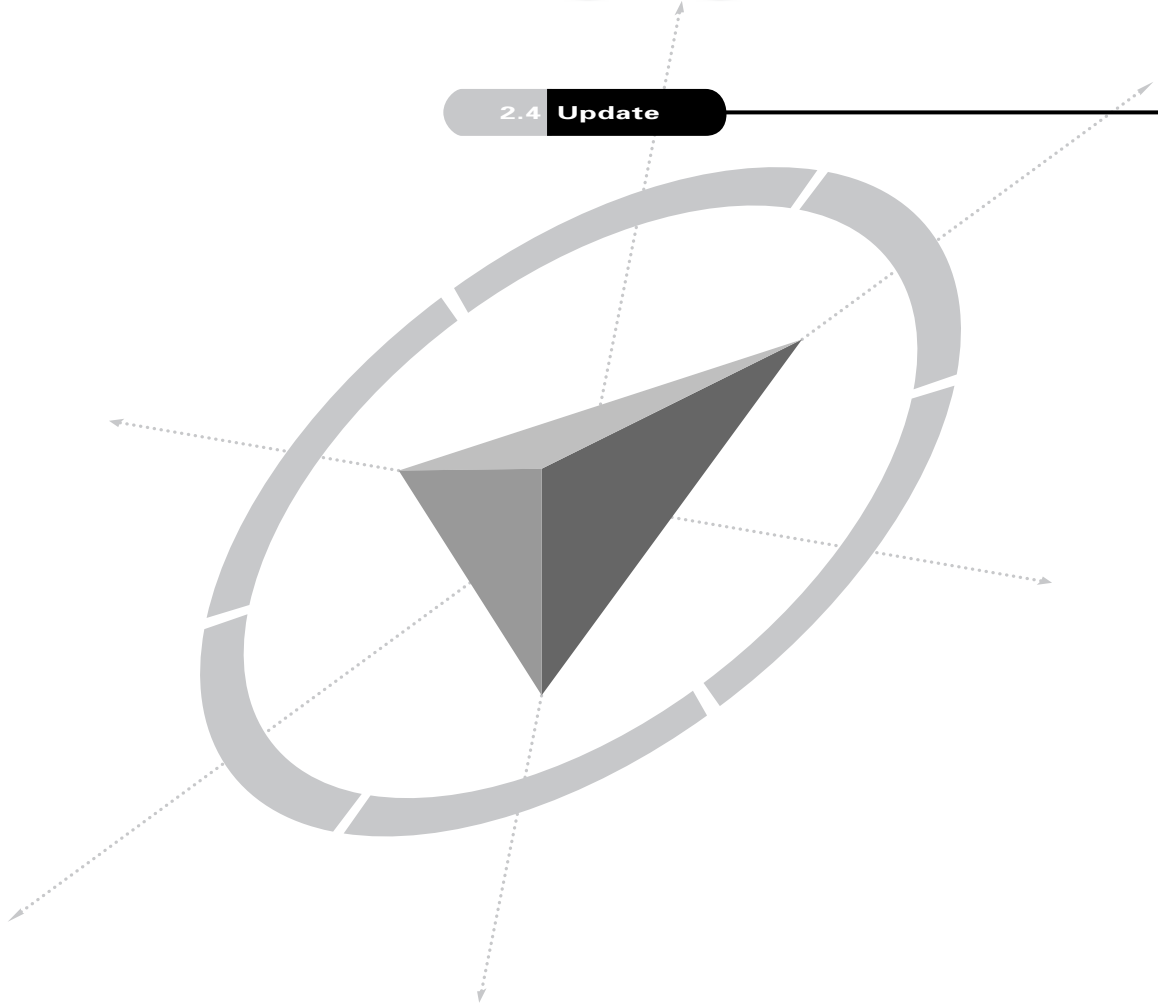


HYSYS

2.4 Update



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Since software is always a work in progress, any version, while representing a milestone, is nevertheless but a point in a continuum. Those individuals whose contributions created the foundation upon which this work is built have not been forgotten. The current authors would like to thank the previous contributors.

A special thanks is also extended by the authors to everyone who contributed through countless hours of proof-reading and testing.

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Detailed information on accessing Hyprotech Technical Support can be found in the **Technical Support** section in the preface to this manual.

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1 What's New

There are a number of new features included with HYSYS v2.4. The purpose of this chapter is to provide an introduction to these new features:

- Software License Manager,
- Simultaneous Adjust,
- Simulation Navigator,
- Workbook Printing Enhancements,
- Pipe Segment,
- Waxing Correlation,
- Utilities,
- Original Form of the Peng Robinson Equation,
- Separator,
- Compressible Gas Pipe,
- Bulk Property Fitting,
- Controller Options,
- Reciprocating Compressor,
- Integration of TASC-MUSE,
- Fired Heater (Furnace),
- and Li-Mather electrolyte model added to the Amines property package.

Software License Manager

The new Software License Manager (SLM) will allow for greater flexibility in dealing with Hyprotech's various products. SLM consists of a set of license codes for each application that is locked to a hardware key. The licensing works as follows: one license is consumed per feature, decreasing the available licenses for that feature by one until you run out of licenses. When a user is finished with that application or feature, the license is released back to the license server allowing other users access to the license.

There are two modes that can be used to license Hyprotech applications: Standalone licensing and Network licensing.

Standalone licensing is setup so that both the application and the licenses are installed on the a single computer. This kind of

configuration is most often used when the application is only used by an individual on a particular computer.

Network licensing is setup so that the application is installed on a user's computer and the licenses are installed on a network license server. The license server consists of network licenses and the license server application. The license server is used to manage all of the license codes.

For more information regarding the Software License Manager refer to [Chapter 4 - Software Licensing](#) of the Version 2.4 Update Manual.

Simultaneous Adjust

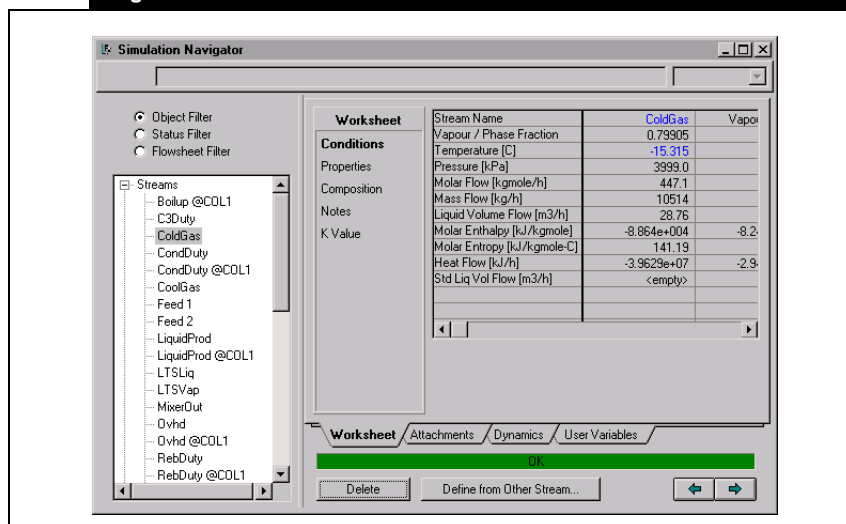
The Simultaneous Adjust Manager (SAM) allows you to monitor and modify all adjusts that are specified as simultaneous. This gives you access to a more efficient method of calculation and more control over the calculations.

For more information regarding the Simultaneous Adjust Manager refer to [Chapter 10 - Logical Operations](#) of the Steady State Modeling Guide.

Simulation Navigator

The Simulation Navigator acts as a short-cut means of quickly viewing the property view of any stream or unit operation within your HYSYS case.

Figure 1.1

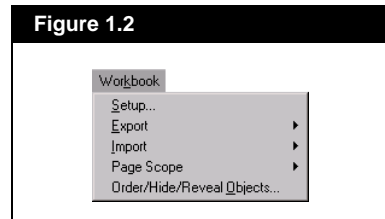


Selecting an object from the tree list on the left will display its property view on the right just as it would appear as if accessed from the flowsheet.

For more information regarding the Simulation Navigator refer to [Chapter 5 - Flowsheet Analysis in HYSYS](#) of the User's Guide.

Workbook Printing Enhancements

When the Workbook is active, HYSYS will redraw the Menu Bar adding the **Workbook** menu. The following options have been modified or added to this menu.



The Order/Hide and Reveal dialogues have been combined into a new more intuitive dialog.

Once a Workbook has been customized with the addition/deletion/sorting of tabs and variables, the workbook can be exported to a file for use with future simulation cases. This same workbook setup can then be used in another simulation case by importing this file into HYSYS.

For both the Importing/Exporting options you are given the choice to either import/export the entire workbook or just some of the pages of the workbook. A unique-naming function has been added to distinguish imported pages from pre-existing pages that have the same name

A Mixed Liquid Phase has also been added to the already existing Overall, Vapour, Liquid, Aqueous, and Second Liquid phases that have properties displayed in workbooks or spreadsheets. The Mixed Liquid Phase combines the Liquid phases of all components in a specified stream, and calculates all liquid phase properties for the resulting fluid. The Mixed Liquid Phase does not add its composition or molar flow to the stream it is derived from, it is only another representation of existing liquid components. There are certain variables that are meaningless for a Mixed Liquid Phase (i.e. phase viscosity for components that do not mix) but these vars remain viewable in HYSYS in the event that they would serve some other purpose.

For more information regarding the Workbook Enhancements refer to [Chapter 4 - Workbook](#) of the User's Guide.

Pipe Segment

The Pipe Segment unit operation will now calculate the inner diameter of the pipe for you when a pressure difference and pipe length is specified.

For more information regarding the Pipe Segment refer to [Chapter 4 - Piping Equipment](#) of the Steady State Modeling Guide.

Waxing Correlation

The Profes Wax model has been integrated into the Pipe Segment unit operation. The Deposition tab is used to calculate the deposition of the wax from the bulk oil onto the pipe wall. A wax deposition rate is integrated over each timestep to give the total quantity of wax laid down on the pipe wall.

For more information regarding the Waxing Correlation refer to [Chapter 4 - Piping Equipment](#) of the Steady State Modeling Guide.

Utilities

Dynamics Tab

The Dynamics tab allows you to control how often the utility gets calculated when running in Dynamic mode. This tab is available in the following properties.

- Boiling Point Curves
- Cold Properties
- Critical Properties
- Envelope Utility
- Hydrate Formation Utility
- Property Table

Property Table Enhancements

The property view for the Property Table utility has been modified. The method used to define the Independent and Dependent variable has been simplified by adopting the variable navigator. A Design tab has

replaced the Ind. Prop and the Dep. Prop tabs. With the independent variables defined on the Connections page and the dependent variables defined on the Dep. Prop page.

For more information regarding the Utilities refer to [Chapter 8 - Utilities](#) of the User's Guide.

Original Form of the Peng Robinson Equation

HYSYS now allows you to choose between the original form of the Peng Robinson method or the modified HYSYS version of the Peng Robinson method.

For more information regarding both Peng Robinson Equation methods refer to [Section 1.2 - Fluid Packages Tab](#) of [Chapter 1 - Fluid Package](#) of the Simulation Basis Guide.

Separator

When in the Dynamic Simulation mode a weir can be specified for any horizontal separator. You can specify the weir height and position and HYSYS will calculate the levels and phase moles in each chamber of the separator.

For more information regarding the Separator unit operation in Dynamic mode refer to [Chapter 7 - Separation Operations](#) in the Dynamics Modeling Guide.

Compressible Gas Pipe

The Compressible Gas Pipe is a new feature found with Plant+. This unit operation is primarily designed for transient calculations with streams. Steady state calculations have been implemented primarily for initialization of the Pipe State prior to transient calculations.

The Compressible Gas Pipe Model uses an algorithm that solves a vector system using the Two-Step Lax-Wendroff method with Boris & Book anti-diffusion.

For more information regarding the Compressible Gas Pipe refer to [Chapter 1 - Dynamic Theory](#) of the Dynamic Modeling Guide.

Bulk Property Fitting

If you have a light-ends analysis along with light-ends free input curves and total bulk properties or light-ends free bulk properties you can use the HYSYS oil manager to combine the light-ends analysis with the light-ends free input curves to match the specified bulk properties. This functionality is clearly seen in the case of chromatographic input, where you may want to input the light-ends along with the C6+ as the chromatographic data groups. Because of the nature of the analysis, the chromatographic data is light-ends free.

HYSYS now allows you to specify if a given curve contains light-ends contributions, set if a specified bulk property contains light-ends and partition a property curve so that some sections can be adjusted more than others.

These values can be set within the Light Ends Handling & Bulk Fitting Options view that is accessed by clicking either of the Light Ends Handling & Bulk Fitting Options buttons found on the Input Data and User Curves tabs of the Assay Property view.

For more information regarding Bulk Property Fitting refer to the [Light Ends Handling and Bulk Fitting](#) section in [Chapter 3 - HYSYS Oil Manager](#) of the Simulation Basis Guide.

Controller Options

There have been three new PID controller options added to HYSYS:

- Signal filtering
- Noise filtering
- Feedforward control

The Signal Processing page on the Parameters tab of the PID controller now gives you the capability to add filters to any signal associated with the PID controller. For the moment the filter type is just a first order type filter and, therefore, there is only the parameter filter time that you can supply.

This page also allows you to test the robustness of any tuning on a given controller by filtering noise for any signal associated with the controller, i.e., Pv, Op, Sp, Dv.

At present the PID controller now has the ability to be configured as a feedback and feedforward controller. The availability of the

feedforward option enables the user to design a controller that takes into account measured disturbances. For example the disturbance may be the total flowrate to a given unit operation.

All Feedforward controllers require a process model in order that the controllers work properly. Presently, HYSYS is limited to a model that results in a lead-lag process.

For more information regarding Controller Options refer to [Chapter 10 - Logical Operations](#) of the Dynamics Modeling Guide.

Reciprocating Compressor

HYSYS now allows you to model a reciprocating compressor in both Dynamic and Steady State modes. A reciprocating compressor is just another type of compressor used for applications where higher discharge pressures and lower flows are needed. It is known as a positive displacement type. Reciprocating compressors have a constant volume and variable head characteristics, as compared to the centrifugal compressor that has a constant head and variable volume.

The reciprocating compressors is accessed via the compressor unit operation. However, the solution methods differ slightly as a reciprocating compressor does not require a compressor curve and the required geometry data. The present capability of reciprocating compressors in HYSYS is focused on a single stage compressor with single or double acting piston.

For more information regarding the Reciprocating Compressor refer to [Chapter 5 - Rotating Equipment](#) of the Steady State Modeling Guide or [Chapter 6 - Rotating Equipment](#) of the Dynamic Modeling Guide.

Integration of TASC-MUSE

The LNG unit operation now has a new tab that links HYSYS with the TASC-MUSE application. MUSE is used to perform a range of calculations on plate-fin heat exchangers, either simple two-stream exchangers, or complex ones with multiple streams.

For more information regarding this link to MUSE refer to [Chapter 3 - Heat Transfer Equipment](#) of the Steady State Modeling Guide.

Fired Heater (Furnace)

HYSYS now allows you to model a dynamic **Fired Heater** (Furnace). This operation performs energy and material balances to model a direct fired heater type furnace. This type of equipment requires a large amount of heat input. Heat is generated by the combustion of fuel and transferred to process streams.

The Furnace operation allows multiple stream connections at tube side in each zone and optional economizer and convection zone selections. The operation incorporates a single burner model and a single feed inlet and outlet on the flue gas side.

Some of the major features included in the dynamic Furnace operation include:

- Flexible connection of process fluid associated in each furnace zone, e.g. radiant zone, convective zone or economizer zone. Different furnace configurations can be modeled or customized using tee, mixer and heat exchanger unit operations.
- A pressure-flow specification option on each side and pass realistically models flow through furnace operation according to the pressure gradient in the entire pressure network of the plant. Possible flow reversal situations can therefore be modeled.
- A comprehensive heat calculation inclusive of radiant, convective and conduction heat transfer on radiant zone enables the prediction of process fluid temperature, furnace wall temperature and flue gas temperature.
- A dynamic model which accounts for energy and material hold-ups in each zone. Heat transfer in each zone depends on the flue gas properties, tube and furnace wall properties, surface properties of metal, heat loss to the ambient and the process stream physical properties.
- A combustion model which accounts for imperfect mixing of fuel and allows automatic flame ignition or extinguished based on the oxygen availability in the fuel air mixture.

For more information regarding the Fired Heater refer to [Section 4.5 - Fired Heater \(Furnace\)](#) of the Dynamic Modeling Guide.

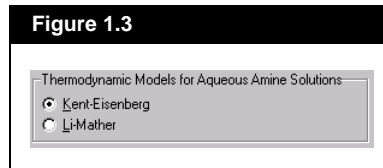
Li-Mather Electrolyte Model

The Amines property package has been modified to allow you to simulate three phase behaviour. For the three phase simulation the K values from the Peng Robinson property package were combined with the K values from the AMines LLE and VLE package.

The Li-Mather model shows a strong predictive capability over a wide range of temperatures, pressures, acid gas loadings, and amine concentrations. AMSIM is capable of simulating processes with blended solvents made up of any two of six principle amines (MEA, DEA, MDEA, TEA, DGA and DIPA).

HYSYS now gives you the option of choosing between either the Kent-Eisenberg and Li-Mather thermodynamic models.

Figure 1.3



For more information regarding the Li-Mather Electrolyte model refer to [Section C.4 - Equilibrium Solubility](#) of the Simulation Basis Manual.

2 Welcome to HYSYS

We are pleased to present you with the latest version of *HYSYS* — the product that continually extends the bounds of process engineering software. With HYSYS you can create rigorous steady-state and dynamic models for plant design and trouble shooting. Through the completely interactive HYSYS interface, you have the ability to easily manipulate process variables and unit operation topology, as well as the ability to fully customize your simulation using its OLE extensibility capability.

2.1 Hyprotech Software Solutions

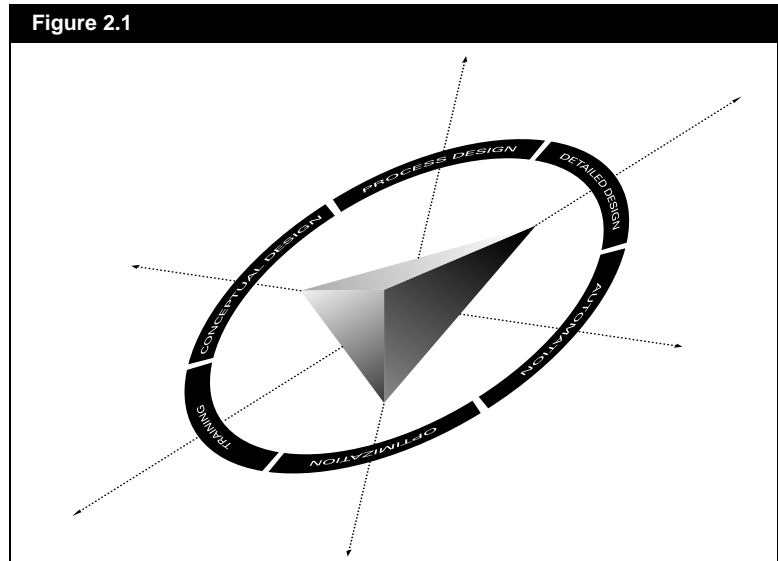
HYSYS has been developed with Hyprotech's overall vision of the ultimate process simulation solution in mind. The vision has led us to create a product that is:

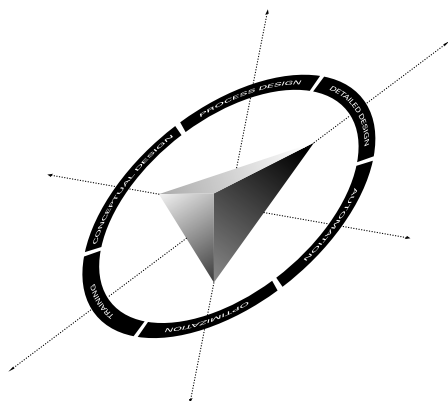
- integrated
- intuitive and interactive
- open and extensible.

Integrated Simulation Environment

In order to meet the ever-increasing demand of the process industries for rigorous, streamlined software solutions, Hyprotech developed the HYSYS Integrated Simulation Environment. The philosophy underlying our truly integrated simulation environment is conceptualized in the diagram below:

Figure 2.1





The central wedge represents the common parameters at the core of the various modelling tools:

- model topology
- interface
- thermodynamics

The outer ring represents the modelling application needs over the entire plant lifecycle. The arrows depict each Hyprotech product using the common core, allowing for universal data sharing amongst the tools, while providing a complete simulation solution.

As an engineer you undoubtedly have process modelling requirements that are not all handled within a single package. The typical solution is to generate results in one package, then transfer the necessary information into a second package where you can determine the additional information. At best, there is a mechanism for exchanging information through file transfer. At worst, you must enter the information manually, consuming valuable time and risking the introduction of data transfer errors. Often the knowledge you gain in the second application has an impact on the first model, so you must repeat the whole process a number of times in an iterative way.

In a truly integrated simulation environment all of the necessary applications work is performed within a common framework, eliminating the tedious trial-and-error process described previously. Such a system has a number of advantages:

- Information is shared, rather than transferred, among applications.
- All applications use common thermodynamic models.
- All applications use common flowsheet topology.
- You only need to learn one interface.
- You can switch between modelling applications at any time, gaining the most complete understanding of the process.

The plant lifecycle might begin with building a conceptual model to determine the basic equipment requirements for your process. Based on the conceptual design, you could build a steady-state model and perform an optimization to determine the most desirable operating conditions. Next, you could carry out some sizing and costing calculations for the required equipment, then do some dynamic modelling to determine appropriate control strategies. Once the design has become a reality, you might perform some on-line modelling using actual plant data for "what-if" studies, troubleshooting or even on-line optimization. If a change at any stage in the design process affects the common data, the new information is available immediately to all the other applications — no manual data transfer is ever required.

While this concept is easy to appreciate, delivering it in a useable manner is difficult. Developing this multi-application, information-sharing software environment is realistically only possible using Object Oriented Design methodologies, implemented with an Object Oriented Programming Language. Throughout the design and development process, we have adhered to these requirements in order to deliver a truly integrated simulation environment as the HYSYS family of products:

For information on any of these products, contact your local Hyprotech representative.

HYSYS Product	Description
HYSYS.Process	Process Design - HYSYS.Process provides the accuracy, speed and efficiency required for process design activities. The level of detail and the integrated utilities available in HYSYS.Process allows for skillful evaluation of design alternatives.
HYSYS.Plant	Plant Design - HYSYS.Plant provides an integrated steady-state and dynamic simulation capability, offers rigorous and high-fidelity results with a very fine level of equipment geometry and performance detail. HYSYS.Plant+ provides additional detailed equipment configurations, such as actuator dynamics.
HYSYS.Refinery	Refinery Modeling - HYSYS.Refinery provides truly scalable refinery-wide modeling. Detailed models of reaction processes can be combined with detailed representations of separation and heat integration systems. Each hydrocarbon stream is capable of predicting a full range of refinery properties based on a Refinery Assay matrix.
HYSYS.OTS	Operations Training System - HYSYS.OTS provides real-time simulated training exercises that train operations personnel and help further develop their skills performing critical process operations. Increased process understanding and procedural familiarity for operations personnel can lead to an increase in plant safety and improvements in process performance.
HYSYS.RTO	Real-Time Optimization - HYSYS.RTO is a real-time optimization package that enables the optimization of plant efficiency and the management of production rate changes and upsets in order to handle process constraints and maximize operating profits.
HYSYS.Concept	Conceptual Design Application - HYSYS.Concept includes DISTIL which integrates the <i>distillation synthesis</i> and <i>residue curve map</i> technology of Mayflower with data regression and thermodynamic database access. HYSYS.Concept also includes HX-Net , which provides the ability to use <i>pinch technology</i> in the design of heat exchanger networks. Conceptual design helps enhance process understanding and can assist in the development of new and economical process schemes.

Intuitive and Interactive Process Modelling

We believe that the role of process simulation is to improve your process understanding so that you can make the best process decisions. Our solution has been, and continues to be, interactive simulation. This solution has not only proven to make the most efficient use of your simulation time, but by building the model interactively – with immediate access to results – you gain the most complete understanding of your simulation.

HYSYS uses the power of Object Oriented Design, together with an Event-Driven Graphical Environment, to deliver a completely interactive simulation environment where:

- calculations begin automatically whenever you supply new information, and
- access to the information you need is in no way restricted.

At any time, even as calculations are proceeding, you can access information from any location in HYSYS. As new information becomes available, each location is always instantly updated with the most current information, whether specified by you or calculated by HYSYS.

Open and Extensible HYSYS Architecture

The Integrated Simulation Environment and our fully Object Oriented software design has paved the way for HYSYS to be fully OLE compliant, allowing for complete user customization. Through a completely transparent interface, OLE Extensibility lets you:

- develop custom steady-state and dynamic unit operations
- specify proprietary reaction kinetic expressions
- create specialized property packages.

With seamless integration, new modules appear and perform like standard operations, reaction expressions or property packages within HYSYS. The Automation features within HYSYS expose many of the internal Objects to other OLE compliant software like Microsoft Excel, Microsoft Visual Basic and Visio Corporation's Visio. This functionality enables you to use HYSYS applications as calculation engines for your own custom applications.

By using industry standard OLE Automation and Extension the custom simulation functionality is portable across Hyprotech software updates. The open architecture allows you to extend your simulation functionality in response to your changing needs.

HYSYS is the only commercially available simulation platform designed for complete User Customization.

2.2 Use of the Manuals

HYSYS Electronic Documentation

The HYSYS Documentation Suite includes all available documentation for the HYSYS family of products.

All HYSYS documentation is available in electronic format as part of the HYSYS Documentation Suite. The HYSYS Documentation CD-ROM is included with your package and may be found in the Version 2.4 Update box. The content of each manual is described in the following table:

Manual	Description
Version 2.4 Update	Contains the information needed to install HYSYS, plus a Quick Start example to get you up and running, ensure that HYSYS was installed correctly and is operating properly.
User's Guide	Provides in depth information on the HYSYS interface and architecture. HYSYS Utilities are also covered in this manual.
Simulation Basis	Contains all information relating to the available HYSYS fluid packages and components. This includes information on the Oil Manager, Hypotheticals, Reactions as well as a thermodynamics reference section.
Steady State Modeling	Steady state operation of HYSYS unit operations is covered in depth in this manual.
Dynamic Modeling	This manual contains information on building and running HYSYS simulations in Dynamic mode. Dynamic theory, tools, dynamic functioning of the unit operations as well as controls theory are covered. This manual is only included with the HYSYS.Plant document set.
Customization Guide	Details the many customization tools available in HYSYS. Information on enhancing the functionality of HYSYS by either using third-party tools to programmatically run HYSYS (Automation), or by the addition of user-defined Extensions is covered. Other topics include the current internally extensible tools available in HYSYS: the User Unit Operation and User Variables as well as comprehensive instruction on using the HYSYS View Editor.
Tutorials	Provides step-by-step instructions for building some industry-specific simulation examples.

Manual	Description
Applications	Contains a more advanced set of example problems. Note that before you use this manual, you should have a good working knowledge of HYSYS. The Applications examples do not provide many of the basic instructions at the level of detail given in the Tutorials manual.
Quick Reference	Provides quick access to basic information regarding all common HYSYS features and commands.

Contact Hyprotech for information on HYSYS training courses.

If you are new to HYSYS, you may want to begin by completing one or more of the HYSYS tutorials, which give the step-by-step instructions needed to build a simulation case. If you have some HYSYS experience, but would still like to work through some more advanced sample problems, refer to the HYSYS Applications.

Since HYSYS is totally interactive, it provides virtually unlimited flexibility in solving any simulation problem. Keep in mind that the approach used in solving each example problem presented in the HYSYS documentation may only be one of the many possible methods. You should feel free to explore other alternatives.

Viewing the Online Documentation

HYSYS online documentation is viewed using **Adobe Acrobat Reader®**, which is included on the Documentation CD-ROM. Install Acrobat Reader 4.0 on your computer following the instructions on the CD-ROM insert card. Once installed, you can view the electronic documentation either directly from the CD-ROM, or you can copy the **Doc** folder (containing all the electronic documentation files) and the file named **main.pdf** to your hard drive before viewing the files.

Manoeuvre through the online documentation using the *bookmarks* on the left of the screen, the navigation buttons in the button bar or using the scroll bars on the side of the view. Blue text indicates an active link to the referenced section or view. Click on that text and Acrobat Reader will jump to that particular section.

Ensure that your version of Acrobat Reader has the Search plug-in present. This plug-in allows you to add a search index to the search list.

For more information on the search tools available in Acrobat Reader, consult the help files provided with the program.

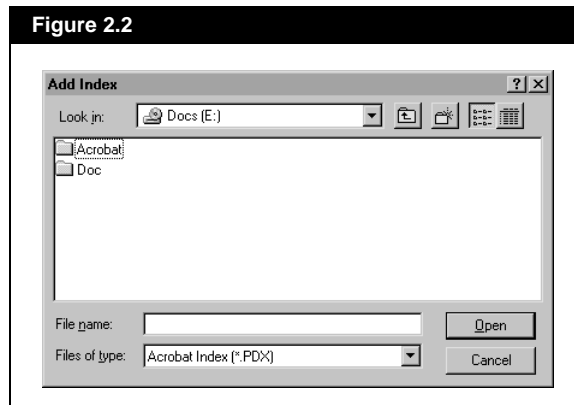
Selecting the Search Index

One of the advantages in using the HYSYS Documentation CD is the ability to do power searching using the Acrobat search tools. The Acrobat **Search** command allows you to perform full text searches of PDF documents that have been indexed using **Acrobat Catalog®**.

To attach the index file to Acrobat Reader 4.0, use the following procedure:

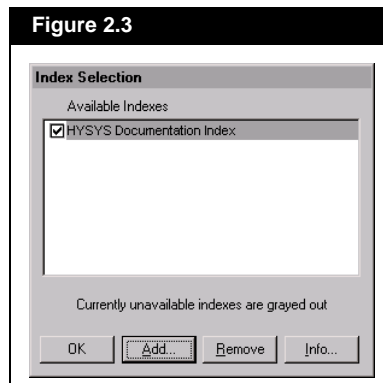
1. Open the **Index Selection** view by selecting **Edit-Search-Select Indexes** from the menu.
2. Click the **Add** button. This will open the **Add Index** view.
3. Ensure that the **Look in** field is currently set to your CD-ROM drive label. There should be two directories visible from the root directory: Acrobat and Doc.

Figure 2.2



4. Open the Doc directory. Inside it you should find the **Index.pdx** file. Select it and click the **Open** button.

Figure 2.3



5. The Index Selection view should display the available indexes that can be attached. Select the index name and then click the **OK** button. You may now begin making use of the Acrobat **Search** command.

Using the Search Command

The Acrobat **Search** command allows you to perform a search on PDF documents. You can search for a simple word or phrase, or you can expand your search by using wild-card characters and operators.

To search an index, first select the indexes to search and define a *search query*. A search query is an expression made up of text and other items to define the information you want to define. Next, select the documents to review from those returned by the search, and then view the occurrences of the search term within the document you selected

To perform a full-text search do the following:

1. Choose **Edit-Search-Query** from the menu.
2. Type the text you want to search for in the Find Results Containing Text box.
3. Click **Search**. The Search dialog box is hidden, and documents that match your search query are listed in the Search Results window in order of relevancy.
4. Double-click a document that seems likely to contain the relevant information, probably the first document in the list. The document opens on the first match for the text you typed.
5. Click the **Search Next** button or **Search Previous** button to go to other matches in the document. Or choose another document to view.

Other Acrobat Reader features include a zoom-in tool in the button bar, which allows you to magnify the text you are reading. If you wish, you may print pages or chapters of the online documentation using the **File-Print** command under the menu.

Conventions used in the Manuals

The following section lists a number of conventions used throughout the documentation.

Keywords for Mouse Actions

As you work through various procedures in the manuals, you will be given instructions on performing specific functions or commands. Instead of repeating certain phrases for mouse instructions, keywords are used to imply a longer instructional phrase:

These are the normal (default) settings for the mouse, but you can change the positions of the left- and right-buttons.

Keywords	Action
Point	Move the mouse pointer to position it over an item. For example, point to an item to see its Tool Tip.
Click	Position the mouse pointer over the item, and rapidly press and release the left mouse button. For example, click the Close button to close the current window.
Right-Click	As for click, but use the right mouse button. For example, right-click an object to display the Object Inspection menu.
Double-Click	Position the mouse pointer over the item, then rapidly press and release the left mouse button twice. For example, double-click the HYSYS icon to launch the program.
Drag	Position the mouse pointer over the item, press and hold the left mouse button, move the mouse while the mouse button is down, and then release the mouse button. For example, you drag items in the current window, to move them.
Tool Tip	Whenever you pass the mouse pointer over certain objects, such as tool bar icons and flowsheet objects, a Tool Tip will be displayed. It will contain a brief description of the action that will occur if you click on that button or details relating to the object.

A number of text formatting conventions are also used throughout the manuals:

Format	Example
When you are asked to access a HYSYS menu command, the command is identified by bold lettering.	'Select File-Save from the menu to save your case.'
When you are asked to select a HYSYS button, the button is identified by bold, italicized lettering.	'Click the <i>Close</i> button to close the current view.'

Note that blank spaces are acceptable in the names of streams and unit operations.

Format	Example
When you are asked to select a key or key combination to perform a certain function, keyboard commands are identified by words in bolded small capitals (small caps).	'Press the F1 key on the keyboard to open the context sensitive help.'
The name of a HYSYS view (also know as a property view or window) is indicated by bold lettering.	'Selecting this command opens the Session Preferences view.'
The names of <i>pages</i> and <i>tabs</i> on various views are identified in bold lettering.	'Click Composition page on the Worksheet tab to see all the stream composition information.'
The name of <i>radio</i> buttons, <i>check boxes</i> and <i>cells</i> are identified by bold lettering.	'Click the Ignored check box to ignore this operation.'
Material and energy stream names are identified by bold lettering.	Column Feed, Condenser Duty
Unit operation names are identified by bold lettering.	Inlet Separator, Atmospheric Tower
When you are asked to provide keyboard input, it will be indicated by bold lettering.	'Type 100 in the cell to define the stream temperature.'

Bullets and Numbering

Bulleted and numbered lists will be used extensively throughout the manuals. Numbered lists are used to break down a procedure into steps, for example:

1. Select the Name cell.
2. Type a name for the operation.
3. Press ENTER to accept the name.

Bulleted lists are used to identify alternative steps within a procedure, or for simply listing like objects. A sample procedure that utilizes bullets is:

1. Move to the Name cell by doing one of the following:
 - Select the Name cell
 - Press ALT+N
2. Type a name for the operation.
 - Press ENTER to accept the name.

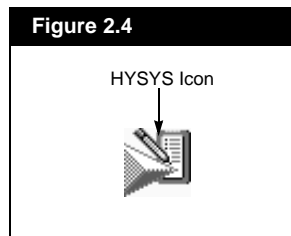
Notice the two alternatives for completing Step 1 are indented to indicate their sequence in the overall procedure.

A bulleted list of like objects might describe the various groups on a particular view. For example, the **Options** page of the **Simulation** tab on the Session Preferences view has three groups, namely:

- General Options
- Errors
- Column Options

Callouts

A callout is a label and arrow that describes or identifies an object. An example callout describing a graphic is shown below.



Annotations

Annotation text appears in the outside page margin.

Text appearing in the outside margin of the page supplies you with additional or summary information about the adjacent graphic or paragraph. An example is shown to the left.

Shaded Text Boxes

A shaded text box provides you with important information regarding HYSYS' behaviour, or general messages applying to the manual. Examples include:

The resultant temperature of the mixed streams may be quite different than those of the feed streams, due to mixing effects.

Before proceeding, you should have read the introductory section which precedes the example problems in this manual.

The use of many of these conventions will become more apparent as you progress through the manuals.

2.3 Technical Support

There are several ways in which you can contact Technical Support. If you cannot find the answer to your question in the manuals, we encourage you to visit our website at www.hyprotech.com, where a variety of information is available to you, including:

- answers to frequently asked questions
- example cases and product information
- technical papers
- news bulletins
- hyperlink to support e-mail.

You can also access Support directly via e-mail. A listing of Technical Support Centres including the Support e-mail address is at the end of this chapter. When contacting us via e-mail, please include in your message:

- Your full name, company, phone and fax numbers.
- The version of HYSYS you are using (shown in the Help, About HYSYS view).
- The serial number of your HYSYS security key.
- A detailed description of the problem (attach a simulation case if possible).

We also have toll free lines that you may use. When you call, please have the same information available.

2.3.1 Technical Support Centres

Calgary, Canada

Hyprotech Ltd.

Suite 800, 707 - 8th Avenue SW
Calgary, Alberta
T2P 1H5

support@hyprotech.com (e-mail)
(403) 520-6181 (local - technical support)
1-888-757-7836 (toll free - technical support)
(403) 520-6601 (fax - technical support)
1-800-661-8696 (information and sales)

Barcelona, Spain (Rest of Europe)

Hyprotech Europe S.L.

Pg. de Gràcia 56, 4th floor
E-08007 Barcelona, Spain

support@hyprotech.com (e-mail)
+34 932 724 424 (technical support)
900 161 900 (toll free - technical support - Spain only)
+34 932 154 256 (fax - technical support)
+34 932 156 884 (information and sales)

Oxford, UK (UK clients only)

AEA Technology Engineering Software

Hyprotech
404 Harwell, Didcot
Oxfordshire, OX11 0RA
United Kingdom

support@hyprotech.com (e-mail)
0800 731 7643 (freephone technical support)
+44 1235 43 4351 (fax - technical support)
+44 1235 43 4852 (information and sales)

Kuala Lumpur, Malaysia

Hyprotech Malaysia Sdn.Bhd

Lot E-3-3a, Dataran Palma
Jalan Selaman ½, Jalan Ampang
68000 Ampang, Selangor
Malaysia

support@hyprotech.com (e-mail)
+60 3 4270 3880 (technical support)
+60 3 4271 3811 (fax - technical support)
+60 3 4270 3880 (information and sales)

Yokohama, Japan

AEA Hyprotech KK

Plus Taria Bldg. 6F.
3-1-4, Shin-Yokohama
Kohoku-ku
Yokohama, Japan
222-0033

support@hyprotech.com (e-mail)
81 45 476 5051 (technical support)
81 45 476 5051 (information and sales)

2.3.2 Offices

Calgary, Canada**Tel:** (403) 520-6000**Fax:** (403) 520-6040/60**Toll Free:** 1-800-661-8696**Newark, DE, USA****Tel:** (302) 369-0773**Fax:** (302) 369-0877**Toll Free:** 1-800-688-3430**Oxford, UK****Tel:** +44 1235 43 4852**Fax:** +44 1235 43 4351**Oudenaarde, Belgium****Tel:** +32 55 310 299**Fax:** +32 55 302 030**Hovik, Norway****Tel:** +47 67 10 6464**Fax:** +47 67 10 6465**Kuala Lumpur, Malaysia****Tel:** +60 3 4270 3880**Fax:** +60 3 4270 3811**Yokohama, Japan****Tel:** 81 45 476 5051**Fax:** 81 45 476 3055**Houston, TX, USA****Tel:** (713) 339-9600**Fax:** (713) 339-9601**Toll Free:** 1-800-475-0011**Barcelona, Spain****Tel:** +34 932 724 424**Fax:** +34 932 154 256**Düsseldorf, Germany****Tel:** +49 211 577933 0**Fax:** +49 211 577933 11**Cairo, Egypt****Tel:** +20 2 720 0824**Fax:** +20 2 702 0289**Seoul, Korea****Tel:** 82 2 3453 3144 5**Fax:** 82 2 3453 9772

2.3.3 Agents

International Innotech, Inc. <i>Katy, USA</i>	Tel: (281) 492-2774 Fax: (281) 492-8144
International Innotech, Inc. <i>Beijing, China</i>	Tel: 86 10 6499 3956 Fax: 86 10 6499 3957
International Innotech <i>Taipei, Taiwan</i>	Tel: 886 2 809 6704 Fax: 886 2 809 3095
KBTECH Ltda. <i>Bogota, Colombia</i>	Tel: 57 1 258 44 50 Fax: 57 1 258 44 50
India PVT Ltd <i>Pune, India</i>	Tel: 91 020 5510141 Fax: 91 020 5510069
Logichem Process <i>Johannesburg, South Africa</i>	Tel: 27 11 465 3800 Fax: 27 11 465 4548
Process Solutions Pty. Ltd. <i>Peregian, Australia</i>	Tel: 61 7 544 81 355 Fax: 61 7 544 81 644
Protech Engineering <i>Bratislava, Slovak Republic</i>	Tel: +421 7 4488 8286 Fax: +421 7 4488 8286
PT. Danan Wingus Sakti <i>Jakarta, Indonesia</i>	Tel: 62 21 567 4573 75/62 21 567 4508 10 Fax: 62 21 567 4507/62 21 568 3081
Ranchero Services (Thailand) Co. Ltd. <i>Bangkok, Thailand</i>	Tel: 66 2 381 1020 Fax: 66 2 381 1209
S.C. Chempetrol Service srl <i>Bucharest, Romania</i>	Tel: +401 330 0125 Fax: +401 311 3463
Soteica De Mexico <i>Mexico D.F., Mexico</i>	Tel: 52 5 546 5440 Fax: 52 5 535 6610
Soteica Do Brasil <i>Sao Paulo, Brazil</i>	Tel: 55 11 533 2381 Fax: 55 11 556 10746
Soteica S.R.L. <i>Buenos Aires, Argentina</i>	Tel: 54 11 4555 5703 Fax: 54 11 4551 0751
Soteiven C.A. <i>Caracas, Venezuela</i>	Tel: 58 2 264 1873 Fax: 58 2 265 9509
ZAO Techneftechim <i>Moscow, Russia</i>	Tel: +7 095 202 4370 Fax: +7 095 202 4370

Internet

Web site: www.hyprotech.com

E-mail: info@hyprotech.com

3 Installing HYSYS

3.1 Basic Requirements

System Component	Requirement
Operating System	Microsoft Windows 2000/NT 4.0/98/95
Disk Space	Approximately 90 MB of free disk space is required.
Serial Port	The green security key is used with the standalone version of HYSYS and can only be attached to a serial communications port of the computer running the application (do not plug in a serial mouse behind the security key).
Parallel Port	SLM keys are white Sentinel SuperPro keys, manufactured by Rainbow Technologies. The Computer ID key is installed on the parallel port (printer port) of your computer. An arrow indicates which end should be plugged into the computer. This is the new key that is used for both Standalone and Network versions of HYSYS.
Monitor/Video	Minimum usable: SVGA (800x600). Recommended: SVGA (1024x768).
Mouse	Required. Note that a mouse cannot be plugged into the back of the green serial port key used with the "standalone" version of HYSYS.

3.2 Installing HYSYS

The following instructions are written assuming installation on Windows 2000/NT 4.0 or Windows 95/98.

1. Shut down all other operating Windows programs on the computer before starting the installation process.
2. Insert the HYSYS software CD into the CD-ROM drive of the computer.

Note that for computers which have the CD-ROM **Autorun** feature enabled, steps #3 and #4 will be automatically performed.

For instructions on installing the PIPESYS extension refer to [Section 2.3 - Installing PIPESYS](#) of the PIPESYS Reference Manual.

3. From the **Start Menu**, select **Run**
4. In the **Run** dialog box, type: **d:\setup.exe** and click on the **OK** button (where d: corresponds to the drive letter of the CD-ROM drive).
5. Select 'HYSYS' or 'License Server' to install either of these products. If you are installing HYSYS continue with the following steps. For more information about installing the license server refer to [Section 4.2.4 - Network Licensing](#) of the Version 2.4 Update Manual.

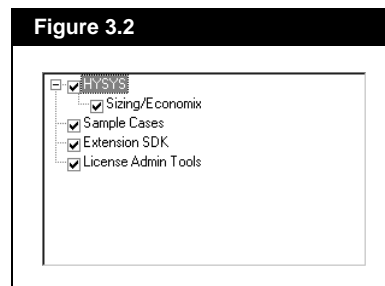
Figure 3.1



6. The first dialog that appears welcomes you to the installation program and displays the name of the application you are trying to install. If all of the information is correct click the **Next** button.
7. The following dialog provides information regarding Hyprotech's new software security system. Please read the information presented on this screen it is important. Click the **Next** button to continue.

8. Specify a destination folder where the setup will install the HYSYS files. If you do not wish to install the application in the default directory use the **Browse** button to specify the new path. When the information is correct click the **Next** button.
9. Select the Setup Type you would like to use to install the application. You are given three choices: Typical, Compact and Custom.

Custom allows you to choose the options you want to install. There are four options and one sub option:



- HYSYS - Installs the main HYSYS application files. If you do not have this option active you will not be able to run HYSYS.
 - Sizing/Economix - Installs the HYSYS.Economix features.
- Sample Cases - Installs the HYSYS sample cases with the application.
- Extension SDK - Installs the HYSYS extension tools with the application.
- License Admin Tools - Installs the license administration tools required when using network licenses (refer to the next chapter for information on the software licensing). You do not require this option if you have standalone licenses.

When the information is correct click the **Next** button.

10. Select the name of the Program Folder that will appear in the Windows Start menu. Click **Next** to continue

The message 'Searching for Network Licenses...' will then be displayed. The installation program is searching your sub-network for a license server. If a license server is not found the application will assume that you are running a standalone version of HYSYS and would like to install the license file on your computer.

11. You are then given two options: installing local licenses or not installing any licenses.

To install local licenses select the Yes, install local license radio button, click **Next** and proceed to [step 12](#).

For more information regarding the Software License Manager and license servers refer to [Chapter 4 - Software Licensing](#) of the Version 2.4 Update Manual.

To install no licenses at this time select the No, install with no licenses radio button, click **Next** and proceed to [step 13](#).

Note, you will not be able to run HYSYS without a license file. If you choose not to install a license file at this time you can refer to [Chapter 4 - Software Licensing](#) of the Version 2.4 Update Manual for information on installing your license file.

12. From the Windows file browser select the location of your license file and click **Open**. By default your license file is located on the floppy disk sent to you with your HYSYS software.
13. The installation program will then allow you to review the information that you have provided. If all of the information is correct click the **Next** button. HYSYS will then begin installing files to your computer.
14. Click **Finish** to complete the installation.

3.2.1 HYSYS Installation to a Network Server

The following discussion is optional.

If HYSYS is to be run on a relatively large number of computers, it may be advantageous to install the software on a network server rather than on individual computer hard disks.

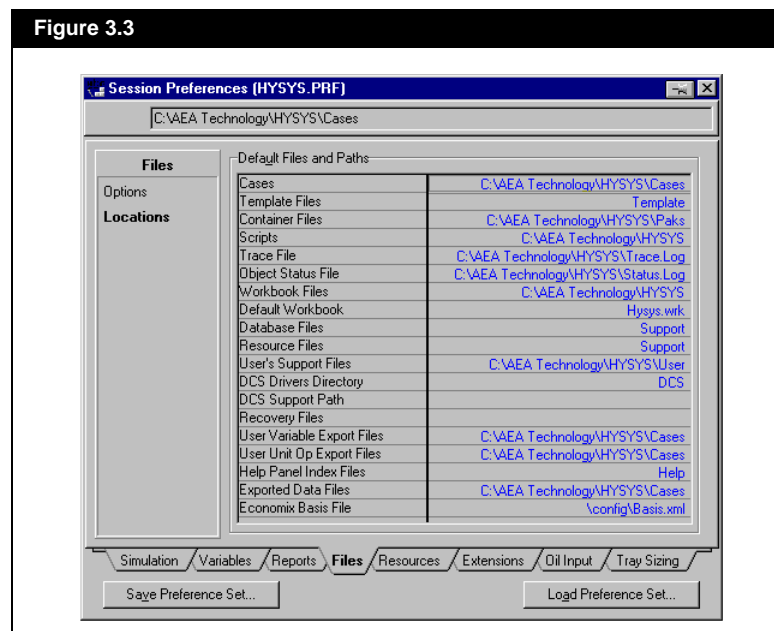
The disadvantage of installing the software on a network server is that HYSYS startup will be slower as the program is loaded over the network from the hard disk of the server into the memory on the local computer.

Installing HYSYS onto a server follows exactly the same process as outlined in the previous section. Simply choose the network drive instead of the local drive when on the **Select Components** screen. To prevent accidental modification or deletion of files, it is recommended that HYSYS users be allowed read-only access to the software. Each HYSYS user should then configure an individual preferences file as follows and store that file on their local hard disk (or write-enabled network drive).

To run HYSYS on users' computers,

1. Create a short-cut to HYSYS.EXE (on the desktop or in the **Start** menu).
2. Set the **Start In** directory to a directory on the local hard disk (e.g. C:\Program Files\Hyprotech\HYSYS 2.3 Build 3854). On startup, HYSYS will search this directory for the user's preferences file (HYSYS.PRF).
3. In this directory, create the subdirectories **CASES**, **PAKS** and **USER**.
4. Register the strgxi2.dll, located in the following directory c:\program files\common files\hyprotech\shared\, using Regsvr32.exe. The Regsvr32.exe is located in the HYSYS root directory.
5. Start HYSYS and, from the menu bar, select **Tools**, then **Preferences**.
6. Go to the **Files** tab of the **Session Preferences** view and select **Locations**.
7. Configure the **Default Files and Paths** as is shown in the accompanying **Figure 3.3**. These are suggestions only and some modification may be required depending on the circumstances.

Figure 3.3



8. Select the **Save Preference Set** button, and direct the file save operation to the HYSYS working directory on the local disk.

4 Software Licensing

4.1 Glossary of Terms

Term	Description
License	Permission granted to program/application/component to use a specific feature.
License Code	An encrypted alphanumeric text string used to define a single licensed feature. Each code is locked to a hardware key (SLM key or Green Key).
License File	File containing license codes for the specific features licensed to the user.
Standalone License	License granted is local to the user's machine.
Network License	License granted/obtained is from a network license server.
Network License Server	Program/service running on a computer that is attached to the Local Area Network (LAN). This grants licenses to the application that is running on network user machines.
Hardware Key	Physical hardware device used to secure licenses (also referred to a 'dongle' or 'key').
SLM	Software License Manager.

4.2 Licensing

4.2.1 Overview

Standard Licensing

Standard licensing is based on setting a specific limit of users that are licensed to use a certain application. In Standard mode, one license is consumed per feature, thus decreasing the available licenses for that feature by one. For example, a customer with 10 network licenses for application A, and 5 network licenses for application B, can simultaneously run up to 10 copies of application A and up to 5 copies of application B. When a user closes a copy of the application, the license is released back to the license server allowing other users access to that application.

Optionally, a system administrator can customise this process by setting the license server to issue specific licenses only to specific users. See [Section 4.5 - User Options](#) for more information.

Licenses can also be mixed between standalone and network computers (refer to [Section - License Modes](#)). The Software License Manager will always look for a standalone license first; if a standalone license is not found, it searches for an available network license.

License Modes

There are two modes that can be used to license Hyprotech applications: Standalone licensing and Network licensing.

Standalone licensing is configured so that both the application and the licenses are installed on a single computer. This kind of configuration is most often used when the application is only used by an individual on a particular computer. Refer to [Section 4.2.3 - Standalone Licensing](#) to configure the application to run with Standalone licenses.

Network licensing is configured so that the application is installed on a user's computer and the licenses are installed on a network license server. The license server consists of a file of network license codes and the license server application. The license server is used to issue all of the license codes. Refer to [Section 4.2.4 - Network Licensing](#) to configure the application to run with Network licenses.

4.2.2 Installing the Hardware Key

Both the standalone and network licensing modes of the application require the use of a hardware key. A unique locking identity is read from the hardware key and is used to generate license codes needed to run the software. This identity locks the hardware key to the licenses. When the application runs, the locking codes must then match the hardware key's identifier for the licenses to be valid.

Please note that to avoid damage to the computer or key, the computer should be shut down before adding or removing the key.

Key Types

Software License Manager Keys

Software License Manager keys (or SLM keys) are white Sentinel SuperPro keys, manufactured by Rainbow Technologies. The SLM key is installed on the parallel port (printer port) of your computer. An arrow indicates which end should be plugged into the computer.

SLM keys can be used for both standalone and network licensing. Note that network licensing requires that a SLM key be installed on machines that will be used as license servers (refer to [Section - Setting up a Network License Server](#) for additional information). Standalone licensing requires a SLM key to be installed on every machine that will be running the application.

DO NOT PLACE THIS KEY IN THE SERIAL PORT, YOU WILL DAMAGE YOUR COMPUTER

Any computer using the SLM key requires certain drivers to talk to the key. If you are having problems with your licensing, ensure that these drivers are installed on your computer by running the setup.exe program found in the Driver directory on the included CD.

Hyprotech Green Keys

Hyprotech green keys are installed into either a 9-pin or 25-pin serial port of your computer. The arrow on the label of the green key must point towards the computer.

Hyprotech green keys can only be used for standalone licensing of the software. Standalone licensing requires that a key is installed on every machine that will be running the application.

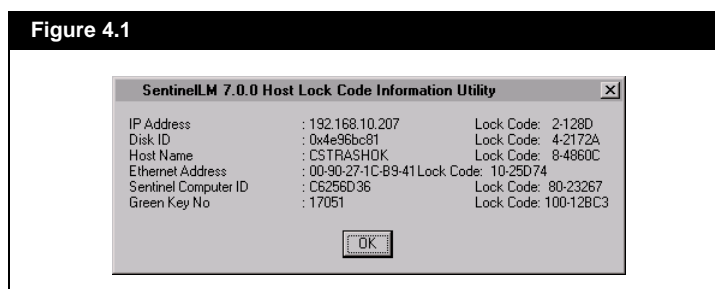
DO NOT PLACE THIS KEY IN THE PARALLEL PORT YOU WILL DAMAGE YOUR COMPUTER

Echoid32

The echoid32 application can be run to ensure that your key has been installed properly and your computer can communicate with the key. The application is located in the following directory.

C:\Program File\Common Files\Hyprotech\SLM Admin Tools

When the application is run the following window will appear displaying the serial number and locking code of your IP Address, Disk ID, Host Name, Ethernet Address and either the Sentinel Computer ID key or the Green Key No.



If you cannot see the serial number and locking code for either the Sentinel Computer ID key or the Green Key No make sure that the key is properly installed on your computer and run the application again.

A text version, echoid32.txt, of this display is also produced in this directory when this application is run. This provides you with an easy way of sending Hyprotech your key information if the need every arises.

4.2.3 Standalone Licensing

Once the application and the hardware key have been installed on your computer, you need to install the license file. The license file contains all of the license codes specifying all licensed features of the application(s).

Software Leases\Purchases\Upgrades

If you are upgrading your software, you will find included in your package a software CD and a floppy disk (or e-mail) containing a license file locked to your existing standalone green key. If you have newly leased or purchased your software, you will receive a SLM key in addition to a floppy disk or e-mail containing your license file.

The license file name is in the following format:

Lservr_XXX_lockcode (or serial number for a green key).AEALIC where XXX is the locking criteria.

During the software installation, you will be asked to point to the directory or floppy disk containing your license file. The installer then automatically configures your software. If you do not have the license file, you may continue with the installation and perform the following steps in the future:

1. Copy the license file from the floppy disk (or e-mail) to the following directory: C:\Program Files\Common Files\Hyprotech\Shared.
2. Change the extension of the license file from 'AEALIC' to 'LIC'.

For future license upgrades you will be sent a new license file, with the extension 'AEALIC', containing your new licenses. To install the new licenses, simply double click the new license file and licenses will automatically be installed in the proper place.

4.2.4 Network Licensing

Network licensing is configured so that each user must install the software on their computer and the license file containing the license codes are installed on a network computer that will act as the network license server.

The new SLM network security and the old network security systems are *not* compatible. The SLM security system must *not* be installed on the same computer as the old network security system.

Setting up a Network License Server

A network license server computer is made up of the following components.

- SLM key (refer to the [Section 4.2.2 - Installing the Hardware Key](#)).
- License Server software - follow the steps outlined below to install the network License Server on your network license server computer.
- Network License file containing network license codes.

Multiple license server computers can be configured to spread the licensing load. This can also be used as a simple effective form of redundancy.

Because the network license server computer must be operational for the network users to run their applications, the best choice for the license server computer is one that is always running. The most trouble-free installation will result from a license server computer used only for the license server function. This avoids conflicts with other software.

Installing the License Server

The following instructions are written under the assumption that installation will occur on Windows NT 4.0 (SP 5) or Windows 95/98. We currently do not support Windows ME or Windows 2000 as license servers.

The network key previously used by Hyprotech is incompatible with the SLM. Therefore, you must exchange your existing network keys for a SLM key. When you receive the SLM key, you must send your existing network key(s) back to Hyprotech. When this key is received by Hyprotech, a new license file will be sent to you that is set to expire 30 calendar days (one month) after the expiration date of your lease.

The license file that is initially sent with the software will expire in 60 calendar days. Please return the old network key to Hyprotech within 60 calendar days to receive a new license file used to replace this temporary license file.

Please use the following steps to exchange your key and install the license server.

You can have both the old security and new security running on different computers during the 60 calendar day exchange period. To install the new security on a computer that is clean of the old security follow the steps stated to the right starting with step 5.

1. Shut down the old network security server. Ensure that no users are logged into the server.
2. Uninstall the old network security server software.
3. Shut down the computer and replace the old network key with the new SLM key.
4. Restart the computer.
5. Ensure that no Windows programs are running on the computer before starting the network license server installation process.
6. Insert the software CD into the CD-ROM drive of the computer.

Note that for computers which have the CD-ROM **Autorun** feature enabled, steps #7 and #8 are automatically performed. Some Hyprotech products may have variants on the way the installation of Network License Server software is initiated.

7. From the **Start Menu**, select **Run**.
8. In the **Run** dialog box, type: **d:\Server\setup\setup.exe** and click on the **OK** button (where d: corresponds to the drive letter of the CD-ROM drive).
9. From the window that appears click 'License Server' to start the installation.
10. Follow the on-screen instructions to proceed with installation.

Installing System Drivers

1. Insert the software CD into the CD-ROM drive of the computer.
2. Browse the CD. Open the Driver folder.
3. Depending on which operating system you are using open the appropriate folder. For Windows 95/98 open the win_9x folder and for Windows NT open the win_nt folder.
4. Run the application that is located in this folder. For Windows 95/98 double click the sentw9x.exe icon and for Windows NT double click the setupx86.ex icon.
5. From the Functions menu select Install Sentinel Driver.

Software Leases\Purchases\Upgrades

When you have leased or purchased your software for use with a network license, you will find included in your package a software CD, a SLM key and a floppy disk (or e-mail) with the license file locked to the SLM key. Copy the license file from the floppy disk (or e-mail) to the SLM license server directory. The default SLM license server directory is:

C:\Program Files\Rainbow Technologies\sentLM\Server

Once you have copied the license file to the SLM license server directory, you must rename the file to 'LSERVRC' (no file extension). Then you must **stop and re-start** the license system server. This is done differently depending on the operating system you are using and is explained below.

*Ensure that you **stop and re-start** the license server whenever you change your license file.*

All users must exit any software using the SLM before a restart is performed.

Operating System	Description
Windows NT 4.0 (SP 5+)	The license server controls are accessed by double-clicking on the Services icon found in the Control Panel. The license server is seen in the list as SentinelLM. To stop the server, highlight SentinelLM and click on the Stop button. To re-start the server, click on the Start button.
Windows 95/98	The license server has its own window running that allows you to access the license server controls.

Now that you have the proper license codes in place, see the next section on setting your network users computer's system environment variable to point to your license server.

4.3 Licensing Environment Variables

With a Network license, there are a number of options you can set to control its operation.

If you choose to set any of the environment variables, and you are unfamiliar with the system tools for Windows NT 4.0, use the following steps:

1. On your workstation click the **Start** menu. Select **Settings**, and then select **Control Panel**.
2. Double-click on the **System** icon to open the **System Properties** window.
3. Select the **Environment** tab.
4. In the **Variable** text box, enter the name of the environment variable as **LSHOST**.
5. In the **Value** text box enter the IP address or hostname of the server(s).
6. Click the **Set** button.
7. If you do not need to set any more variables, click **OK** to exit the System Properties.

4.3.1 LSForceHost/LSHost

When the application is started, it first tries to identify a standalone license. If there is no standalone license, it will then attempt to obtain a license by searching for license servers over the network. This broadcast search is limited to the user's local network subnet. If the License Server is located outside the user's local subnet, then the IP address/hostname of the server must be specified to the remote network license server for the Hyprotech application(s) to establish a connection.

There are three ways you can specify the connection to the proper license server. The following lists the steps Hyprotech applications take to look for a license server:

- If the **LSFORCEHOST** environment variable is set, the application looks for the specific license server host listed in that variable. If it cannot find that computer, an error message is displayed, and the application closes.

Note the lhost file does not have a file name extension attached to it and capitalization does not matter. If you choose to use this file you must place it in the application root directory.

Note if you are using a network system where the DNS is variable, then you cannot use the IP address for this purpose.

- If no **LSFORCEHOST** environment variable is set, then the application looks for the **LSHOST** environment variable. If this variable has been set, then the application looks for any of the license server hosts listed.
- If **LSFORCEHOST** and **LSHOST** are not set, then a check is made for a file with the name **lshost** in the application root directory. If this file is found, then the application looks for any of the license server hosts listed in the file.

The LSHOST variable naming conventions are:

- Any valid hostname recognized by your network.
- Numeric names (IP address).
- **NO_NET** to disable the default network broadcast mechanism from searching the network for any other network license server. Only your local computer will be checked for license file and key

LSFORCEHOST

The **LSFORCEHOST** environment variable is used to force the application to look for a single license server computer. If the license server specified cannot be found, the application stops searching and returns an error. **LSFORCEHOST** overrides an **LSHOST** environment variable or an **lshost** file, and disables the network broadcast search for servers.

LSFORCEHOST is used by all Sentinel License Manager protected products; as such its use could interfere with the security used by other applications also protected using Sentinel Computer ID keys. Please use LSFORCEHOST only with discretion and care.

LSHOST

The **LSHOST** environment variable is used to tell the application to search for one or more license servers. When this variable is set, the application attempts to contact each server in the list beginning with the first license server in the list. If none of the specified license servers is found, the application stops searching and returns an error. **LSHOST** disables the network broadcast search for servers.

Note when using multiple server names on the same line you need to separate the names, in both the environment variable string and "lshost" file, with a colon (:).

The **lshost** file works the same way as the LSHOST environment variable. The following is an example of an **lshost** file.

Figure 4.2

```
# This is a generic lshost file
# Created June 20, 2000

TESTSERV_1
TESTSERV_2:TESTSERV_3:#TESTSERV_4
TESTSERV_5
```

This file searches for TESTSERV_1, TESTSERV_2, TESTSERV_3, and TESTSERV_5, in that order. Notice that TESTSERV_4 has been commented out. Anything that follows a number/hash symbol (#) is treated as a comment.

4.3.2 LSERVOPTS

The LSERVOPTS variable is used to set network license server options. Note that this variable is set as a **System** variable and not a local user environment variable. The procedure for setting up this variable is the same as outlined at the beginning of this section, however you must place the cursor in the System Variables group before clicking the **Set** button. The options for this variable are found in the following table.

Option	Description
-s license file	Specifies the name and location of the license code file. By default, the license server uses the file, lservrc , in the local directory. This can also be specified by the LSERVRC environment variable.
-e license configuration file	Specifies the name and location of the optional license configuration file. This can also be specified by the LSERVRC CNF environment variable.
-l usage log file	Enables usage logging by specifying the name and location of the usage log file (note you can <i>not</i> include any spaces in the path name). A typical log file name is lserv.log . By default, usage logging is disabled.

Some of the options that can be set with LSERVOPTS can be set with a specific environment variable. It is recommended that the specific environment variable be used whenever possible.

Option	Description
-z usage log file size	Specifies the maximum size of the usage file. The default value for the maximum size of the log file is 1 megabyte. The size can be specified in bytes, kilobytes, or megabytes. For example, -z 2000 means 2000 bytes, -z 2k means 2 kilobytes and -z 2m means 2 megabytes. Once the maximum size of the file is reached, the license server creates a backup log file (unless the -x option has been used). The maximum number of backup files is 99. However you can move existing backup log files to another directory and the license server begins logging again.
-x	By default—on overflow of the usage log file—the file contents are moved into a backup file. New usage records are then written to the original file until it overflows again. If the -x option is specified, the file will <i>not</i> be backed up on overflow. Instead the license server will simply stop writing further records to the file.
-com percentage	Commuter licensing uses the same license codes as other network licenses. To ensure that not all license codes are used up by the commuter, set this option to the percentage of license codes you want used for commuter licensing. Once that percentage of codes are used up, no more will be made available to commuters until commuter licenses are returned.
-rlf redundant license file	Starts the license server as a redundant license server using the specified redundant license file. You do not need to use this option to start the license server as a redundant license server if a lservrlf redundant license file is in the same directory as the license server.
-lfe encryption level	Specifies the level of encryption that license transactions are written to in the licenses server log file. The levels are 1 to 4: <ul style="list-style-type: none"> • 1 - No encryption. • 2 - No encryption. Transaction data is readable, but tampering with or deleting an entry is detected by lsusage. This is the default encryption level. • 3 - Encrypt usage only. Transaction data is readable except for license usage data. Such entries are not displayed by lsusage. • 4 - Encrypt entire record. All transaction data for the license code is encrypted. Such entries are not displayed by lsusage.
-f error file	Specifies the name and location of the error file where the license server logs occurrences of unexpected conditions. By default, this is disabled until the option is specified. Then the license server appends the lservlog file in the current directory.
-u group reservations file	Specifies the name and location of the optional group reservations file. By default, the license server uses the lsreserv file in the current directory.

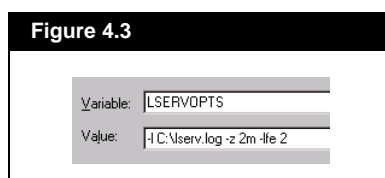
Setting Usage Logging

If you activate the usage logging option, the network license server records all license requests and returns in this file. Usage reports can be viewed by using the **lsusage** tool (refer to [Section 4.4.3 - Lsusage](#) on how to view the log file). Information is recorded in the file one entry per line in the following format.

Element	Description
Server-LFE	User-defined log file encryption level as specified by the license server <code>-lfe</code> option.
License-LFE	Vendor-defined log file encryption level. If this is non-zero, it overrides the Server-LFE.
Date	The date the entry was made.
Time-Stamp	The time stamp of the entry.
Feature	Name of the feature.
Ver	Version of the feature.
Trans	The transaction type. 0 indicates an issue, 1 a denial, and 2 a release.
NumKeys	The number of licenses in use after the current request/release. (Encrypted if encryption level is set to 3 or 4.)
Keylife	Length of time the license was issued (measured in seconds). Only applicable after a license release.
User	The user name of the application associated with the entry.
Host	The host name of the application associated with the entry.
LSver	The version of the license server.
Currency	The number of licenses handled during the transaction. (Encrypted if encryption level is set to 3 or 4.)
Comment	The text passed in by the protected application.

Example

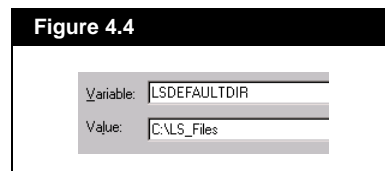
The following example creates a usage log file with a maximum size of 2 megabytes and level 2 encryption. When entering the path and name of the log file, there can be **NO** spaces and quotes are not required.



4.3.3 LSDEFAULTDIR

The `LSDEFAULTDIR` environment variable can be used to set the default location of the license file. It's recommended that the license server default directory *not* be changed. The default directory is located in the same directory as the license server executable.

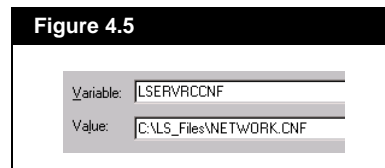
Example



4.3.4 LSERVCCNF

The `LSERVCCNF` environment variable can be used to set the name and location of the network license server configuration file. This file is used in setting up user alerts and other options. It is recommended that the default name and location are used for this file. In most installations, this file is called `lservc.cnf` and resides in the license server default directory. If `LSERVCCNF` is not used to specify the configuration file, then the name and location of this file will be based upon the name and location of the license code file. In this case, the configuration file resides in the same directory as the license code file and has the same base name as the license code file but with the extension `.cnf`.

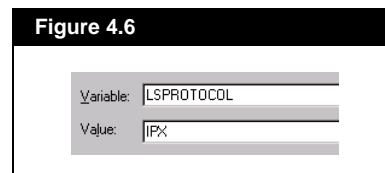
Example



4.3.5 LSPROTOCOL

The `LSPROTOCOL` environment variable is used to specify the communications protocol that is used to communicate with the network license server. Specify `IPX` or `UDP` (for TCP/IP) to choose the protocol.

Example



4.4 License Server Tools

All of the license server tools are located in the following directory:

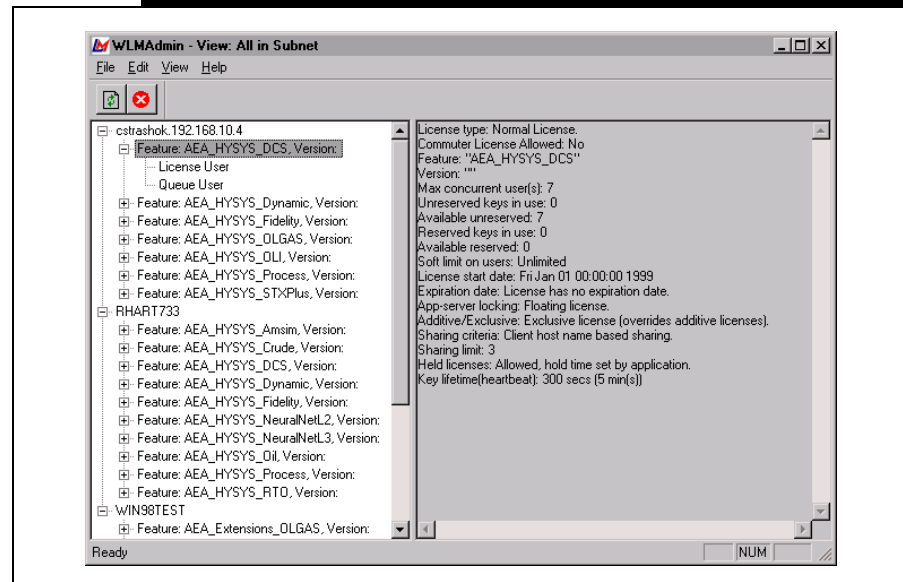
C:\Program Files\Common Files\Hyprotech\SLM Admin Tools

4.4.1 WLMAdmin

WLMAdmin is a network administration tool that provides you with information on licensing activities, such as license servers detected, detail on active licenses, and information on licensed users. Running the **WLMAdmin** application opens the following window.

Note that when you first open WLMAdmin you will see a blank screen. From then on, WLMAdmin will start up with the view mode that was last used.

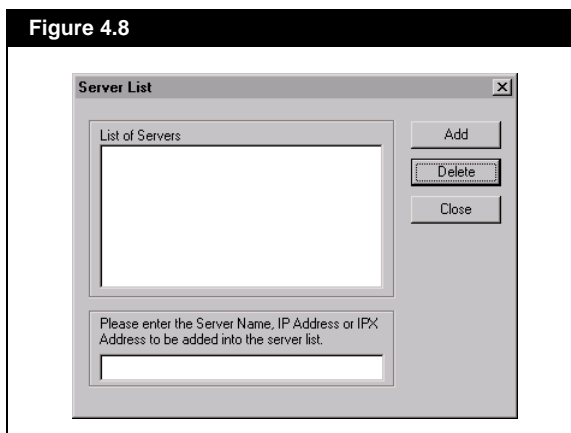
Figure 4.7



The **View** menu provides three ways to query license servers:

- **Single Server** - allows you to specify the host name, IP address or IPX address of a single license server.

- **Server List** - allows you to create a list of license servers you would like to view. The list is created by choosing the **Server List** option from the **Edit** menu. You will see the following window.



Specify the host name, IP address or IPX address of the license server in to the text box and click **Add**. You can add as many servers as you want. To delete a license server from the list highlight the server and click **Delete**. Click **Close** when you are done.

- **All in Subnet** - lists all of the license servers found on your area of the network. This option may be slow since WLMAAdmin searches the entire subnet.

The list located in the left frame displays all of the **license servers** that could be found on the network. Beneath the license server name is a list of the all the **licenses** associated with that license server.

As you can see in [Figure 4.7](#) highlighting a license displays information on the characteristics of the license in the right frame. You will see information such as:

- license type,
- how many concurrent users can use the license,
- when the license expires,
- which users are currently using the license, and
- whether or not the license can be used for commuter licensing.

Clicking on the user name located under the license user heading displays information about that user in the right frame.

Option	Description
Change distribution criteria	For this license, change how its licenses are distributed among the redundant license servers. When you select this command, you see a text box where you can type the new distribution criteria. Use the following format: <i>Server1:licenses1^Server2:license2...</i> where <i>Server</i> is the host name, IP address or IPX address that identifies the redundant license server and <i>licenses</i> is the number of licenses to allocate to that server.
Get distribution criteria	See how the license licenses are currently distributed. This is the dynamic allocation, not the initial allocation set in the redundant license file. You see a list of the license servers. Each server is followed by three numbers, where the first number is the number of licenses allocated, the second number is the licenses in use, and the third number is commuter licenses in use.
Disable borrowing	For this particular license, disables license borrowing for this license server only.
Enable borrowing	For this particular license, enables license borrowing for this license server only.

4.4.2 Lsmon

Lsmon is a command line utility that retrieves information about all features currently licensed by the license server and the clients using those features. The following option may be supplied:

Option	Description
Server-host	The name of the computer that the license server is running.

If **Server-host** is omitted, **lsmon** will attempt to talk to the license server on the computer indicated in the **LSHOST** environment variable or in the **LSHOST** file. If the variable or file does not exist, then it will attempt to contact a license server using the broadcast mechanism. If **lsmon** fails to find a license server, you will receive an error message and the utility will exit.

4.4.3 Lsusage

Lsusage is a command line utility that displays a summary of application usage, providing information on license transactions contained in the license server usage file. At the command line, enter the name and path of the **lsusage logfile**. Where logfile is the name you have given to the log file. The log file displays the following information.

Element	Description
Feature name/Version	Identifies the license for which this entry was made.
%age Denied	The percentage of requests for this license that were denied (usually because the hard limit of the license had already been reached).
%age Issued	The percentage of requests for this license that were granted.
Ttl Keys Issued	The number of licenses for this license that were issued.
%age Queued granted	The percentage of queued license requests that were granted.
%age Qreq.	The percentage of license requests that were placed in the license queue. (License requests are queued only if license queuing is enabled for this license.)
Min. App. Duration	The minimum number of minutes the application for this license was in use.
Avg. App. Duration	The average number of minutes the application for this license was in use.
Max. App. Duration	The maximum number of minutes the application for this license was in use.
LOG REPORT FOR Sessions: x	The session numbers for this license server that were logged in this file.

4.4.4 Ipxecho

Displays the IPX network address. When using the IPX network protocol, the license server host name must be the IPX address of the computer on which the license server resides. The address is returned in the form of four hexadecimal bytes (network-node address) followed by six hexadecimal bytes (IPX-address).

4.4.5 Lswhere

Lswhere is a command line utility used to display the network names of the computers running the license server. By default the address of the computer that the license server is running, as well as its host name, is displayed. You can specify the following options:

Option	Description
-d	Displays details on the license servers found on the network. This is the default setting.
-r	Displays just the IP or IPX addresses of the license servers found on the network.

4.5 User Options

4.5.1 Setting Group Reservations

Group reservations allows you to associate user groups with each feature and reserving for each group a pool containing a certain number of licenses. Any licenses not specifically reserved fall into the general pool.

A group specification consists of the following:

- the name of the feature for which the reservation applies,
- the name of the group,
- the number of licenses reserved for that group, and
- the login names of users or host IDs of computers that belong to that group.

The groups must be mutually exclusive. Different groups for the same feature should not have common users or computers. The number of licenses reserved for a feature cannot exceed the number of concurrent copies specified in the license code for that feature.

When the license server receives a request, it checks whether the user making the request belongs to a group. If so, and licenses are available for that group, the license server issues the license(s) and removes it from that group's pool. Otherwise, requests are serviced with licenses from the general pool until no licenses are available.

The characters \$ and ! have special meaning. \$ indicates the computer name, and ! indicates a logical NOT.

Group reservations should be entered according to the following format, with one group per line:

```
feature_name[,ver ]:group_name:num_of_licenses:{ user_name |
computer}
```

One or more user_name and/or computer may be specified, but at least one value must be specified in the last field. The version number is optional. If no version number is specified, only the feature name is used.

4.6 Troubleshooting

This section is designed to give you answers to some of the common problems encountered when setting up your licensing software. Please work through the following checklists if you encounter any problems. If you have gone through the checklist and you still have problems, contact your local technical support centre as outlined in the Introduction chapter.

Port /ID Key Problems

If you run the echiod32 application and no lock code is displayed, ensure that the SLM key is properly attached to the computer (refer to [Section 4.2.2 - Installing the Hardware Key](#)).

If your key is properly attached to the server and still no lock code is displayed, ensure that you have installed the sentinel system drivers used by the server to communicate with the SLM key. Refer to [Section 4.2.4 - Network Licensing](#) for information on installing the system drivers.

If you still cannot communicate with your key then either the port is dead or the key is dead. To test if the port is working properly connecting a printer or other device to the port. If you do not have a device to attach to the port you can also try installing the software on another computer.

Network Problems

If your server cannot be located using the WLMAAdmin tool then review the following checklist:

- Have you installed the license server software on the server (refer to [Section 4.2.4 - Network Licensing](#))
- Check that the server is running. If the server is not running, start the server as explained in [Section 4.2.4 - Network Licensing](#).
- Check that the LSHOST or LSFORCEHOST environment variable is not set to NO_NET (refer to [Section 4.3.1 - LSForceHost/LSHost](#)).
- If the server is not on the same sub-net try specifying the IP address of the server.
- Check that there is no problem with your network. Ensure that your workstation and server machines can communicate properly.

If you cannot connect to the server but you can see the server using WLMAAdmin then review the following checklist:

- If license server is outside of your sub-network, you need to set the LSHOST environment variable to point to that server (refer to [Section 4.3.1 - LSForceHost/LSHost](#)).
- Check that the host name or IP address that you specified for the LSHOST or LSFORCEHOST environment variable is entered correctly (refer to [Section 4.3.1 - LSForceHost/LSHost](#)).
- Check that the LSHOST or LSFORCEHOST environment variable is not set to NO_NET (refer to [Section 4.3.1 - LSForceHost/LSHost](#)).

License Server Problems

If the license server can be located using WLMAAdmin and the license file is in the correct place but you do not see any licenses, or you see the wrong licenses then review the following checklist:

- Have you entered that the correct server in the LSHOST or LSFORCEHOST environment variable (refer to [Section 4.3.1 - LSForceHost/LSHost](#)).
- Did you stop and re-start your license server after installing the licenses on your server as described in [Section 4.2.4 - Network Licensing](#).

If you still can not see the licenses you require, you may not have purchased those licenses. If this is the case, contact your sales representative about purchasing the needed licenses.

Common Error Messages

"6. This feature is node locked but the request for a key came from a machine other than the host running the SentinelLM server" usually occurs with "Unable to check out license"

- Meaning: License for this product or feature was found but the locking information couldn't be authenticated; i.e. the license file was located but the lock code in the file couldn't match any of the "lock nodes" (security key or other hardware containing lock code) available.
- Possible causes: the key / port is not functioning; either the key or the lock code in the license file are wrong (ie. the 2 are not matched); the license file was generated for a standalone installation and is being used on a key server computer

"18. No such feature recognized by server"

- License for this product or feature could not be found; either the license file could not be located or the license file does not contain authorization for the required product or feature (if this is a network installation, this could be confirmed by running WLMAAdmin and checking which licenses are available from the key server)

5 Get Started

The **Get Started** section gives a quick introduction to HYSYS by recalling a saved case and illustrating how to manoeuvre around HYSYS.

5.1 Starting HYSYS

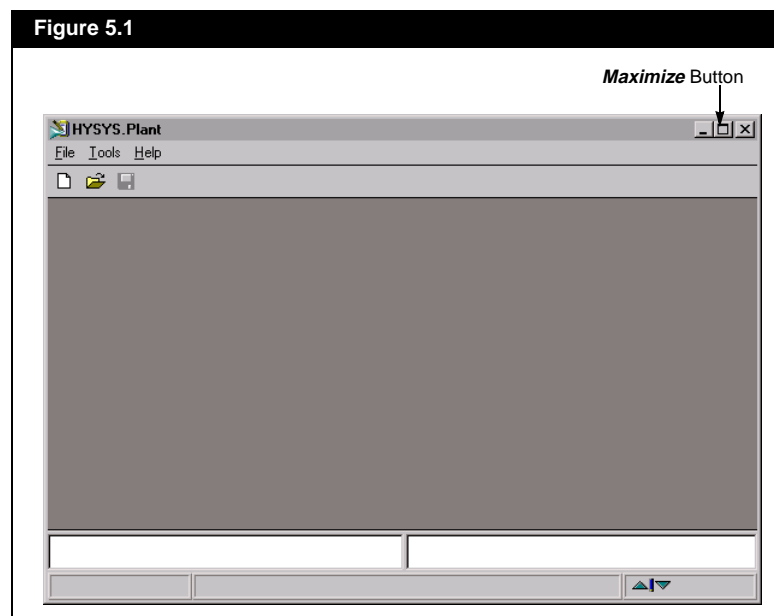
To start HYSYS:

1. Select the **Start** menu in Windows.
2. Move from **Programs** to **AEA Technology** to **HYSYS**.
3. Select **HYSYS**.



Now you are ready to begin working with HYSYS. **Get Started!**

After you start HYSYS, the HYSYS Desktop will appear:

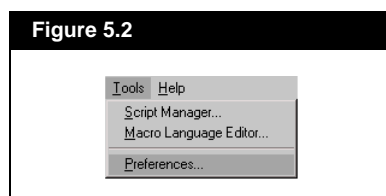


Note that this view has been resized; your Desktop view should appear larger than this when initially opened. To re-size the view, click and drag the outside border. To make the view full size, click the *Maximize* button in the upper right hand corner.

Before opening the pre-built **Get Started** case, you should choose the HYSYS unit set used for displaying information. You can check your current unit set by accessing the **Session Preferences**:

1. Select **Tools-Preferences** from the menu, and the **Session Preferences** view will open.

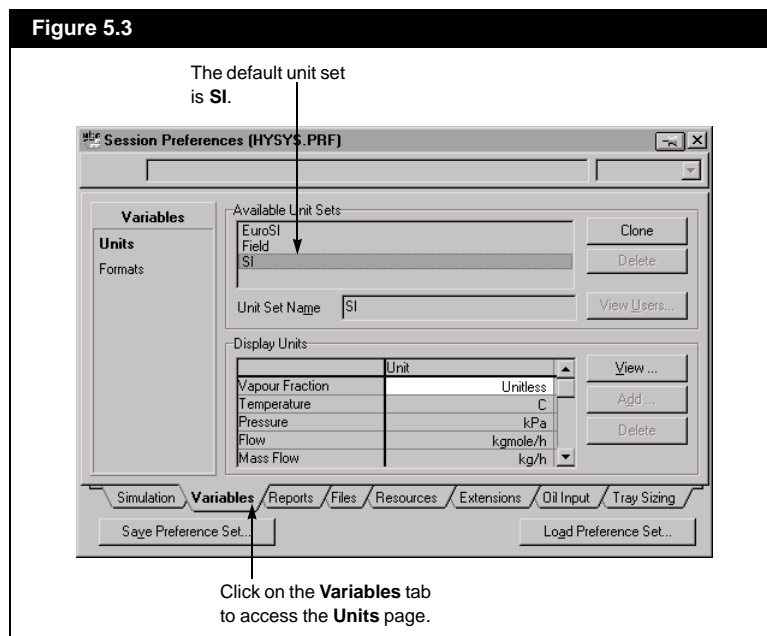
Figure 5.2



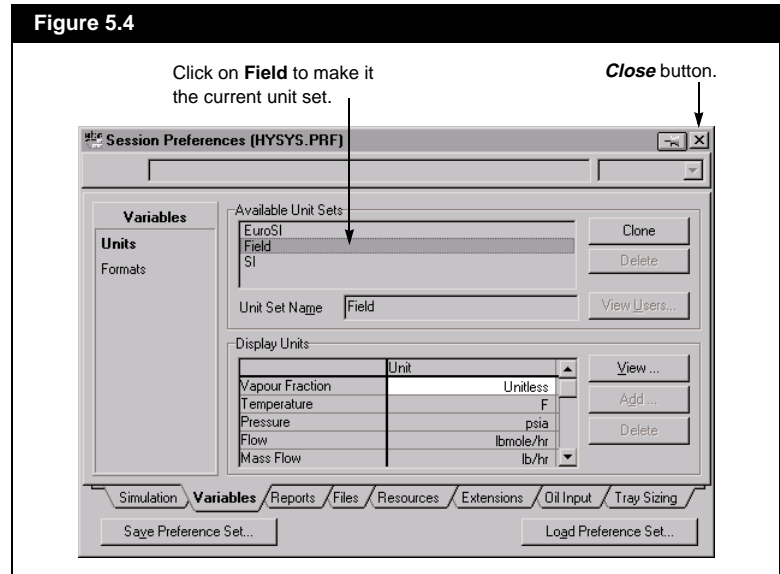
2. Move to the **Units** page of the **Variables** tab.

The **Current Unit Set** is shown highlighted in the list of **Available Unit Sets**. The HYSYS default is **SI**; however the Get Started example has been developed in **Field** units.

Figure 5.3



3. Click on **Field** to make it the **Current Unit Set**.



4. Click the *Close* button to close the **Session Preferences** view.

Recalling the Simulation Case from Memory

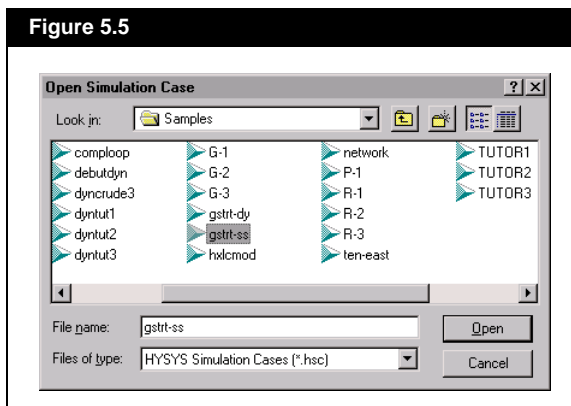
Included with your HYSYS package are a number of pre-built simulation cases, located in the **SAMPLES** subdirectory of the HYSYS root directory. One of these cases is named **gstrt-ss.hsc** and is the example used for this **Get Started** example. To load the case:

1. Do **one** of the following:
 - Click the **Open Case** button on the button bar.
 - Select **File-Open-Case** from the menu.
 - Press **CTRL+O**.



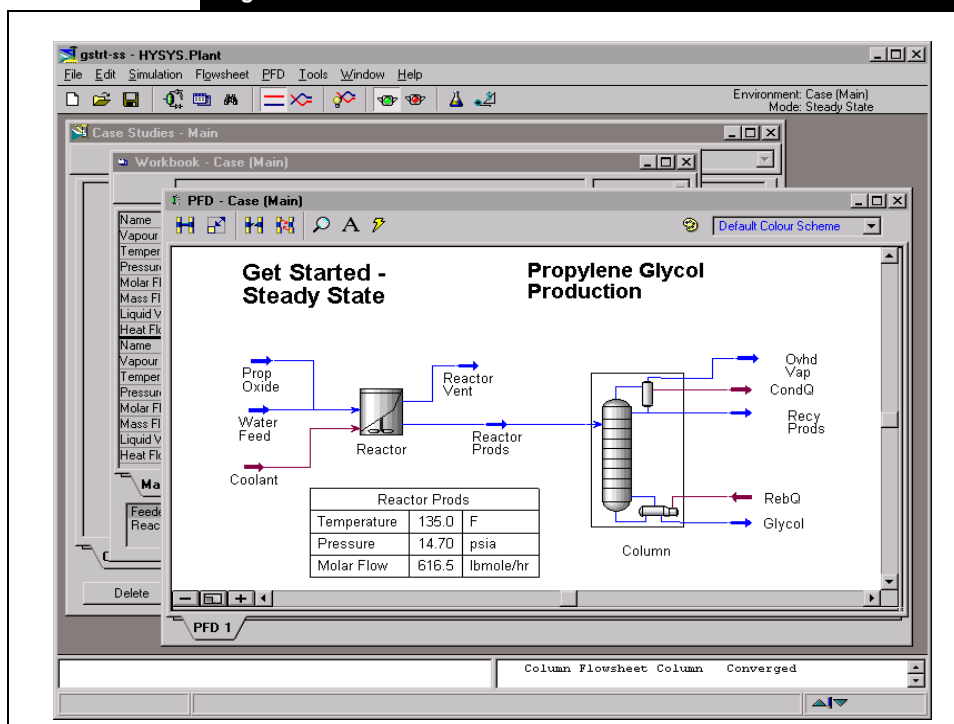
Open Case Button

The Open Simulation Case dialog will appear.



2. Open the **Samples** subdirectory and scroll through the list of files until **gstrt-ss.hsc** is visible.
3. Click on **gstrt-ss.hsc**, then click the **Open** button. The pre-built simulation case will appear on your Desktop.

Figure 5.6



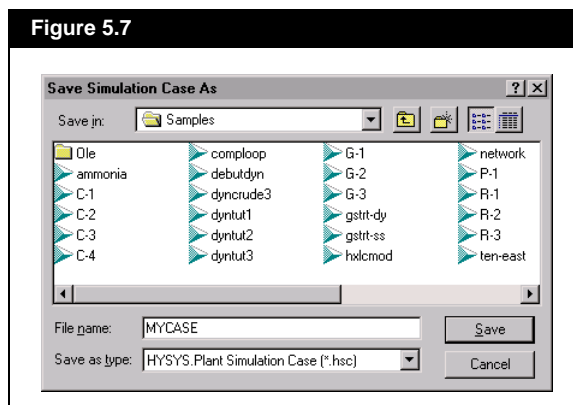
Saving the Case Under a New Name

Before working with this case, you should save it using a new name to ensure that the original file remains intact.

1. Do **one** of the following:
 - Select **File-Save As** from the menu.
 - Press **CTRL+SHIFT+S**

The **Save Simulation Case As** dialog box will become visible.

2. Type a new name, for example **MYCASE**, in the **File name** cell. Note that you do not have to enter the **.HSC** extension; HYSYS will add it automatically.



3. Click the **Save** button, and HYSYS will save your case with the new name.

5.2 Steady State Case

This Steady State simulation models the production of propylene glycol. Using a continuously-stirred-tank reactor (CSTR), propylene oxide and water are reacted at atmospheric pressure. The reaction is exothermic, so a coolant is circulated to the reactor to maintain its temperature. The reactor effluent, consisting of propylene glycol and unreacted feed, is fed to a distillation column. In the column, 99.5 mol% glycol is produced from the bottoms, while unreacted propylene oxide and water are recovered overhead.



The Steady State - Dynamic toggle in the button bar indicates that you are currently in Steady State.

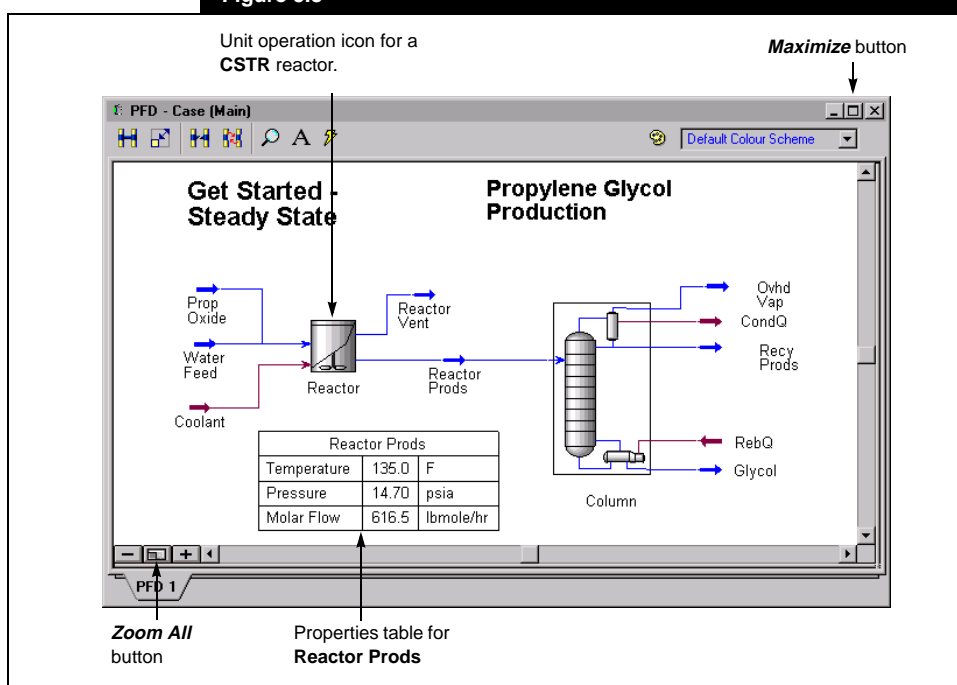
Three windows, or views, are currently displayed on the HYSYS Desktop. Each view is identified by its title at the top of the view. The

current active view is the PFD, which is a graphical representation of the process flowsheet. The PFD shows:

- The streams and unit operations, represented by symbols (called icons), in the flowsheet.
- The connectivity amongst the streams and unit operations.
- A property tables for the **Reactor Prods** stream

If you wish, you can re-size the PFD view to make it more readable.

Figure 5.8



1. Do one of the following:
 - Click and drag the outside order to the new size.
 - Click the **Maximize** button in the upper right corner of the view.
2. Click the **Zoom All** button to zoom-in on all items in the PFD, filling the resized view.

Prop Oxide	
75.00	F
14.70	psia
163.8	lbmole/hr

Stream Fly-By

You can display summary information for a particular object (stream or operation) simply by placing the cursor over the object's icon. For example, position the cursor over the icon for stream **Prop Oxide**. A fly-by view will appear at the cursor tip, showing the stream temperature, pressure and molar flow.

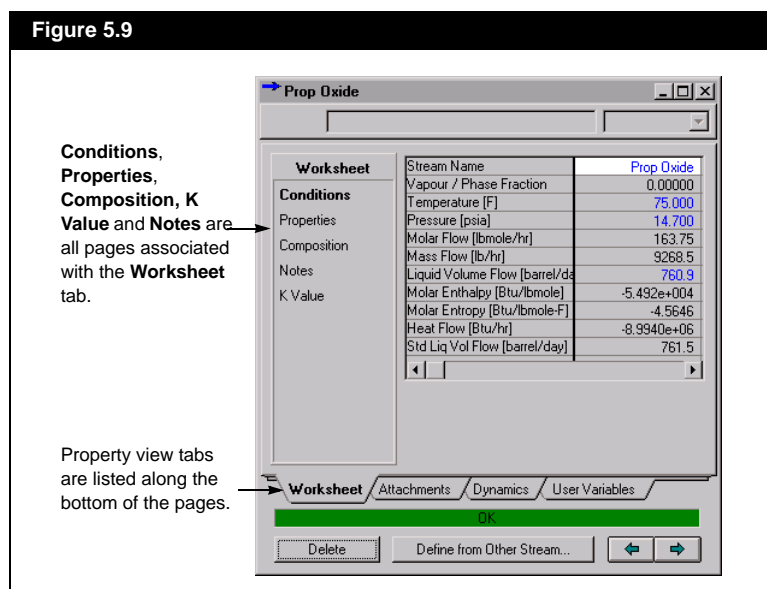
Accessing Stream Information from the PFD

Every stream and operation (object) contained in a HYSYS simulation has its own Property View, which contains multiple tabs and related pages of information or properties describing the object. You can access the Property View for a stream directly from the PFD by simply double-clicking on the stream icon.

Prop Oxide →

Prop Oxide Icon

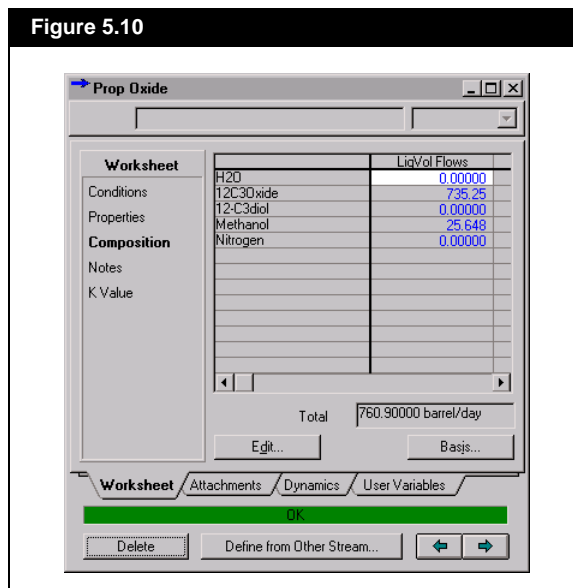
For example, open the property view for one of the streams entering the reactor. Double-click on **Prop Oxide** icon on the PFD. The property view for **Prop Oxide** is shown in [Figure 5.9](#):



When an object's property view is initially opened, it displays the first page on the first tab of the view. For the **Material Stream** property view, the first tab is the **Worksheet** tab; its first page is the **Conditions** page. Tabs are listed along the bottom of an object's view. Each tab has associated pages that are listed in the column on the left-hand side of the view, under the tab name. Change the page or tab by selecting the object with the cursor. The **Conditions** page of the **Worksheet** tab gives the basic conditions of the stream: the vapour fraction, temperature, pressure, material flows and heat flow (enthalpy).

Move to the **Composition** page by selecting **Composition** in the left-hand column of the view. This page displays the material composition of the stream. In this case, five components are displayed along with the liquid volume flow for each component. You can display the

composition on another basis, such as mass or molar fraction, by clicking the *Basis* button.



The remaining property view tabs and their associated pages are:

Attachments Tab

- **Unit Ops Page** - Lists the unit operation(s) to which the stream is attached.
- **Utilities Page** - Allows you to create and attach utilities to the stream.

Dynamics Tab

- **Specs Page** - Applicable only in **Dynamic** mode. You activate dynamic specifications on this page.

User Variables Tab

- Lets you write and attach code as a User Variable to extend the functionality of your stream.



Close Button

Once you have finished examining the stream properties, close the view using the *Close* button in the upper right hand corner of the view. The next time you open the property view, it will open to the last page that you accessed before closing the view.

Using the Workbook to Change a Stream Temperature

Select the *Workbook* button from the HYSYS button bar to change the current view to the Workbook.



Workbook Button

Figure 5.11

The screenshot shows the 'Workbook - Case (Main)' window with a table of stream properties. The table is divided into two sections. The first section lists properties for 'Prop Oxide', 'Water Feed', 'Reactor Vent', and 'Reactor Prods'. The second section lists properties for 'Ovhd Vap', 'Recy Prods', and 'Glycol'. Below the table, there are tabs for 'Material Streams', 'Compositions', 'Energy Streams', and 'Unit Ops'. A vertical scroll arrow is visible on the right side of the table.

Name	Prop Oxide	Water Feed	Reactor Vent	Reactor Prods
Vapour Fraction	0.0000	0.0000	1.0000	0.0000
Temperature [F]	75.00	75.00	135.0	135.0
Pressure [psia]	14.70	14.70	14.70	14.70
Molar Flow [lbmole/hr]	163.8	600.0	0.0000	616.5
Mass Flow [lb/hr]	9269	1.081e+04	0.0000	2.008e+04
Liquid Volume Flow [barrel/day]	760.9	741.6	0.0000	1357
Heat Flow [Btu/hr]	-8.994e+06	-7.368e+07	0.0000	-8.743e+07

Name	Ovhd Vap	Recy Prods	Glycol	** New **
Vapour Fraction	1.0000	0.0000	0.0000	
Temperature [F]	160.9	160.9	367.3	
Pressure [psia]	14.70	14.70	14.70	
Molar Flow [lbmole/hr]	4.721e-07	468.4	148.0	
Mass Flow [lb/hr]	2.075e-05	8856	1.122e+04	
Liquid Volume Flow [barrel/day]	1.667e-06	618.4	738.7	
Heat Flow [Btu/hr]	0.0000	5.609e+07	7.914e+07	

Material Streams | Compositions | Energy Streams | Unit Ops

FeederBlock_Prop Oxide
Reactor

Include Sub-Flowsheets
 Show Name Only
Number of Hidden Objects: 0

Lists the unit operations to which the stream is attached. Vertical scroll arrow.

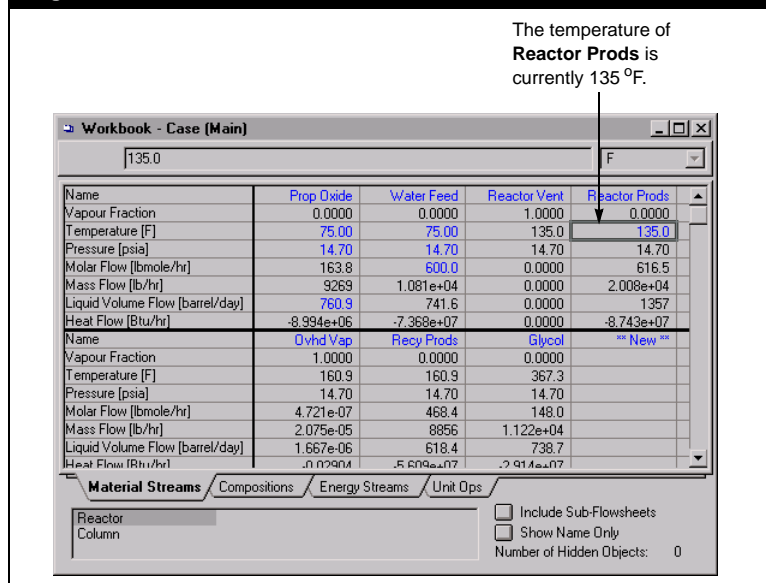
The **Workbook** view displays tabular information pertaining to the streams and unit operations in the simulation. You can also add, delete or modify streams and unit operations in the Workbook. The first tab of the Workbook, **Material Streams**, displays for each stream the same information that is available on the **Conditions** page of the stream property view. You can view the streams that are not currently visible by re-sizing the view, or by clicking repeatedly on the vertical scroll arrow.

The remaining **Workbook** tabs include:

- **Compositions** - displays the composition of each material stream.
- **Energy Streams** - displays the name and heat flow of each energy stream.
- **Unit Ops** - lists summary information for all unit operations.

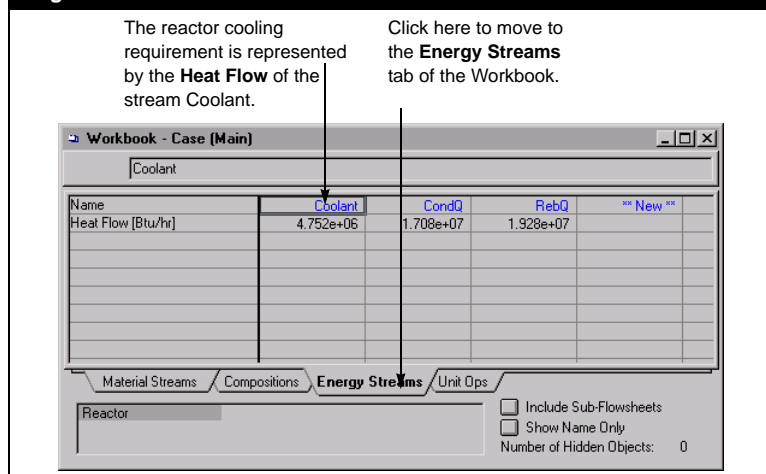
Suppose you want to investigate the amount of cooling required to maintain the reactor at certain temperatures. The reactor is currently operating at 135°F, which is the temperature of the product **Reactor Prods**.

Figure 5.12



To see the cooling requirement to achieve this temperature, move to the **Energy Streams** tab in the Workbook.

Figure 5.13



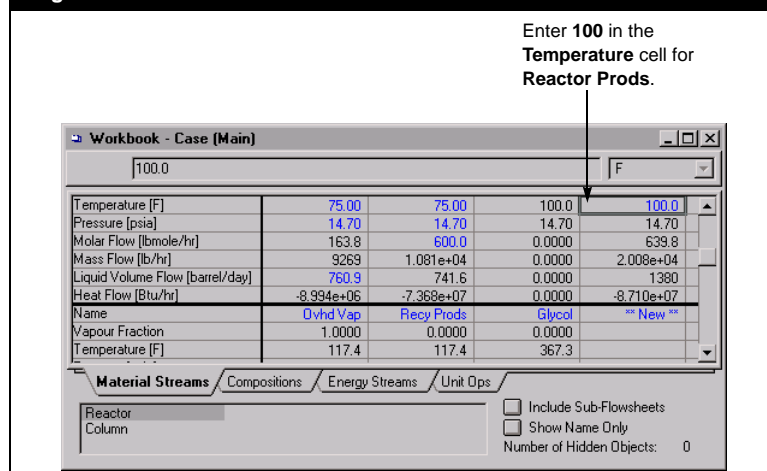
The cooling duty required to maintain the specified reactor temperature is **4.8 MMBtu/hr**, the **Heat Flow** of the energy stream **Coolant**. Check the cooling requirement for outlet temperatures of 100°F. The reactor temperature is set by the specification on the outlet stream **Reactor Prods**.

To specify the new separator temperature:

1. Return to the **Material Streams** tab in the Workbook by clicking on its tab.
2. Select the temperature cell for the **Reactor Prods** stream.
3. Type **100**, then press ENTER. HYSYS will automatically re-calculate the Flowsheet based on the new temperature.

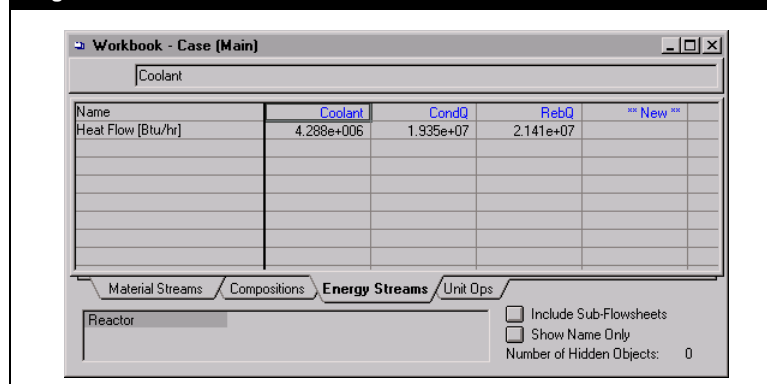
Workbook values shown in blue are user-specified. Values in black are calculated by HYSYS.

Figure 5.14



4. Return to the **Energy Streams** tab to see the re-calculated cooling requirement.

Figure 5.15



The temperature change has decreased the required cooling duty to 4.4 MMBTU/hr.

You might expect the cooling requirement to increase as the reactor temperature is lowered. However, the reaction has two attributes that dominate the reactor's heat balance:

1. The reaction produces heat proportional to the amount of reaction occurring.
2. Less reaction occurs at 100°F than at 135°F.

So by lowering the reactor temperature, less reaction is taking place and less heat is produced by the reaction. Therefore, less cooling is required.

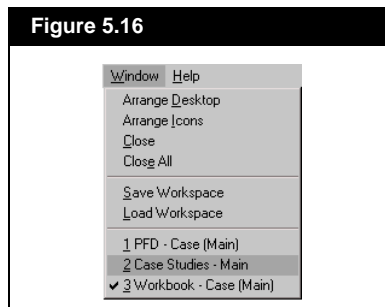
Suppose you want to examine the cooling duty at a number of other temperatures. Instead of repeating the above procedure for each new temperature, the HYSYS Case Study feature will automatically make changes and tabulate the results for you.

Using the Case Study

The third view open on your Desktop is the **Case Studies** view. To access this view,

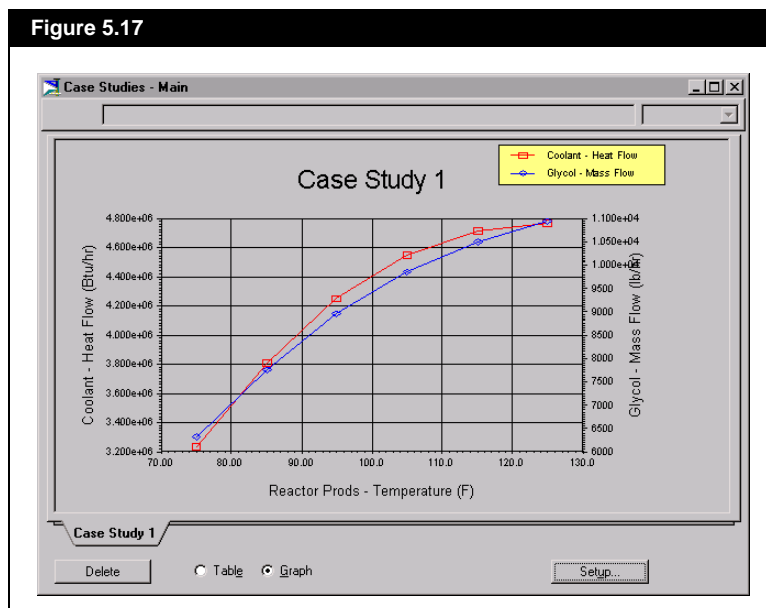
1. Select **Window** on the HYSYS menu bar to open the available menu. The three views that are currently open on the Desktop are listed at the bottom of the menu. A check mark indicates the view that currently has focus. In this case, it is the **Workbook** view.

Figure 5.16



2. Select **Case Studies - Main** from the menu to make it the active view. The case studies view is shown in [Figure 5.17](#):

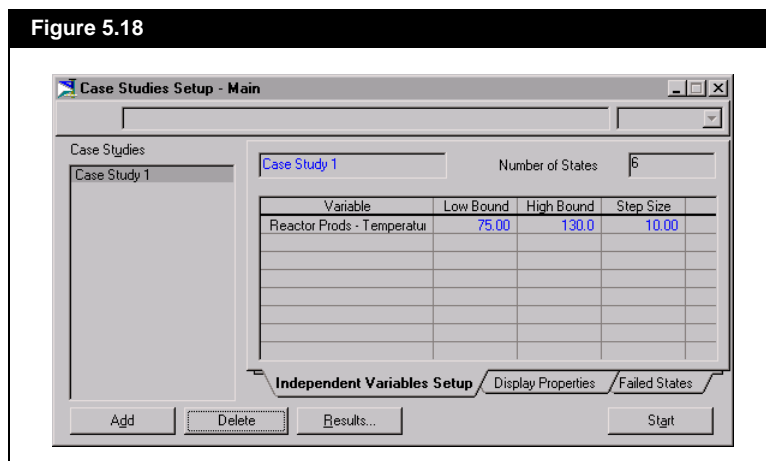
Figure 5.17



The **Case Studies** view shows a plot of the separator cooling duty and the **Glycol** stream molar flow rate (dependent variables) versus the separator temperature (independent variable).

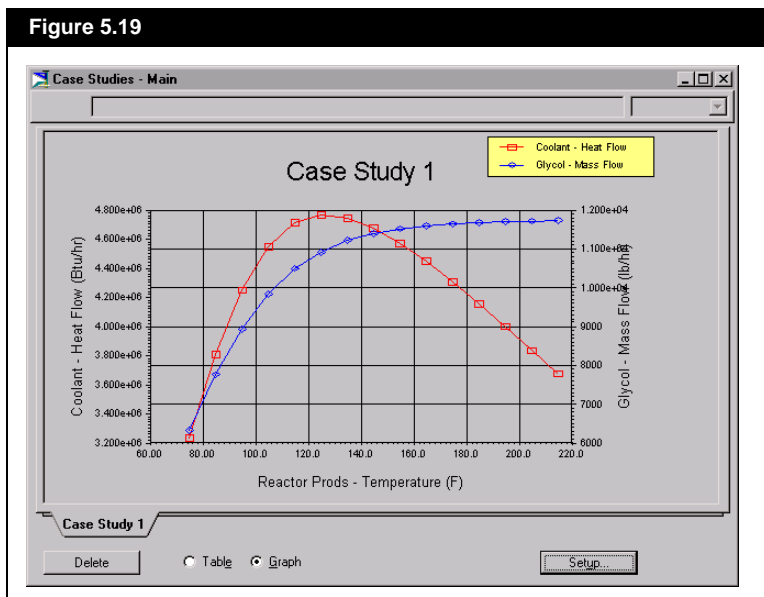
Case Study 1 has been configured to calculate and plot values over an independent Temperature range of 75°F to 130°F with an increment of 10°F. You may actually want to observe the results over a wider range. To change the bounds of the independent variable for the case study, select the **Setup** button at the bottom of the view. The **Case Studies Setup** view will open:

Figure 5.18



Leave the **Low Bound** as its value of 75 °F, and the **Step Size** as 10°F. Change the **High Bound** value to 215 °F. Click the **Start** button then the **Results** button on the **Case Studies Setup** view. HYSYS will begin calculations immediately, solving the Flowsheet at each temperature and plotting the results on the **Case Studies** view. When the Flowsheet has been solved at the final temperature of 215°F, calculations will stop automatically. The final **Case Studies** view is shown following.

Figure 5.19



The Case Study shows that the cooling requirement increases to its maximum value at approximately 125 °F and then decreases, while the glycol production rate increases over the entire temperature range.

You have now completed your first HYSYS simulation! You can save your case by doing **one** of the following:



Save Button

- Click the **Save** button on the HYSYS button bar.
- Select **File-Save** from the menu.
- Press **CTRL+S**.

You are now free to explore this case on your own. If you wish, you can quit HYSYS by doing **one** of the following:

- Select the **File-Exit** from the menu.
- Press **ALT+F4**
- Click the **Close** button in the right hand corner of the HYSYS window.

If you have made any changes to your case since the last time it was saved, HYSYS will prompt you to save before exiting.

This concludes the **Get Started** case. If you would like more help getting to know HYSYS, you are encouraged to proceed to the HYSYS Tutorials manual for a more in-depth look at building simulation cases.

Note that HYSYS.Process will not run the Dynamics Case. In order to continue with section 3.3, you must be running HYSYS.Plant.

5.3 Dynamics Case

The steady state section of this manual continues with the addition of a reactor control scheme in dynamics mode. To open the case,



Open Case Button

1. Do **one** of the following:
 - Click the **Open Case** button on the button bar.
 - Select **File-Open-Case** from the menu.
 - Click **CTRL+O**.

The **Open Simulation Case** dialog box will appear.

2. Open the **Samples** directory. Scroll through the list of files until **gstrt-dy.hsc** is visible.

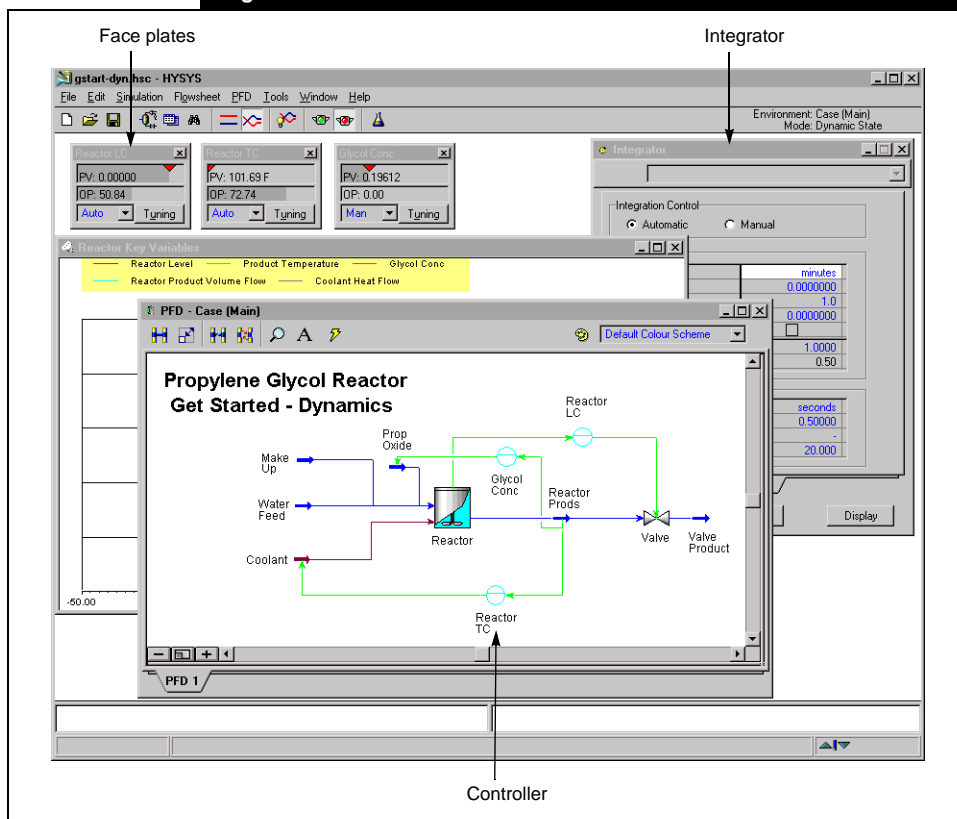
If the PFD is not open, you can open it by clicking the PFD button in the button bar.



PFD Button

- Click on `gstrt-dy.hsc`, then click **Open**. The pre-built simulation case will appear on the Desktop.

Figure 5.20



As with the Steady State case, you should save this case under a new name before making any changes.

- Do one of the following:
 - Select **File-Save As** from the menu.
 - Press **CTRL+SHIFT+S**

The **Save Simulation Case As** dialog box will appear.

- Type a new name, for example **MYCASE2**, in the **File Name** cell. Note again that you do not have to enter the **.HSC** extension; HYSYS will add it automatically.
- Click the **Save** button and HYSYS will save the simulation case under its new name.

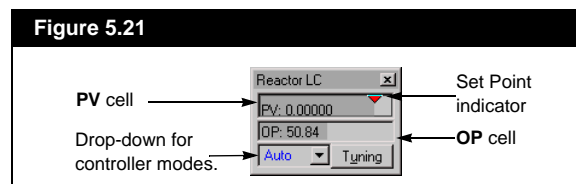
This case is a dynamic model of the propylene glycol reactor from the Steady State portion of Get Started. The PFD shows the control scheme for the reactor, which includes the following three controllers.

Controller	Action
Reactor LC	Controls the liquid level in the reactor by manipulating the reactor outlet flow.
Reactor TC	Maintains the reactor temperature by manipulating the coolant flow.
Glycol Conc	Controls the concentration of propylene glycol in the reactor outlet stream by manipulating the flow of the propylene oxide feed.

The face plates for these three controllers are open along the top of the Desktop. The face plates components are listed in the following table;

Face Plate Field	Description
PV Cell	The PV cell shows the current value of the Process Variable, or <i>controlled</i> variable. For example, the PV for the Reactor LC is the percent liquid level in the reactor. The current Set Point for the Process Variable is indicated by the red pointer on the top of the PV cell.
OP Cell	The OP cell displays the current value of the controller Output as a percentage.
Controller Mode Drop-Down	Provides a drop-down list of the available controller modes. Currently, two of the controllers are in Automatic mode and the third is in Manual mode.

The face plate for the **Reactor LC** (level controller) is shown in [Figure 5.21](#):



You can also start and stop dynamic calculations using the Integrator toggle buttons in the button bar.



The green button (left) starts the integrator. The red button stops it.

In addition to the PFD and controllers, two other views appear on the Desktop. They are:


- The **Integrator**, which lets you to start and stop dynamic calculations.
- The **Reactor Key Variables** view that is currently behind the PFD. To display this view, click on its title bar. The view is a customized HYSYS Strip Chart, on which the values of selected key variables will be plotted during dynamic calculations.

In **Dynamic** mode, HYSYS performs flowsheet calculations with each time step. Currently, the **Step Size** is 0.5 seconds, so HYSYS will perform Flowsheet calculations for every 0.5 seconds of real plant time.

In this example, the CSTR reactor will be set up from an empty condition using the following procedure:

1. Fill the vessel with water until the level set point is reached, at which time the **Reactor LC** controller will open the outlet control valve to maintain the level.
2. Slowly introduce propylene oxide into the reactor while observing:
 - The **Reactor TC** controller maintaining the reactor temperature
 - The concentration of propylene glycol in the product stream
3. Switch the **Glycol Conc** controller to automatic mode to maintain the product concentration at a specified set point.

Starting Dynamic Calculations

Switch to dynamics mode by clicking the Dynamics mode button  in the button bar. HYSYS will indicate that the dynamic assistant has identified items that need attention, click No.

Ensure that the **Reactor Key Variables** view is visible by clicking on its title bar. To begin, click the **Start** button on the **Integrator**. HYSYS will again indicate that the dynamic assistant has identified items that need attention, click No.

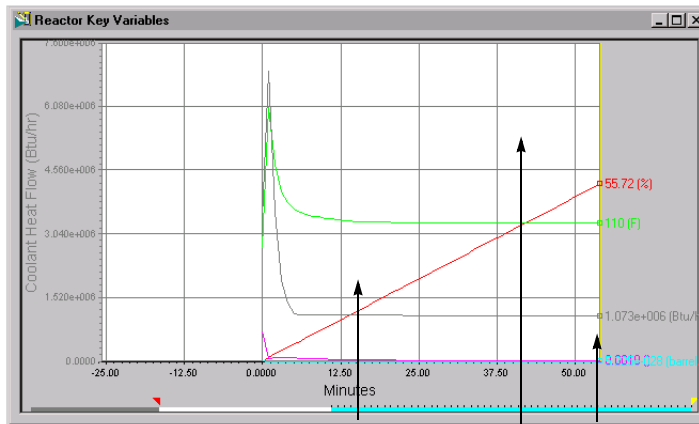
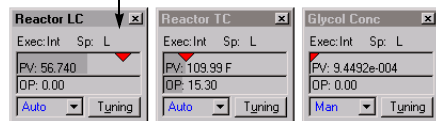
The reactor will begin to fill and the values of the process variables will immediately be displayed on the controllers and plotted on the strip chart. When the **Current Time** reaches about 55 minutes, click the **Stop** button.

Note that this case has been set up to run without any modifications from the dynamic assistant. However everything will still work if the changes are made.

The dynamic assistant can be toggled on/off in the preferences found under the Tools menu.

Figure 5.22

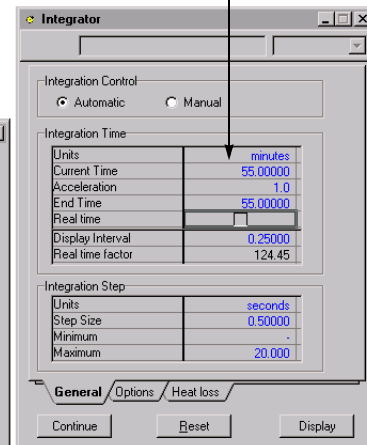
To check the current level set point, place the cursor over the Set Point Indicator. When the cursor changes to a double-headed arrow, click and hold the primary mouse button.



The rising vessel level is plotted on the Strip Chart and displayed in the **PV** cell of the **Reactor LC** controller

Coolant rate
Product temperature

The **Current Time** displays the real plant time.

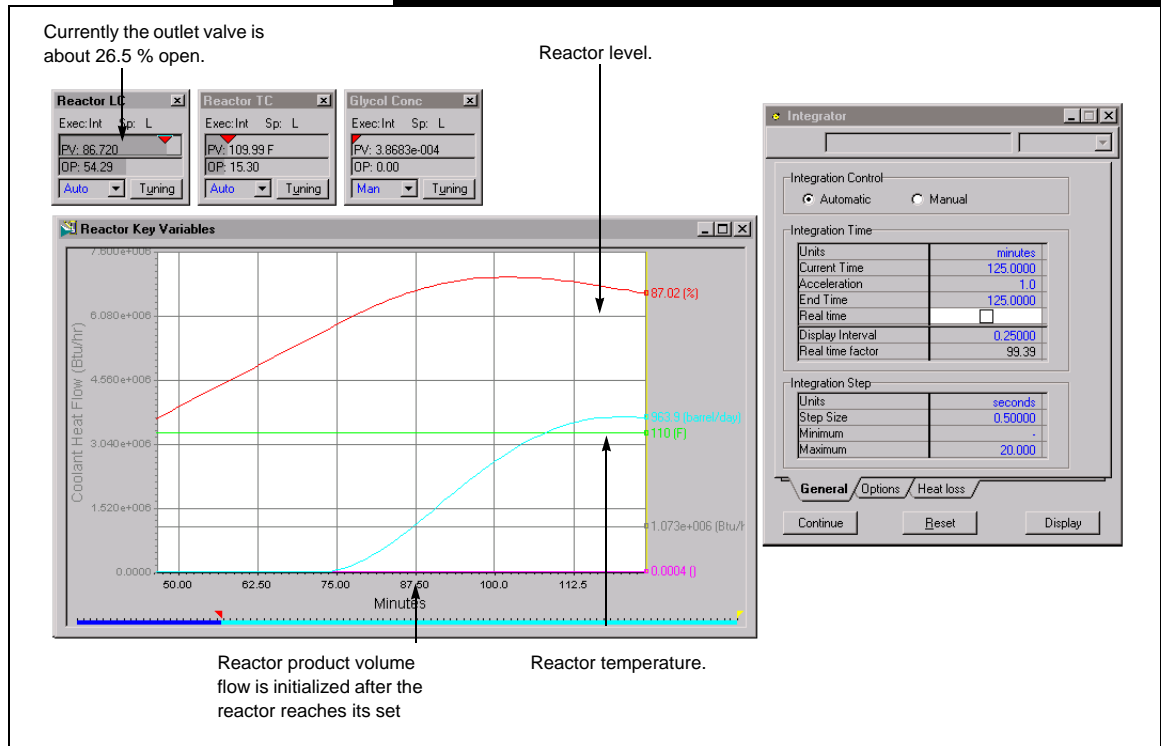


Notice that the reactor level rises linearly as the vessel fills to its set point of 85%.

If you want to reset dynamic calculations, click the **Reset** button on the **Integrator**. Then click the **Start** button to restart the calculations from zero. HYSYS will ask for confirmation before resetting the values.

Click the **Continue** button on the **Integrator**. As the reactor level approaches its set point, the **Reactor LC** controller will open the outlet valve to maintain the level. When the current time reaches approximately 125 minutes, click **Stop**.

Figure 5.23



Adding a Process Disturbance

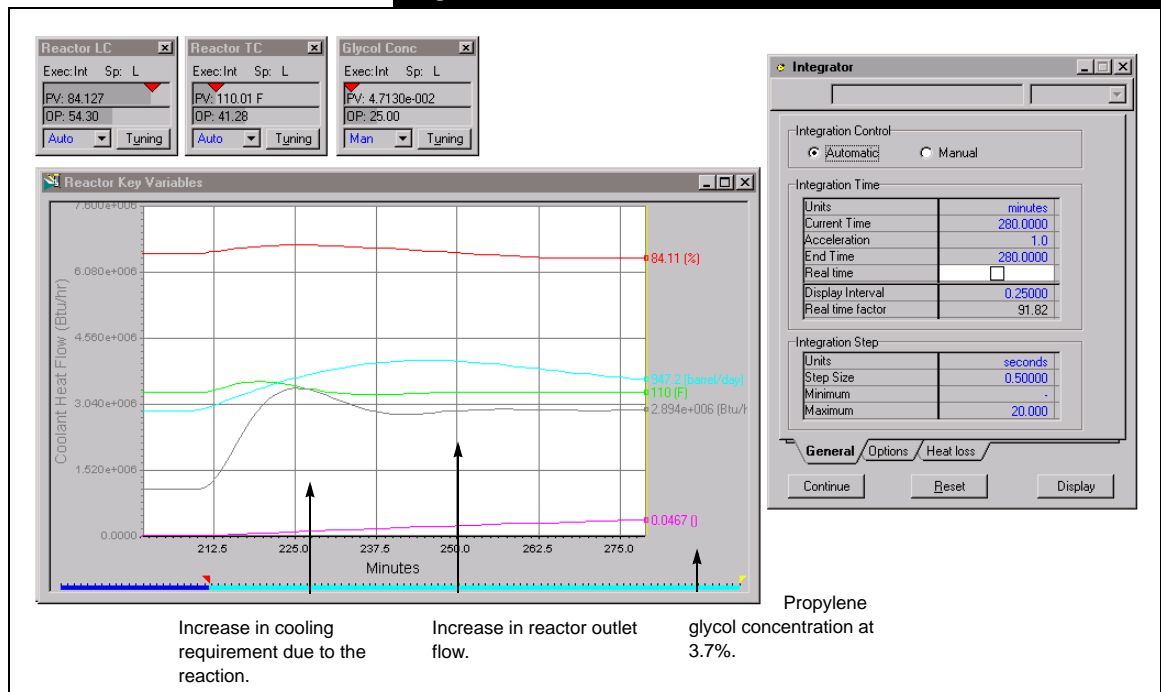
Click the *Continue* button of the *Integrator*. When the reactor level and product volume flows reach a steady state value, at about 200 minutes, click *Stop*. To add the disturbance, introduce some propylene oxide into the reactor by doing the following:

1. Double-click on the OP cell on the *Glycol Conc* controller face plate.
2. Type 25, then press ENTER. The control valve for the propylene oxide feed will open 25%.
3. Note the **Current Time** displayed on the *Integrator*.
4. Start the *Integrator* again.
5. After the **Current Time** has increased by about 70 minutes stop the *Integrator*.

As a result of the disturbance,

- The reactor temperature increases due to the exothermic reaction. The reactor coolant will increase in flow to maintain the reactor temperature at 110 °F.
- The outlet flow increases to maintain the reactor level because of the increased feed.
- The propylene glycol begins to appear in the product stream.

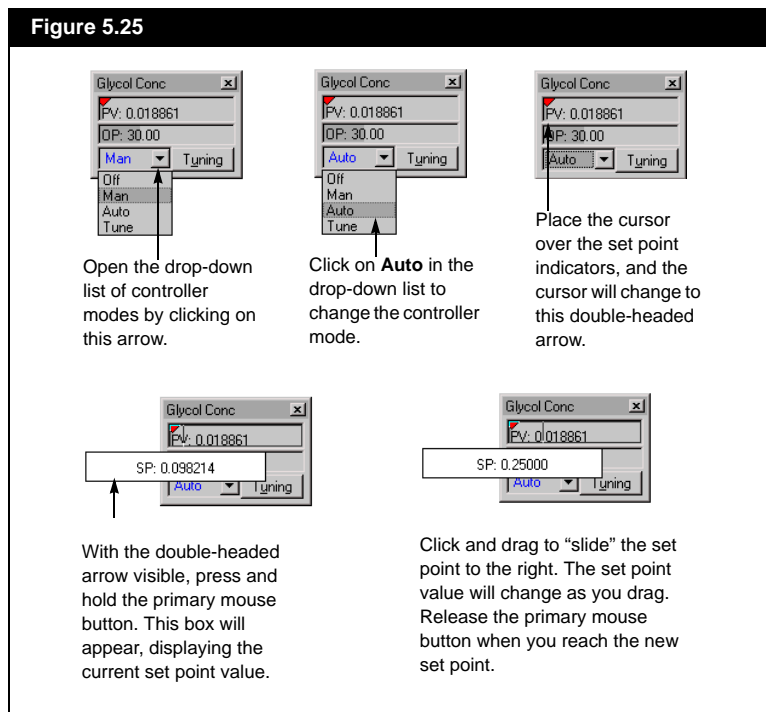
Figure 5.24



If you wish, start the Integrator again and try entering other values for the **OP**, such as 40 or 50%, and watch the response.

The next step is to switch the composition controller **Glycol Conc** to automatic mode and let it maintain a concentration set point. Use a set point of 0.25 mole fraction propylene glycol. Before changing the set point, stop the Integrator again. To change the set point follow the procedure outlined in [Figure 5.25](#):

Figure 5.25



Alternatively, you can enter an exact set point by typing the value in the PV cell, then pressing the ENTER key.

After you have entered the new set point, start the **Integrator** again. The system will react to the new set point as follows:

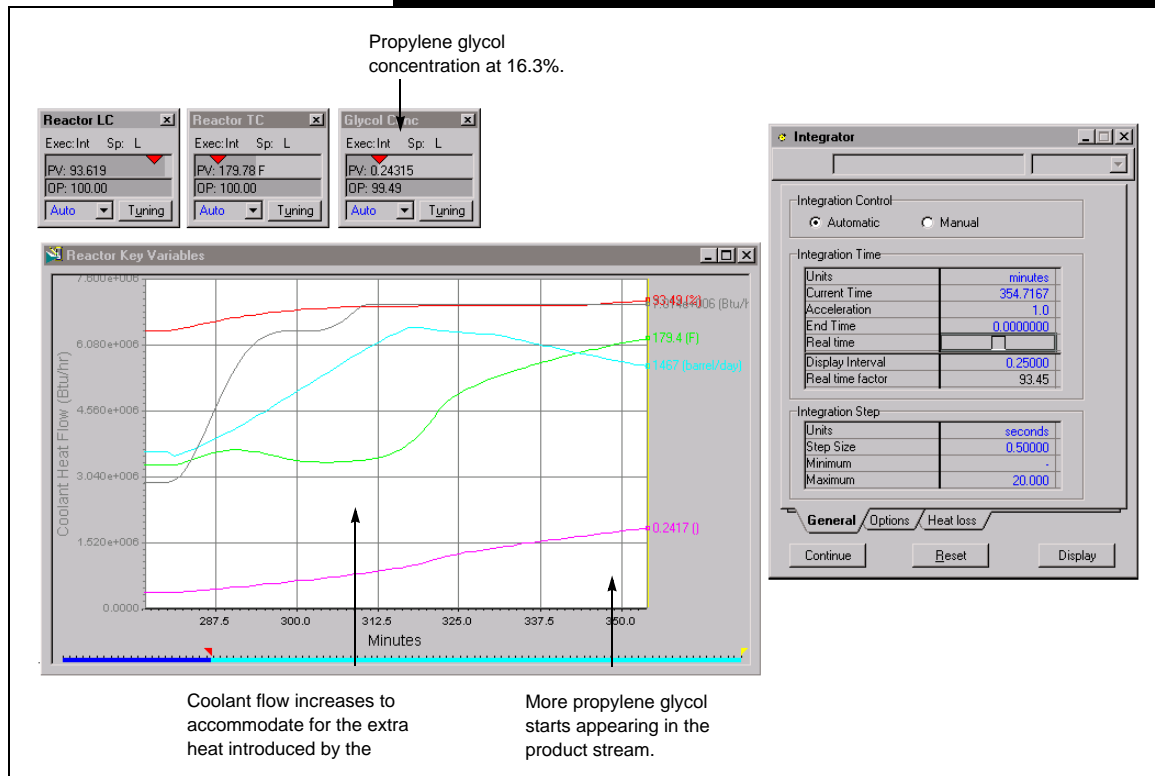
If you wish at any time to reset dynamic calculations and begin filling the vessel again:

1. Press the **Reset** button.
2. Return the **Glycol Conc** controller to **Manual** mode.
3. Enter a value of **0** in the **OP** cell of the **Glycol Conc** controller.
4. Click the **Start** button.

- The flow of propylene oxide feed increases because the composition controller wants to raise the concentration of glycol in the product stream.
- The reactor level rises as a result of the higher feed rate; the product flow therefore increases to maintain the level set point.

- The reactor temperature rises because more exothermic reaction is taking place, and the coolant flow increases to compensate for this temperature change.

Figure 5.26



Feel free to experiment by changing either of the other set points and watch the response. When you are finished, stop the **Integrator**.

You have now completed your first dynamic simulation using HYSYS! Before moving on, you can save your case by doing one of the following:



Save Button

- Click the **Save** button on the HYSYS button bar.
- Select **File-Save** from the menu.
- Press **CTRL+S**.

If you wish, you can quit HYSYS by doing **one** of the following:

- Select the **File-Exit** from the menu.
- Press **ALT+F4**
- Click the **Close** button in the right hand corner of the HYSYS window.

If you have made any changes to your case since the last time it was saved, HYSYS will prompt you to save before exiting.

This concludes the **Get Started** example. You are encouraged to proceed to the HYSYS Tutorials manual. The Tutorial problems provide a more in-depth look at HYSYS by guiding you step-by-step through a number of example simulations. Both steady state and dynamic tutorials are available.