3. In the Enter Retrofit Environment view, you need to select how you want to enter the retrofit mode.
   There are two methods to enter the mode:
   - The selected scenario and selected design is cloned.
   - The selected scenario and selected design is converted.

In the conversion option, all other designs (aside from the selected design) in the scenario will be deleted.

Or

Options view

2. If you have selected a **design** to enter the retrofit mode, the Options view appears.
3. In the Options view, you need to select how you want to enter the retrofit mode.
   There are two methods to enter the mode:
   - The selected design and associate scenario is cloned.
   - The selected design and associate scenario is converted.

In the conversion option, all other designs (aside from the selected design) in the scenario will be deleted.

4. Click the **Enter Retrofit Environment** button, when you have selected the method of entrance.

Enter Retrofit Environment View

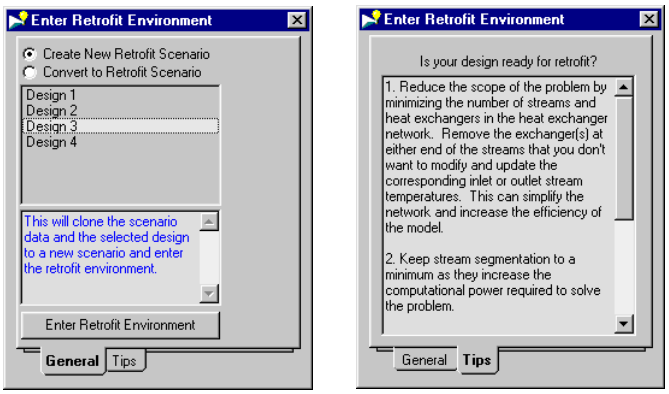
The Enter Retrofit Environment view pops up before you go into retrofit mode. There are two tabs in the Enter Retrofit Environment view: General and Tips.

The General tab allows you to do the following:

- Choose whether you want to convert or copy the selected scenario/ design into retrofit mode by selecting the appropriate radio button.
- Select which design in the scenario you want to change into retrofit mode from the list of designs.

If the selected scenario only contains one design, that design is automatically selected.

Figure 5.1



The Tips tab displays the retrofit tips/hints provided by HX-Net.

HEN Retrofit Tips

It is recommended that you read and follow the hints in the **Tips** tab. The tips are:

1. Reduce the scope of the problem by minimizing the number of streams and heat exchangers in the heat exchanger network. Remove the exchanger(s) at either end of the streams that you don't want to modify and update the corresponding inlet or outlet stream temperatures. This can simplify the network and increase the efficiency of the model.
2. Keep stream segmentation to a minimum as they increase the computational power required to solve the problem.

3. Combine adjacent heat exchangers between two process streams into one heat exchanger when possible. This has no effect in the final outcome but makes the solver work more efficiently.
4. Remove all energy streams. Energy streams are important to establish the targets of a process but are not necessary to perform a retrofit study. By removing them, the problem becomes easier to solve.

It is important that the HEN view represented in HX-Net matches the setup that exists in the plant, before entering the retrofit environment. This will ensure that good and meaningful designs are generated when retrofit is performed.

When heat exchanger network is extracted from HYSYS:

HYSYS does not require the temperature and the cost of utility streams to model a utility exchanger.

HX-Net however does require the temperature of utility streams to calculate the area and the cost of heaters and coolers. During data extraction, HX-Net places the utility streams on utility exchangers based on the thermodynamic feasibility. It is quite possible that more than one heaters or coolers are placed on the process streams during data extraction. These utility streams and placement of utility exchangers by HX-Net may not represent the actual network in the process.

Therefore it is important to check the temperature and cost of utility streams and placement of heaters/coolers. This will ensure that meaningful results are generated from HX-Net. A default economics set also exists in HX-Net and user should check and modify this after data extraction.

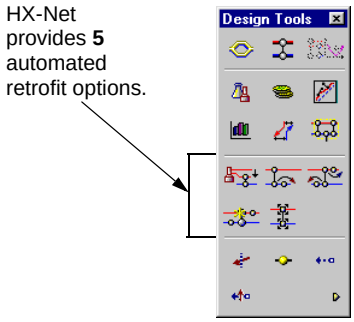
5.1.2 Applying Automated Retrofit Options

After changing the selected scenario and design from design mode to retrofit mode, you can begin applying the automated retrofit options available in HX-Net.

1. In the Viewer group, select the **design** in retrofit mode.
2. Open the Design Tools palette by doing one of the following:
   - In the Main pane, click the **Open Palette View - F4** icon.
   - Press **F4**.
3. In the Design Tools palette, click the icon of the automated retrofit option that you want to apply to the design.

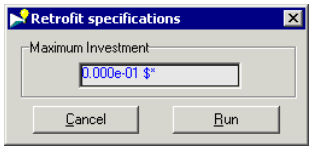
Open Palette View icon

Figure 5.2



If you selected any retrofit option, except the **Modify utility heat exchanger** icon, the Retrofit Specifications view appears.

Figure 5.3



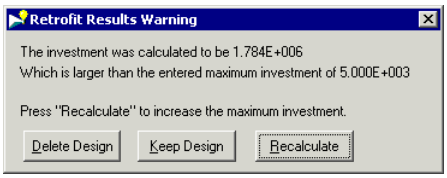
Click the **Cancel** button to cancel the retrofit option command.

Specify the maximum amount of money that will be invested to make the retrofit changes in the **Maximum Investment** field, and click the **Run** button.

Refer to **Section 8.3.2 - Automated Retrofit Capabilities** from the **Reference Guide** for detail procedure on how HX-Net executes the automatic retrofit option.

4. HX-Net analyses the heat exchanger network (HEN) design and decides whether the selected retrofit option is feasible.
   - If the retrofit option is infeasible, a view appears stating that HX-Net fail to apply the selected retrofit option to the HEN design.
   - If the retrofit option is feasible and successfully implemented, a view appears stating that the retrofit option was successfully applied to the HEN design.
     The Grid Diagram also indicates which heat exchanger had been modified due to the retrofit option.
   - If the retrofit option is feasible but the invested money was insufficient, the following warning view appears:

Figure 5.4



- Click the **Delete Design** button to remove the design generated by the retrofit option.
- Click the **Keep Design** button to accept the change in the amount of money invested, and keep the design generated by the retrofit option. The Grid Diagram will indicate which heat exchanger had been modified due to the retrofit option.
- Click the **Recalculate** button to re-enter a new amount of investment in the Retrofit Specifications view, and ignore the design generated by the retrofit option.

5.2 Retrofit Mode View

For more information on the general setup of the Heat Integration Project, refer back to **Chapter 4 - Heat Integration Project**.

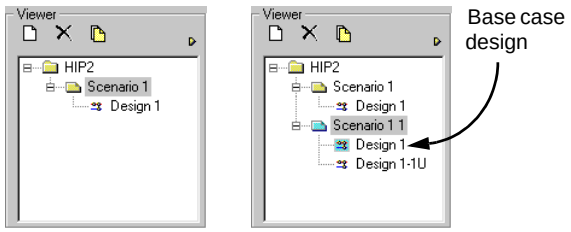
The view for HI Project in retrofit mode is very similar to the HI Project view in design mode. The purpose of the following sections are to highlight the differences between retrofit mode, and design mode.

5.2.1 Viewer Pane

The *base case* design is the original/existing design upon which all retrofit modifications are applied to/performed on.

Once you have entered retrofit mode, the icon beside the retrofit scenario and the original/base case design will appear light blue. This is to help you easily distinguish between scenarios in design mode and retrofit mode.

Figure 5.5



Viewer group

Viewer group in Retrofit Mode

When a retrofit action has been performed on a design, HX-Net automatically create a new design with a name that reflects the retrofit action.

For more information about the naming of the retrofit design, refer to the **Retrofit Design Terminology** section in **Section 8.3.2 - Automated Retrofit Capabilities** from the **Reference Guide**.

5.3 Scenario Level

At the Scenario level, much of the information has remained the same, but there has been additions and changes to the information available.

The following table lists and describes changes made to certain icons at the bottom of the view:

Object	Icon	Description
Data Extraction from Simulation icon		This icon and the associate option has been made unavailable.
Open Forbidden Matches icon		Allows you to only see the forbidden matches between streams.
Relative to target checkbox		This checkbox and associate option has been replaced with the *Relative to base case* checkbox.
Relative to base case checkbox		Allows you to view the information in percentage format relative to the base case.
Enter Retrofit Mode icon		This icon has been removed and replaced with the *Unlock Retrofit Mode* icon.
Unlock Retrofit Mode icon		Allows you to change the selected scenario to design mode

The Open Forbidden Matches icon is only available when the *Data* tab is active.

The Relative to base case checkbox is only available when the *Designs* tab is active.

5.3.1 Main Pane

The Main pane in retrofit mode allows you to display plots selected from the drop-down list, just like the Main pane in design mode. The only differences are:

- Three more plots are added into the drop-down list.
- The **Folder** icon beside the drop-down list changes from yellow to light blue.

For more information about the difference between retrofit mode and design mode, refer to **Section 8.2.6 - Operation Modes** from the **Reference Guide**.

5.3.2 Data Tab

The three pages in the Data tab that were available in the HI Project are also available in the Automatic Retrofit mode:

For more information on the values displayed on these three pages, refer to **Section 4.4.1 - Data Tab**.

- Process Streams page
- Utility Streams page
- Economic page

The information displayed in the three pages has been cloned from the scenario that you selected when you entered Automatic Retrofit mode. The difference with the pages is that you cannot change the values of the text appearing in blue colour. The blue colour text indicate the values specified by the user.

If you tried to change any of the blue text values the following warning view appears:

Figure 5.6

5.3.3 Targets Tab

The three pages in the Targets tab that were available in the HI Project are also available in the Automatic Retrofit mode:

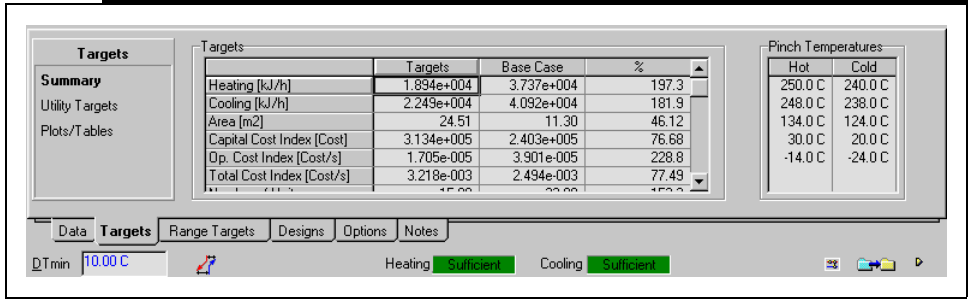
For more information on the values displayed on the Utility Targets and Plot/Tables pages, refer to **Section 4.4.2 - Targets Tab**.

- Summary page
- Utility Targets page
- Plots/Tables page

Only the **Summary** page in retrofit mode differs from non-retrofit mode. The following paragraphs describe the new information available in the **Summary** page.

The Summary page displays information for both target and base case and allows you to compare key parameters between the target and base case.

Figure 5.7



Targets Group

The Targets group contains a table that displays the target variables for the following three different instances.

- The target value calculated appear in the first column.
- The actual value of the variable in the base case design in the second column.
- The value of the base case expressed as a percentage of the target in the third column.

For more details on the calculation of the target values for these variables, refer to **Section 6.3 - Targets** from the **Reference Guide**.

The following table lists and describes the target variables:

Variable	Description
Heating	The hot utility load required.
Cooling	The cold utility load required.
Area	The area of the heat exchangers in the network.
Capital Cost Index	The capital cost, based on the area.
Op. Cost Index	The operating cost, based on the utility loads and economic parameters entered.
Total Cost Index	The annualized cost, based on the operating and capital costs.
Number of Units	The number of heat exchangers.
Shells	The number of shells on the heat exchangers.

Pinch Temperatures Group

The Pinch Temperatures group contains a table that displays all of the pinch temperatures in the system.

5.3.4 Range Targets Tab

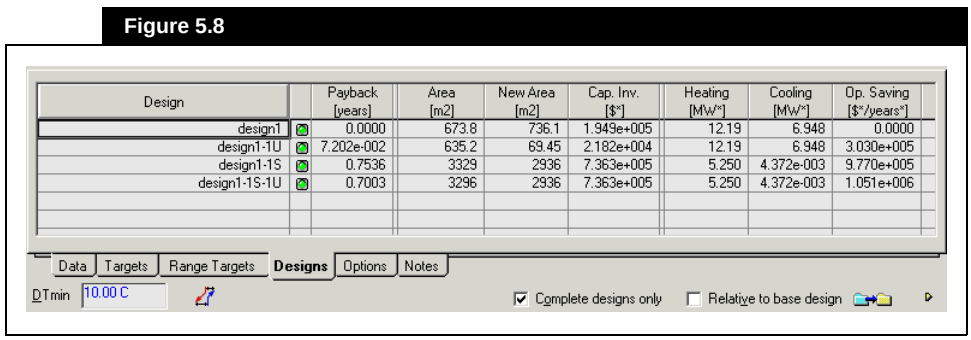
For more information on the Range Targets tab, refer to **Section 4.4.3 - Range Targets Tab**.

The Range Targets tab in the Automatic Retrofit mode is exactly the same as the Range Targets tab in the HI Project view.

5.3.5 Designs Tab

The Designs tab in retrofit mode is the same as the Designs tab in the design mode. One of the differences is instead of comparing built/generated design(s) with the target value, you are comparing retrofitted design(s) with the base case.

Figure 5.8



Refer to the **Comparing Designs** section in **Section 8.3.2 - Automated Retrofit Capabilities** from the **Reference Guide** for more information about the **Designs** tab in retrofit mode.

5.3.6 Options and Notes Tabs

Both of these tabs have identical functionality in Automatic Retrofit mode as they did in HI Project. For more information, refer to **Section 4.4.5 - Options Tab** and **Section 4.4.6 - Notes Tab**, respectively.

5.4 Design Level

At the Design level, there has been additions and changes to the information available, but much of the information has remained the same.

The Design level can be accessed by clicking any design on the tree browser in the Viewer group. At the Design level, you can create, modify, and remove heat exchangers in the HEN view.

Enter Retrofit Mode icon

At the bottom of the view, the **Enter Retrofit Mode** icon has been removed.

5.4.1 Performance Tab

For more information regarding the Performance tab for HI Project, refer to **Section 4.6.1 - Performance Tab**.

The Performance tab of the Base Case design in retrofit mode is exactly the same as the Performance tab in the design mode.

However, the Performance tab of the retrofitted design is different than the Performance tab in the design mode. Refer to the **Design Level** section in **Section 8.3.2 - Automated Retrofit Capabilities** from the **Reference Guide** for more information about the Performance tab.

5.4.2 Worksheet Tab

Refer to **Section 7.7 - Worksheet Tab** for more information.

The Worksheet tab in the retrofit mode is the same as the Worksheet tab in the design mode.

5.4.3 Heat Exchangers Tab

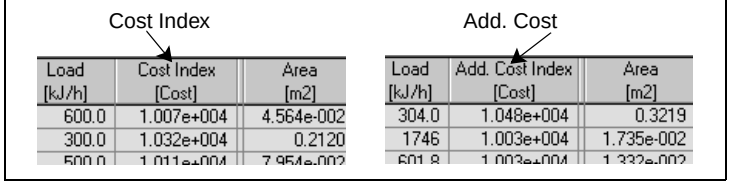
In retrofit mode, the Heat Exchangers tab contains two pages (Summary and Area) instead of one (Summary) in the design mode.

For more information on the Summary page in design mode, refer to **Section 4.6.3 - Heat Exchangers Tab**.

The Summary page for the base case displays the same information as in the Summary page for the design mode. The Summary page of the retrofitted design is similar except for one column variable.

The **Cost Index** column from the design mode becomes **Add. Cost Index** column in the retrofit mode. The **Add. Cost Index** column displays the additional cost associated with each individual heat exchanger due to the retrofit option(s).

Figure 5.9



Load [kJ/h]	Cost Index [Cost]	Area [m2]
600.0	1.007e+004	4.564e-002
300.0	1.032e+004	0.2120
500.0	1.011e+004	7.954e-002

Load [kJ/h]	Add. Cost Index [Cost]	Area [m2]
304.0	1.048e+004	0.3219
1746	1.003e+004	1.735e-002
601.8	1.003e+004	1.332e-002

The Area page in the retrofit mode allows you to specify restrictions to the heat transfer area in the heat exchangers. For more information about the Area page, refer to the **Applying Constraints** section of **Section 8.3.2 - Automated Retrofit Capabilities** from the **Reference Guide**.

5.4.4 Targets Tab

Refer to **Section 4.6.4 - Targets Tab** for more information.

The Targets tab provides a location for all targets to be displayed for reference at the design level. The Targets tab in the retrofit mode is exactly the same as the Targets tab in HI Project.

5.4.5 Notes Tab

The Notes tab in retrofit mode is exactly the same as the Notes tab in HI Project. Refer to **Section 4.6.5 - Notes Tab** for more information.

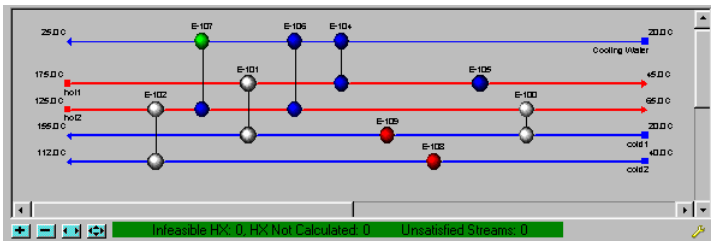
The Notes tab allows you to supply a description about the design and check the modifications performed on the design (e.g., if the design was generated using the repiping retrofit action, the modification log would indicate the base case design's name and the command/option used to generate the current design).

5.5 Grid Diagram

The Grid Diagram in the retrofit mode is similar to the Grid Diagram in HI Project. Refer to **Chapter 7 - Grid Diagram** for more information.

The Grid Diagram in retrofit mode can be manipulated in exactly the same manner as in HI Case or HI Project. However, a few changes have been added to accommodate the new functionality in Automatic Retrofit mode.

Figure 5.10



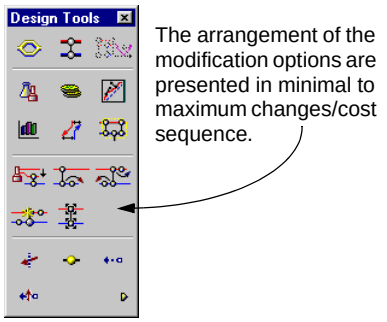
As displayed in the above figure, the icons at the left bottom corner of the Grid Diagram is light blue in colour to indicate Automatic Retrofit Mode.

5.5.1 Design Tools Palette

Refer to **Section 7.2.2 - Design Tools Palette Icon** for more information regarding the retrofit action of each icon.

For the Design Tools palette in Automatic Retrofit mode, the Optimize Network icon is no longer active, and there are five new icons. Each of the five new icons represents a retrofit action.

Figure 5.11



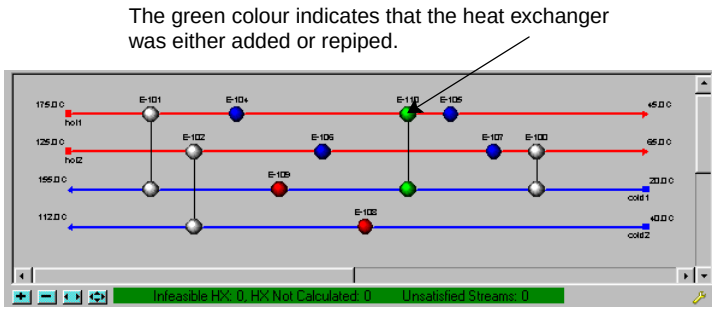
The following table lists and describes each retrofit option icon:

Name	Icon	Description
Modify Utility heat exchanger		Allows HX-Net to search and check if it is optimal to change the type of utility connected to a heat exchanger.
Move one end of a heat exchanger		Allows HX-Net to search and check if it is optimal to move one end of a heat exchanger.
Move both end of a heat exchanger		Allows HX-Net to search and check if it is optimal to move both ends of a heat exchanger.
Add a heat exchanger		Allows HX-Net to search and check if it is optimal to add another heat exchanger into the HEN design.
Add Area		Allows HX-Net to search and check if it is optimal to increase heat transfer area in a heat exchanger.

5.5.2 Modified Heat Exchangers

Any heat exchanger that has been modified during a retrofit process will appear green in the Grid Diagram. Furthermore, only the end(s) of the heat exchanger that has been modified will change.

Figure 5.12



In the figure above, both ends of the exchanger are green. This indicates that either a new heat exchanger has been added or an existing heat exchanger has been repiped.

6 Stream View

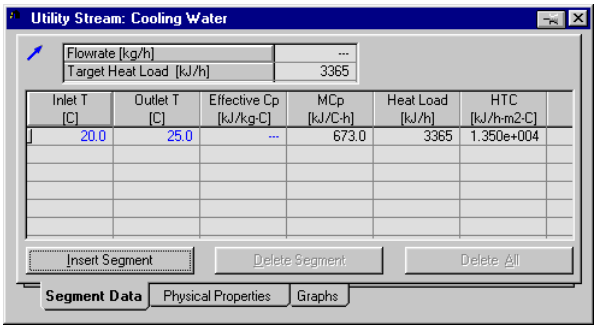
6.1 Introduction

Refer to **Section 2.3.4 - Modal vs. Non-Modal Views** from the **User Guide** for more information.

The stream view is a modal view and it contains calculated information based on the parameter values you specified for the selected stream.

There are two types of stream views in HX-Net: Process Stream and Utility Stream. Both Process Stream and Utility Stream views are identical. So the following description on the stream view applies to both views.

Figure 6.1



To access the stream view:

1. Open the HI Case or HI Project operation view.
2. Locate and go to the **Process Streams/Utility Streams** tab or page.
3. Double-click on any of the cells along the row of the stream you want to open, *except* for the **HTC** cells.

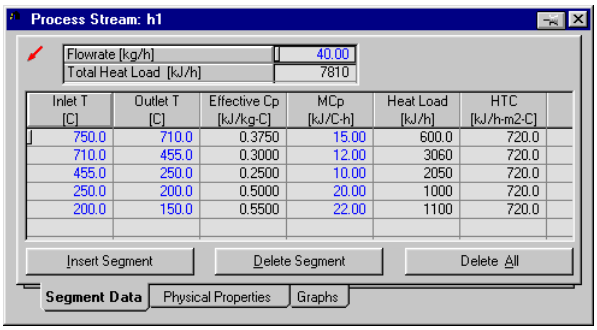
The stream view contains three tabs: Segment Data, Physical Properties, and Graphs. The following sections will explain each tab in detail.

6.1.1 Segment Data Tab

For information regarding segmenting the stream, refer to **Section 6.2.4 - Segmenting Streams** from the **Reference Guide**.

The Segment Data tab allows you to add segments to the stream.

Figure 6.2



The following table lists and describes the objects available in the Segment Data tab:

Object	Description
Stream Type icon	Displays stream type of the selected stream. • **COLD.** A cold process stream is heated up in the heat exchange network. The inlet temperature of a cold process stream is lower than the outlet temperature. • **HOT.** A hot process stream is cooled down in the heat exchange network. The inlet temperature of a hot process stream is higher than the outlet temperature.
Flowrate field	Allows you to specify the flow rate of the stream.
Total Heat Load field	Displays the calculated total heat load value based on the specified parameter values of the stream.
Inlet T column	Allows you to specify the inlet temperature of the segment in the stream.
Outlet T column	Allows you to specify the outlet temperature of the segment in the stream.
Effective Cp column	Displays the specific heat capacity of the stream. This value is calculated once the flow rate value has been specified.
MCp column	Allows you to specify the product of the specific heat capacity and flow rate of the stream segment.
Heat Load column	Allows you to specify the change in enthalpy between the segments in the stream.
HTC column	Displays the local heat transfer coefficient associated with the stream.
Insert Segment button	Allows you to add a segment to the stream. Refer to **Section 6.2.1 - Adding Segments** for more information.

Cold Stream icon

Hot Stream icon

The heat load value is usually calculated.

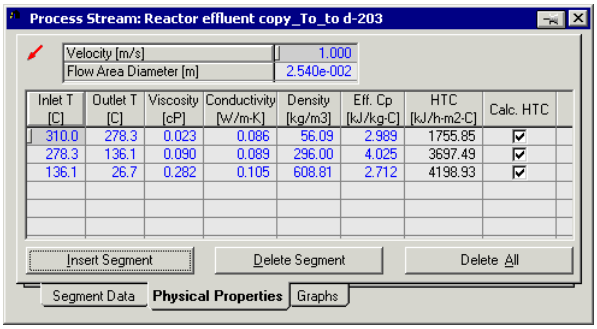
- For a Cold segment, the enthalpy change is the total duty required to heat the stream from its supply to target temperature.
- For a Hot segment, the enthalpy change is the total duty required to cool the stream from its supply to target temperature.

Object	Description
Delete Segment button	Allows you to delete a selected segment from the stream. Refer to **Section 6.2.2 - Deleting a Segment** for more information.
Delete All button	Allows you to delete all the segments in the stream. Refer to **Section 6.2.3 - Deleting all the Segments** for more information.

6.1.2 Physical Properties Tab

The Physical Properties tab allows you to manipulate the HTC value.

Figure 6.3



There are two ways to manipulate the HTC value on this tab:

- Enter values for the viscosity, conductivity, and density, and check the **Calc. HTC** checkbox to calculate the HTC value based on the parameter values you specified.
- Specify a new value for the HTC by entering the value in the HTC cell.

The following table lists and describes the objects available in the Physical Properties tab:

Cold Stream icon

Hot Stream icon

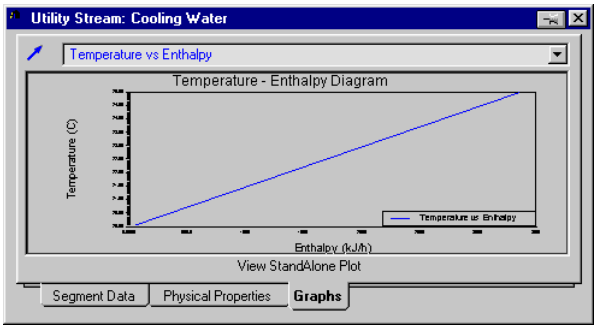
Object	Description
Stream Type icon	Displays stream type of the selected stream. • **COLD.** A cold process stream is heated up in the heat exchange network. The inlet temperature of a cold process stream is lower than the outlet temperature. • **HOT.** A hot process stream is cooled down in the heat exchange network. The inlet temperature of a hot process stream is higher than the outlet temperature.
Velocity field	Allows you to specify the velocity of the stream.

Object	Description
Flow Area Diameter field	Allows you to specify the diameter of the flow area for the stream.
Inlet T column	Allows you to specify the inlet temperature of the segment in the stream.
Outlet T column	Allows you to specify the outlet temperature of the segment in the stream.
Viscosity column	Allows you to specify the viscosity of the stream segment.
Conductivity column	Allows you to specify the conductivity of the stream segment.
Density column	Allows you to specify the density of the stream segment.
Eff. Cp column	Displays the specific heat capacity of the stream. This value is calculated once the flow rate value has been specified.
HTC column	Allows you to specify the local heat transfer coefficient associated with the stream segment.
Calc. HTC checkbox	Allows you to toggle between calculating or not calculating the HTC value based on the parameter values you specified.
Insert Segment button	Allows you to add a segment to the stream. Refer to **Section 6.2.1 - Adding Segments** for more information.
Delete Segment button	Allows you to delete a selected segment from the stream. Refer to **Section 6.2.2 - Deleting a Segment** for more information.
Delete All button	Allows you to delete all the segments in the stream. Refer to **Section 6.2.3 - Deleting all the Segments** for more information.

6.1.3 Graphs Tab

The Graphs tab allows you to observe four types of plots.

Figure 6.4



The following table lists and describes the objects available in the Graphs tab:

Object	Description
Stream Type icon	Displays stream type of the selected stream. • **COLD.** A cold process stream is heated up in the heat exchange network. The inlet temperature of a cold process stream is lower than the outlet temperature. • **HOT.** A hot process stream is cooled down in the heat exchange network. The inlet temperature of a hot process stream is higher than the outlet temperature.
Graphs drop-down list	Allows you to select a different type of plot. There are four types of plot you can display: • temperature vs. enthalpy • temperature vs. density • temperature vs. viscosity • temperature vs. thermal conductivity. To display a different plot: 1. Click the down arrow icon in the Graphs drop-down list. 2. Select the type of plot you want to observe from the drop-down list.
Plot	Displays the plot type you selected from the Graphs drop-down list. For information on manipulating plots, refer to **Section 7.4 - Plot Area** and **Chapter 8 - Plot Properties** from the **User Guide**.

Cold Stream icon

Hot Stream icon

6.2 Segmenting Streams

For more information on segmenting streams, refer to **Section 6.2.4 - Segmenting Streams** from the **Reference Guide**.

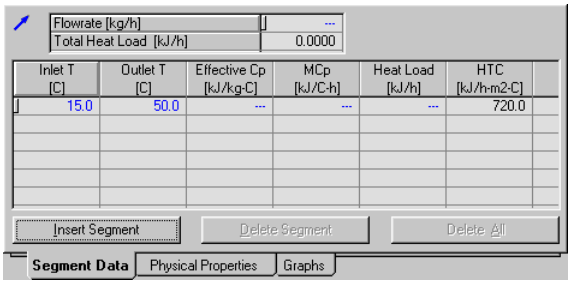
Segmenting a stream becomes necessary when the heat capacity of a stream varies greatly over its temperature range across the heat exchanger network. Large variations in heat capacity can result from a phase change in the stream.

6.2.1 Adding Segments

To add segments into a stream:

1. Access the stream view by doing one of the following:
   - Click on the **Segm.** cell.
   - Double-click any of the cells associated to the stream **except** the following: HTC and Clean HTC cells.
2. On the stream view, go to the **Segment Data** tab. As shown in the table below there is only one segment representing the stream

Figure 6.5

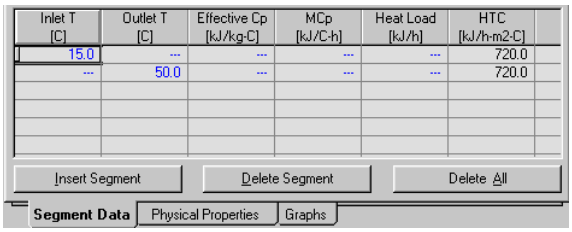


3. Select the initial temperature of a segment in the Inlet T cell, and click the **Insert Segment** button.

The *Delete Segment* and *Delete All* button becomes available when the stream contains more than one segment.

4. HX-Net will add a row to the table to represent the new segment, as shown in the figure below:

Figure 6.6



5. Repeat steps #3 to #4 until you have added the number of segment you want on the stream.

HX-Net automatically place the outlet temperature from the current segment, as the inlet temperature for the next segment.

6. Enter the outlet temperature for each segment in the Outlet T cells that contain the symbol (---).
   The inlet and outlet temperature in each row represents the temperature range within which each segment data is valid.
7. Enter the MCp or heat load value for each segment.
8. Close the stream view when you are done by clicking the **Close** icon .

6.2.2 Deleting a Segment

You cannot delete the first segment of the stream.

To delete a selected segment:

1. Access the stream view by doing one of the following:
   - Click on the **Segm.** cell.
   - Double-click any of the cells associated to the stream **except** the following: HTC and Clean HTC cells.
2. On the stream view, go to the **Segment Data** tab.
3. Select a cell in the row containing the segment you want to delete.
4. Click the **Delete Segment** button.
   HX-Net deletes the segment you selected and replaced the deleted segment's outlet temperature as the outlet temperature for the previous segment.
5. Close the stream view when you are done by clicking the **Close** icon .

6.2.3 Deleting all the Segments

To delete all the segments:

1. Access the stream view by doing one of the following:
   - Click on the **Segm.** cell.
   - Double-click any of the cells associated to the stream **except** the following: HTC and Clean HTC cells.
2. On the stream view, go to the **Segment Data** tab.
3. Click the **Delete All** button.
   HX-Net deletes all the segment in the stream except one. The remaining segment will contain the inlet and outlet temperature you specified for the stream.
4. Close the stream view when you are done by clicking the **Close** icon  .

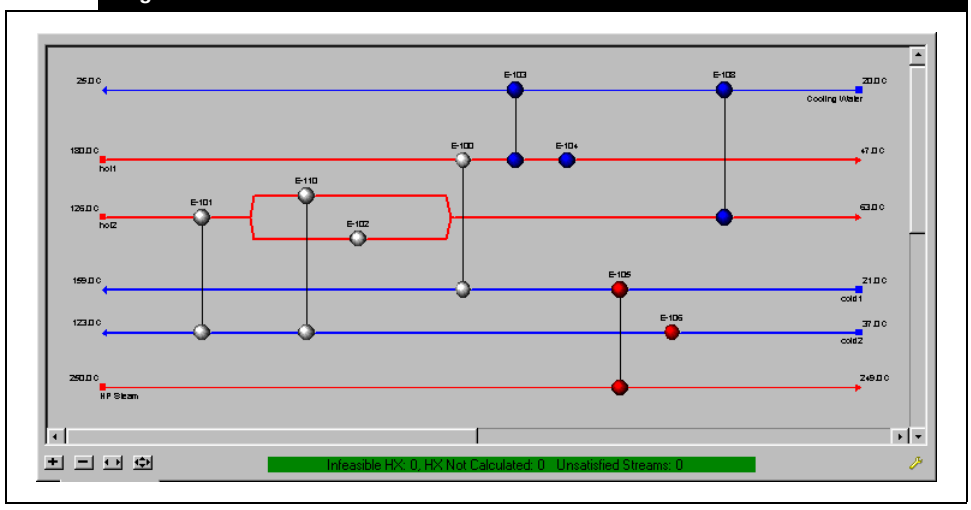
7 Grid Diagram

7.1 Introduction

The Grid Diagram represents a graphical form of the heat exchanger network (HEN) design.

- For HI Case operation, the Grid Diagram is located in the HEN view. Refer to **Section 2.4 - Heat Exchanger Network View** for more information.
- For HI Project operation, the Grid Diagram is located in the Main pane at design level. Refer to **Section 4.6 - Design Level** for more information.

Figure 7.1

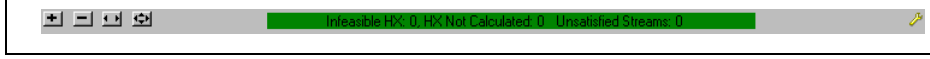


HX-Net provides a set of tools that allow you to manipulate the HEN design in the Grid Diagram. Refer to **Section 7.2 - Grid Diagram Tools** for more information about the tools available.

7.2 Grid Diagram Tools

At the bottom of the Grid Diagram there are a set of icons and a status bar. The icons represent tools you can use to manipulate the Grid Diagram, and the status bar is used to indicate the status of the heat exchanger network displayed on the Grid Diagram.

Figure 7.2



7.2.1 Zoom Icons

The first four icons at the bottom left corner of the Grid Diagram allows you to zoom in and away from the HEN design. The following table lists and describes the four icons in detail:

The table displays all zoom icons for HI Case, HI Project, and Retrofit mode operations.

Name	Icons	Description
Zoom In		Allows you to zoom in on the Grid Diagram.
Zoom Out		Allows you to zoom out from the Grid Diagram.
Fit HEN Width / Fit Width		Allows you to zoom and fit the HEN on the Grid Diagram in such a way that the HEN fills the width of the diagram area.
Zoom All / Fit Both		Allows you to zoom and fit the HEN on the Grid Diagram in such a way that the HEN fills the entire diagram area.

7.2.2 Design Tools Palette Icon

Open Palette View icon

The Open Palette View icon is located at the lower right corner of the Grid Diagram. The Open Palette View icon allows you to open the Design Tools palette.

The Design Tools palette will stay open and “float” above the Grid Diagram, so that you have constant access to the palette as you are building the network of heat exchangers.

Figure 7.3

Design Tools palette for HI Case operation

Design Tools palette for HI Project operation

Design Tools palette for HI Project operation in Retrofit mode

You can also access the Design Tools palette by pressing **F4**.

The Design Tools palette provides options that allows you to manipulate the heat exchanger network on the Grid Diagram. The palette also provides the ability to:

- Display network performance, cost information, driving force plot, bar charts, and topology information.
- Optimize the current heat exchanger network.
- Retrofit the current heat exchanger network.

The following table lists and describes the icons available in the Design Tools palette for HI Case operation, HI Project operation in Design and Retrofit mode:

Name	Icon	Description
Add Split		Allows you to add a splitter and mixer into any stream in the Grid Diagram. Refer to **Section 7.3.4 - Installing Splitters-Mixers** for more information.
Add Heat Exchanger		Allows you to add a heat exchanger into any stream in the Grid Diagram. Refer to **Section 7.3.1 - Installing Heat Exchangers** for more information.
Open Optimization View		Allows you to optimize the heat exchanger network by minimizing total annualized cost or by minimizing total area. For more information, refer to **Section 6.6 - Parametric Optimization** from the **Reference Guide**.

Streams can be split across or between exchangers in the network.

Any hot and cold process or utility stream can be connected by a *Heat Exchanger* in HX-Net.

The Open Optimization View icon is *not* available in Retrofit mode.

Name	Icon	Description
View Capital and Energy Targets		Allows you to access the Targets view. Refer to the **Section 7.2.3 - Targets View** section for more information.
Open Network Performance View		Allows you to access the Network Performance view. This view displays key performance variables. Refer to **Section 7.2.4 - Network Performance View** for more information.
Open Network Cost View		Allows you to access the Network Costs view. This view displays all important cost values. Refer to **Section 7.2.5 - Network Cost Indexes View** for more information.
Open Bar Chart View		Allows you to access the Bar Chart view. Refer to **Section 7.2.6 - Bar Chart View** for more information.
View the Driving Force Plot		Allows you to access the Driving Force Plot view. Refer to **Section 7.2.7 - Drive Force Plot View** for more information.
Open Topology View		Allows you to access the Topology view. Refer to **Section 7.9 - Topology View** for more information.
Open Cross Pinch Load View		Allows you to access the Cross Pinch Load view. Refer to **Section 7.2.8 - Cross Pinch View** for more information.
Open Heat Exchanger Status View		Allows you to access the Heat Exchanger Status view. Refer to **Section 7.2.9 - Heat Exchanger Status View** for more information.
Open Unsatisfied Stream View		Allows you to access the Stream Load Status view. Refer to **Section 7.2.10 - Stream Load Status View** for more information.
Open Property Preset View		Allows you to access the Property Presets view. Refer to **Section 7.2.11 - Property Presets View** for more information.
Open Page		Allows you to open the Grid Diagram into a separate view.
The five icons below are only available for HI Project view in retrofit mode.		
Modify Utility heat exchanger		Allows HX-Net to search and check if it is optimal to change the type of utility connected to a heat exchanger.
Move one end of a heat exchanger		Allows HX-Net to search and check if it is optimal to move one end of a heat exchanger.
Move both end of a heat exchanger		Allows HX-Net to search and check if it is optimal to move both ends of a heat exchanger.
Add a heat exchanger		Allows HX-Net to search and check if it is optimal to add another heat exchanger into the HEN design.
Add Area		Allows HX-Net to search and check if it is optimal to increase heat transfer area in a heat exchanger.

The Driving Force Plot icon is only available for the HI Case operation.

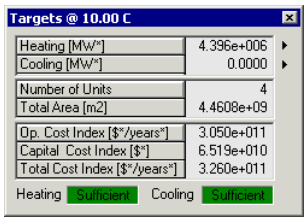
Refer to **Chapter 5 - Retrofit Mode** for more information.

7.2.3 Targets View

This view will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

The Targets view displays all of the target information for the active HEN system.

Figure 7.4



To access the Targets view for the active Grid Diagram:

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **View capital and energy targets** icon to open the Targets view.

Open Palette View icon

View capital and energy targets icon

The following table lists and describes the objects available in the Targets view:

Object	Description
Heating cell	Displays the minimum hot utility load required. Click the *Open Heating Utilities Target* icon ▸ for more information about the hot utility targets.
Cooling cell	Displays the minimum cold utility load required. Click the *Open Cold Utilities Target* icon ▸ for more information about the cold utility targets.
Number of Units cell	Displays the minimum total number of heat exchanger units required.
Total Area cell	Displays the minimum area when all exchangers are shell and tube type.
Op. Cost Index cell	Displays the minimum operating cost, based on energy targets.
Capital Cost Index cell	Displays the minimum capital cost, based on area targets.
Total Cost Index cell	Displays the minimum annualized cost, based on capital and operating targets.

Refer to the **Heating and Cooling Targets Views** section for more information about the hot and cold utility targets.

The status bars in the Targets view are only available for the HI Case operation.

Object	Description
Heating status bar	Indicates whether there is sufficient heating utilities for the HEN design.
Cooling status bar	Indicates whether there is sufficient cooling utilities for the HEN design.

Heating and Cooling Targets Views

The Heating and Cooling Targets views display the distribution of target for every individual utilities.

Both views will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

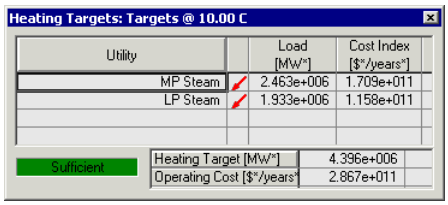
To access the Heating or Cooling Target view:

Open Palette View icon

View capital and energy targets icon

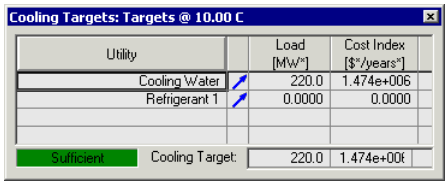
1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **View capital and energy targets** icon to open the Targets view.
4. In the Targets view:
   - Click the **Open Heating Utilities Target** icon ▸ beside the Heating cell for the Heating Targets view.
     The figure below displays the Heating Targets view from a HI Case operation.

Figure 7.5



- Click the **Open Cold Utilities Target** icon beside the Cooling cell for the Cooling Targets view.
  The figure below displays the Cooling Targets view from a HI Project operation.

Figure 7.6



The following table lists and describes the objects available in both Heating and Cooling Targets views:

Hot and Cold Stream icons

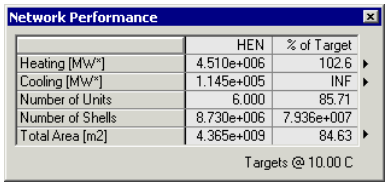
Object	Description
Utility column	Displays the name of the utility.
Utility type column	Indicates the utility type by displaying a hot or cold stream icon.
Load column	Displays the target load for the individual utility.
Cost Index column	Displays the operating cost of the individual utility.
Status bar	Indicates whether there is sufficient heating/cooling utilities for the HEN design.
Heating Target cell	Displays the total target load of the utilities. This cell is only available from the HI Case operation.
Operating Cost cell	Displays the total operating cost of the utilities. This cell is only available from the HI Case operation.
Heating/Cooling Target row	First cell displays the total target load of the utilities. Second cell displays the total operating cost of the utilities. This row is only available from the HI Project operation.

7.2.4 Network Performance View

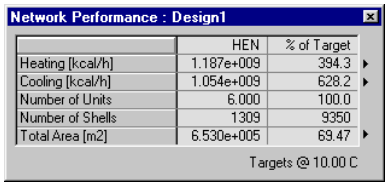
This view will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

The Network Performance view displays five key variables that are calculated for the network and then calculated as a percentage of the target values.

Figure 7.7



Network Performance view for HI Case



Network Performance view for HI Project

To access the Network Performance view:

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **Open Network Performance View** icon to open the Network Performance view.

Open Palette View icon

Open Network Performance View icon

The following table lists and describes the objects available in the Network Performance view:

Object	Description
Heating row	Displays the total hot utility load used in the network and the percentage of that value to the target value. Click the *Open Heating Utilities* icon ▸ for more information about the hot utility loads used.
Cooling row	Displays the total cold utility load used in the network and the percentage of that value to the target value. Click the *Open Cooling Utilities* icon ▸ for more information about the cold utility loads used.
Number of Units row	Displays the total number of heat exchanger units and the percentage of that value to the target value.
Number of Shells row	Displays the total number of shells in the heat exchanger network and the percentage of that value to the target value.

Refer to the **Heating and Cooling Views** section for more information about the hot and cold utility loads.

Refer to the **Heat Exchanger View** section for more information about the heat exchangers.

Object	Description
Total Area row	Displays the total area when all exchangers are shell and tube type and the percentage of that value to the target value. Click the *Open Heat Exchanger View* icon ▸ for more information about the individual heat exchangers.
Targets @ () text	Displays the minimum approach temperature value for all streams. HX-Net assumes a default value of 10°C.

Heating and Cooling Views

The Heating and Cooling views display the distribution of cost among different utilities.

Both views will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

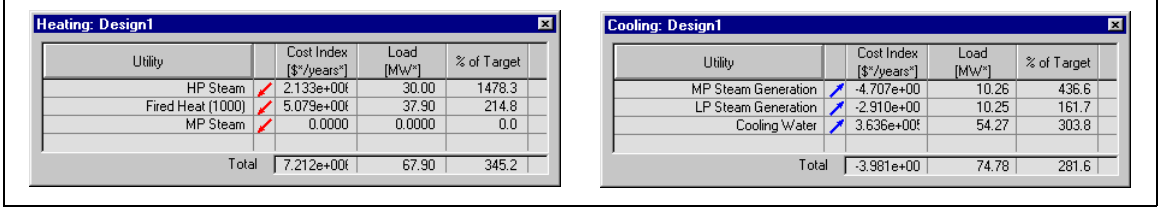
To access the Heating or Cooling view:

Open Palette View icon

Open Network Performance View icon

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **Open Network Performance View** icon to open the Network Performance view.
4. In the Network Performance view:
   - Click the **Open Heating Utilities** icon ▸ beside the Heating cell for the Heating view.
   - Click the **Open Cooling Utilities** icon ▸ beside the Cooling cell for the Cooling view.

Figure 7.8



The following table lists and describes the objects available in both Heating and Cooling views:

Object	Description
Utility column	Displays the name of the utility.
Utility type column	Indicates the utility type by displaying a hot or cold stream icon.
Load column	Displays the load for the individual utility. The bottom cell displays the total load on all the utilities.
Cost Index column	Displays the cost of the individual utility. The bottom cell displays the sum of the cost indexes.
% of Target column	Displays the load as a percentage of the target load of the individual utility. The bottom cell displays the sum of the percent target values.

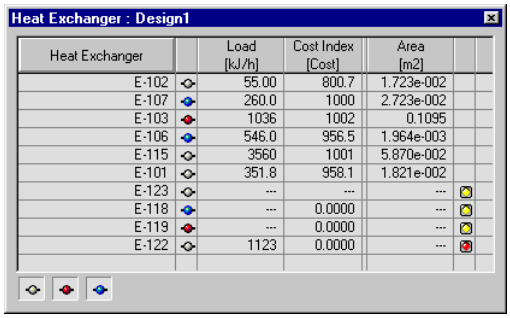
Hot and Cold Stream icons

Heat Exchanger View

This view will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

The Heat Exchanger view displays information about the individual heat exchangers in the Grid Diagram.

Figure 7.9



To access the Heat Exchanger view:

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **Open Network Performance View** icon to open the Network Performance view.
4. In the Network Performance view, click the **Open Heat Exchanger View** icon beside the Total Area cell for the Heat Exchanger view.

Open Palette View icon

Open Network Performance View icon

The following table lists and describes the objects available in the Heat Exchanger view:

Process-Process icon

Cooler icon

Heater icon

Yellow icon represents: Partially Calculated, Under Specified, and Over Specified status.

Red icon represents: Infeasible and Failed to Calculate status.

Show and Hide Process-Process Exchangers icons

Show and Hide Heaters icons

Show and Hide Coolers icons

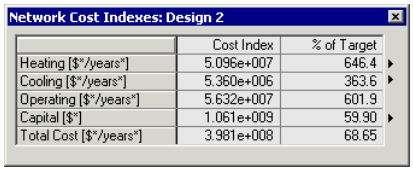
Object	Description
Heat Exchanger column	Displays the name of the heat exchanger.
Heat exchanger type column	Indicates the heat exchanger type by displaying a heat exchanger type icon. There are three types of heat exchangers: • **Process-Process.** The heat exchanger is attached to two process streams. • **Cooler.** A cold utility stream is being used in the heat exchanger to cool a process stream. • **Heater**. A hot utility stream is being used in the heat exchanger to heat a process stream.
Load column	Displays the heat load on each individual heat exchanger.
Cost Index column	Displays the capital cost of each area. The values calculated are based on the area and specified economic parameter values. Refer to **Section 2.2.3 - Economics Tab** for information about modifying economic parameter.
Area column	Displays the area of each individual heat exchanger.
Status column	Displays the status of the individual heat exchanger calculations. The following statuses are available: • **OK Status.** The specifications are okay and the heat exchanger is feasible. No icon is displayed. • **Partially Calculated**. There is insufficient information about the conditions to complete the calculations. Yellow icon is displayed. • **Under Specified**. When some of the conditions are specified and some of the conditions are not specified, for either the heat exchanger or the stream. Yellow icon is displayed. • **Over Specified.** There are too many conditions specified. Yellow icon is displayed. • **Infeasible.** The specifications provided will not make a feasible heat exchanger. Red icon is displayed. • **Failed to Calculate.** There was a problem with the calculations. Red icon is displayed.
Displays Process-Process Exchangers icon	Allows you to toggle between showing or hiding the Process-Process heat exchangers data in the Heat Exchanger view.
Displays Heater icon	Allows you to toggle between showing or hiding the Heaters data in the Heat Exchanger view.
Displays Cooler icon	Allows you to toggle between showing or hiding the Coolers data in the Heat Exchanger view.

7.2.5 Network Cost Indexes View

This view will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

The Network Cost Indexes view displays all the cost information pertaining to the current heat exchanger network (HEN) design.

Figure 7.10



To access the Network Cost Indexes view for the active Grid Diagram:

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **Open Network Cost View** icon to open the Network Cost Indexes view.

Open Palette View icon

Open Network Cost View icon

The following table lists and describes the objects available in the Network Cost Indexes view:

Object	Description
Heating row	Displays the costs of hot utilities used in the network and the percentage of that value to the target value. Click the *Open Heating Utilities* icon for more information about the hot utility used.
Cooling row	Displays the costs of cold utilities used in the network and the percentage of that value to the target value. Click the *Open Cooling Utilities* icon for more information about the cold utility used.
Operating row	Displays the total operating costs of the network and the percentage of that value to the target value.
Capital row	Displays the capital cost of the network and the percentage of that value to the target value. Click the *Open Heat Exchanger View* icon for more information about the individual heat exchangers.
Total Cost	Displays the annualized cost, based on capital and operating costs.

Refer to the **Heating and Cooling Views** section in **Section 7.2.4 - Network Performance View** for more information about the hot and cold utility.

Refer to the **Heat Exchanger View** section in **Section 7.2.4 - Network Performance View** for more information about the heat exchangers.

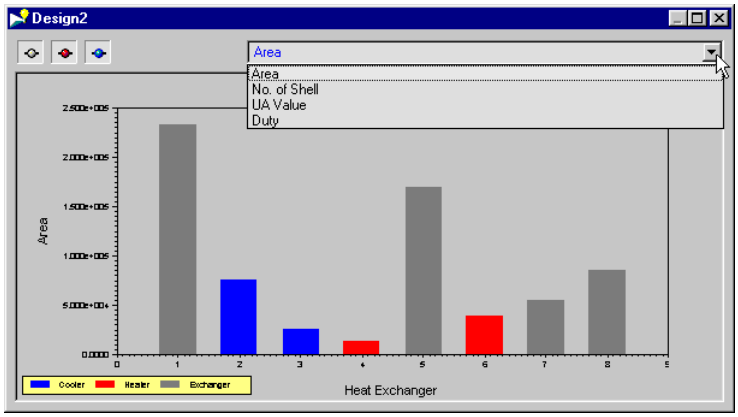
7.2.6 Bar Chart View

This view will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

Refer to **Chapter 8 - Plot Properties**, from the **User Guide**, for information on how to manipulate the appearance of the bar chart.

The Bar Chart view displays one of the four types of bar charts: heat transfer area of each exchanger, number of shells in each exchanger, *UA* value of each exchanger, and duty of each exchanger.

Figure 7.11



To access the Bar Chart view for the active Grid Diagram:

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **Open Bar Chart View** icon.

Open Palette View icon

Open Bar Chart View icon

The following table lists and describes the objects available in the Bar Chart view:

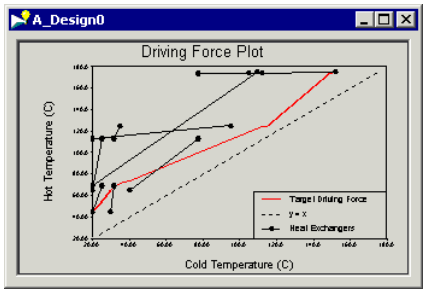
Object	Icon	Description
Display Process-Process Exchangers icon		Allows you to toggle between showing or hiding the process-process exchangers data in the bar chart.
Displays Heaters icon		Allows you to toggle between showing or hiding the heaters data in the bar chart.
Displays Coolers icon		Allows you to toggle between showing or hiding the coolers data in the bar chart.
Drop-down list		Allows you to switch between the four types of bar charts.

7.2.7 Drive Force Plot View

This view will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

The Driving Force Plot view displays the drive force plot of the selected/ active heat exchanger network system. Refer to the **Hot Driving Force Curve** and **Cold Driving Force Curve** sections in **Section 6.3.7 - Plots** from the **Reference Guide** for more information about driving force plot.

Figure 7.12



To access the Driving Force Plot view for the active Grid Diagram:

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **Open Driving Force Plot** icon.

Open Palette View icon

Open Driving Force Plot icon

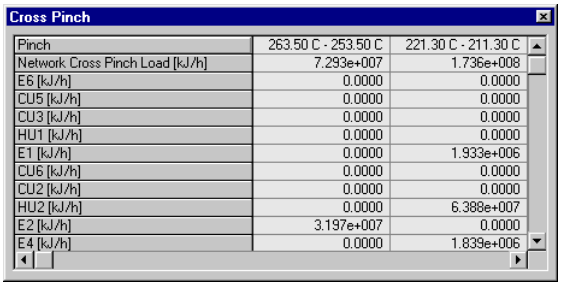
You can manipulate the appearance of the driving force plot by using the options available in the Graph Control view. To access the Graph Control view, right-click and select **Graph Control** command from the Object Inspect menu. Refer to **Chapter 8 - Plot Properties** from the **User Guide** for information about the graph options.

7.2.8 Cross Pinch View

The view will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

The Cross Pinch view contains a table that displays the portion of the heat exchangers load that has been allocated across the pinch line.

Figure 7.13



Pinch	263.50 C - 253.50 C	221.30 C - 211.30 C
Network Cross Pinch Load [kJ/h]	7.293e+007	1.736e+008
E6 [kJ/h]	0.0000	0.0000
CU5 [kJ/h]	0.0000	0.0000
CU3 [kJ/h]	0.0000	0.0000
HU1 [kJ/h]	0.0000	0.0000
E1 [kJ/h]	0.0000	1.933e+006
CU6 [kJ/h]	0.0000	0.0000
CU2 [kJ/h]	0.0000	0.0000
HU2 [kJ/h]	0.0000	6.388e+007
E2 [kJ/h]	3.197e+007	0.0000
E4 [kJ/h]	0.0000	1.839e+006

To access the Cross Pinch View for the active Grid Diagram:

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **Open Cross Pinch Load View** icon.

Open Palette View icon

Open Cross Pinch Load View icon

The top row in each column is the pinch temperatures. The second row in each column is the **Network Cross Pinch Load**, or the sum total of the cross pinch loads from all heat exchangers on the network. The remaining rows list of all heat exchangers on the Grid Diagram and their individual cross pinch load around that pinch temperature.

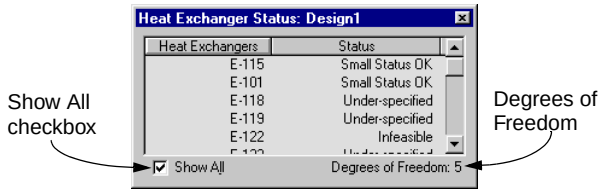
Refer to the **Cross Pinch Heat Load/Pinch Division** section in **Section 6.2.7 - Grid Diagram** from the **Reference Guide** for more information about cross pinch load.

7.2.9 Heat Exchanger Status View

The view will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

The Heat Exchanger Status view displays the name and status of each heat exchanger currently in the Grid Diagram. This view provides an easy way for checking the status of all heat exchangers.

Figure 7.14



To access the Heat Exchanger Status View for the active Grid Diagram:

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **Open Heat Exchanger Status View** icon.

Open Palette View icon

Open Heat Exchanger Status View icon

The following table lists and describes the possible status for the exchanger:

Status	Description
Small Status OK	The specifications are OK and the heat exchanger is feasible.
Partially Calculated	There is insufficient information about the conditions to complete the calculations.
Under Specified	When some of the conditions are specified and some of the conditions are not specified, either in the heat exchanger or the stream segmentation.
Over Specified	Too many of the conditions are specified.
Infeasible	The specifications provided will not make a feasible heat exchanger.
Failed to Calculated	There was a problem with the calculations.

Check the Show All checkbox to display all the heat exchangers from the Grid Diagram.

When the Show All checkbox is unchecked, as it is by default, only heat exchangers that do not have an *OK* status will appear. This makes it very easy to locate the exchangers that require more attention.

The number of degrees of freedom left to be satisfied is displayed at the bottom right corner of the Heat Exchanger Status view.

Yellow icon

Red icon

In some views, the status of a heat exchanger is represented by an icon.

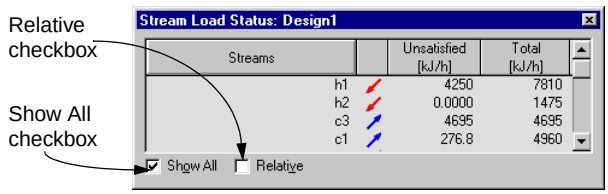
- A yellow icon represents the following status: Partially Calculated, Under Specified, and Over Specified.
- A red icon represents the following status: Infeasible and Failed to Calculate.

7.2.10 Stream Load Status View

The view will stay open and "float" above the Grid Diagram, so that you can view the information as you are building the network of heat exchangers.

Similar to the Heat Exchanger Status view, the Stream Load Status view provides a table that helps you identify the streams on the Grid Diagram that have not had their heat load completely satisfied.

Figure 7.15



To access the Stream Load Status View for the active Grid Diagram:

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **Open Unsatisfied Streams View** icon.

Open Palette View icon

Open Unsatisfied Streams View icon

Hot and Cold Stream icons

The following table lists and describes the columns in the Stream Load Status view:

Column	Description
Streams	Displays the name of the stream.
Stream Type	Displays the type of the stream, either hot or cold, as indicated by an icon.
Unsatisfied	Displays the amount of heat load that has not been satisfied for the stream. If the value is zero, then the stream has been satisfied.
Total	Displays the total heat load available from the stream. Available when the **Relative** checkbox is unchecked.
% of Total	Displays the amount of heat load that has not been satisfied as a percentage of the total heat load available from the stream. Available when the **Relative** checkbox is checked.

When the **Show All** checkbox is checked, all streams are displayed. When the **Show All** checkbox is unchecked, only those streams that are unsatisfied will appear.

When the **Relative** checkbox is checked, the **Total** column is replaced with the **% of Total** column.

7.2.11 Property Presets View

The Property Presets view will stay open and "float" above the Grid Diagram, so that you can view the changes in the Grid Diagram as you are manipulating the property preset.

The Property Presets view allows you to select the appearance of the Grid Diagram from a list of default property preset, and/or manipulate and personalize the options of a property preset to suit your project.

Figure 7.16

A property preset is a setting that manipulates the appearance of the Grid Diagram. The property preset can change the following objects in the Grid Diagram:

- the order of the streams
- the show or hide status of the streams
- the information displayed beside the streams and heat exchangers

To access the Property Presets view:

1. Access the Grid Diagram of the operation.
2. Do one of the following:
   - Click the **Open Palette View** icon to open the Design Tools palette, and click the **Open Property Preset View** icon.
   - Right-click in an empty area of the Grid Diagram to access the Object Inspect menu, and select the **Properties** command.

Open Palette View icon

Open Property Preset View icon

HX-Net provides six default property presets you can select and/or manipulate.

The six default property presets can be edited, but they cannot be deleted. You can create, edit, and delete you own property preset.

The following table list and describes the objects in the Property Preset view:

Object	Description
Property Preset list	Displays and allows you to select a property preset from the list of property presets available in the current operation. HX-Net provides six default property presets, but there are only three different type of proper preset: • **Temperature.** Hotter streams appear higher on the Grid Diagram than cooler streams. The temperatures used for sorting are inlet temperatures for hot streams, and outlet temperatures for cold streams. • **Heat Load**. Streams with higher total heat loads appear higher on the Grid Diagram. The total heat load can be seen by moving the mouse pointer over the stream. • **Alphabetical**. Streams closer to the beginning of the alphabet appear higher on the Grid Diagram. For example, stream alpha appears above stream beta, which appears above stream gamma. When the property preset has *No. Util* at the end of the name, only the process streams are sorted and displayed on the Grid Diagram.
Delete button	Allows you to delete the selected property preset. Refer to the **Deleting a Property Preset** section for more information.
Edit button	Allows you to access the Property Preset view. This view allows you to edit the selected property preset. Refer to the **Editing a Property Preset** section for more information.
New button	Allows you to create a new property preset. Refer to the **Creating a Property Preset** section for more information.

The six default property presets can also be accessed from the Grid Diagram Object Inspect menu.

The property presets can also be edited and created by using the *Edit Property Preset* and *New Property Preset* command from the Object Inspect menu.

Refer to **Section 7.7 - Grid Diagram** from the **User Guide** for more information.

Creating a Property Preset

To create a new property preset:

1. Access the Grid Diagram of the operation.
2. Right-click and select the **Properties** command from the Object Inspect menu to open the Property Presets view.
3. In the Property Presets view, click the **New** button.

4. In the New Property Preset view, enter the name of the new property preset in the Name field.

Figure 7.17

5. Press ENTER when you have finish entering the name.

The Property Presets list now contains the new property preset you have just created.

6. HX-Net automatically closes the New Property Preset view, and returns you to the Property Presets view.
7. Select the new property preset and click the **Edit** button to access the Property Preset view.

Refer to the **Property Preset View** section for more information on setting the property preset options.

8. In the Property Preset view, you can set the property preset options for the new property preset.
9. Click the **Close** icon ✕ when you are done setting up the new property preset to close the Property Preset view.

Editing a Property Preset

To edit a property preset:

1. Access the Grid Diagram of the operation.
2. Right-click and select the **Properties** command from the Object Inspect menu to open the Property Presets view.
3. In the Property Presets view, select the property preset you want to edit from the list.

Refer to the **Property Preset View** section for more information on modifying the property preset options.

4. Click the **Edit** button, and the Property Preset view of the selected property preset appears.
5. Edit the information in the Property Preset view, and click the **Close** icon ✕ when you are done modifying the selected property preset to close the Property Preset view.

Deleting a Property Preset

The six default property presets cannot be deleted. You can only delete the property preset you created.

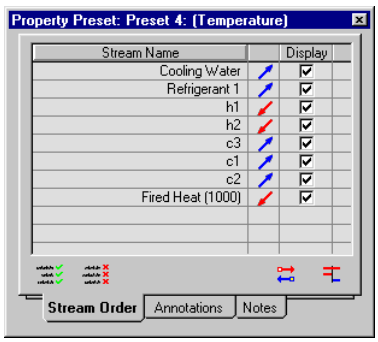
To delete a property preset:

1. Access the Grid Diagram of the operation.
2. Right-click and select the **Properties** command from the Object Inspect menu to open the Property Presets view.
3. In the Property Presets view, select the property preset you want to delete from the list.
4. Click the **Delete** button.

Property Preset View

The Property Preset view allows you to set/manipulate the options in the active property preset. The options are grouped into three tabs: Stream Order, Annotations, and Notes.

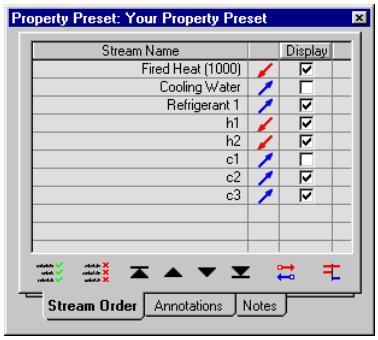
Figure 7.18



Stream Order Tab

The Stream Order tab allows you to define the order in which the streams will appear, and which streams will appear.

Figure 7.19



The following table lists and describes objects available in the Stream Order tab:

Object	Icon	Description
Stream Name column		Displays the names of all the streams available in the active Grid Diagram.
Stream Type column		Indicates the stream type by displaying a Hot or Cold Stream icon.
Display column		Allows you to toggle between showing or hiding the stream on the Grid Diagram. • Check the Display checkbox to display the stream. • Uncheck the Display checkbox to hide the stream.
Show All icon		Allows you to check all the checkboxes in the Display column, thus display all the streams in the Grid Diagram.
Hide All icon		Allows you to uncheck all the checkboxes in the Display column, thus hide all the streams in the Grid Diagram.
Top of List icon		Allows you to move the selected stream to the top of the row of streams displayed on the Grid Diagram.
Step Up icon		Allows you to move the selected stream up one row in the row of streams displayed on the Grid Diagram.
Step Down icon		Allows you to move the selected stream down one row in the row of streams displayed on the Grid Diagram.

HX-Net' default setting is to have all the checkboxes, in the Display column, checked.

The four icons that change the order of the streams are only available for property presets created by you.

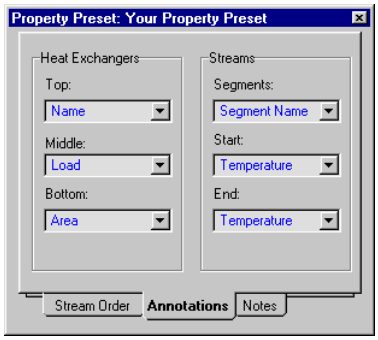
By default, hot stream inlet temperatures are to the left and outlets to the right, and cold stream inlet temperatures are to the right and outlets are to the left.

Object	Icon	Description
Bottom of List icon		Allows you to move the selected stream to the bottom of the row of streams displayed on the Grid Diagram.
Switch Direction icon		Allows you to switch the direction of the streams on the Grid Diagram.
Show Pinch icon		Allows you to toggle between displaying or hiding the pinch line(s) on the Grid Diagram. Pinch lines appear as black dashed vertical lines.

Annotations Tab

The Annotations tab allows you to define the text information to be displayed on the Grid Diagram.

Figure 7.20



The number and type of annotations displayed on the Grid Diagram can be altered by selecting different options from the drop-down lists in the two groups on the Annotations tab: Heat Exchangers and Streams.

Heat Exchangers Group

The Heat Exchangers group allows you to select and display up to three lines of information above the heat exchangers on the HEN diagram. The **Top**, **Middle**, and **Bottom** drop-down list represent the three lines of information above the heat exchangers. Using the three drop-down lists provided, you can select one of six option of information: Load, Area, HTC, Mean Temp. Diff., Nothing, or Name.

Streams Group

The Streams group allows you to display a value on any *segments* in the stream, at the *start* of the streams, and at the *end* of the streams. For the segments, you can select Temperature, Split Fraction, or Nothing option from the **Segments** drop-down list. For the start and end of the streams, you can only select either Temperature or Nothing from the **Start** and **End** drop-down lists.

Notes Tab

The Notes tab allows you to:

- Change the name of the property preset by entering a new name in the **Name** field.

Figure 7.21

You **cannot** change the name of the default property preset. An example is shown in the above figure, where the text in the Name field is black in colour.

- Enter information regarding the property preset by entering the information in the **Notes** text editor.

7.2.12 Status Bar

The status bar located below the Grid Diagram provides useful information about the heat exchanger network. It displays the number of infeasible heat exchangers, the number of heat exchangers that have been placed in the diagram but are not calculated, and the number of streams that have not been completely satisfied.

When the network is incomplete, the status bar will appear grey. When the entire network is calculated and feasible, the status bar will turn green.

7.2.13 Grid Diagram Object Inspect Menu

For more information about the Object Inspect menus in the Grid Diagram, refer to **Section 7.7 - Grid Diagram** from the **User Guide**.

The Grid Diagram contains four different Object Inspect menu:

- The Object Inspect menu for the Grid Diagram that can be accessed by right-clicking in an **empty** area in the Grid Diagram.
- The Object Inspect menu for the streams in the Grid Diagram that can be accessed by right-clicking on the stream in the Grid Diagram.
- The Object Inspect menu for the heat exchangers in the Grid Diagram that can be accessed by right-clicking on the heat exchanger in the Grid Diagram.
- The Object Inspect menu for the splitters/mixers in the Grid Diagram that can be accessed by right-clicking on the splitters/mixers in the Grid Diagram.

7.3 Installing Objects into the Grid Diagram

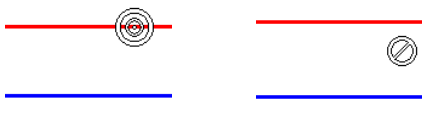
The Grid Diagram provides an easy way to install heat exchangers and splitters on any stream in the heat exchanger network. You install the objects by dragging the object's icon from the Design Tools palette into the Grid Diagram.

The general procedure to install any objects on to the Grid Diagram is:

Open Palette View icon

1. Open the Design Tools palette by clicking the **Open Palette View** icon.
2. Placed the mouse pointer over the icon of the object you want to install into the Grid Diagram.
3. Right-click, hold, and drag the mouse pointer into the Grid Diagram.
4. When the mouse pointer is in the Grid Diagram, the pointer changes to a **Crossed Circle** or **Bull's eye**.
   When you are installing objects into the HEN design using the Design Tools palette, HX-Net will indicate acceptable locations in the Grid Diagram where you can *drop* the object.
   - Bull's eye cursor appears if the location you want to drop the object is acceptable.
   - Crossed Circle cursor appears if the location you want to drop the object is unacceptable.

Figure 7.22



Bull's eye Cursor Crossed Circle Cursor

It is not possible to connect two streams of the same type into the same heat exchanger. By definition, heat exchanger must have one hot side (hot stream) and one cold side (cold stream). Similarly HX-Net will not allow you to place a heat exchanger between a hot and cold utility.

7.3.1 Installing Heat Exchangers

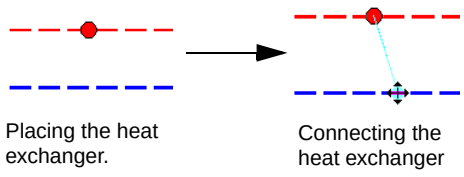
A heat exchanger in the Grid Diagram is represented as two nodes connected by a line. The two nodes represent the hot and cold side of the heat exchanger.

To add a heat exchanger in the Grid Diagram:

1. Open the Design Tools palette by pressing **F4**.
2. On the Design Tools palette, right-click and hold the **Add Heat Exchanger** icon.
3. Drag the heat exchanger into the Grid Diagram and drop the heat exchanger on to a stream. Once the heat exchanger icon has been "dropped" onto a stream, it appears as a red dot on the stream.

Add Heat Exchanger icon

Figure 7.23



You are not allowed to connect two hot streams together, or two cold streams together. You are also not allowed to connect a hot utility to a cold utility.

4. You must connect the red dot to another stream in order to completely install the heat exchanger. To place a heat exchanger between two streams in the network, position the mouse pointer on the red dot of a stream, click and drag the mouse pointer to another stream.

7.3.2 Removing Heat Exchangers

Refer to **Section 7.7 - Grid Diagram** from the **User Guide** for more information.

To remove heat exchangers on the Grid Diagram, you have to use the Object Inspect menus and/or the heat exchanger property view.

To remove one-side heat exchangers (the red dots):

1. Right-click in a blank are of the Grid Diagram, and the Object Inspect menu will appear.
2. Select **Remove Markers** command from the Object Inspect menu. Any red dots on the streams in the Grid Diagram will be removed.

To remove a heat exchanger:

1. Place the mouse pointer on the node of a heat exchanger.
2. Right-click to access the Object Inspect menu of the heat exchanger.
3. Select **Delete** command from the Object Inspect menu.

7.3.3 Changing Streams in Heat Exchanger

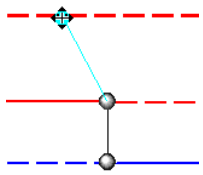
It is possible to move individual heat exchangers in the network. To change the stream connections to a heat exchanger in the Grid Diagram.

1. Place the mouse pointer on the node of a heat exchanger
2. Click and drag the node to a new location in the network.

If you drag a node from a hot stream, you can only place the node on to another hot stream.

If you drag a node from a cold stream, you can only place the node on to another cold stream.

Figure 7.24



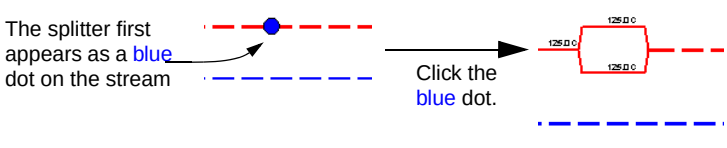
7.3.4 Installing Splitters-Mixers

To install a splitter-mixer in the Grid Diagram:

1. Open the Design Tools palette by pressing **F4**.
2. On the Design Tools palette, right-click and hold the **Add Split** icon.
3. Drag the splitter on to the stream (you want to modify) in the Grid Diagram.
4. Once the Bull's eye cursor appears and the cursor is in the correct position along the stream, "drop" the splitter onto a stream.

Add Split icon

Figure 7.25



5. Place the mouse pointer on the blue dot of a stream.
6. Click on the blue dot and the stream will be divided into two branches and reconnected.

7.3.5 Removing a Splitter-Mixer

To remove a split in the Grid Diagram:

1. Place the mouse pointer over the initial branching area of the split, or the end combining area of the split.
2. Right-click to access the Object Inspect menu of the split.
3. Select the **Delete Split** command in the Object Inspect menu.

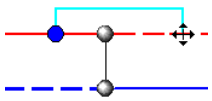
The heat exchangers in the split will also be deleted/removed.

7.3.6 Modifying a Splitter-Mixer

To split a stream around a heat exchanger (create a by pass):

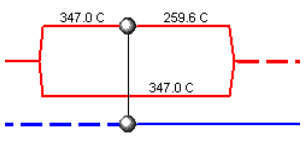
1. Place the mouse pointer on the blue dot of a stream.
2. Click and drag the node over any heat exchanger(s) on the stream. A light blue line will appear, displaying over which heat exchangers the stream will be split.

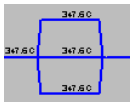
Figure 7.26



3. Release the mouse button when you are satisfied with how the stream will be divided.

Figure 7.27





To add another branch to a splitter:

1. Place the mouse pointer over the initial branching area of the split, or the end combining area of the split.
2. Right-click to access the Object Inspect menu of the split.
3. Select the **Add Branch** command in the Object Inspect menu. A new branch will be added to the splitter.

You can also add a branch in the Split Editor view. Refer to **Section 7.6 - Split Editor View** for more information.

To delete a branch from a splitter:

1. Place the mouse pointer on the branch you want to delete.
2. Right-click to access the Object Inspect menu of the branch.
3. Select the **Delete Branch** command in the Object Inspect menu. HX-Net will delete the selected branch.

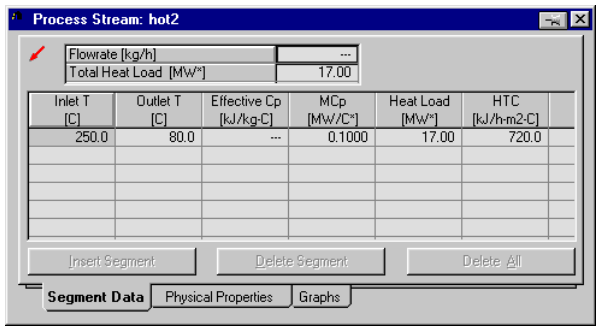
You can also delete a branch from a splitter in the Split Editor view. Refer to **Section 7.6 - Split Editor View** for more information.

7.4 Stream View

As indicated by the black colour text, you cannot modify any value on the Stream view that is accessed from the Grid Diagram.

The Stream view displays the calculated information based on the parameter values you specified for the selected stream.

Figure 7.28



For more information about the Stream view, refer to **Chapter 6 - Stream View**.

To access the Stream view from the Grid Diagram, do one of the following:

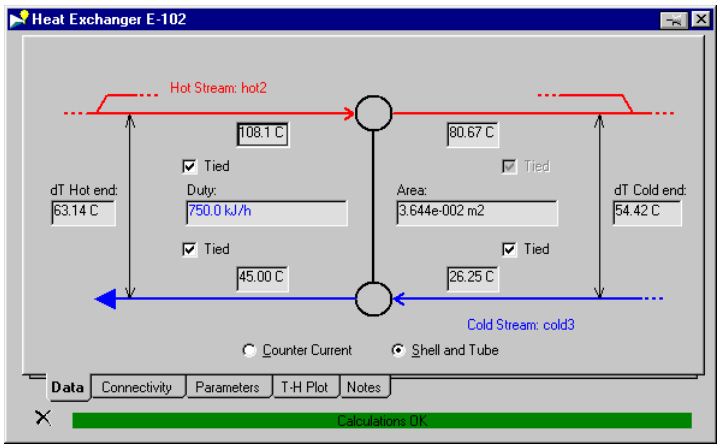
- Double-click on the stream you want to observe in the Grid Diagram.
- Right-click on the stream to access the Object Inspect menu. Select **View** command in the Object Inspect menu.

7.5 Heat Exchanger View

The Heat Exchanger view can be accessed by doing one of the following:

- Double-click on the heat exchanger in the Grid Diagram.
- Right-click on the heat exchanger node to access the Object Inspect menu. Select **View** command in the Object Inspect menu.

Figure 7.29



This view contains five tabs: Data, Connectivity, Parameters, T-H Plot, and Notes. At the bottom of the view, visible from all tabs are the status bar and **Delete** icon.

Delete Icon

Delete icon

You can remove the heat exchanger from the network from the Heat Exchanger view by clicking the **Delete** icon.

Status Bar

The status bar will display one of three colors along with a message to indicate the current condition of the specific heat exchanger being examined. The statuses and the bar colour are listed in the following table:

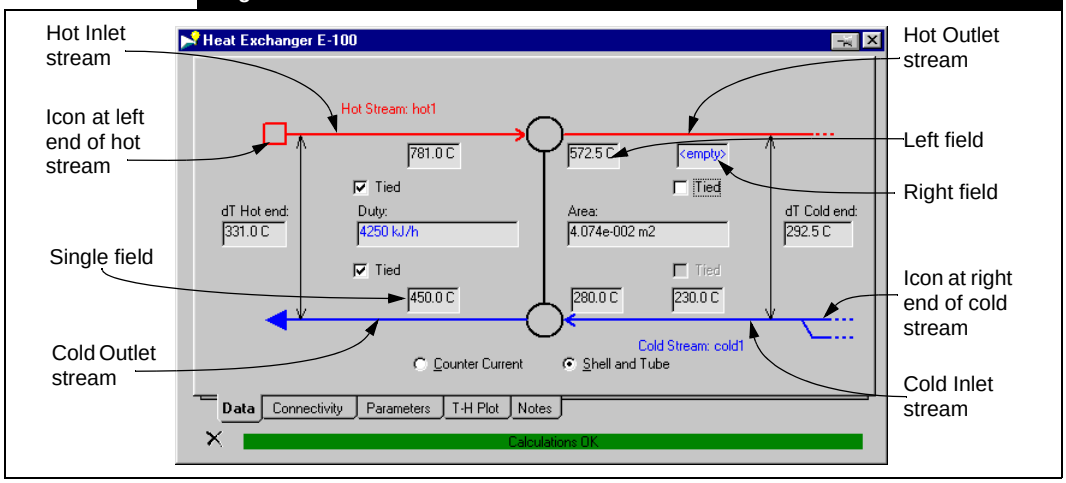
Bar Color	Status	Description
Green	**OK**	The specifications are OK and the heat exchanger is feasible
Yellow	**Partially Calculated**	There is insufficient information about the conditions to complete the calculations
	Under Specified	When some of the conditions are specified and some of the conditions are not specified, either in the heat exchanger or the stream segmentation
Red	**Over Specified**	Too many of the conditions are specified
	Infeasible	The specifications provided will not make a feasible heat exchanger
	Failed to Calculated	There was a problem with the calculations.

The following sections describe each tab in detail.

7.5.1 Data Tab

The Data tab graphically displays the hot and cold streams associated with the heat exchanger. The hot stream is shown in red while the cold stream is shown in blue.

Figure 7.30



The following table lists and describes the objects available in the Data tab:

Object	Description
Icons at the left and right end of the streams	Indicates the element connected to the stream *before entering* or *after exiting* the heat exchanger. Refer to the **Elements Attached to the Streams** section for more information.
Hot Inlet Stream	The hot inlet stream is located on the top left side of the heat exchanger. Depending on the element connected to the stream and the selection of the option available, the following objects may or may not be present: • **Single field**. Displays the temperature of the stream entering the heat exchanger. • **Tied checkbox**. Allows you to toggle between fixing or not fixing the inlet stream temperature to the temperature of the stream exiting the previous element. • **Left field**. Displays the temperature of the stream entering the heat exchanger based on the temperature of the stream exiting the previous element. • **Right field**. Allows you to specify the temperature of the stream entering the heat exchanger. Available only when the *Tied* checkbox is unchecked.

Element can refer to: heat exchangers, mixers, splitters, inlets of the streams entering the HEN, and outlets of the streams exiting the HEN.

If the *Tied* checkbox is checked, the stream's temperature is tied.

If the *Tied* checkbox is unchecked, the stream's temperature is not tied.

Refer to the **Tying Streams** section for more information.

Object	Description
dT Hot end field	Displays the temperature difference between the inlet hot stream and the outlet cold stream of the heat exchanger.
Duty field	Allows you to specify the amount of energy being transferred between the hot stream and cold stream in the heat exchanger.
Cold Outlet Stream	The cold outlet stream is located on the bottom left side of the heat exchanger. Depending on the element connected to the stream and the selection of the option available, the following objects may or may not be present: • **Single field**. Displays the temperature of the stream exiting the heat exchanger. • **Tied checkbox**. Allows you to toggle between fixing or not fixing the outlet stream temperature to the temperature of the stream entering the next element. • **Left field**. Displays the temperature of the stream exiting the heat exchanger based on the temperature of the stream entering the next element. • **Right field**. Allows you to specify the temperature of the stream exiting the heat exchanger. Available only when the *Tied* checkbox is unchecked.
Hot Outlet Stream	The hot outlet stream is located on the top right side of the heat exchanger. Depending on the element connected to the stream and the selection of the option available, the following objects may or may not be present: • **Single field**. Displays the temperature of the stream exiting the heat exchanger. • **Tied checkbox**. Allows you to toggle between fixing or not fixing the outlet stream temperature to the temperature of the stream entering the next element. • **Left field**. Allows you to specify the temperature of the stream exiting the heat exchanger. Available only when the *Tied* checkbox is unchecked. • **Right field**. Displays the temperature of the stream exiting the heat exchanger based on the temperature of the stream entering the next element.
dT Cold end field	Displays the temperature difference between the outlet hot stream and the inlet cold stream of the heat exchanger.
Area field	Allows you to specify the heat transfer area available in the heat exchanger.

If the *Tied* checkbox is checked, the stream's temperature is tied.

If the *Tied* checkbox is unchecked, the stream's temperature is not tied.

Refer to the **Tying Streams** section for more information.

If the *Tied* checkbox is checked, the stream's temperature is tied.

If the *Tied* checkbox is unchecked, the stream's temperature is not tied.

Refer to the **Tying Streams** section for more information.

Object	Description
Cold Inlet Stream	The cold inlet stream is located on the bottom right side of the heat exchanger. Depending on the element connected to the stream and the selection of the option available, the following objects may or may not be present: • **Single field**. Displays the temperature of the stream entering the heat exchanger. • **Tied checkbox**. Allows you to toggle between fixing or not fixing the inlet stream temperature to the temperature of the stream exiting the previous element. • **Left field**. Allows you to specify the temperature of the stream entering the heat exchanger. Available only when the *Tied* checkbox is unchecked. • **Right field**. Displays the temperature of the stream entering the heat exchanger based on the temperature of the stream exiting the previous element.
Counter Current radio button	Allows you to select counter current as the heat exchanger type.
Shell and Tube radio button	Allows you to select shell and tube as the heat exchanger type.

If the *Tied* checkbox is checked, the stream's temperature is tied.

If the *Tied* checkbox is unchecked, the stream's temperature is not tied.

Refer to the **Tying Streams** section for more information.

For example, in **Figure 7.30** you can modify the *Duty* of the heat exchanger, but not the cold stream inlet temperature.

As with other views in HX-Net, you can modify the fields which contains blue text.

Elements Attached to the Streams

Depending on the stream type, the icons are red for hot stream and blue for cold stream.

The Data and Connectivity tabs displays the elements that are immediately attached to the hot and cold stream in the network. The elements are indicated by icons located at the left and right ends of the streams. For example, in **Figure 7.30** the heat exchanger's cold stream inlet is connected to a mixer.

The following table lists and describes the five possible connections that the Data tab displays:

Connection	Icon	Description
Stream Start		Indicates inlet stream to the heat exchanger is connected to the process/utility stream entering the heat exchanger network.
Heat Exchanger	 or 	Indicates the stream entering or exiting the heat exchanger *came from* or *going to* another heat exchanger.

The Stream Start temperature is the stream's inlet temperature specified in the *Process* or *Utilities Streams* tab/page for the HI Case/HI Project operation view.

Connection	Icon	Description
Mixer	 or 	Indicates the stream entering or exiting the heat exchanger *came from* or *going to* a mixer.
Splitter	 or 	Indicates the stream entering or exiting the heat exchanger *came from* or *going to* a splitter.
Stream End		Indicates the outlet stream from the heat exchanger is connected to the process/utility stream exiting the heat exchanger network.

The Stream End temperature is the stream's outlet temperature specified in the *Process* or *Utilities Streams* tab/page for the HI Case/HI Project operation view.

Resolving the Heat Exchanger

In general, a heat exchanger has 3 degrees of freedom when hot and cold MCp are known, as shown by the energy balance:

$$Q = (T_{h\,in} - T_{h\,out}) \times hot\,MCp \tag{7.1}$$

$$Q = (T_{c\,out} - T_{c\,in}) \times cold\,MCp \tag{7.2}$$

where:

Q = *Duty*

$T_{h\,in}$ = *Inlet hot stream temperature*

$T_{h\,out}$ = *Outlet hot stream temperature*

$T_{c\,in}$ = *Inlet cold stream temperature*

$T_{c\,out}$ = *Outlet cold stream temperature*

hot MCp = *Hot stream MCp*

cold MCp = *Cold stream MCp*

With five variables to solve ($T_{h\,in}$, $T_{h\,out}$, $T_{c\,in}$, $T_{c\,out}$ and Q) and 2 available equations, the degrees of freedom for this system is 3 (5 - 2 = 3).

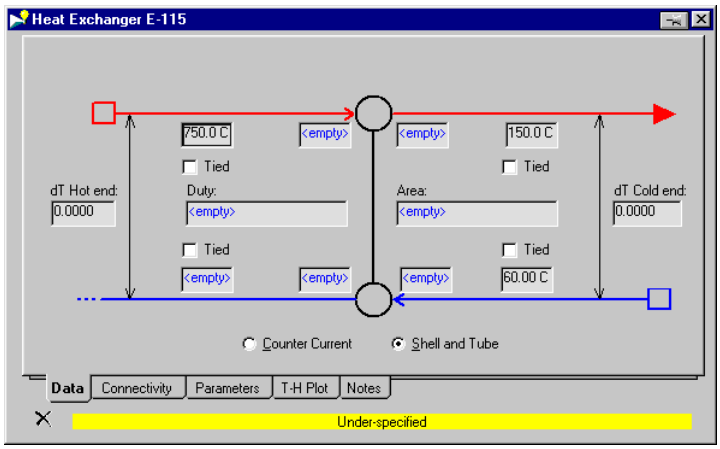
Thus, if any combination of three variables is specified, the system is resolved and HX-Net takes into account remaining degrees of freedom.

The following is an example on resolving a heat exchanger:

1. Access the Grid Diagram.
2. Add a heat exchanger between a hot and cold stream.
   HX-Net forbid you to connect a heat exchanger between the hot and cold utility streams.
3. Access the heat exchanger view by double-clicking on one of the heat exchanger node.
4. The Heat Exchanger view will appear as shown in the figure below.

Figure 7.31

Notice the status bar is yellow, and reads *Under-specified*. This indicates that the heat exchanger cannot solve due to lack of information.



5. You need to specify values for *only* three variables in the tab. The following is a list of variables you can specify:
   - Hot stream inlet temperature
   - Hot stream outlet temperature
   - Heat transfer duty
   - Heat transfer area
   - Cold stream outlet temperature
   - Cold stream inlet temperature

To change the calculated values, you have to delete/ remove one of the variable values that you had previously specified.

6. If you specified any three of the above listed variables, HX-Net will solve the rest of the missing information in the heat exchanger. The values calculated by HX-Net are indicated by black text.

Refer to the **Tying Streams** section for tips on how to *tie* the temperatures of streams entering and exiting heat exchangers in the heat exchanger network.

Tying Streams

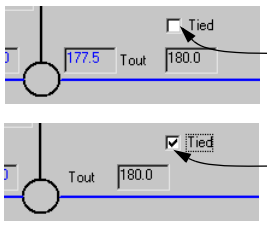
There are problems associated with connecting a heat exchanger in a sequential order.

In most cases, there are numerous exchangers on a single process stream. Adding heat exchangers in the middle of a process stream is not a problem, as long as temperature requirements of the inlet or outlet temperatures match those of the stream. But, in many cases, when adding a heat exchanger, both inlet and outlet temperatures cannot equal the process stream temperature requirements.

In creating a heat exchanger network, you cannot satisfy the process stream heat load requirements with a single exchanger. As you add exchangers, you will fill in heat load "gaps" in the process stream. Eventually, the heat load requirement of the stream will be satisfied through heat exchange with other process and utility streams.

HX-Net provides you the option of specifying whether the immediate inlet or outlet temperatures of the heat exchanger equal the immediate inlet or outlet temperatures of unit operations adjacent to that heat exchanger. If an inlet or outlet temperature of the heat exchanger stream equals the temperature of the adjacent unit operation, that stream is said to be *tied*. Heat load "gaps" in the process can be modeled by *untying* the streams temperatures.

Figure 7.32

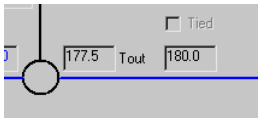


Untied Streams.
The stream temperatures are not equal. There is a heat load gap from 177.5°C to 180°C.

Tied Streams.
The stream temperatures are equal.

Tying a stream, in effect, reduces the degrees of freedom in the heat exchanger by one. If the degrees of freedom for a process stream are completely satisfied, it will not be possible to tie any stream temperatures together. In this case, the **Tied** checkbox will be greyed out.

Figure 7.33

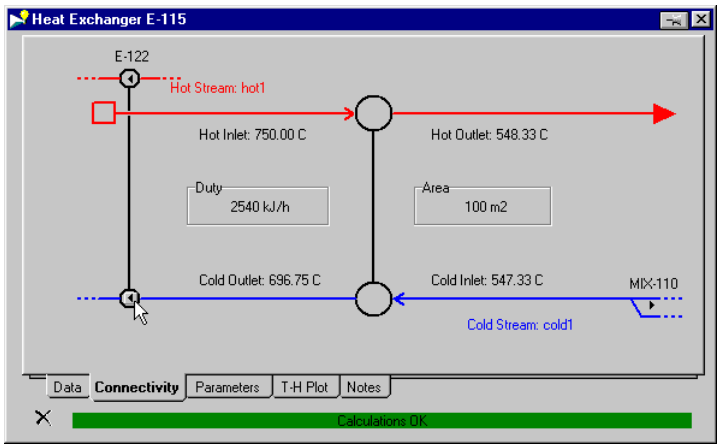


7.5.2 Connectivity Tab

Refer to previous **Elements Attached to the Streams** section for more information.

The Connectivity tab displays the names of the objects connected to the heat exchanger's inlet and outlet streams, and provides icons that allow you to open object's property view.

Figure 7.34



To open the property view of the object connected to a stream:

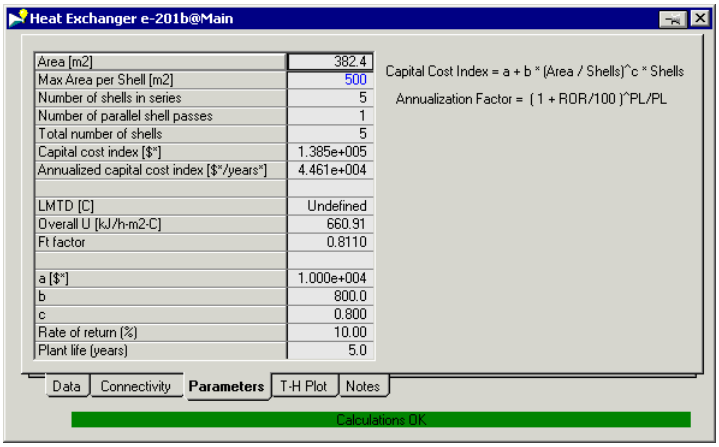
1. Place the mouse pointer over the **View** () icon . The **View** () icon becomes active, as shown in the above figure for the cold outlet stream.
2. Click the **View** () icon and the property view of the object that contained the **View** () icon will appear.

For the figure above, if the **View ()** icon was clicked, the property view for heat exchanger E-122 would appear.

7.5.3 Parameters Tab

The Parameters tab displays a number of values related to the individual heat exchanger.

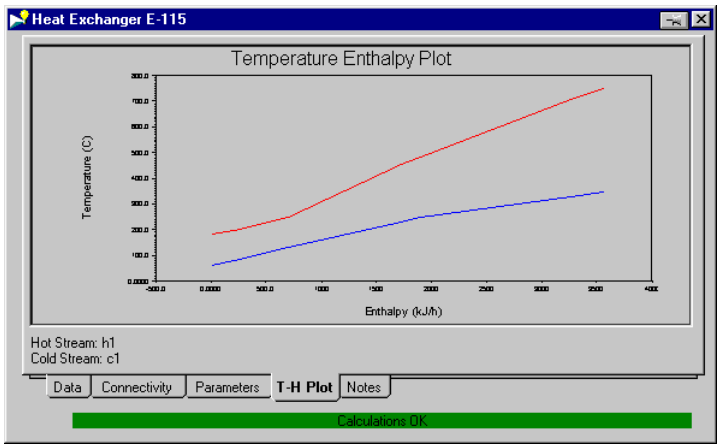
Figure 7.35



7.5.4 T-H Plot Tab

The T-H Plot tab displays the temperature enthalpy plot for the two streams passing through the heat exchanger.

Figure 7.36



7.5.5 Notes Tab

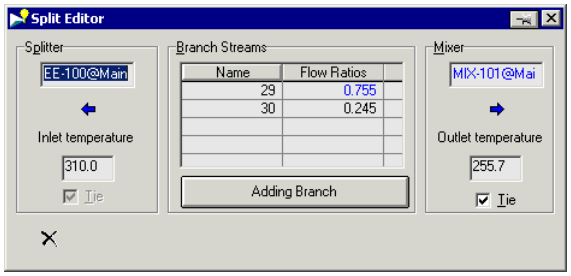
The Notes tab allows you to:

- Specify a name for the heat exchanger by entering a name in the **Name** field.
- Supply a description of a specific heat exchanger in the HEN by entering the information in the **Notes** text editor.

7.6 Split Editor View

The Split Editor view allows you to manipulate the split and contains information about the split.

Figure 7.37



To access the Split Editor view:

1. Place the mouse pointer over the initial branching area of the split, or the end combining area of the split.
2. Right-click to access the Object Inspect menu of the split.
3. Select the **View** command in the Object Inspect menu.

Delete icon

The Split Editor view contains three groups: Splitter, Branch Streams, and Mixer, and a **Delete** icon at the bottom of the view. You can remove the split from the stream by clicking the Delete icon.

The following sections describe each group in detail.

7.6.1 Splitter Group

The Splitter group displays the following information: splitter name and inlet temperature.

Open Upstream Unit Operation icon

- You can change the splitter name by typing a new one in the **Splitter** field.
- You can access the property view of an object upstream of the splitter by clicking the **Open Upstream Unit Operation** icon.
- You can change the inlet temperature by entering the new value in the **Inlet Temperature** field, if the field contains blue colour text.

7.6.2 Branch Streams Group

The Branch Streams group displays all branches of the split process stream.

- You can change the flow ratios of each of the branches in the **Flow Ratios** column.
- You can add another branch to the splitter by clicking the **Adding Branch** button located near the bottom of the Branch Streams group. You need to place the mouse pointer over the button to make it active.

HX-Net will only allow you to specify *n-1* branches.

The Split Flow Ratio is determined using the following equation:

$$FR_i = \frac{M_i}{\sum_{i=1}^{n} M_i} \tag{7.3}$$

where:

FR_i = *branch i flow ratio*

M_i = *branch i flow*

7.6.3 Mixer Group

The Mixer group displays the following information: mixer name and outlet temperature .

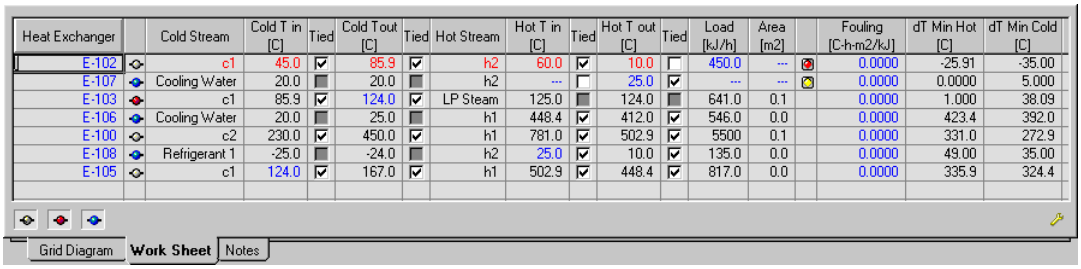
- You can change the mixer name by typing a new one in the **Mixer** field.
- You can access the object's property view that is downstream of the mixer by clicking the **Open Downstream Unit Operation** icon.
- You can change the outlet temperature by entering the new value in the **Inlet Temperature** field with the blue colour text.
- You can *tie* the outlet temperature to the mixer operation by checking the **Tie** checkbox.

Open Downstream Unit Operation icon

7.7 Worksheet Tab

The Worksheet in the HI Case and HI Project operation is a tabular representation of the information contained within the Grid Diagram. It is possible to manipulate existing heat exchangers through this tool.

Figure 7.38



Heat Exchanger		Cold Stream	Cold T in [C]	Tied	Cold T out [C]	Tied	Hot Stream	Hot T in [C]	Tied	Hot T out [C]	Tied	Load [kJ/h]	Area [m2]		Fouling [C-h-m2/kJ]	dT Min Hot [C]	dT Min Cold [C]
E-102		c1	45.0	☑	85.9	☑	h2	60.0	☑	10.0	☐	450.0	---		0.0000	-25.91	-35.00
E-107		Cooling Water	20.0		20.0		h2	---	☐	25.0	☑	---	---		0.0000	0.0000	5.000
E-103		c1	85.9	☑	124.0	☑	LP Steam	125.0		124.0		641.0	0.1		0.0000	1.000	38.09
E-106		Cooling Water	20.0		25.0		h1	448.4	☑	412.0	☑	546.0	0.0		0.0000	423.4	392.0
E-100		c2	230.0	☑	450.0	☑	h1	781.0	☑	502.9	☑	5500	0.1		0.0000	331.0	272.9
E-108		Refrigerant 1	-25.0		-24.0		h2	25.0	☑	10.0	☑	135.0	0.0		0.0000	49.00	35.00
E-105		c1	124.0	☑	167.0	☑	h1	502.9	☑	448.4	☑	817.0	0.0		0.0000	335.9	324.4

The following table lists and describes the objects available in the Worksheet tab:

Process-Process icon

Cooler icon

Heater icon

Object	Description
Heat Exchanger column	Displays the name of the heat exchanger.
Heat Exchanger Type column	Displays an icon to indicate the heat exchanger type. There are three types of heat exchangers. HX-Net determines the type of exchanger based on the following information: • **PROCESS-PROCESS.** The heat exchanger is attached to two process streams. • **COOLER.** A cold utility stream is being used in the heat exchanger to cool a process stream. • **HEATER**. A hot utility stream is being used in the heat exchanger to heat a process stream.
Cold Stream column	Displays the name of the cold stream that is attached to the heat exchanger.
Cold T In column	Displays the inlet temperature of the cold stream. You can change the values in the cells that contain blue colour text.
Tied column	Displays a checkbox that indicates whether the inlet temperature of the cold stream is tied or untied. • The stream is tied if the checkbox is checked. • The stream is untied if the checkbox is greyed out.
Cold T Out column	Displays the outlet temperature of the cold stream. You can change the values in the cells that contain blue colour text.

Object	Description
Tied column	Displays a checkbox that indicates whether the outlet temperature of the cold stream is tied or untied. • The stream is tied if the checkbox is checked. • The stream is untied if the checkbox is greyed out.
Hot Stream column	Displays the name of the hot stream that is attached to the heat exchanger.
Hot T In column	Displays the inlet temperature of the hot stream. You can change the values in the cells that contain blue colour text.
Tied column	Displays a checkbox that indicates whether the inlet temperature of the hot stream is tied or untied. • The stream is tied if the checkbox is checked. • The stream is untied if the checkbox is greyed out.
Hot T Out column	Displays the outlet temperature of the hot stream.
Tied column	Displays a checkbox that indicates whether the outlet temperature of the hot stream is tied or untied. • The stream is tied if the checkbox is checked. • The stream is untied if the checkbox is greyed out.
Load column	Displays the duty of the heat exchanger. You can change the values in the cells that contain blue colour text.
Area column	Displays the heat transfer area of the heat exchanger. • You can change the values in the cells that contain blue colour text. or • HX-Net calculates the area based on the type of heat exchanger (counter current or shell and tube) is specified on the **Data** tab of the Heat Exchanger view.
Status column	Displays the status of the heat exchanger calculations using an icon. The following statuses are available: • **OK Status.** The specifications are OK and the heat exchanger is feasible. No icon is displayed. • **Partially Calculated.** There is insufficient information about the conditions to complete the calculations. Yellow icon is displayed. • **Under Specified**. When some of the conditions are specified and some of the conditions are not specified, for either the heat exchanger or the stream. Yellow icon is displayed. • **Over Specified.** There are too many conditions specified. Yellow icon is displayed. • **Infeasible**. The specifications provided will not make a feasible heat exchanger. Red icon is displayed. • **Failed to Calculate.** There was a problem with the calculations. Red icon is displayed.
Fouling column	Allows you to specify the fouling factor of the streams in the heat exchanger.
dT Min Hot column	Displays the temperature difference between the inlet hot stream and the outlet cold stream of the heat exchanger.

Yellow icon represents: Partially Calculated, Under Specified, and Over Specified status.

Red icon represents: Infeasible and Failed to Calculate status.

Show and Hide Process-Process Exchangers icons

Show and Hide Heaters icons

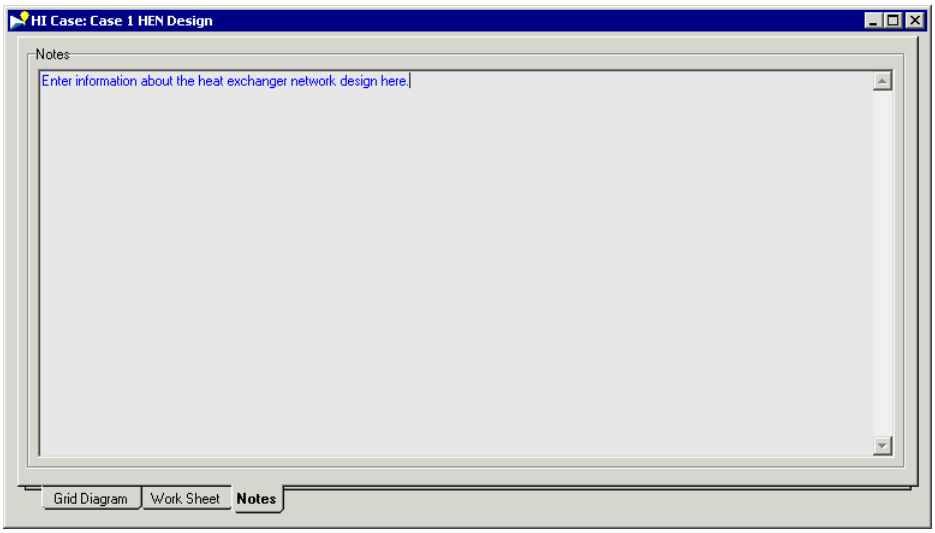
Show and Hide Coolers icons

Object	Description
dT Min Cold column	Displays the temperature difference between the outlet hot stream and the inlet cold stream of the heat exchanger.
Displays Process-Process Exchangers icon	Allows you to toggle between showing or hiding the Process-Process heat exchangers data in the Heat Exchanger view.
Displays Heater icon	Allows you to toggle between showing or hiding the Heaters data in the Heat Exchanger view.
Displays Cooler icon	Allows you to toggle between showing or hiding the Coolers data in the Heat Exchanger view.

7.8 Notes Tab

The Notes tab allows you to supply a description of the heat exchanger network design in the HEN view by entering the information in the **Notes** text editor.

Figure 7.39

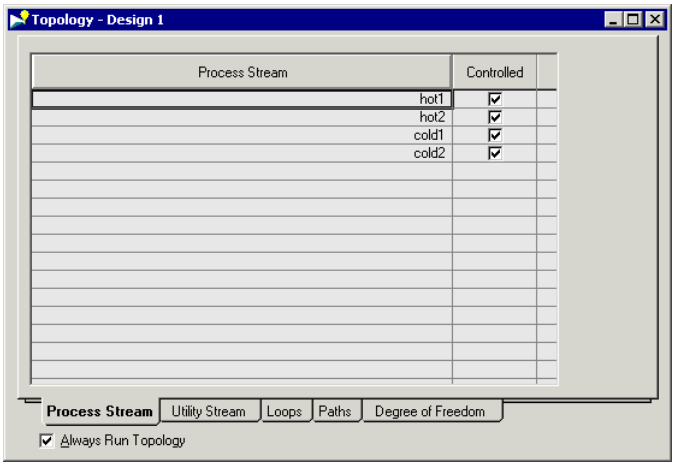


7.9 Topology View

For more information about manipulated variables and degrees of freedom, refer to **Section 6.4 - Controllability** from the **Reference Guide**.

The Topology view displays information on the controllability of the heat exchanger network (HEN) design. In the case of HEN design, the variables you want to control are the output temperature of the process streams exiting the HEN design.

Figure 7.40



The **Always Run Topology** checkbox allows you to disable the HEN topology calculations. The HEN topology calculations are triggered every time a change is made to the heat exchanger network. For example, in large cases the HEN topology calculations can slow down the overall time required to complete the changes. Therefore, you can turn these calculations off if you are not interested in using the topology results.

To access the Topology view for the active Grid Diagram:

1. Access the Grid Diagram of the operation.
2. Click the **Open Palette View** icon to open the Design Tools palette.
3. Click the **Open Topology View** icon.

Open Palette View icon

Open Topology View icon

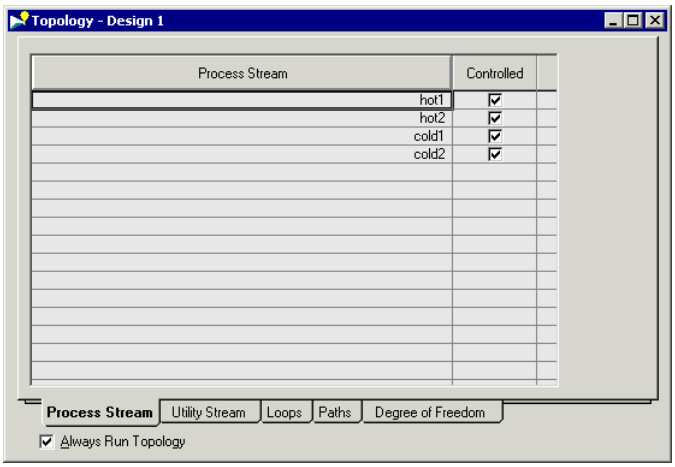
To be able to control the output temperature of the process streams, you have to check if the HEN design has enough manipulated variables to implement control on the HEN design. HX-Net helps you identify if there is enough manipulated variables and displays this information in the Topology view.

The data regarding the control structure of a HEN design is split into five tabs: Process Stream, Utility Stream, Loops, Paths, and Degree of Freedom.

7.9.1 Process Stream Tab

The Process Stream tab displays all the process streams in the active HEN and indicates whether the streams' output temperatures are being controlled.

Figure 7.41



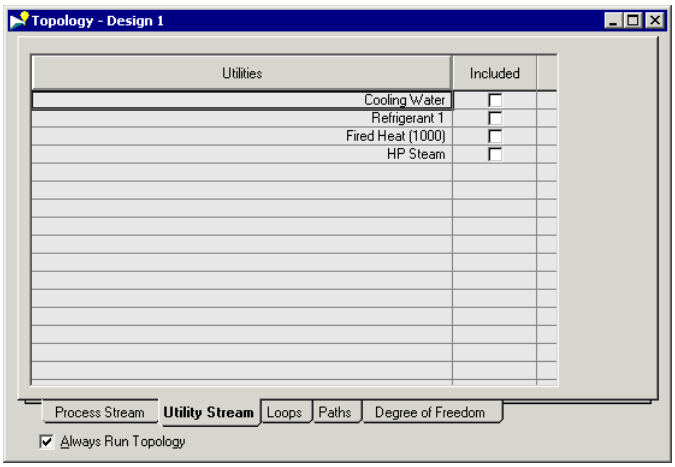
When you release the control on a process stream, the degree of freedom increase by one.

You can toggle between controlling or not controlling the streams temperature by checking or unchecking the checkboxes in the **Controlled** column. A controlled process stream is called a *target stream*.

7.9.2 Utility Stream Tab

The Utility Stream tab displays all the utility streams in the active HEN.

Figure 7.42



Refer to **Section 6.4.3 - Sub-networks** from the **Reference Guide** for more information about sub-networks.

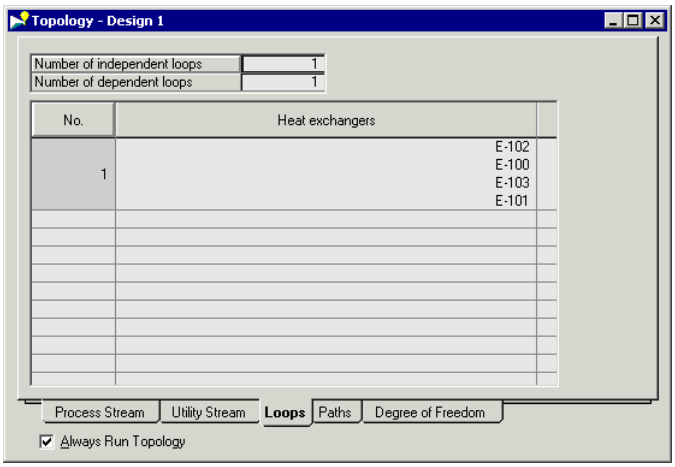
You can toggle between including or excluding the utilities in the sub-networks. The number of sub-network in a HEN depending on whether a utility is included or not.

Refer to **Section 6.3.4 - Number of Units Targets** from the **Reference Guide** for more information on locating sub-networks/subsets.

7.9.3 Loops Tab

The Loops tab displays the number of loops in the current heat exchanger network (HEN) design. More loops occurring in a HEN design, may imply more than required heat exchangers exist in the HEN design.

Figure 7.43



The following table lists and describes the objects available in the Loops tab:

Refer to **Section 6.2.9 - Loops in the Grid Diagram** from the **Reference Guide** for more information about loops.

Object	Description
Number of independent loops field	Displays the number of the independent loops in the HEN design.
Number of dependent loops field	Displays the number of dependent loops in the HEN design.
No. column	Displays the integer number used to designate each loop within the HEN design.
Heat Exchangers column	Displays the names of the heat exchangers in each loop.

Loops

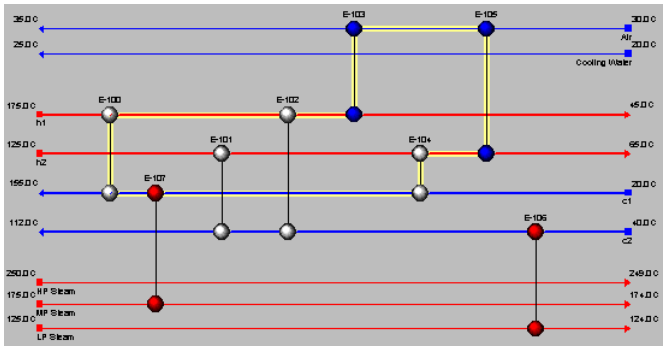
The heat exchangers in a loop does not have to be the same type.

A loop in a HEN starts from a heat exchanger (A) and flows along several exchangers and streams before ending back to the first heat exchanger (A).

The HEN design may contain multiple loops, but HX-Net can only display one loop at a time.

The figure below shows how HX-Net displays/indicates a loop in the Grid Diagram.

Figure 7.44



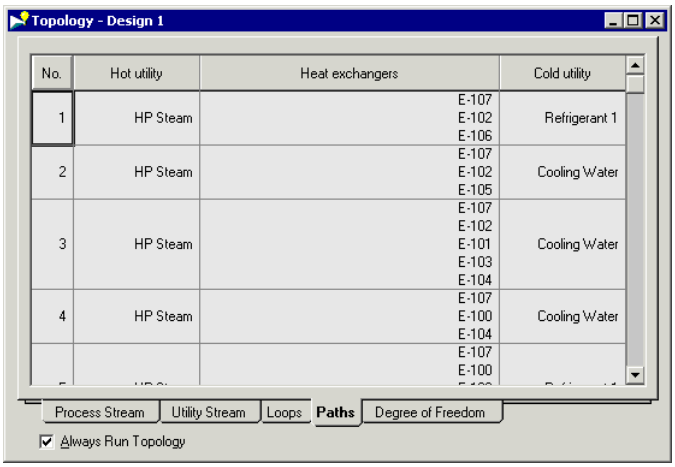
To display/indicate a loop in the Grid Diagram:

1. Open the HEN Design view and go to t he **Grid Diagram** tab.
2. Right-click in an empty area on the Grid Diagram to access the Object Inspect menu.
3. If the HEN design contains one or more loops, the **Show Loops** command will be available in the Object Inspect menu.
4. Select the **Show Loops** command to open a sub-menu. From the sub-menu you can select to:
   - Display any of the loops listed. The loops are listed according to the names of the heat exchangers within the loop.
     For example, the above loop would be listed as: **E-103 / E-105 / E-104 / E-100**.
   - To remove any loop or path indicated in the Grid Diagram by selecting the **None** command.

7.9.4 Paths Tab

The Paths tab displays the number of paths that exist in the current heat exchanger network design.

Figure 7.45



The following table lists and describes the objects available in the Paths page:

Refer to **Section 6.2.10 - Paths in the Grid Diagram** from the **Reference Guide** for more information about paths.

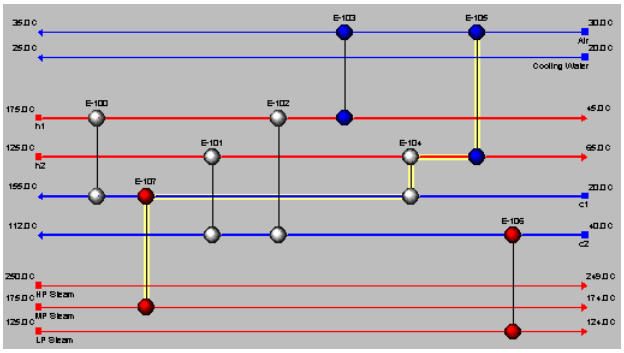
Object	Description
No. column	Displays the integer number used to designate each path within the HEN design.
Hot utility column	Displays the name of the hot utility in the path.
Heat exchangers column	Displays the names of the heat exchangers in the path.
Cold utility column	Displays the name of the cold utility in the path.

Paths

A path starts at a hot or cold utility stream and flows along exchangers and process streams before ending at a cold or hot utility stream.

The figure below displays an example of a path.

Figure 7.46



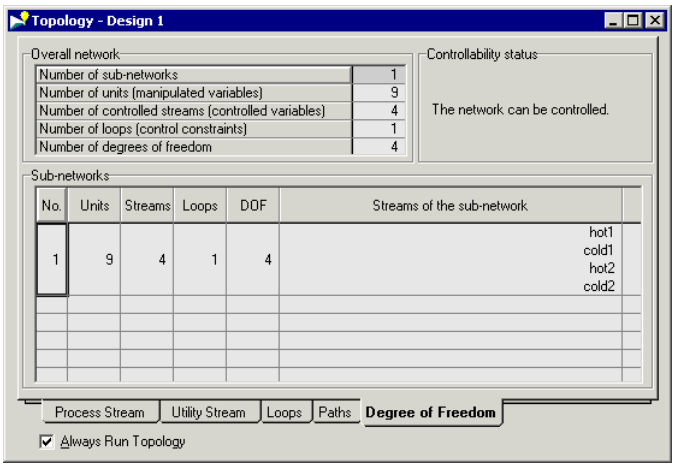
To display/indicate a path in the Grid Diagram:

1. Open the HEN Design view and go to t he **Grid Diagram** tab.
2. Right-click in an empty area on the Grid Diagram to access the Object Inspect menu.
3. If the HEN design contains one or more paths, the **Show Paths** command will be available in the Object Inspect menu.
4. Select the **Show Paths** command to open a sub-menu. From the sub-menu you can select to:
   - Display any of the paths listed. The paths are listed according to the names of the heat exchangers within the path.
     For example, the above path would be listed as: **E-107 / E-104 / E-105**.
   - To remove any loop or path indicated in the Grid Diagram by selecting the **None** command.

7.9.5 Degree of Freedom Tab

The Degree of Freedom tab displays the variables used to calculate the determine the selected design's degrees of freedom.

Figure 7.47



The following table lists and describes each group in the Degrees of Freedom tab:

Group	Description
Overall network	Contains the following information: • The total number of units/heat exchangers in the HEN design. • The total number of controlled streams in the HEN design. • The number of loops in the HEN design that do not include utility streams. • The number of degrees of freedom in the HEN design based on the above three variable values.
Controllability status	Displays whether or not the HEN design's process streams output temperature can be controlled.
Sub-networks	Contains a table that displays information of each sub-network available in the HEN design. The following information of each sub-network is displayed in the table: • Integer number used to designate each sub-network. • Number of units/heat exchangers in the sub-network. • Number of controlled streams in the sub-network. • Number of loops in the sub-network. • Number of degrees of freedom in the sub-network. • Names of all the streams in the sub-network.

For more information about degrees of freedom, refer to **Section 6.4.2 - Degrees of Freedom** from the **Reference Guide**.

The number of sub-networks available in the HEN design depends on which type of sub-network you are considering.

For more information about the types of sub-network, refer to **Section 6.4.3 - Sub-networks** from the **Reference Guide**.

8 Data Extraction

8.1 Introduction

HX-Net has the option to extract data from a process flowsheet and (if possible) generate a heat exchanger network diagram based on the information from the process flowsheet.

Refer to **Section 6.5 - Data Extraction** from **Reference Guide** for more information.

You can extract data of a process flowsheet from a HYSYS or Aspen Plus case. The HYSYS case has to be created in HYSYS version 3.0 or higher, and the Aspen Plus case has to be created in Aspen Plus version 12.1.

8.2 Extraction Wizard

The Extraction Wizard view contains the options that allow you to extract information/data from an existing simulation in HYSYS or Aspen Plus.

To access the Extraction Wizard view:

1. Open the HI Case view or HI Project view.
2. Go to the **Process Stream** tab or page.
3. Locate the **Process Stream Data Extraction from Simulation** icon. This icon is usually found at the bottom right corner of the view.
4. Click the **Process Stream Data Extraction from Simulation** icon to open the Extraction Wizard view.

Process Stream Data Extraction from Simulation icon

The Extraction Wizard consist of one view with many pages. Each page represents a step you have to follow through to extract the data from a HYSYS or Aspen Plus simulation. You can only move from page to page after supplying the required amount of information in each page.

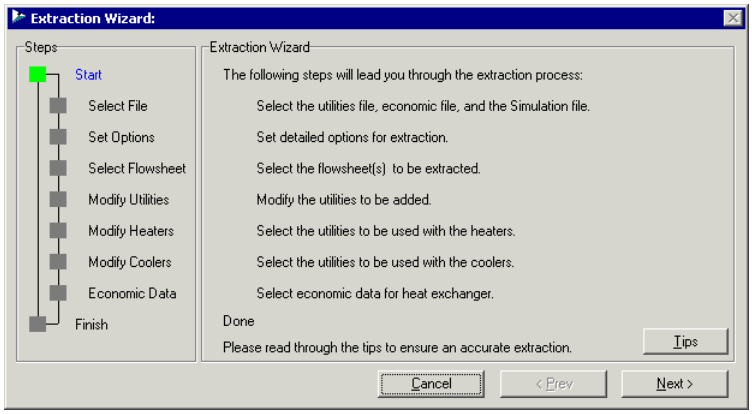
There are three common buttons located at the bottom of the Extraction Wizard view for most of the pages:

- **Cancel** button allows you to exit from the Extraction Wizard view if you do not want to perform the extraction procedure.
- **Prev** button allows you to go back to the previous step/page if you want to change something in the previous step. This button is only available if there is a previous step from your current page position.
- **Next** button allows you to move to the next step/page as you perform the extraction. This button is only available if there is another step following your current page position and/or you have entered the required information in the current page.

8.2.1 Start Page

The Start page displays a summary of the steps that will be performed by the Extraction Wizard to extract the data from the specified simulation.

Figure 8.1

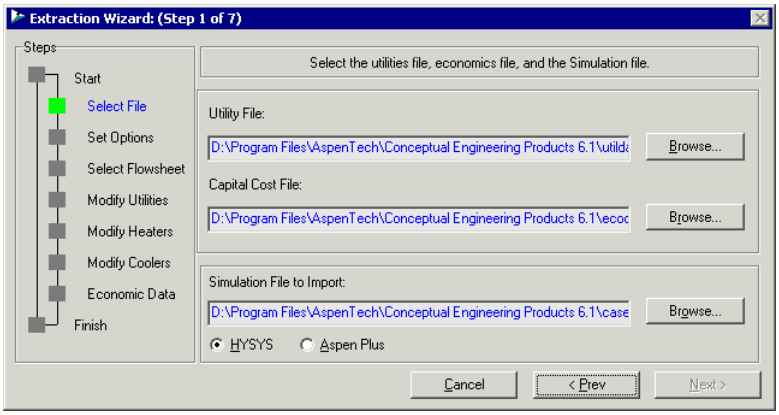


This page also contains the *Tips* button. You can click on the *Tips* button to access the Extraction Tips view. The Extraction Tips view displays hints/suggestions for extracting data, refer to **Section 6.5.3 - Extraction Tips** from the **Reference Guide** for more information.

8.2.2 Select File Page

The Select File page allows you to select the utility database file, capital cost database file, and the case file containing the simulation.

Figure 8.2



To select a file:

1. Select the appropriate simulation file type using the radio buttons located below the **Simulation Files to Import** field.
   - Select **HYSYS** radio button to import stream information from a HYSYS file (*.hsc).
   - Select **Aspen Plus** radio button to import stream information from an Aspen Plus backup file (*.bkp).
2. Click the appropriate **Browse** button and the Import File view appears.
3. Use the **Look In** drop-down list to find the file you want.
4. Select the file you want and click the **Open** button to import the selected file into Extraction Wizard.
   The Import File view automatically close when you click the **Open** button.
5. Click the **Next** button to move to the next step.

Utility Database

The default set of data contained in the utility database may not be a true representation of the conditions of your project. You can edit this file to suit your conditions. Refer to **Section 10.2 - Utility Database View** from the **User Guide**.

The utility database file is required because the utility streams defined during the extraction will be defined from this database. This file type has the extension *.hud. If an appropriate file is not found in the location specified by the user, HX-Net will use the default file. The location of the default file is specified in the Session Preferences view.

Capital Cost Database

The default set of data contained in the capital cost database may not be a true representation of the conditions of your project. You can edit this file to suit your conditions. Refer to **Section 10.1 - Capital Cost View** from the **User Guide**.

The capital cost file contains the economic parameters required for the calculation of the target and design capital costs. This type of file has the extension *.hcc. If an appropriate file is not found in the location specified by the user, HX-Net will use the default file. The location of the default file is specified in the Session Preferences view.

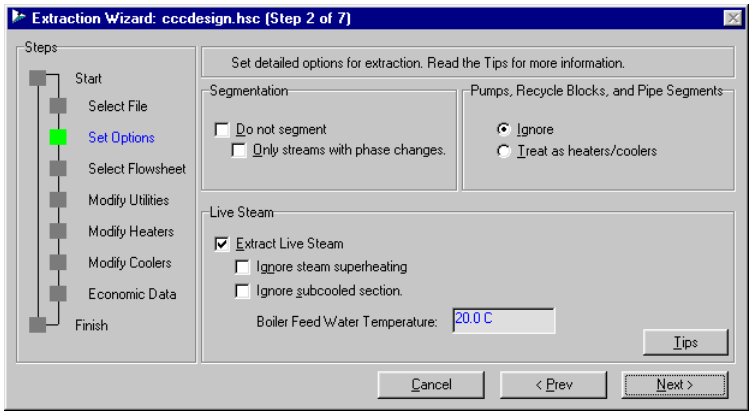
Simulation File

The simulation file is the file to be extracted into HX-Net. HYSYS files have the extension *.hsc, and Aspen Plus backup files have the extension *.bkp. Two sample HYSYS files have been included during the installation of HX-Net and can be found on the \Samples\HYSYSTestCases directory.

8.2.3 Set Options Page

The Set Options page allows you to specify how the data from the selected simulation/file will be extracted into HX-Net.

Figure 8.3



The options available in the Set Options page are split into three groups.

Segmentation Group

The Segmentation group contains two checkboxes that controls the segmentation options:

- If the **Do Not Segment** checkbox is checked, none of the streams extracted from HYSYS or Aspen Plus will be segmented. The heat transfer coefficient will be constant for the entire stream, which can or cannot be a good approximation of the stream.
- If the **Only streams with phase changes** checkbox is checked, the streams extracted from HYSYS or Aspen Plus that contain phase changes are segmented. The heat transfer coefficient will not be constant for the entire stream.

Live Steam Group

HX-Net extracts any steam used in the simulation as a process stream that has an inlet temperature at ambient temperature and an outlet temperature of the steam temperature in HYSYS or Aspen Plus. However, you can choose to alter this by checking or clearing the checkbox options in the Live Steam group.

- If the **Extract Live Steam** checkbox is checked, the steam streams extracted into HX-Net will always account for the phase change from liquid to vapour.
- If the **Ignore subcooled section** checkbox is unchecked, HX-Net will ignore the heating of the steam stream from ambient temperature to the boiling point.
  The ambient temperature is displayed in the **Boiler Feed Water Temperature** field. You can also change the ambient temperature by entering a new value in this field.
- If the **Ignore steam superheated** checkbox is unchecked, HX-Net will include the superheated section of the steam when extracting the steam stream from HYSYS or Aspen Plus.
- The **Tips** button allows you to access the Extraction Tips view. The Extraction Tips view displays hints/suggestions for extracting data, refer to **Section 6.5.3 - Extraction Tips** from the **Reference Guide** for more information.

The *Boiler Feed Water Temperature* field is only available when the *Ignore subcooled section* checkbox is unchecked.

Pumps, Recycle Blocks, and Pipe Segments Group

The pump, recycle blocks, and pipe segments are the unit operations in HYSYS or Aspen Plus that pose a challenge for the data extraction in HX-Net. The reason for the challenge is the enthalpy change across these operations.

For example, pumps will always increase the enthalpy of the stream, but without the use of a heater, cooler, or heat exchanger.

The enthalpy change must be accounted for, or the temperature entering the next heat exchanger will be altered, which can result in an infeasible heat exchanger somewhere in the network.

HX-Net provides two options to deal with the enthalpy change problem in the Pumps, Recycle Blocks, and Pipe Segments group.

- **Ignore** radio button. This option will simply ignore the enthalpy change in the middle of the stream, but account for it by adjusting the outlet temperature of the stream. For pumps, which always increase the enthalpy, this will result in a lower outlet temperature for both hot and cold streams.

- **Treat as heaters/coolers** radio button. This option will place a heater or cooler to account for the enthalpy change. A default utility, named **Very High Temp**, will only be used for this purpose so that the costing can be properly accounted for. For example, for hot streams that require heating in place of a pump, this heat exchanger will have an infeasible status.

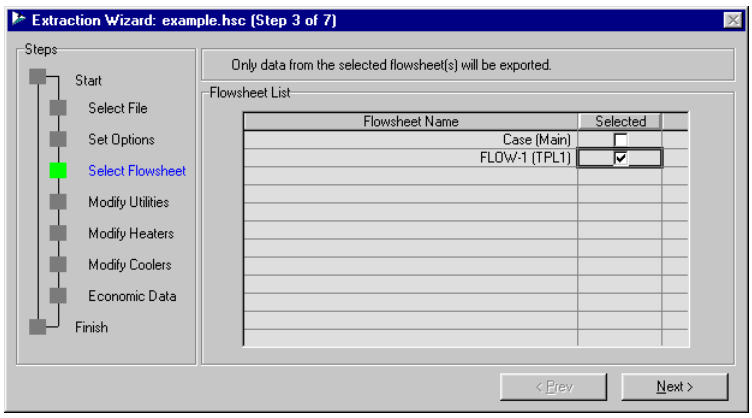
When you click the *Next* button to move from this step to the next, and HX-Net automatically opens the selected simulation case in HYSYS or Aspen Plus before proceeding to the next page/step.

8.2.4 Select Flowsheet Page

HX-Net automatically opens the selected case in HYSYS or Aspen Plus, so you can easily check which flowsheet you want to extract the data from.

If the selected case has multiple flowsheets, the Select Flowsheet page allows you to select the flowsheets that contains the streams you want to extract.

Figure 8.4



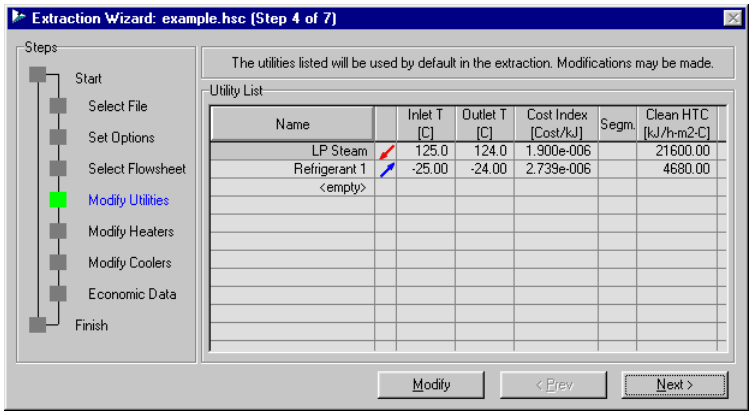
To select the flowsheet that contains the streams you want, check the checkboxes (in the *Selected* column) associated to the flowsheet listed in the *Flowsheet List* table.

Uncheck the checkbox associated to the flowsheet to ignore the streams in that particular flowsheet when extracting the data from HYSYS or Aspen Plus.

8.2.5 Modify Utilities Page

The Modify Utilities page displays the utilities that HX-Net has selected for the heaters and/or coolers in the selected flowsheet(s).

Figure 8.5



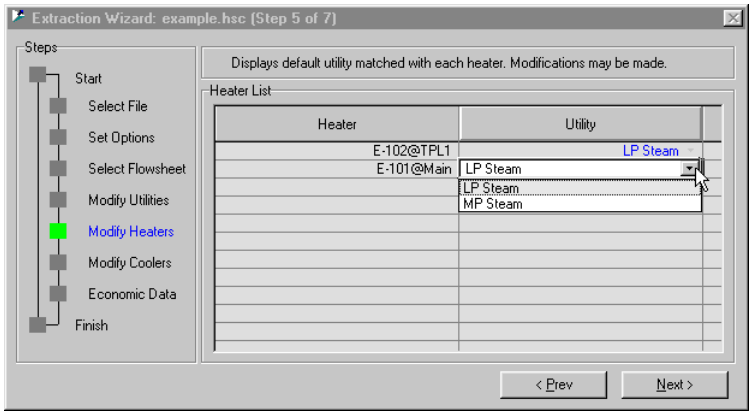
You can change the selected utility by clicking the *Modify* button. When the *Modify* button is clicked:

- The black text in the Utility List table changes to blue colour.
- You can change the value of any blue text in the Utility List table.
- You can add a different utility for heating and/or cooling by clicking the down arrow in the **<empty>** cell.
- The **Modify** button is replaced by a **Lock** button.

8.2.6 Modify Heaters Page

The Modify Heaters page list all the heaters and their associated utilities in the selected flowsheet(s).

Figure 8.6

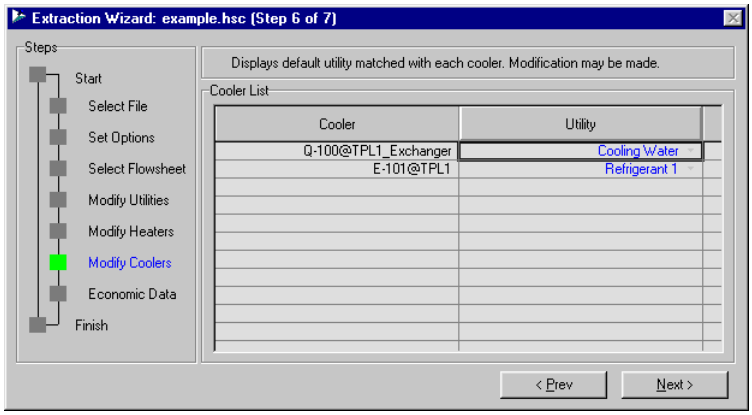


If you had selected/specify more than one hot utility in the *Modify Utilities* page, you can select a different utility for the heaters by clicking the down arrow in the appropriate *Utility* cell and selecting a different utility from the drop-down list.

8.2.7 Modify Coolers Page

The Modify Coolers page list all the coolers and their associated utilities in the selected flowsheet(s).

Figure 8.7



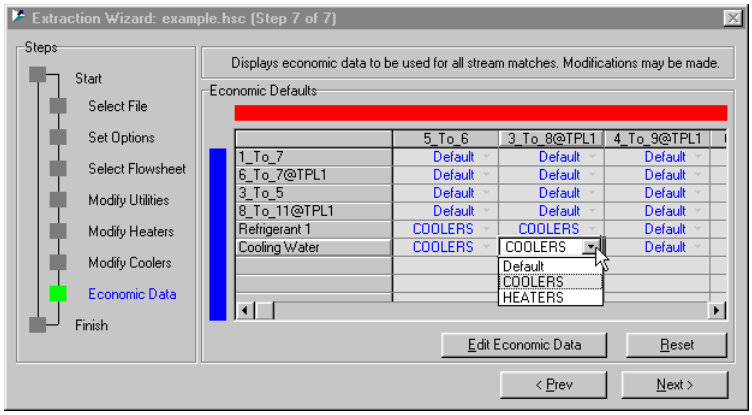
If you had selected/specify more than one cold utility in the *Modify Utilities* page, you can select a different utility for the coolers by clicking the down arrow in the appropriate *Utility* cell and selecting a different utility from the drop-down list.

8.2.8 Economic Data Page

The Economic Defaults table is similar to the Matchwise Economic view. Refer to **Section 1.4 - Matchwise Economic View** for more information.

The Economic Data page allows you to select which economic setting you want to apply to the heat exchangers.

Figure 8.8

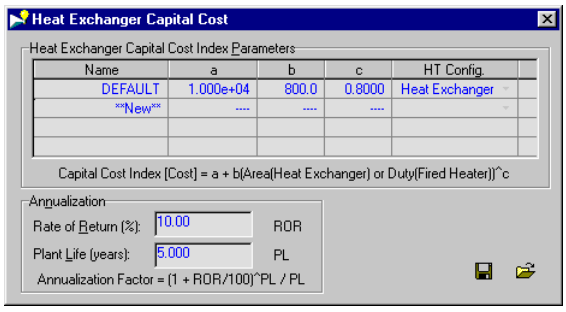


You can modify the economic set associated to the heat exchangers by:

- Clicking the down arrow in the appropriate cell and selecting the economic set you want from the drop-down list.
- Click the **Edit Economic Data** button to open the Heat Exchanger Capital Cost view, and editing the parametric values of the economic set.

The Heat Exchanger Capital Cost view is similar to the *Economics* tab of the HI Case view. Refer to **Section 2.2.3 - Economics Tab** for more information.

Figure 8.9

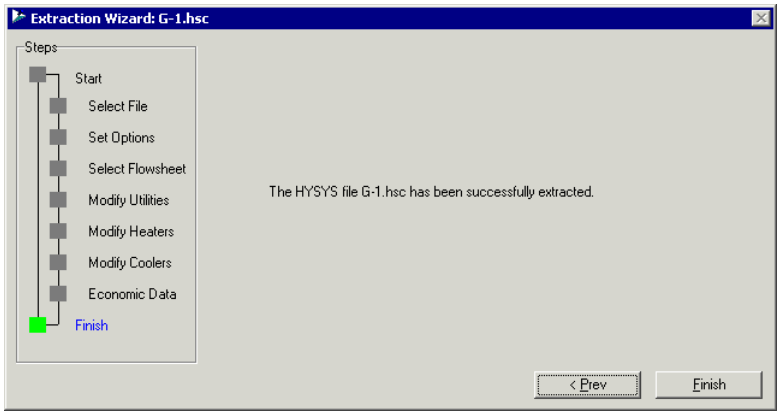


- Click the **Reset** button to reset all the heat exchangers economic setting to the HX-Net default setting.

8.2.9 Finish Page

The Finish page displays a message that indicates whether the extraction was successful or not.

Figure 8.10



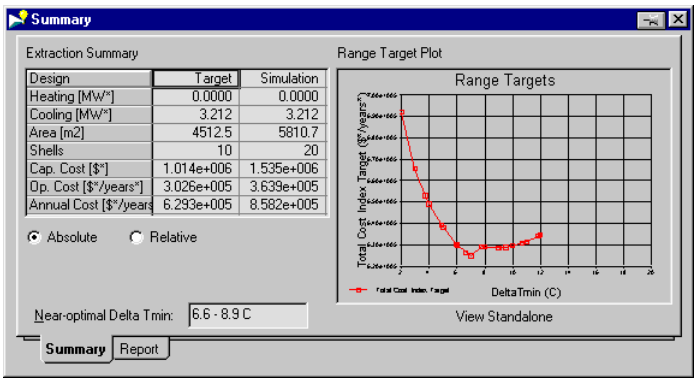
8.3 Summary View

After the data extraction has been completed, a view containing the summary report will appear. The Summary view contains two tabs: *Summary* and *Report*.

8.3.1 Summary Tab

The Summary tab displays all of the new targets calculated from the newly extracted data, and the simulation values from the extracted data.

Figure 8.11



By toggling the radio buttons *Absolute* and *Relative*, you can view the actual values as they are calculated, or as a percentage of the target values.

You can click the View Standalone button to open the plot in a separate view.

On the right side of the Summary tab is a plot of the total cost index target versus the minimum approach temperature.

Since the interest is in minimizing the total cost, a range of minimum approach temperatures can be found that will produce a near optimal value for the total cost. This is displayed in the Near Optimal Delta T Min field.

8.3.2 Report Tab

HX-Net recommends that you inspect the Report tab of the Extraction Summary view where the data extraction log is shown.

The warning section will detail any difficulty encountered by HX-Net during the extraction process.

The report from the data extraction is broken into three sections. The first section deals with the stream extracted from the HYSYS or Aspen Plus case. It gives the name of the stream as it will appear in HX-Net, and then describes the stream as it was in HYSYS or Aspen Plus, mainly what unit operations the stream was attached to.

The second section provides the assumptions, which is the list of utilities used to satisfy the process streams. The last section gives any warnings that resulted from the data extraction.

Refer to the **Warnings and Limitations** section in **Section 6.5.2 - Summary Report** from **Reference Guide** for more information about the warning results from the data extraction.

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