VisualDOE 3.0 Program Documentation

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Technical Support

You may call Eley Associates for technical support for a period of 90 days. Eley Associates reserves the right to restrict the hours when questions are answered concerning the use of the program to the normal work week (Pacific time).

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This agreement will be governed by the laws of the State of California, U.S.A.

Table of Contents

1   What is VisualDOE 3.0

VisualDOE 3.0 is a third generation Windows™ application that enables architects, engineers, energy analysts and utility personnel to quickly evaluate the energy savings of building design options. The program uses the DOE-2.1E hourly simulation tool as the calculation engine so that energy use and peak demand are accurately evaluated on an hourly basis. In the past, energy simulation programs such as DOE-2 has been limited to a small circle of energy experts with special expertise. VisualDOE extends this power to mainstream architects, engineers and energy consultants. VisualDOE is designed so that more advanced calculation engines such as EnergyPlus can be used with the interface.

The VisualDOE 3.0 Windows™ interface is truly graphic. Pictures of your building and HVAC system diagrams are produced as you create your model. You can verify that your model is accurate and see right away the size and shape of thermal zones, windows and other building elements. Information is organized by objects that are familiar to designers. To modify the properties of an object, you simply click on the object and a form will appear showing you the current properties and enabling you to make necessary modifications. VisualDOE can also import data from CADD files to speed the process of producing input files for complicated buildings.

With VisualDOE, building shapes or blocks of zones can be created by dragging and dropping one of the standard building shapes on to your model. You can also create your own custom block by drawing an outline of each zone or importing data from a CADD file. The standard building shapes (or blocks) can have one of several standard zoning patterns, or a standard block can be divided into custom zones. With custom blocks, you can create any block shape or zoning pattern you want, within certain constraints.

If you are used to directly working with DOE-2, you will be pleased that VisualDOE produces DOE-2 input files that you can subsequently modify or expand. The goal of VisualDOE is to make it extremely easy to do 90% or more of your work. You can still do the remaining 10% through direct modification of the DOE-2 input files, although this requires knowledge of DOE-2 program. VisualDOE 3.0 has simplified this process by enabling users to edit the DOE-2 input files from within the program interface.

The international community can use VisualDOE effectively. You can use either inch-pound or SI (metric) units, eliminating time-consuming conversions. The VisualDOE library can be modified to include special holidays, schedules, equipment templates and other information unique to a particular country or region of the world.

Data entry can be speeded through the use of templates. Templates contain schedules of constructions, operation schedules, materials, and other basic information needed to start your project. HVAC equipment templates can also be created and edited with the Equipment Editor program module. In many cases an entire piece of equipment such as a chiller, boiler or cooling tower can be specified by making a single choice in the templates list box.

Each project file contains information about the base case design as well as information about up to 99 design alternatives. Design alternatives can be quickly created from the base case or from one of the other design alternatives by choosing Aletrnatives|Define Alternatives from the main menu. If you know the construction cost associated with the design alternatives, VisualDOE will calculate the life-cycle cost of each one.

You can make a simulation for a single design alternative or for a selected group of design alternatives (batch mode). Advanced users can edit the DOE-2 input files to include DOE-2 modeling features not supported by the VisualDOE graphic interface.

Scheduling building operation is vastly simpler than using DOE-2 directly. You can choose an occupancy type from the library and all the schedules and other information associated with that occupancy type are applied. The Schedule Editor program module can be used to create new schedules and combine these into occupancies.

The program is supported by an on-line help system that explains how to use the program and gives details about information needed to enter data or to perform a simulation. The help system is context sensitive, providing immediate information about the form displayed on the screen. Error checking is provided after you enter information in each field. If the information is outside an acceptable range or is of the wrong data type (date, numeric, alpha, etc.), a warning appears with information about how to correct the error. VisualDOE starts you with a set of reasonable defaults. These are generally consistent with the DOE-2 defaults, but sometimes depend on other data you have entered. The help system also contains explanatory information about the DOE-2 reports.

In addition to the reports generated by DOE-2, VisualDOE generates five additional reports that summarize information about your model(s) and present the results. You can also make graphs of annual or hourly results when you choose Simulation|View Results|Graphs. Diagnostic information is provided to help you assure that your results are reasonable. A Simulation|Diagnostics form presents average temperatures of each space, the hours that the space is cooler than the heating setpoint or warmer than the cooling setpoint. It also summarizes total and outside air volumes to each space. If a simulation fails, diagnostic information is written to a LOG file. Finally, there is the BDL report that has diagnostic errors, warnings and cautions from DOE-2. In addition to the on-line help system, the program is supported by a User's Manual.

VisualDOE 3.0 customers receive free telephone support for a period of 90 days. After that we will continue to support the program through email correspondence. Premium support can be purchased on an annual basis.

1.1 New Features

VisualDOE Version 3.0 has a number of important improvements over previous versions.

Some of the new features include:

- New custom block editor
- Custom facade editor for windows
- Skylight editor
- Updated schedule organizers
- DOE2.1E input and output file editor
- Scheduling of central plant availability
- More powerful 3D viewer
- New schedule editor
- Weather data for all 239 TMY locations in the United States included
- New construction editor
- New utility rate editor
- 99 design alternatives
- Project files independent from library
- Complete DOE2.1E technical documentation
- Recently used files list
- Automatic program updates over the Internet.
- Export VisualDOE reports as RTF or PDF

Custom Block Editor: The custom block editor allows complicated block shapes to be created by stretching two point rectangles, drawing a polygon, entering coordinates or importing data from CADD files. Blocks can also be rotated, standard blocks can be converted to custom blocks and modified, rooms can be combined or merged, vertices can be dragged to change shapes, and daylight reference points can be positioned with the mouse. An introduction to the new custom block editor is in a PDF file on the CD.

Custom Facades: Custom facades can be created with windows of any size. The Openings Editor displays an elevation view of the selected façade. An image of each opening in the schedule appears in a window. These can be dragged and dropped onto the façade at any position. The process is repeated until all the windows are correctly positioned. Once windows are placed on the façade, they can be repositioned by choosing the Move tool and dragging the window to its new location. The Openings Editor allows users to turn on a snap-to-grid feature to enable more accurate positioning.

Skylights: Skylights can be created for rooms with exposed roofs. Since most spaces in commercial buildings have plenums, VisualDOE creates a special "skylight holder" surface to contain the skylight. The Skylight Editor works like the custom façade editor. Individual skylights are dropped onto the plan view of the room, where the can subsequently be accurately positioned with the Move tool.

Schedules and Organizers: Common elements that are repeated in a building model can be created once, placed in a schedule, and then referenced where they are needed. Schedules are included for

openings (windows or skylights), glazing materials, constructions, materials, occupancies, utility rates etc. An organizer enables elements to be copied from a master library to your project file or vice versa.

DOE-2 Editor: DOE-2 input, output and BDL files can now be viewed and edited directly in the main application. If the case is set to use existing input file in the alternatives form then the user can edit the input (*.i0) file directly in the VisualDOE interface and save the changes. This option becomes enabled in the "Simulation" menu after a simulation is complete.

Central Plant Scheduling: Heating and cooling availability can now be scheduled by time of day and time of year. In addition, custom load ranges can be entered to control multiple chillers and/or boilers.

3D viewer: A new 3D view of the building model can be launched by clicking the "Show 3D View" button from the main application form. Use the left and right mouse buttons with the "Ctrl" key on the keyboard to zoom and rotate the 3D view of the building. Users can select the building components to be viewed.

Schedule Editor: The new schedule editor eases the creating and editing of a schedule. A day schedule can be imported from the library and/or saved to the library. In the schedule main form, day schedules can be dragged and dropped and their images can be copied to the clipboard for reporting. A schedule can also be created by importing a time series of 8760 hourly values. A new Holiday Editor can be launched from within the Schedule Editor.

Weather Files: The Green Design Tools includes 239 TMY weather data files for locations throughout the United States and several other international locations at no extra cost.

Construction Editor: The new construction editor eases the process to create and edit a construction including its layers/materials.

Utility Rate Editor: The new utility rate editor includes the demand rachet to be input at the utility rate level and time charge period level.

More Design Alternatives: A project file may contain up to 99 design alternatives, compared to a maximum of 25 in VisualDOE 2.6.

Project Files are now independent from the VisualDOE library: The library still exists, but objects may be copied back and forth between the library and the project file.

DOE2.1E Technical Documentation: The Green Design Tools CD includes the complete set of DOE2 technical manuals in the form of Adobe Acrobat files.

Recent Files List: Recently used project files are now listed in the File menu, where they can be opened with a single click.

Automatic program updates over the Internet: Run the GDTLiveUpdate program to automatically download and install latest VisualDOE files from our web site.

Exporting Reports as RTF and PDF: VisualDOE reports can be exported as RTF or PDF file for further editing.

2 Installation and Setup

2.1   Installing the Program

Minimum Requirements

To install the program, you need a PC with a Pentium-II, 64 megabytes (MB) of random access memory (RAM), and at least 140 MB of free space on your hard disk. The program takes about 40 MB of space, but another 100 MB or so is needed for temporary files created when DOE-2 runs. In order to install the program, your system must be running Windows 95, 98, 2000, or ME. For optimum performance a P-III with 128 MB RAM running Windows 98 or 2000 is recommended.

Installation Procedures

VisualDOE is distributed on CDs. To install:

1. Start Windows.

2. Close all applications that are running in the Windows operating system. It is essential that all applications be closed but it is good practice to close all applications.

3. Insert the CD in your CD drive.

4. If autostart is enabled on your computer, the installation window will show up automatically, otherwise start the program by double clicking on the InstallAll.exe file on the CD.

What the Setup Program Does

The Setup program copies a number of files from the disks onto your hard drive. Some of the files are copied into the directory you specified above, but others are copied into the Windows/System directory. The Windows/System directory is a place where files, which are used by one or more programs, are kept. All VisualDOE and other Green Design Tools files are installed in the program directory (C:\Program Files\GDT).

If you want to install the programs in a different directory, you'll have to run the individual installations for each program. To do so, simply go the individual program subdirectories on the CD and run Setup.exe files. If the installation program generates errors or any of the software components is not installed, then you'll have to rerun the installation for individual setup programs from the CD. See FAQ on Installation and Setup for further help. By default, the following directories will be created on your computer,

>   C:\Program Files\GDT

>   C:\Program Files\GDT\DOE2

>   C:\Program Files\GDT\Weather

>   C:\Program Files\GDT\Shared

>   C:\Program Files\GDT\Shared\Help

>   C:\Program Files\GDT\VisualDOE

>   C:\Program Files\GDT\VisualDOE\Projects

>   C:\Program Files\GDT\VisualDOE\Templates

VisualDOE can be uninstalled from the Add/Remove Programs in Control Panel by selecting VisualDOE and Clicking the Remove button. Most installed files will be removed automatically, but some project files may have to be removed manually.

Running VisualDOE

Either double click the shortcut/icon on the computer desktop, or go to menu Start|Programs|Green Design Tools to run VisualDOE 3.0.

Registration

Launch the registration form from the Help|Register VisualDOE menu. Enter user name, company name, and registration code, then click Register button to register the VisualDOE program. This information should come with the sale receipt of VisualDOE CD.

2.1.1   Files Created by Setup

WINDOWS SYSTEM FILES (Windows\System Directory)

File	Date	Size	Version
"gswdll32.dll"	11/11/98	152688	"5.50.0.0"
"gswag32.dll"	11/11/98	242816	"5.50.0.0"
"gsw32.exe"	11/11/98	423016	"5.50.0.0"
"msvfw32.dll"	5/11/98	143360	"4.10.0.1998"
"msvcrt20.dll"	5/11/98	274432	"2.11.0.0"
"msvcrt40.dll"	10/14/96	65024	"4.2000.0.6172"
"msvcrt.dll"	12/7/99	295000	"6.1.8637.0"
"msvcirt.dll"	6/17/98	77878	"6.0.8168.0"
"asycfilt.dll"	1/20/00	143632	"2.40.4514.1"
"stdole2.tlb"	1/20/00	16896	"2.40.4514.1"
"riched32.dll"	3/25/98	172816	"5.0.1458.47"
"crtdll.dll"	5/11/98	184320	"3.50.746.1"
"dciman32.dll"	5/11/98	24576	"4.3.0.1998"
"mpr.dll"	5/11/98	57344	"4.10.0.1998"
"msacm32.dll"	5/11/98	102400	"4.3.0.1998"
"oledlg.dll"	5/11/98	155648	"5.0.1555.0"
"avifil32.dll"	5/11/98	98304	"4.3.0.1998"

"vdoe32.dll"	2/4/98	229888	
"mfc42.dll"	10/27/99	995383	"6.0.8665.0"
"comdlg32.ocx"	5/7/99	140288	"6.0.84.18"
"graphs32.ocx"	11/11/98	636032	"5.50.0.0"
"vsocx32.ocx"	3/11/97	152576	"5.0.4.0"
"mscomctl.ocx"	5/22/00	1066176	"6.0.88.62"
"mscomct2.ocx"	5/22/00	647872	"6.0.88.4"
"mfc40.dll"	6/1/99	924432	"4.1.0.6140"
"oleaut32.dll"	1/5/00	614672	"2.40.4514.1"
"olepro32.dll"	1/20/00	164112	"5.0.4514.1"
"msvbvm60.dll"	5/27/00	1388544	"6.0.88.77"
"ctl3d32.dll"	2/4/99	45056	"2.31.0.0"
"comctl32.ocx"	5/22/00	608448	"6.0.81.5"
"armaccess.dll"	5/16/00	32768	"1.3.0.0"
"serialbag.ocx"	12/5/99	73728	"0.1.0.29"
"msflxgrd.ocx"	5/7/99	244232	"6.0.84.18"
"richtx32.ocx"	5/22/00	203976	"6.0.88.4"
"tabctl32.ocx"	5/22/00	209608	"6.0.88.4"
"scrrun.dll"	9/19/00	147512	"5.1.0.4615"
"vbajet32.dll"	1/22/99	30992	"6.0.1.8268"
"msjint40.dll"	7/13/00	151824	"4.0.2927.2"
"msjter40.dll"	7/13/00	53520	"4.0.2927.2"
"msjet40.dll"	1/27/00	1495312	"4.0.2927.17"
"vb5db.dll"	9/1/99	89360	"6.0.81.69"
"msjtes40.dll"	7/13/00	237840	"4.0.2927.8"
"msrepl40.dll"	7/13/00	553232	"4.0.2927.2"
"msrd3x40.dll"	7/13/00	315664	"4.0.2927.4"
"msrd2x40.dll"	7/13/00	422160	"4.0.2927.2"
"mswdat10.dll"	7/13/00	831760	"4.0.2927.10"
"mswstr10.dll"	7/13/00	614672	"4.0.2927.10"
"expsrv.dll"	7/13/00	379152	"6.0.0.8540"
"msstdfmt.dll"	3/14/00	118784	"6.0.88.4"
"dao360.dll"	3/15/99	557328	"3.60.2521.8"
"3dlinx.dll"	5/11/00	811520	"1.5.0.20"
"vsprint7.ocx"	12/12/00	348160	"7.0.0.27"

"vsdraw7.ocx"	6/5/00	143360	"7.0.0.4"
"vspdf.ocx"	12/12/00	147456	"7.0.0.10"
"dwstg.dll"	4/20/00	143360	"2.0.0.17"
"stgdes32.dll"	10/27/98	19456	"2.0.0.0"

VISUALDOE FILES

The Setup program copies the following files to the program directory (C:Program Files\GDT\).

 (Dates and version numbers vary)

"eawthr.dll"

"eaconst.dll"

"eakernel.dll"

"ealights.dll"

"ealoads.dll"

"eaopn.dll"

"earoot.dll"

"easch.dll"

"eautil.dll"

"ctool.dll"

"eahvac.dll"

"eahvaced.dll"

"vdoectrls.ocx"

"eaequip.dll"

"eadhw.dll"

"visdoe30.exe"

2.2   Program Updates and Technical Support

VisualDOE updates are free to licensed customers at no cost. They can be obtained by visiting the Eley website at www.eley.com. Please run the "GDTLiveUpdate" program to get the latest files.

If you don't have "GDTLiveUpdate" installed, please download it from

http://www.eley.com/gdt/downloads/GDTLiveUpdateSetup.exe

If you are unable to download the files using GDTLiveUpdate, follow these steps to get the latest files:

1. Download files individually from http://www.eley.com/gdt/downloads
2. Copy all the *.dll files to the 'Shared' directory in your installation
3. Folder and the *.exe files to the respective program folders.
4. Download RegGDT.exe from http://www.eley.com/gdt/downloads to the shared directory.
5. Run RegGDT.exe to register all the shared components.
6. Reboot.

2.2.1   Technical Support

Telephone support is provided for 90 days following purchase of VisualDOE. Additional telephone support can be purchased on an annual subscription basis. Email support is provided for all users. Send your questions to support@eley.com.

3 VisualDOE Information Flow

VisualDOE is a Windows interface to DOE-2.1E. The following diagram shows how information is passed to the DOE-2 calculation engine and processed. The VisualDOE interface creates and modifies two files: the project file and a library file. The project file stores information about each of the design alternatives in your project. The library is a repository of data and resources that you can draw on to create your project file.

VisualDOE Interface

Project File

VisualDOE Library

VisualDOE Reports and Graphs

DOE-2 Input File

DOE-2 Weather Files

DOE-2 Library

DOE-2 Simulation Engine

Text Processor

DOE-2 Reports

DOE-2 Output File
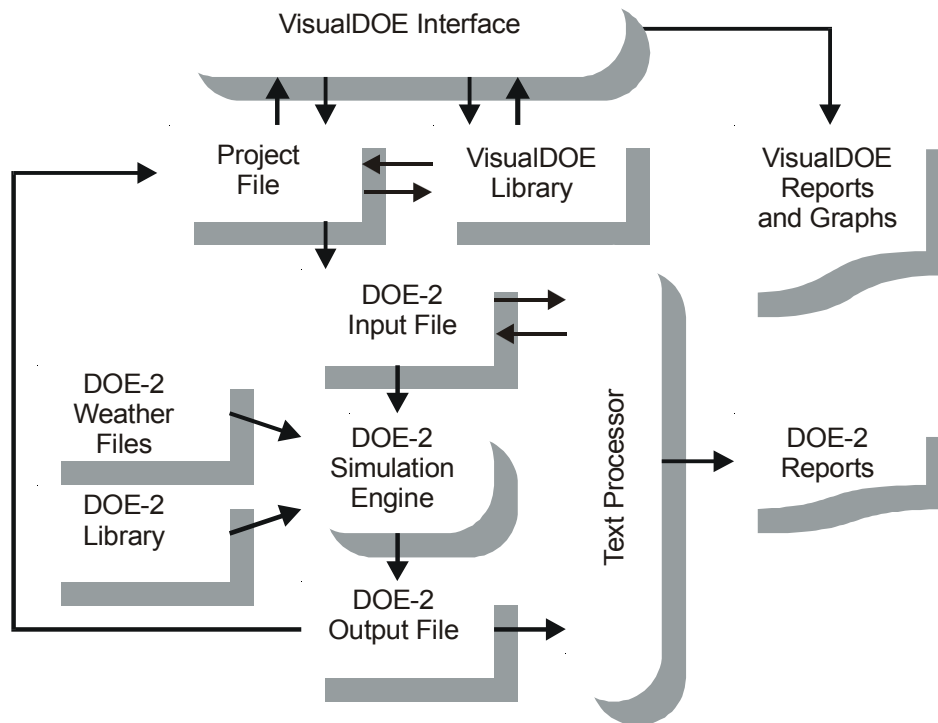
VisualDOE library contains utility rates, equipment data, schedules, constructions, climate information and many other valuable data. As you develop your library, it will become a valuable professional resource. Some of the information in the library can be fixed, which disables editing features. This is especially important when a library is being shared by more than one user.

When you make a simulation by choosing Simulation|Setup, VisualDOE creates a DOE-2 input file from information in the project file. The DOE-2 input file is an ASCII text file. VisualDOE creates a separate input file for each of the design alternatives. Experienced DOE-2 users will be familiar with the structure and format of the input files. The input files have a file suffix that indicates the design alternative. An example is MyFile.i1, MyFile.i2, etc. where the number represents the design alternative.

The input file is passed along to the DOE-2 calculation engine for processing. The DOE-2 calculation engine also processes a weather file and its own library file that contains standard construction materials. When the simulation is complete, the calculation engine produces a DOE-2 output file. The output file is also an ASCII text file. A separate output file is created for each of the design alternatives. The output files have names like MyFile.o1, MyFile.o2, etc. where the number represents the design alternative.

At the completion of the simulation, VisualDOE reads the output files and extracts summary results. These results are stored in the project file for each design alternative so that they can be reported and/or graphed. In addition to the reports and graphs available through the VisualDOE interface, you can also open the

DOE-2 output files with a text processor and print one or more of these reports. The VisualDOE help system includes information about the standard DOE-2 reports.

4 Modeling Concepts in VisualDOE

Most energy simulation programs require that you separately enter information about each wall, window, door and thermal zone in the building. This can be a very time consuming and tedious process for most users. VisualDOE cuts through this process with the concept of blocks. A block is a contiguous group of thermal zones located at the same level that have certain common properties such as a floor-to-floor height, roof construction, floor construction, etc. You can quickly create, delete and edit blocks as a whole entity. This reduces the drudgery of creating individual zones, surfaces, and openings.

The contiguous zones that make up a block are represented in VisualDOE as adjoining polygons. These polygons are extruded in a vertical direction to create the walls. The sides of polygons that adjoin other polygons are treated as interior walls. If a polygon side does not adjoin another zone it is treated as an exterior wall or facade. Finally, roofs are placed on top of the zones. The following diagrams illustrate the concept of zones for a block with no plenum.
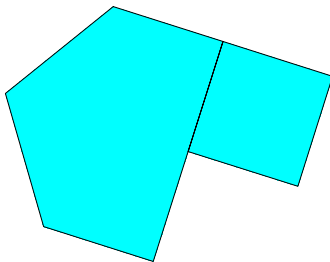
This block consists of two thermal zones represented by adjoining polygons.
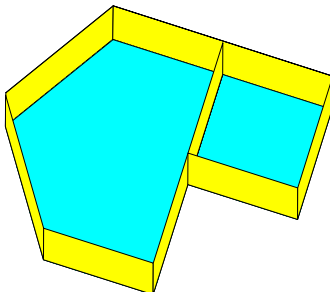
The sides of the polygons are extruded vertically a distance equal to the floor to ceiling height specified for the block. This process creates seven exterior walls or facades and one interior wall.
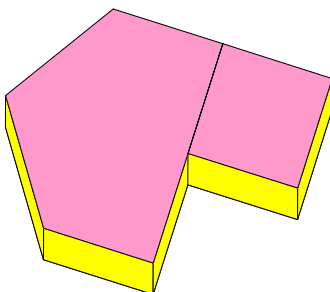
A roof surface is placed over each of the thermal zones.

For simplicity, the models above show a block with no plenum. When blocks have plenums, additional zones are created to represent the plenum(s). Each zone has its own plenum if it is served by a separate HVAC system. Zones served by the same HVAC system share plenums.

4.1   Standard Blocks

The following figure shows standard block shapes that can be dragged and dropped into your model. Each of the block shapes can be configured as a single thermal zone or as multiple zones where each façade becomes its own thermal zone. Standard blocks can be stretched, rotated and/or dimensioned to closely represent a floor of your building. The following are examples of how standard blocks can be used.

Rectangle

L-shape

H-shape

Chop

Cross

Slant

U-shape

T-shape
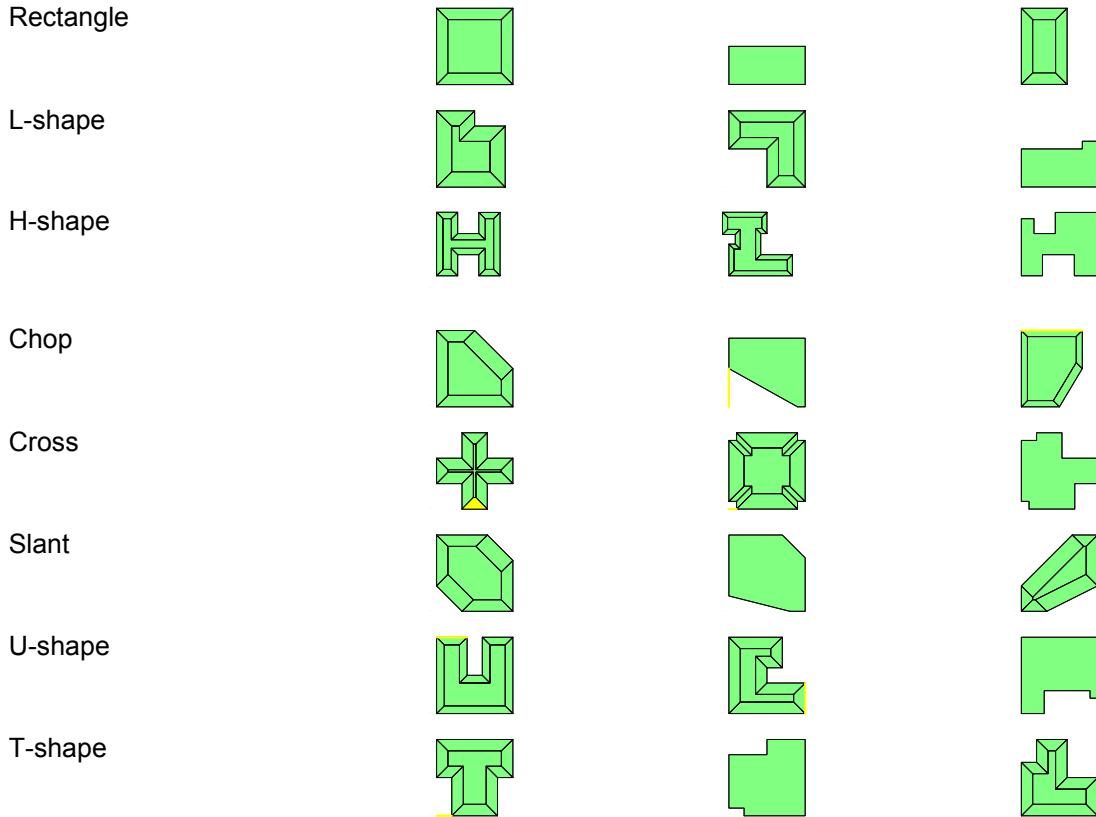
4.2   Custom Blocks

With custom blocks, you can arrange zones in just about any configuration. The following figure shows a block of zones created with the custom block editor. This plan is one of the floors of the Four Times Square green office tower in New York. This custom block consists of seven perimeter zones and four interior zones. The block has 16 facades (polygon sides that do not adjoin other polygons). Each facade can have its own properties such as wall construction, window configurations, etc. For more information, see the help topic on the Custom Block Editor.
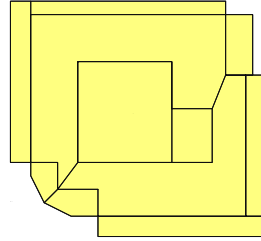
4.3   Arranging Blocks

Blocks can be located on the same level or stacked on top of each other. The following show examples of models that are constructed with standard block shapes.
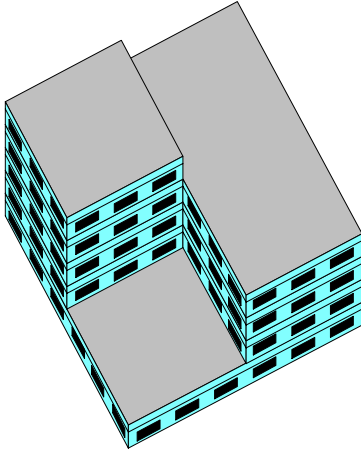
This model has three blocks. A rectangle (square in shape) is at the first level. An L-shape with three floors is located at the second level and a second rectangle (small square) is located at the third level. The model has three roof planes, although these may be subdivided depending of the plenum zones on the top floors.
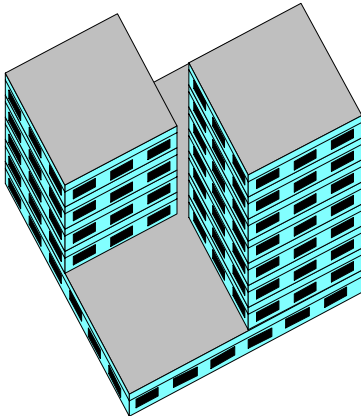
This model has three blocks. On the first level is a rectangle with a square shape. Two additional rectangular blocks are located at the second level. One has seven floors and one has four floors. The model has three main roof planes.

5   VisualDOE Interface

Overview

VisualDOE interface for editing and viewing your model has several elements:

Pull-Down Menus. Pull-down menus at the top of the form can be used to carry out most functions.

Plan View. A plan view of your model is displayed in the upper left corner. The behavior and display of the plan view depends on the folder you are working in.

> Project folder: All the blocks in the project are displayed and highlighted.
>
> Blocks folder: The selected block is highlighted and displayed. Only one block can be selected at a time.
>
> Rooms folder: The selected rooms are highlighted and the parent block is displayed. If the selected rooms are on different levels, then a list containing all the floors becomes visible. You can select the level to be displayed by selecting it from this list.
>
> Facades folder: The selected facades are highlighted and the parent block is displayed. If the selected facades are on different levels, then a list containing all the floors becomes visible. You can select the level to be displayed by selecting it from this list.
>
> Systems folder: The selected system and all the zones belonging to it are highlighted and the parent block is displayed. If the selected system has zones on different levels, then a list containing all the floors becomes visible. You can select the level to be displayed by selecting it from this list. Only one system can be displayed at a time.
>
> Zones folder: The selected zones are highlighted and the parent block is displayed. If the selected zones are on different levels, then a list containing all the floors becomes visible. You can select the level to be displayed by selecting it from this list.

Perspective View. A perspective view of your model is displayed in the lower left corner. This is a static view and is updated when the 'Refresh 3D View' button is clicked while the '3D Viewer' form is visible.

Status Bar. A status bar at the bottom of the form shows current information about the object or objects you are working with. The status bar displays the current file name and path, name and number of the case being edited, coordinates of the mouse location, current units, and the current date.

Data Entry Folders: Data are organized as six tabs or folders labeled: Project, Blocks, Rooms, Facades, Systems and Zones. You can move back and forth between the folders, but in general, it is best to use the following procedure to create a model. This will minimize effort and speed the process.

1   Move to the Project Folder and enter general information such as the project name, climate zone, utility rates, etc.

2   Move to the Blocks Folder and add blocks to your model. You can use the standard block shapes or create your own custom shape. Dimension each standard block as you create it. As you add blocks to your model, plan and elevation views are updated. Specify the properties of each block such as roof, partition and floor constructions, floor-to-floor height, plenum definitions and number of floors.

3   Move to the Rooms Folder and make any necessary room specific modifications. When you drag and drop blocks into your model, the rooms are automatically created with default properties. You can change these properties, including lighting power, equipment power, occupant density, and schedules of operation. If a room has skylights, you define them on this form.

4   Move to the Facades Folder and make any facade specific modifications, e.g. change facades that are not like the default facade. You can define windows using the classic VisualDOE typical bay method or you can define

5   Use the Systems Folder to define the HVAC systems and plant that serve your building.

6   Use the Zones Folder and make zone specific HVAC edits.

If you are new to VisualDOE, you should go through the tutorial, which will familiarize you with the basic concepts and procedures

5.1   Project Folder
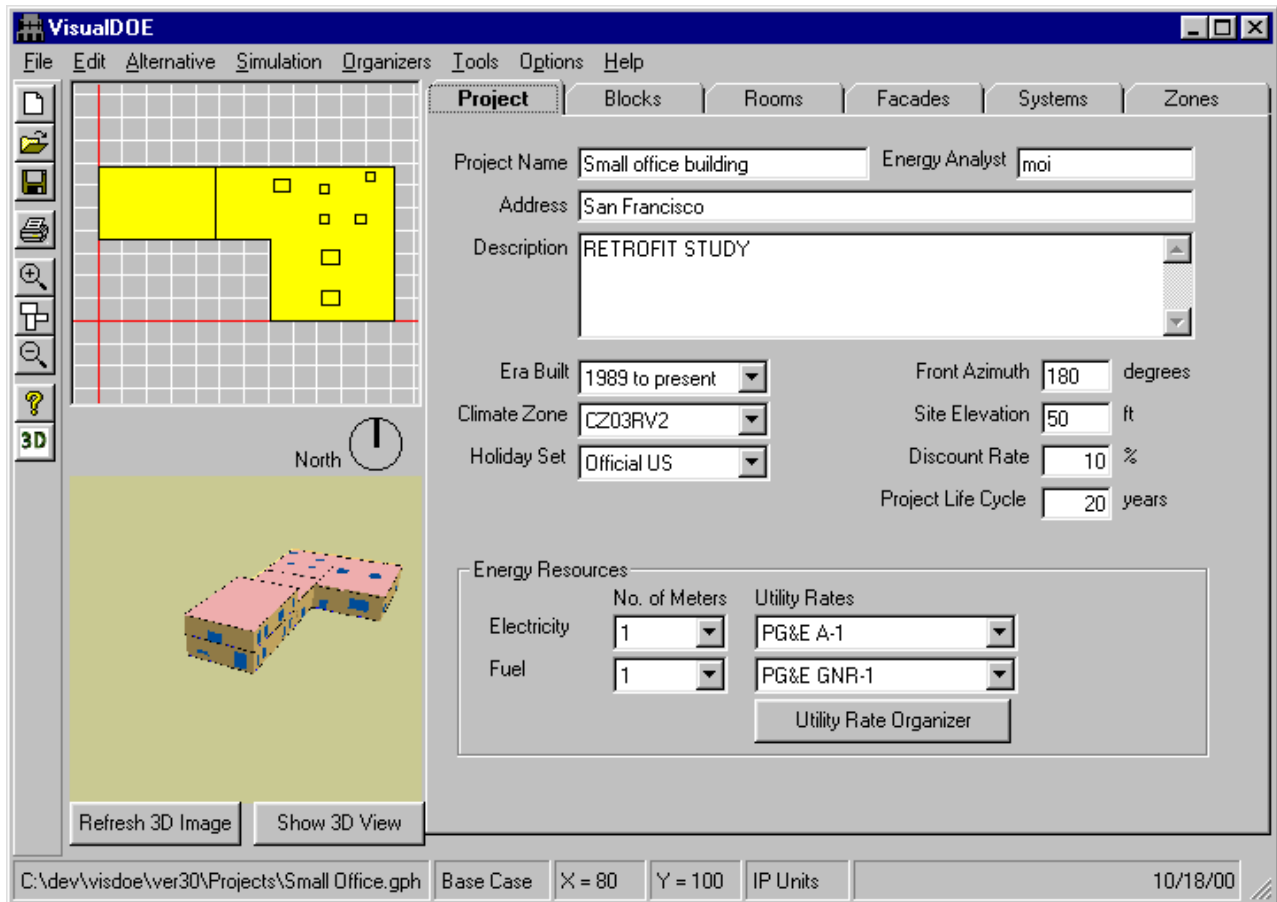
The Project folder is used to enter general information about your project. This general information is common for your base case and each of the design alternatives. It includes the following.

Name. A descriptive project name that does not exceed 60 characters.

Address. The address of your project, using no more than 120 characters.

Description. A description of your project, using no more than 240 characters. This description should apply to the project in general, not to a particular design alternative or the base case. A separate description can be assigned to each of the design alternatives using the Edit | Define Alternatives pull-down menu choice.

Energy Analyst. The name of the person who is responsible for performing the energy analysis.

Era Built (list box). If your project is an existing building, select the era in which it was originally constructed. The four choices are 1950 or before, 1951 - 1977, 1978 - 1988 and 1989 to present. Some of the default information is based on your choice of era.

Climate Zone (list box). Select a climate from the list of available choices. VisualDOE 3.0 is distributed with weather files for most U. S. and several international locations. The list displays all the weather files in the "Weather" directory on your computer. To add new locations, copy the respective weather files to the "Weather" directory located in the default installation directory [C:\\Program Files\GDT\Weather] on your computer.

Holidays Set (list box). Select a set of holidays to use in your simulations. The default list contains 'Official US', 'No Holidays' and 'Custom Holidays'. Selecting 'Custom Holidays' enables the you to create new holidays using the Custom Holidays Editor.

Front Azimuth. Enter the azimuth of the front facade of your model. The front is the side of your building facing the bottom in the plan view. A zero azimuth means that the front of the building faces north. Azimuth is then measured in a clockwise direction: east = 90, south = 180, west = 270, etc. Units are in degrees for both inch-pound and SI measurement systems. Clicking on the North arrow when the "Project" folder is selected can also change the azimuth.

Discount Rate. The discount rate (expressed as a percentage) that will be used in life-cycle cost calculations. This should be the real discount rate without consideration of inflation.

Project Life Cycle. The period of time in years for which energy savings will be considered in calculating the life-cycle cost of the project.

Show 3D View. Clicking on this button launches the '3D Viewer' form. Unlike most of the other forms in VisualDOE, this form can be left open while you work on the project. Close the '3D Viewer' form if it degrades the performance of the software or generates errors.

Refresh 3D Image. This button is enabled when the 3D Viewer form is open. Clicking on it updates the static 3D image of the building.

Energy Resources. The Energy Resources frame is used for specifying the gas, electric, steam and chilled water energy resources that are available at your project site. For most projects, the entire building will be on just one meter. Large project, however, the chilled water plant or other services may be on a separate meter. In this case you specify a number larger than one for the number of meters. When you have more than one meter, or you are purchasing chilled water or steam, the drop-down list box is replaced by a command button where you can launch a form to select more than one electric rate. For the current release of VisualDOE 3.0 with DOE2.1E engine, the options for chilled water and steam meters are not enabled.

- *Electric Rate (list box)*. Select an electric rate from the list of available choices. With more than one meter, the list box is replaced by a command button to allow you to select the multiple rates.

- *Fuel Rate (list box)*. Select a fuel rate from the list of available choices. With more than one meter, the list box is replaced by a command button to allow you to select the multiple rates.

5.1.1   Custom Holiday Editor
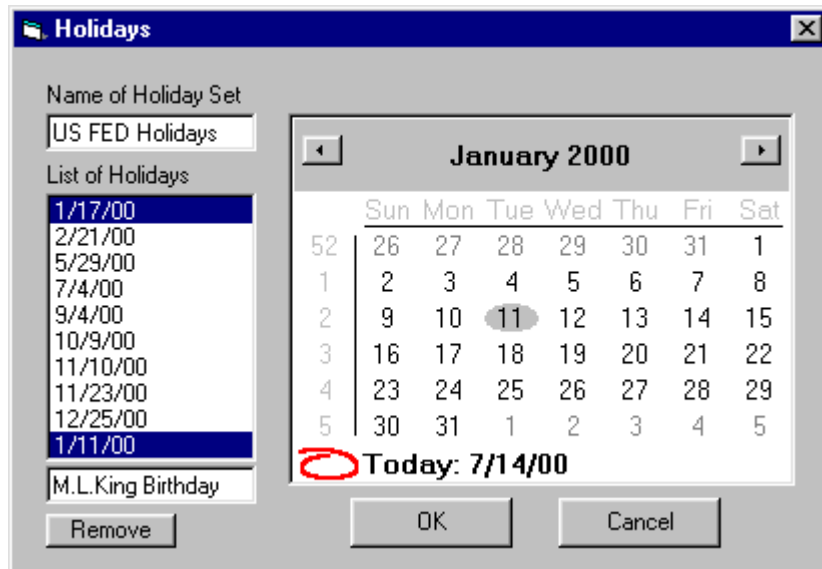
New holidays can be added by double clicking on the selected dates in the calendar. This control becomes enabled if custom holidays are selected on the Project folder. The maximum number of holidays allowed by DOE-2 is 40. DOE-2 does not model leap years. The holiday data is stored in the project file, not the library, and thus needs to be recreated for every project if required.

5.1.2 Multiple Meters

When you have more than one electric or gas meter in your model, this form is launched from the Project tab of VisualDOE to define multiple meters. The form above is for electricity. A similar form appears for multiple gas meters.

5.1.3   3d Viewer
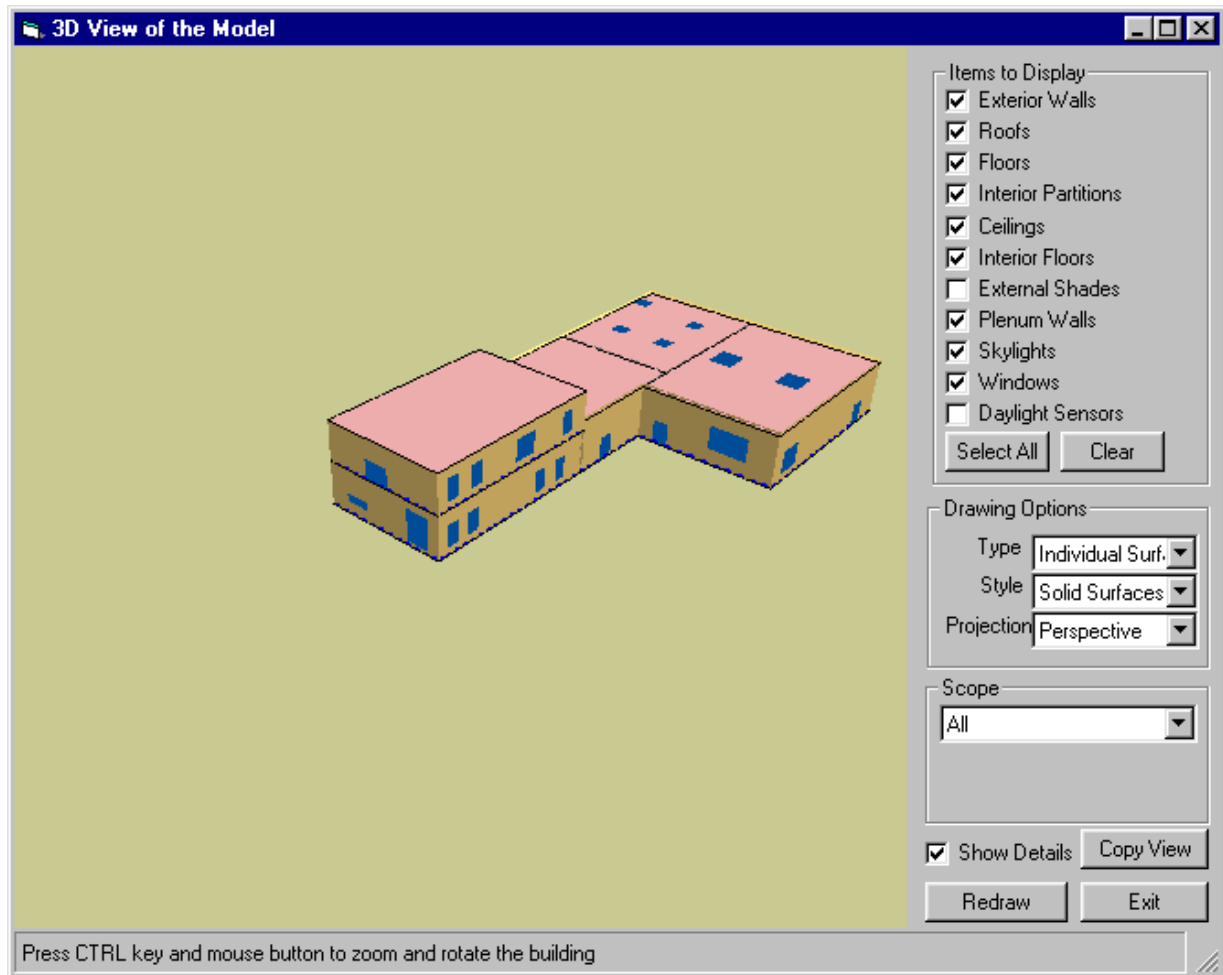
The 3D viewer displays the building geometry and its various components. Horizontal surfaces are not displayed in the 3D viewer till a simulation is conducted. The control can be navigated by simultaneously pressing the CTRL key on your keyboard and using the left or the right mouse button. Unlike most of the other forms in VisualDOE, the 3D viewer form can be left open while you work on other parts of the program. If 'Show Details' box is unchecked, the option items on the right side of the form disappear. To update or refresh the view, click on the 'Redraw' button. The view can be copied to the clipboard by clicking on the "Copy View" button. It can then be pasted in another application.

Items to Display. Select or deselect items to show in the view. Click Select All button to select all items, click Clear button to deselect all items. The view will be refreshed automatically.

Drawing Options. Type can be Floor Plans or Individual Surfaces, Style can be Solid Surfaces, Wire Frame, Points, or Projection can be Perspective or Orthogonal. User needs to click the Redraw button to refresh the view.

Scope. Scope can be All, Selected Block or Selected Room. This will show portion of the 3D view of the model.

Show Details. If this box is not checked, user can't change viewing options.

Copy View. Click this button to copy the image of the 3D view to the clipboard.

Redraw. Click this button to redraw the view if drawing Type and Style are changed.

5.2   Blocks Folder
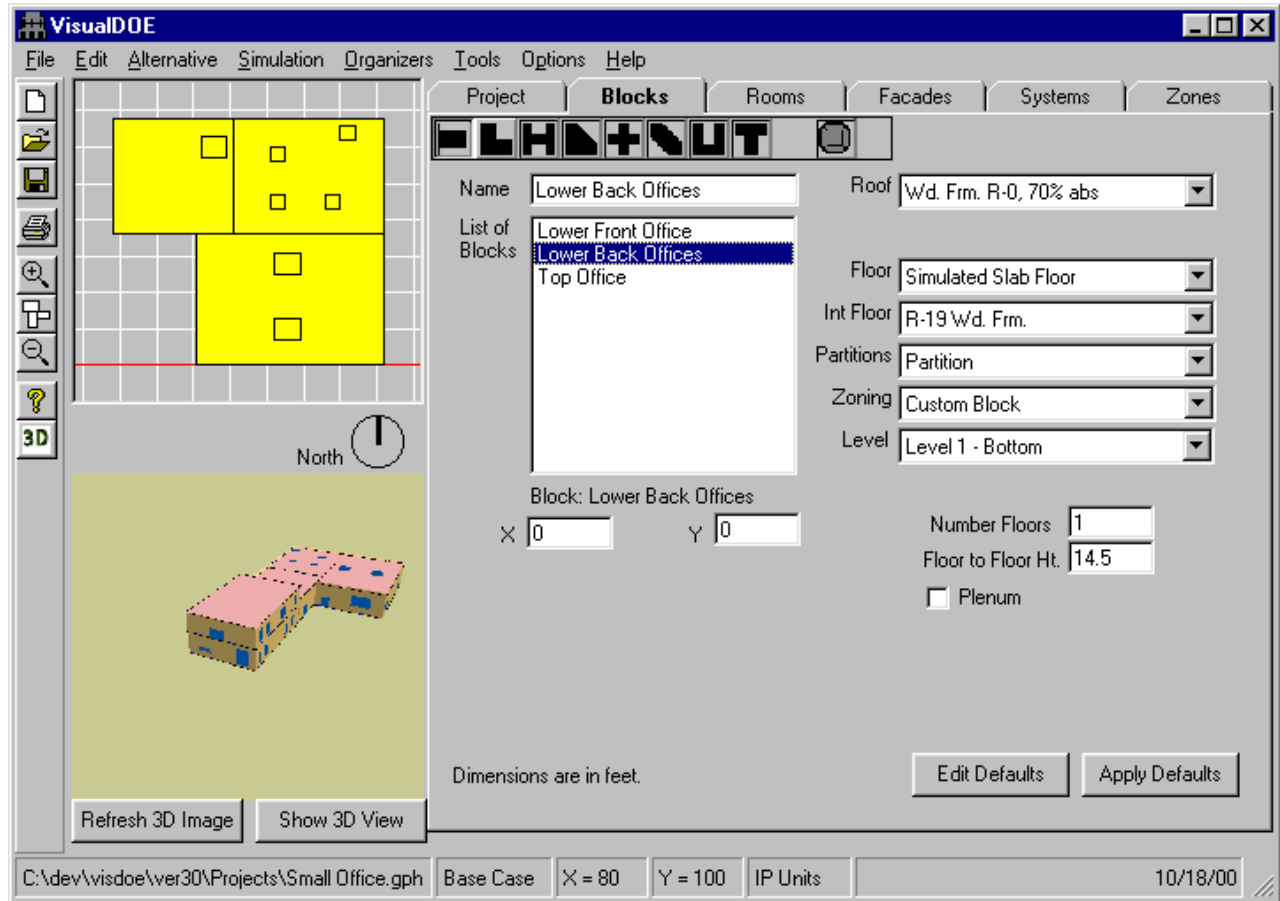
5.2.1   Overview

Select the Blocks folder when you want to add, insert, modify or delete <u>blocks</u> from your model. To add a block to your model: (1) select one of the shapes at the top of the folder, (2) hold down the left mouse button, (3) drag the shape to the plan view, and (4) release the left mouse button. If the plan view is empty, the selected block will be drawn on the plan view. If the plan view already has a block, you will be prompted to select the level for the new block.

VisualDOE supports eight standard block shapes representing rectangles, L-shapes, etc. Many of the standard block shapes can be rotated. For instance the L-shape can have four rotations. You must properly rotate the block shape before you drop it on the plan. Once a block shape has been dropped on a plan, it cannot be rotated. To rotate a standard block, (1) double click on the block shape in the tool bar at the top of the folder, (2) this will cause all the possible rotations to appear beneath the original block shape, (3) select the rotation you want by clicking on it once, (4) the rotated shape will appear in the Blocks folder tool bar, (5) drag the rotated block shape to one of the plan views and release the mouse button.

The hexagon shape is a special icon used to create a custom block. This icon is separated from the standard block shapes to indicate its differences. When you drop the custom block icon on your model, the Custom Block Editor is opened, enabling you to define your custom block. Once a custom block is created,

you may edit it by selecting it and choosing Edit|Custom Block. You may also convert standard blocks to custom blocks by choosing the block in the list box and choosing Edit | Custom Block.

When you are using the Blocks folder, the Delete Block option is available from the Edit pull-down menus. This will delete the selected block(s).

5.2.2 Block Properties

Name. A descriptive name for the block, not exceeding 40 characters, the first 12 characters of the names should be unique.

Constructions. Drop down list boxes are provided so you can select a roof, ceiling, floor, interior floor and interior wall constructions for the block. These list boxes include all constructions available in your construction schedule. If the choices in the list boxes are not acceptable to you, you should launch the constructions organizer from the 'Organizer' menu to add constructions to the project schedule. *Remove the constructions and materials from the project schedules it they are not being used in the current project.*

Zoning. For standard blocks only, there are two zoning choices. Single zone, means that the block is not subdivided, but rather left as a single thermal zone. "Interior Perimeter" means that the block is divided into thermal zones with each façade having its own thermal zone and the remainder of the block lumped into one interior zone.

- *Interior Perimeter*. With this zoning pattern, a perimeter zone is associated with each block facade. The remainder of the block is grouped into a single interior zone. This zoning pattern is commonly used in energy modeling when the exact zoning is not known, for instance with buildings are still in the schematic design phase. The number of zones that are created depends on the block shape: a rectangle has five zones, an L-shape has seven, etc. Each of the zones is automatically given a descriptive name that appears in the list box. You can change this name, however, if you choose.

- *Single Zone.* The entire block is modeled as a single zone. This is appropriate for blocks that have small overall dimensions or that have a single thermostat. With this zoning pattern the block has only one zone. You can convert 'Interior Perimeter' blocks to 'Single Zone' and vice versa.

- *Custom Block.* You can select this option to convert standard blocks into custom blocks. Once the conversion is complete, the block can be edited using the custom block editor.

Level. Choose the level where you want to locate the block by making a choice from the drop-down list box. By default, VisualDOE stacks blocks one on top of the other so that the level property is incremented as each new block is added to the model. However, if you choose, you can locate more than one block at the same level. This is useful when you need to model multiple building complexes or complex geometric shapes. When more than one block is located on a single level, the starting elevation for the blocks on the next level is equal to the highest of the blocks on the previous level. The height of a block is the number of floors times the floor-to-floor height.

Number Floors. Enter the number of floors for the block, not the total floors in your building. The total number of floors in your model will be the sum of all the stacked blocks. When your model has a number of floors with the same shape and use patterns, it is good practice to model these as a single block. This reduces the complexity of your model and the time required to perform the simulation. The program calculates the loads for one block and multiplies it by the number of floors to calculate the total energy use.

Floor-to-Floor Ht). Units are ft (m). This is the distance from the top surface of one floor to the top surface of the floor above. If a block has more than one floor, all must have the same floor-to-floor height.

Plenum (check box). Click the check box if the block has a plenum. Your choice for this control will cause the plenum height control to become visible or disappear. When a block has a plenum, the ceiling height is the floor-to-floor height less the plenum height.

Plenum Ht. Units are ft (m). This dimension only applies when a block has a plenum. It is the distance from the ceiling to the floor above. The floor-to-floor height minus the plenum height is the ceiling height.

Perimeter Depth. Units are ft (m). This control is only used for standard blocks when the zoning pattern is "Interior Perimeter". The perimeter depth determines the depth of the perimeter zones.

Width, W2, W3, W4, W5. Units are ft (m). The width is the overall width or the maximum extents of the block. The other four dimensions, W2 through W5, apply to some, but not all the blocks. The rectangular shape only requires an overall width. The L-shape requires an overall width plus W2. The more complex block shapes, e.g. the H-shape, require all of the dimensions. When you select a dimension with the mouse or with the tab key, the dimension is highlighted on the plan so you know the side of the block that you are dimensioning. These properties are not visible when a custom block is selected. To change the dimensions of a custom block, choose Edit | Custom Block.

Depth, D2, D3, D4, D5. Units are ft (m). This set of dimensions is similar to the Width set (see above). The dimension you are working with is highlighted on the plan. Dimensions that are not applicable to a particular block shape are not shown. These properties are not visible when a custom block is selected. To change the dimensions of a custom block, choose Edit | Custom Block.

X, Y. Units are ft (m). These values represent the coordinates of the front-left corner of the block. Usually the block located at the lowest level will have an X and Y of zero. Upper blocks are assigned an X and Y value to correctly position the block relative to the block on the first level. A positive X value moves the block to the right; negative to the left. Similarly, a positive Y value moves the block toward the top, negative toward the bottom.

Edit Defaults (command button). When you click this button, you are able to edit the default block dimensions. Change the width, depth, number floors, etc. to the default values you want and then click the OK command button. Once you begin editing the defaults you will not be able to leave the Blocks folder until you have clicked the OK button. After you have set the block defaults, all new blocks that are created with the drag and drop procedure will have the default properties. The default block is saved in the project template when a template file is created.

Apply Defaults (command button). Press this button to reset a block's properties to the default values.

5.2.3   Custom Block Editor
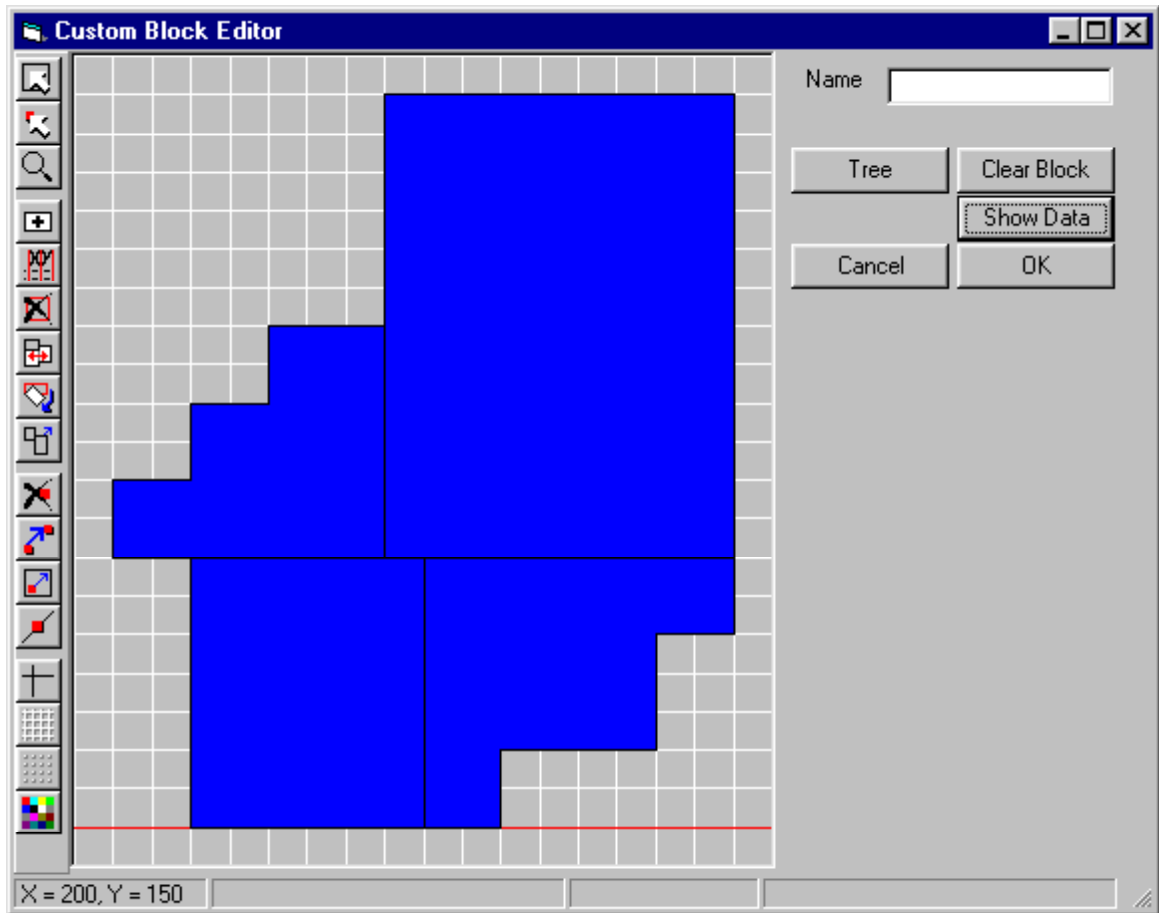
The Custom Block Editor is a key component of VisualDOE program that allows you to create blocks of special shapes or blocks or with unusual zoning configurations. All blocks, including custom blocks, are a collection of rooms that have certain properties in common, including the floor-to-floor height, number of floors (floor multiplier in DOE-2 terms), the vertical position (height above the ground), roof construction, ceiling construction and floor construction. You can think of a block as a typical floor in the building, although this is somewhat of a simplification. There are only a few rules. Custom blocks require a little more work to create than standard block shapes, but they enable you to model buildings with extremely complex shapes.

Standard blocks have been a feature of VisualDOE since version 2.0 was first released in early 1996. The custom block was added later to enable you to model almost any building shape or zoning configuration. You create a custom block by dropping the custom block icon (hexagon) on the plan view. After a custom block is created, it can be subsequently edited by choosing Edit | Custom Block.

You create custom blocks by adding rooms to your model one at a time. You can draw rooms using either the polygon tool or the rectangle tool. You can also enter the coordinates of the vertices that define the room. Finally, you can import polygons from an external DXF file that you can create with your CADD program. Once you have created one or more rooms you can use other tools to modify them. Within the rooms you can position the daylight reference points. You can select a vertex and drag it to a different position. You can select two adjacent rooms and combine them into a single room. And, you can select and delete a room, as long as you do not violate the construction rules. See the topic on the custom block toolbar for more information.

You create a custom block by dropping the custom block icon (hexagon) on the plan views. After a custom block is created, it can be subsequently edited by choosing Edit | Custom Block. You can also convert a standard block to a custom block by selecting it and choosing Edit | Custom Block. When a standard block has been converted to a custom block, you can merge rooms, delete rooms, relocate vertices, and perform other custom block functions. Once converted, however, you loose the convenience of being able to change the overall dimensions of the block and have all the rooms change shape accordingly.

You create a custom block by adding rooms one at a time. Rooms can be created by drawing them as a rectangle or a polygon, by entering the X Y coordinates, or by importing data from a CADD file. The latter approach is useful if you already have a CADD drawing of the building you are modeling and are experienced in using CADD programs.

Toolbar Summary

	Select Room
	Select Vertex
	Zoom
	Add Room
	Edit Room
	Delete Room
	Combine Rooms
	Rotate Block
	Move Block
	Delete Vertex
	Move Vertex
	Move Daylight Reference Point(s)
	Insert Vertex
	Snap Settings
	Color Settings
	Toggle Grid
	Grid Settings

Custom Block Editor Toolbar

Select Tools	Zoom Tools	Add Room Tools	Editing Tools	Display Tools
Select Polygon	Zoom, Flyout	Add Room, Flyout	Delete Room	Display Grid
Select Vertex	Zoom, In	Add Room, Rectangle	Edit Room	Snap Settings
	Zoom, Out	Add Room, Polygon	Combine Rooms	Colors
	Zoom, Extents	Add Room, DXF	Rotate All	Grid Setup
		Add Room, X Y Coordinates	Move All	
			Delete Vertex	
			Move Vertex	

Coordinates.

Move Daylight Reference Point

Insert Vertex

The Custom Block Editor tool bar is used for just about all the drawing functions. Tools are used to zoom and pan the drawing, to add rooms, to move or delete vertices and to perform other functions. The Custom Block Editor tools are described below.

Select Room. Use this tool to select one or more rooms. Other toolbar buttons are enabled or disabled depending on the number of rooms that are selected. For instance, the Delete Room tool is enabled only when a single room is selected. The Combine Rooms toolbar button is enabled only when two and only two rooms are selected.

Select Vertex. Use this tool to select a vertex. You must select a vertex before it can be deleted. The Delete Vertex toolbar button is not enabled unless a vertex is selected. Only one vertex can be selected at a time. When you select a new vertex, the one that was previously selected (if any) is unselected.

Zoom. This toolbar button causes the Zoom toolbar to "flyout" so you can select how you want to zoom the drawing.   The zooming choices are shown below:

Zoom In. Use this tool to zoom in on a portion of the drawing. Drag the mouse pointer over the area that you want to zoom to and release the button.

Zoom Out. This tool zooms out to the previous view. If there are no previous views, then one grid spacing is added in each direction.

Zoom Extents. This tool zooms so that the extents of the drawing are contained within the visible drawing space.

Add Room. This toolbar button is used to add new rooms to the block you are editing. It causes the Add Room toolbar to "flyout" so you can choose a method of adding a room. You can add a room by drawing a two-point rectangle or a polygon. You can also enter the vertices of the new room or import data from CADD files. With all methods, the process is to create rooms, one-by-one, and merge them into the block. If the process is not successful, a message will be displayed explaining the problem. These alternative methods for adding rooms are described below in greater detail.

Add Room Rectangle. With this tool, you add a room to the model by dragging the mouse to define a two-point rectangle. When you select the tool, the mouse cursor changes to show you that you are defining a two-point rectangle. Press the left mouse button to set the first point of the rectangle. Hold down the mouse button and drag to the second point. When you release the mouse, VisualDOE attempts to merge the new room into your block. If Snap-to-Grid is turned on, the points will be forced to the nearest snap coordinate.

Add Room Polygon. With this tool, you define a room by setting the vertices of a general polygon by clicking with the mouse. The polygon method allows you to define rooms with more complicated geometry. When you have entered the last vertex, click once with the right mouse button to close the polygon. If Snap-To-Grid is turned on, then each vertex you set will be forced to the nearest snap coordinate.

Add Room Coordinates. When you select this tool, a spreadsheet appears on the right side of the form where you can enter the coordinates of a new room and the coordinates of the daylight reference point(s). Use the arrow keys or the mouse to move from cell to cell in the spreadsheet. Use the Insert Row command button to add a row (vertex) to the table. When you have finished entering the coordinates, click the Accept command button to add the room to the model. Snap-to-Grid has no effect when entering the coordinates of a new room.

Add Room DXF. Use this tool when you want to import data from a CADD file. Some new controls appear on the right side of the form that allows you to Open DXF File, if one is not already open. When a DXF file is opened, the Layers list box will display the layers that are contained in the file. When you choose a layer, all the closed polygons on that layer are displayed on the drawing. The polygons are also shown in the Polygons list box. When you select a polygon, it is shown highlighted. Click the Add Poly command button to add the selected polygon to the model. The Scale Factor command button is used to set the conversion factor between the units used in the CADD file to those used in VisualDOE.

Edit Room Vertices. This toolbar button is used to edit the vertices of the selected room. This toolbar button is enabled when one and only one room is selected. When you use this tool, the coordinates of the selected room are displayed in a spreadsheet like control on the right side of the form. You can then change the coordinates by typing over the coordinates that are displayed. This option works in a manner similar to entering a room by entering X-Y coordinates.

Room Delete. This toolbar button is used to delete the selected room. This toolbar button is enabled when one and only one room is selected. A room can be deleted only when the custom block rules are not violated. If the function is not successful, a message is displayed describing the problem

Room Combine. This toolbar button is enabled when two rooms are selected. VisualDOE attempts to combine the two selected rooms. If the function is not successful, a message is displayed describing the problem. Rooms can be combined only if they are adjacent.

Block Rotate. This toolbar button enables you to rotate the block. You cannot rotate individual rooms, only the whole block. Rotating a block is a two-step operation. First you set the pivot point by clicking with the left mouse button. After that, you drag with the left mouse button to rotate the block. When the block is in the position you want, release the button.

Block Move. Use this tool to move the block to a new location. The cursor changes to show that you are moving the block. Hold the left mouse button down and drag the block to the new location. If Snap-to-Grid is on, then the block is moved in snap increments.

Delete Vertex. This tool is used to delete the selected vertex. It is enabled only when a vertex is selected. It is necessary to first

Move Vertex. This tool is used to move a vertex to a new location. Click with the left mouse on the vertex that you want to move and drag it to the new location.

Move Daylight Reference Point. This tool is used to position the daylight reference points. First select a room. The daylight reference points for the selected room will then be displayed and the room itself will be highlighted. If the reference points are located on top of each other it will appear that there is only one. If you drag one to the side, it will expose the other. Each room has two reference points. The first is shown in the highlight color and the second is shown white. The reference point is assumed to be 2.5 ft above the floor.

Insert a New Vertex. This tool is used to insert a new vertex. Click on a line segment where you want to insert a new vertex.

Snap Settings. The snap settings are CADD features that allow you to construct you model with greater precision. This toolbar button causes additional toolbar buttons to "flyout" so that snap options can be turned on or off. The following options are available.

Snap Angle. This toolbar button is used to set the snap angle to use when rotating a block. The snap angle is ignored if Snap-to-Grid is not turned on. When on, the Block Rotation function jumps to the nearest snap angle. [

Snap-to-Grid On. This control turns Snap-to-Grid on. When on, the mouse cursor sets vertices at the nearest snap point. To change the snap point settings, click the Grid Setup toolbar button.

Snap-Off. Turns off both Snap-to-Grid and Snap-to-Vertex.

Snap-to-Vertex On. This toolbar button turns Snap-to-Vertex on. When on, the mouse cursor jumps to the nearest vertex. This mode is useful when you need to enter the vertices of a room that exactly align with an adjacent room. [HOW IS THIS TURNED OFF?]

Color Setup. This toolbar button opens the Color Settings form. Use this tool to choose the colors to be used on the form. The form that is launched is the same as the one that is launched from VisualDOE and from other places.

Display Grid. This toolbar button toggles display of the grid lines.

Grid Setup. This toolbar button opens the Grid Settings form. Use this tool to change the snap to grid settings. The form that is launched is the same as the one that is launched from VisualDOE and from other places.

Creating a New Block

The Custom Block Editor has a large drawing area on the left side of the form that is used to draw the outline of each of the rooms that make up a block. The process of creating a block is as follows:

Step   **VisualDOE Response**

1. Choose the ▦.

    A form will be launched where you can set the grid settings. Enter the grid spacing and snap-to-grid resolution that you want to work with.

2. Choose ┼ and then ⬈ to turn on Snap-to-Grid.

    As you move the mouse over the drawing space the coordinates displayed in the status bar will "jump" to the nearest snap-to-grid resolution.

3. Choose 🔍 and then ⊕ and zoom to the portion of the drawing where you want to add a room.

    As you drag the mouse, an outline will appear showing the rectangular area you are zooming to.

4. Choose ⊞ and then ▭ to add a room by creating a two-point rectangle

    As you drag the mouse over the drawing space an outline will appear showing you the size of the rectangular shaped room you are creating.

5. Choose ⊞ and then ⬑ to add a room by creating a polygon.

    Chick once with the mouse to set a vertex of the polygon. As you move the mouse to another position, a "rubber band" will appear showing the line segment you are about to create. Click again to set another vertex. Click with the right mouse button to close the polygon.

6. Choose ⬈ to position the daylight reference points in each of the rooms in your block.

Hint: The current mouse position is displayed in the status bar. This is helpful in accurately creating rooms.

Editing An Existing Block

After a custom block has been created, it can be subsequently edited. Select the zone you want to edit. You can select a zone by clicking on it in the drawing area or by selecting it from the zones list. You can tell which zone is selected because the vertices that define it are highlighted by small squares. The daylighting control sensor will also be shown. After a zone has been selected, there are several editing functions that you can perform:

▪   *You can move the custom block in its entirety.* To do this, choose the 🔳 (Move Block) tool. Click anywhere on the custom block and drag it to the new location. If Snap-to-Grid is on, the behavior of this tool is affected by the Grid Settings and by the status of Snap-to-Grid.

▪   *You can rotate a custom block.* Choose the 🔄 (Rotate Block) tool. The first step is the mark the pivot point around which you want to rotate the block. Click once with the mouse to do this. The second step is to hold down the left mouse key and drag until the block is rotated to where you want it to be. When you release the mouse, the block will be rotated to the new position. If Snap-to-Grid is on, the block is rotated to the nearest Snap Angle as you drag the mouse.

▪   *You can move a vertex.* Choose the 🡕 (Move Vertex) tool. All the vertices will be displayed. Click on the one you want to move, hold down the mouse and drag it to the new position. When you release the mouse the custom block will be reconfigured. When you drag a vertex, you can't create a self-intersecting polygon or violate any of the other custom block rules. VisualDOE will check for these and other conditions and display a message if the move is not successful.

▪   *You can delete a vertex.* Choose the 🡖 (Select Vertex) tool and select the vertex that you want to delete. Then choose the ✖ (Delete Vertex) tool. VisualDOE will then attempt to delete the vertex. If the operation is not successful, a message will be displayed. A vertex can't be deleted if it adjoins two or more rooms.

- *Delete a room.* Choose the ⬛ (Select Room) tool and select the room that you want to delete. Then chose the ❌ (Delete Room) tool. VisualDOE will then attempt to delete the room. If deleting the room violates the custom block rules, then the operation fails and a message is displayed for the user. The Delete Room tool is enabled when one and only room is selected.

- *Combine rooms.* Choose the ⬛ (Select Room) tool and select the two rooms that you want to combine. Then chose the ⬛ (Combine Rooms) tool. The combine rooms tool is visible only when two rooms are selected.

- *Relocate the daylighting reference point(s).* Choose the ⬛ (Move Daylight Reference Point(s)) tool. With this tool, select a room, which will be come highlighted. The daylight reference points within the room will also be displayed. Click on one of the daylight reference points and drag it to a new location. Each room has two daylight reference points, which are shown in different colors. The status bar tells you which one you are moving.

- *Insert a vertex.* Choose the ⬛ (Insert Vertex) tool. Click on the line segment where you want to insert the vertex. Once the vertex has been added, you can relocate it using the ⬛ (Move Vertex) tool.

- *Edit room coordinates.* Choose the ⬛ (Select Room) tool and select the room that you want to edit. Then chose the ⬛ (Edit Room) tool. This will cause a spreadsheet like control to appear with the coordinates of the selected room. Modify the coordinates within the spreadsheet control. The Edit Room tool is enabled only when a single room is selected.

Custom Block Rules and Restrictions

There are a few rules that you must follow when creating a custom zone.

1 The zones that are created must be contiguous and together they must form a regular polygon, e.g. the overall block polygon must have no holes.

2 Vertices that define adjacent zones must align with each other perfectly. To achieve this, it is helpful to choose Options | Snap to Vertices or Snap to Line.

Importing Data from a CADD File

A handy feature of VisualDOE is the ability to import data from CADD files. This is a two-step process. The first step is to use a CADD program to create the information you will import. The second step is to import the data into VisualDOE.

Preparing CADD Data for Importing. You can use any CADD program as long as it has the capability to save data as a DXF (ASCII Drawing Exchange Format) file. The following procedure is recommended in preparing CADD data for importing to VisualDOE.

1   Create a layer in your CADD drawing file for each block you want to import to VisualDOE. Give these layers names that will make sense to you later. An example layer name is 1stFlrZns.

2   On each layer, draw a group of contiguous closed polygons. Each polygon represents a room in your energy model. When you create the closed polygons, make sure that you honor the custom block rules and restrictions.

3   Save your CADD file using an ASCII DXF format. Depending on the units you used to create your CADD drawing, you may want to set a scale factor as you save your DXF file. It is best that the units in your DXF file match the units you are using in VisualDOE, either feet or meters.

Importing Data to VisualDOE. Once you have prepared you CADD file, you can import the data to VisualDOE. To do so, carry out the following steps

Step   **VisualDOE Response**

1	Choose ⊞ and then DXF.	Additional controls will appear on the right side of the Custom Block Editor form. These will include list boxes for Layers and Polygons and four command buttons with the captions Open DXF File, Add to Model, Scale Factor, and Leave DXF.
2	Click the Open DXF File command button to open a CADD file.	The common dialog box will appear. Choose a DXF file and click Open. VisualDOE will then attempt to read the file you selected. If it is successful, the Layers list box will be filled with the layers that appear on the file.
3	Click the DXF Scale Factor command button if needed to set the conversion factor for importing data.	VisualDOE uses either feet or meters, depending on whether you are working with SI units. The CADD file, however, can use inches, millimeters, or any other units. The scale factor converts the units used on the DXF file to either feet or meters.
4	Click on the layer that has the closed polygons that you want to import.	An outline of all the closed polygons on the layer will be displayed in the drawing space. The Polygons list box is updated to show the closed polygons located on the layer you just selected. These are labeled Polygon1, Polygon2, etc.
5	Click on one of the polygons	The selected polygon is highlighted.
6	Click the Add to Model command button	The selected polygon is added to the block as a room. When the polygon/zone is added, VisualDOE will check to see that the rules or restrictions have been honored. If they have, VisualDOE will add the room to the block.
7	Repeat steps 5 and 6 until you have completed construction of your custom block	An image of your block will be shown in the drawing area.

You may notice that when you select a layer, the caption reads "Add All". If you click this command button before selecting a polygon, VisualDOE will attempt to add all the polygons to the model, essentially, repeating steps 5 and 6 described above. When adding zones from a CADD file, you must add them such that the rules and restrictions are honored at each step along the way. If you have three zones that are side by side as shown below. You can add 1, then 2, then 3, but you cannot add 1 followed by 3, because 1 and 3 by themselves would violate the custom block rules and restrictions. The "Add All" option looks for optional sequences of adding the rooms so that the rules are not violated at each step.
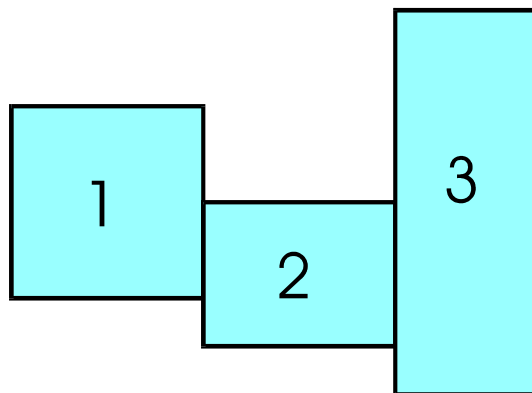
5.3   Rooms Folder
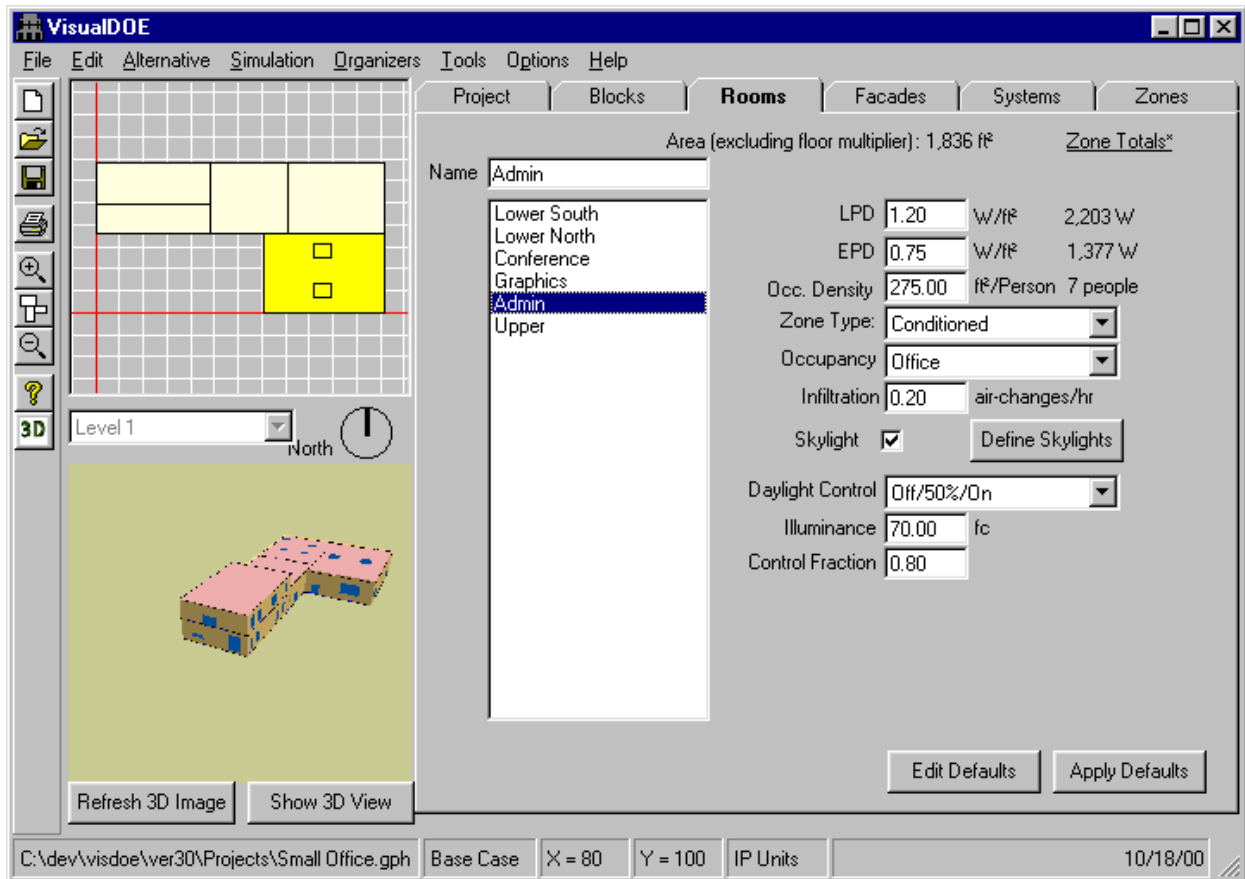
5.3.1   Overview

After you have created and dimensioned the blocks in your model, you use the Rooms folder to edit the properties associated with each of the rooms. Before you even create your blocks, it is good practice to set the default room properties for the most common conditions. When you open a template, the room properties will be initialized. As rooms are created, they will automatically take on the default properties, which reduce the amount of editing that you will need to perform on individual rooms.

A list of rooms is displayed in a list box in the Rooms folder. Select a room in this list and its properties are displayed in the associated text boxes and drop-down list boxes. The selected room(s) is highlighted on the plan. It is possible to select a room in a block that is not displayed. Use the Scroll Plans control to make another set of three blocks visible.The Rooms list is automatically updated whenever a block is added to your model or when a different zoning pattern is applied to a standard block.

The Rooms list can contain all the Rooms in your project, or just the Rooms for the selected block.

To edit the properties associated with a room, (1) select the room from the list box, (2) the properties for that room will be displayed and the room will be highlighted on the plan view, (3) make changes, (4) when you select another room or when you leave the Rooms folder, your changes will be saved.

Group Editing

You can select more than one room at a time and perform group editing. To select more than one room, hold down the control key and click on additional rooms. All selected rooms will be highlighted. You can also use the shift key to select a continuous range of rooms. When you select more than one room, you can see if the rooms have the same properties or different properties. If the selected rooms have the same property, the common value will be displayed in the text box or drop down list box. If any one of the selected rooms has a different value, the text box or drop-down list box will be shown as blank. If you do not make changes to a blank control while doing group editing, the rooms will retain their original (different) values after you have completed editing.

5.3.2   Editing and Applying Defaults

The Rooms folder has two command buttons in the tool bar labeled "Apply Defaults" and "Edit Defaults." To assign defaults, click the "Edit Defaults" button and values you give to LPD, EPD, etc. become the default room properties. When you are finished editing the default zone properties, click the OK button. Rooms are created any time a block is dragged and dropped onto the plan view or any time the zoning pattern is reassigned. Anytime rooms are created by VisualDOE, they rooms will have the default room properties.

You can also select one or more rooms and apply the default room properties to these rooms. To do this, simply select the rooms and click the "Apply Defaults" button.

5.3.3   Room Properties

Name. This name is assigned automatically except for custom zoning. You can change the name however as long as you use no more than 12 characters. You should try to keep the names as simple and short as possible so they will fit in the list boxes. Do not use special characters like #, $, etc. in the name. The first 12 characters of the names should be unique.

LPD (Lighting Power Density). Units W/ft^2 (W/m^2). The overall lighting power density with no consideration of <u>diversity</u>. Keep in mind that this power is modified each hour according to the multipliers in the lighting schedule. These multipliers are between zero and 1.0, so usually the lighting power for any given hour will be less than this value. The total lighting power for the zone is displayed next to the input box.

> If a zone has occupant sensors or other automatic lighting controls that reduce hours of operation, one way to model such controls is to reduce the LPD. As a rule of thumb, occupant sensors reduce lighting hours by about 30% in small enclosed rooms, 15% in large rooms or open areas, and 50% in storage rooms. If half the lighting in a zone had occupant sensors and the overall LPD (before the adjustment) was 2.0 W/ft^2, you might take account of the occupant sensors by entering a value of 1.7 W/ft^2, e.g. (1) lighting power density is 2.0 W/ft^2 in the space without occupant sensors, (2) the adjusted LPD is 2.0 * (1 - 0.30) or 1.4 W/ft^2 in areas with occupant sensors, and (3) the weighted average is (0.5 * 2.0) + (0.5 * 1.4) = 1.7 W/ft^2.

EPD (Equipment Power Density). Units W/ft^2 (W/m^2). The overall equipment power density with no consideration of <u>diversity</u>. Keep in mind that this power is modified each hour according to the multipliers in the lighting schedule. These multipliers are between zero and 1.0, so usually the lighting power for any given hour will be less than this value. The total equipment power for the zone is displayed next to the input box.

Occupant Density. Enter the occupant density. The units are ft^2/person in inch-pound units and m^2/person in SI units. The total number of occupants in the zone is displayed next to the input box.

Zone Type (list box). The choices are conditioned or unconditioned. Rooms that are to be heated and/or cooled or that have exhaust should be modeled as conditioned.

Occupancy (list box). Make a choice from the drop-down list box. This list box has all the occupancies that exist in the project schedule. Each occupancy has a number of schedules and other properties

associated with it. You can choose Organizers|Occupancies to review the schedules and properties associated with each occupancy or to create your own custom occupancy. If the occupancy you are looking for does not show up in the list box, you will have to copy it from the library using the occupancy organizer.

Infiltration. Enter the infiltration rate for the zone in air changes per hour. Tightly constructed buildings will have an infiltration rate of about 0.3 ACH. Average construction will have a rate of 0.5 ACH. Consult the ASHRAE Fundamentals and/or other sources for data on typical infiltration rates.

Skylight. Check the box to model skylights in the selected room. You must ensure that skylights are added to the rooms that have a roof. When the box is checked, a button for defining skylights becomes visible.

Define Skylights. This button is enabled when the "Skylight" box is checked. Clicking on the button launches the "Skylights Editor", where the skylights in the room can be defined.

Daylight Control (list box). Use this control to indicate whether the selected zone(s) have automatic daylighting controls. The available choices are: None, Dimming, On/Off, Off/50%/On, and Off/33%/67%/On. These are described below

None	This choice is appropriate when none of the lighting in the zone has automatic daylighting controls.
Dimming	This type of daylighting control uses continuous dimming to maintain the design specified illuminance. If the lighting level in the space is greater than the specified illuminance, the lights are dimmed until exactly the specified illuminance is maintained. The performance of the dimming control is based on an electronic dimming ballast that operates in a linear fashion between 100% and 20% light output. Within this range, power ranges between 100% and 30%.
On/Off	Electric lights are either on or off. If the specified illuminance can be maintained by daylighting alone, the electric lights are off, otherwise they are on.
Off/50%/On	Electric lights are either off, half-on, or fully-on. In a given hour, if the specified illuminance can be maintained by daylighting alone, the electric lights are off. Otherwise, the electric lights come on a step at a time until the specified illuminance is achieved.
Off/33%/67%/On	This works in a similar manner to the Off/50%/On type of control except that the electric lights are operated in four steps instead of three.

Daylighting is a fairly complicated phenomenon and VisualDOE makes a number of simplifying assumptions. Two daylight sensors are assumed to be located at desk height in the center of the space. The position of the sensor can be re-positioned in the custom block editor. Surface reflectances are assumed to be 80% for the ceilings, 50% for the walls and 20% for the floors. When modeling daylighting, pay special attention to the interior shade control on the facades folder. Make sure the room has at least one window or skylight when specifying daylighting.

Illuminance. Units are foot-candles (lux). This information is used only if the Daylight Control for the zone is a choice other than "None". When daylighting is modeled, electric lighting is turned off or dimmed only when lighting levels in the space exceed the illuminance. With no daylighting contribution, the electric lighting system is assumed to provide this illuminance when the lights are operated at 100% power. The lower the target illuminance, the greater the daylighting savings. The program uses up to two daylighting sensors for each room. You can enter the target for the two sensors separately. By default the two sensors are positioned one third and two thirds of the distance respectively from the window. The position of these sensors can be changed in the custom block editor.

Control Fraction (unit-less). This information is used only if the Daylight Control for the zone is a choice other than "None." Usually not all the lights in a zone will be controlled by the daylighting system. This input indicates the fraction of lights that are dimmed or turned off when lighting levels in the space exceed the design illuminance. The total control fraction for the two sensors can't be more than 1.

Open to Below. Click this check box if you want to combine the zone with a zone below. This control is not visible for single block models or for blocks that do not have other blocks beneath them. This is useful to

model atrium spaces and/or other tall spaces that extend for more than one floor. When this is checked, VisualDOE looks to see which rooms on the level below are directly underneath the selected room and displays them in the "Zone Open To" list box. An open to below room is connected to the room below with an "air partition". The program does not model air exchange between the spaces.

Zone Open To (list box). This list box is only visible when "Open to Below" is checked (see above). It displays the rooms that the selected room can be open to. To construct this list, VisualDOE scans all the rooms in the block below to determine which ones adjoin. A selection must be made in this list box if "Open to Below" is checked.

5.3.4   Skylights Editor
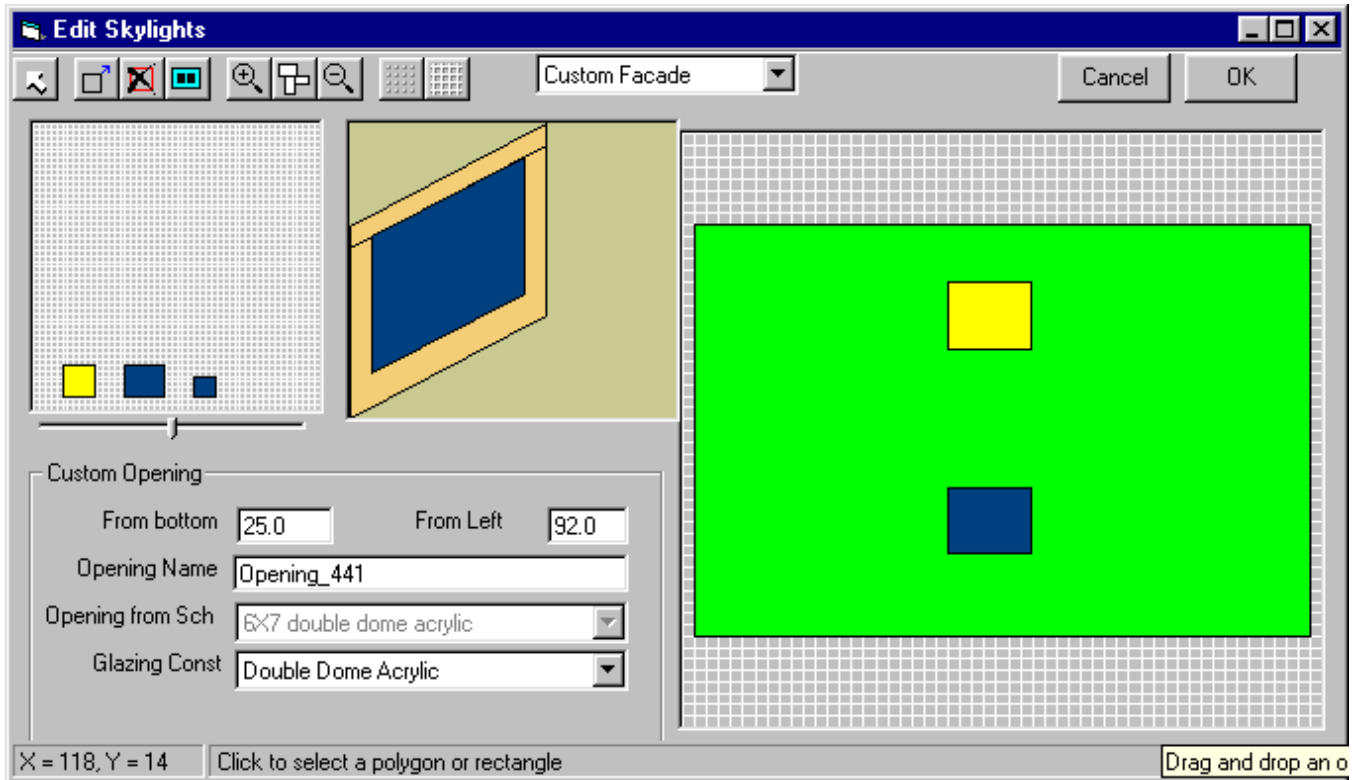
The skylight editor is used to add skylights to a room. A plan view of the room is displayed showing the size and position of the current skylights.

The upper left view displays all the skylights in the project schedule. The skylights can be selected by double clicking on the figure. The selected skylight is highlighted and a detailed view appears in the adjacent box.

Skylights can be added to the façade by dragging them from the schedule view and dropping them on the façade view. Once a skylight is added, it can be repositioned using the 'Move' tool from the toolbar or by specifying its "From Bottom" and "From Left" properties. You can also select a different glazing type for a selected skylight.

Specification Method. Select one of the two choices, Custom Façade and No Openings, in the combo box.

OK. Click this button to save changes made and close the form.

Cancel. Click this button to discard any changes made and close the form.

Tool Bar

Select. Use this tool to select a single skylight. When you select an skylight, its properties are displayed. These properties of the selected window can then be edited. For each skylight you can edit the sill height, the distance from the left side of the wall/surface, the skylight object and the glazing.

Move Opening. Use this tool to reposition an skylight by dragging it to a new location with the mouse.

Delete Opening. Use this tool to delete the selected skylight from the façade or surface.

Refresh Drawing. This tool refreshes the view of the façade/room. Usually the view is automatically refreshed.

Zoom In. Use this tool to zoom in on a portion of the façade/room. Drag the mouse pointer over the area that you want to zoom to and release the button.

Zoom Out. This tool zooms out to the previous view. If there are no previous views, then one grid spacing is added in each direction.

Zoom Extents. This tool zooms so that the extents of the façade/room is wholly contained within the visible drawing space.

Display Grid. This toolbar button toggles display of the grid lines.

Grid Setup. This toolbar button opens the Grid Settings form. Use this tool to change the snap to grid

5.4   Facades Folder
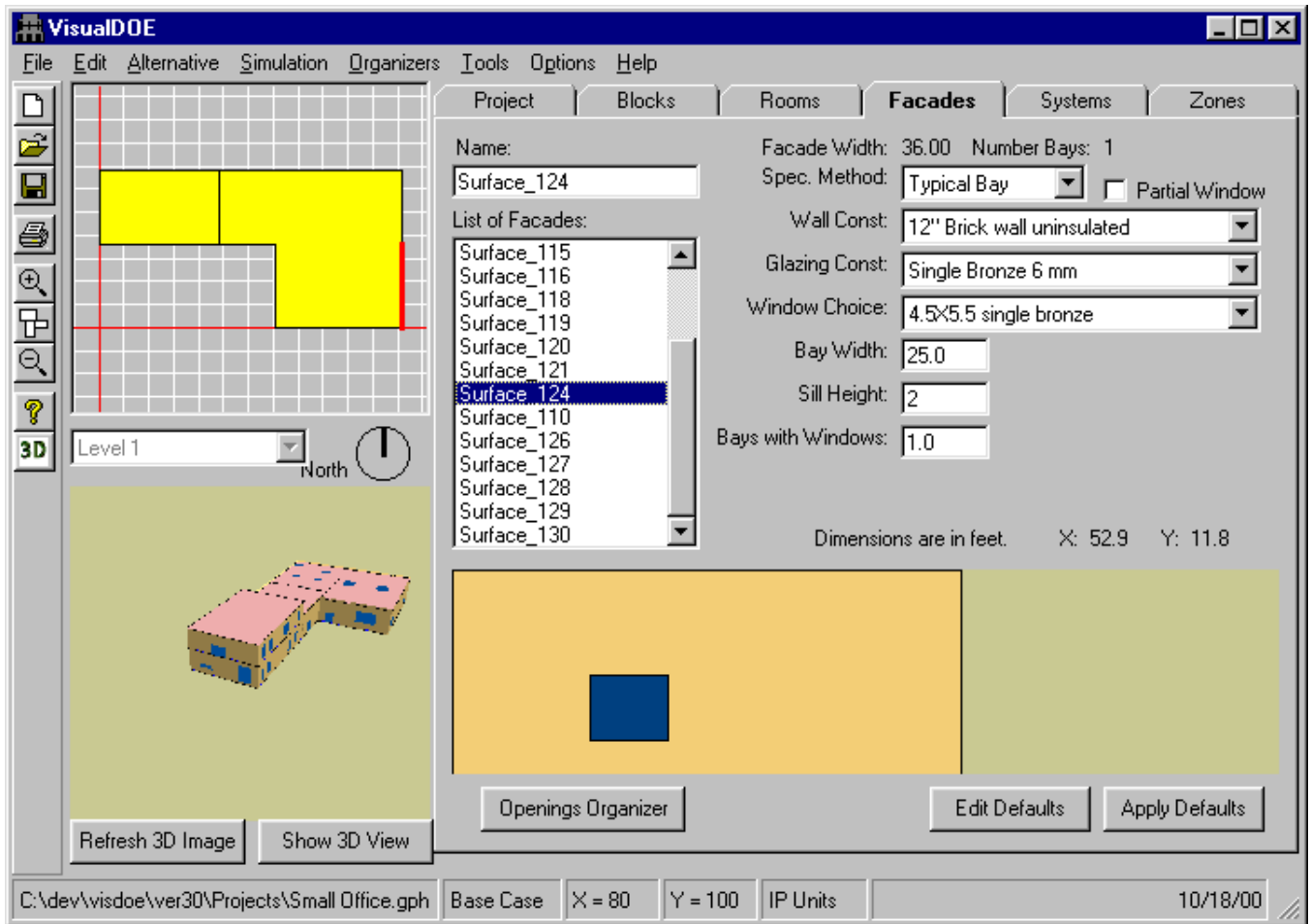
Overview

After creating blocks in your model, you can use the 'Façades' folder to assign properties to the exterior walls in the project. Select the type of fenestration that you want to assign to this wall from the "Spec. Method" list-box. You can select "Custom Façade" to individually place windows on the wall, "Typical Bay" to assign windows based on a typical bay, or "No openings" to remove all windows from the wall.

If you select Custom façade, the "Edit Custom Façade" button becomes visible. Clicking on this button launches the custom façade editor.

If typical bay method is selected, you will have to specify additional properties to define the openings. The facade is divided into bays with the specified bay width, with one window in each bay. You then specify the height and width of the window in each bay, indicate the fraction of bays with windows, check whether you have exterior and/or interior shading, and select a wall and fenestration construction.

A list of facades is displayed in a facades list box on the Facades folder. This list box is located in the upper left corner of the folder. Select a facade in this list and its properties will be displayed in the text boxes and drop-down list boxes. The facade you are defining properties for is highlighted on the plan views. The facades list is automatically updated whenever a block is added to your model. To edit the properties associated with a facade, (1) select the facade from the list box, (2) the facade properties for that facade

will be displayed, (3) make any appropriate changes, (4) when you select another facade or when you leave the Facades folder your changes will be saved.

You can select more than one facade at a time and perform group editing. To select more than one facade, hold down the control key and click the additional facade(s). All selected facades will be highlighted. You can also use the shift key or hold down the left mouse button to select a continuous range of facades. When you select more than one facade, you can see if the facades have the same properties or different properties. If the selected facades have the same property, a value will be displayed in the text box or drop down list box. If any one of the selected facades has a different value, the text box or drop-down list box will be shown as blank. If you do not make changes to a blank control while doing group editing, the facades will retain their original (different) values after you have completed editing.

Before you create your blocks, it is good practice to set the default facade properties for the most common conditions. As you add blocks to your model, their facades will automatically take on the default properties and this will reduce the amount of editing that you will need to perform on individual facades. The Facades folder has two command buttons in the tool bar labeled "Apply Defaults" and "Edit Defaults." Click the Edit Defaults button and values you give to Bay Width, Window Width, etc. become the default facade properties. When you are finished editing the default facade properties, click the OK button. Newly created facades will be born with the default facade properties. Facades are created any time a block is dragged and dropped onto one of the plans. You can also select one or more facades and apply the default facade properties to these facades. Simply select the facade or facades you want to apply the default facade properties to and click the Apply Defaults command button.

If your model does not have daylighting or exterior shading, you can make the Bay Width equal to the facade width and place just one window in the facade with the overall area of the facade. The dimensions of individual windows are important when daylighting is modeled since the windows will need to be distributed along the facade. Also when overhangs or side fins are modeled, it is important to enter the height and width of the typical window.

5.4.1   Facade Properties

Spec. Method. Select one of the three choices Typical Bay, Custom Façade and No Openings.

Wall Construction (list box). Select a wall construction from this list box. A separate wall construction can be selected for each facade or the same facade can be applied to all facades.

Bay Width. Units are ft (m). The bay width is the most important of the facade properties. VisualDOE divides the facade into bays based on this input. For instance, suppose that the entire facade is 100 ft and you specify a bay width of 20 ft. VisualDOE will divide the facade into five bays (100 ft divided by 20 ft/bay). Each bay can contain a window as specified below. When you model daylighting, it is important to distribute the windows appropriately over the facade in a way that reasonably approximates the real building. Also, when your facade has overhangs or sidefins, it is important to correctly divide the facade into bays. Otherwise, if you are not modeling daylighting or exterior shading, the only thing that is important is the total window area on the facade. The width of the facade and the number of bays are displayed on the Facades folder to assist you in defining facade properties.

Sill Height. Units are ft (m). VisualDOE places a window in each bay at this sill height. This value is distance from the floor to the window's lower frame outer edge.

Glazing Construction (list box). Select a glazing from this list box. If the list box does not include the glazing that you want to use, you can modify the list by adding it to the project schedule.

Window Choice (list box). Select an opening from this list box. If the list box does not include the window that you want to use, you can modify the list by adding it to the project schedule.

5.4.2   Custom Facades

Click on the "Edit Custom Façade" button to launch the custom façade editor. You can add or remove openings in the project schedule using the "Openings Organizer".
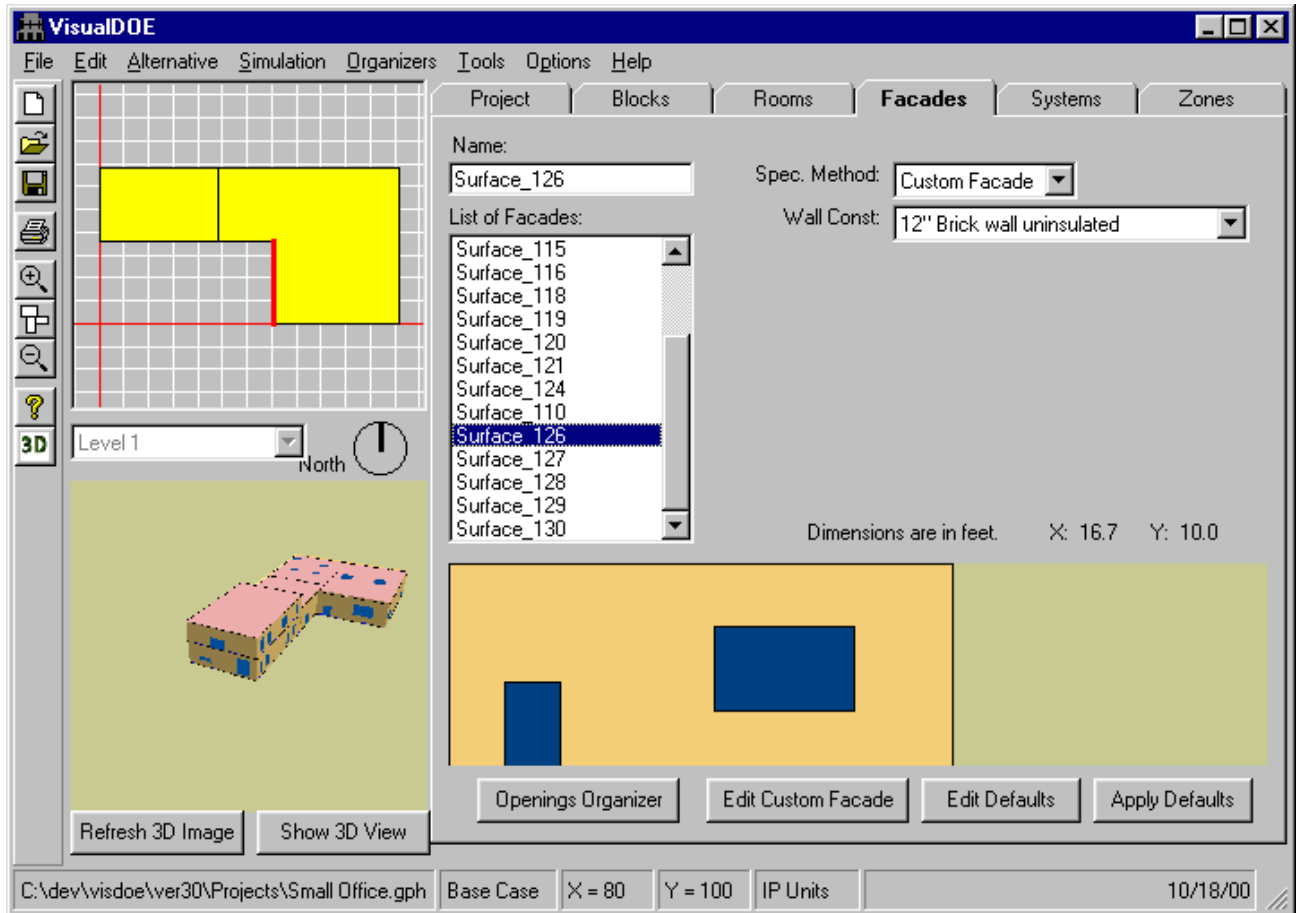
5.4.3   Custom Facade Editor
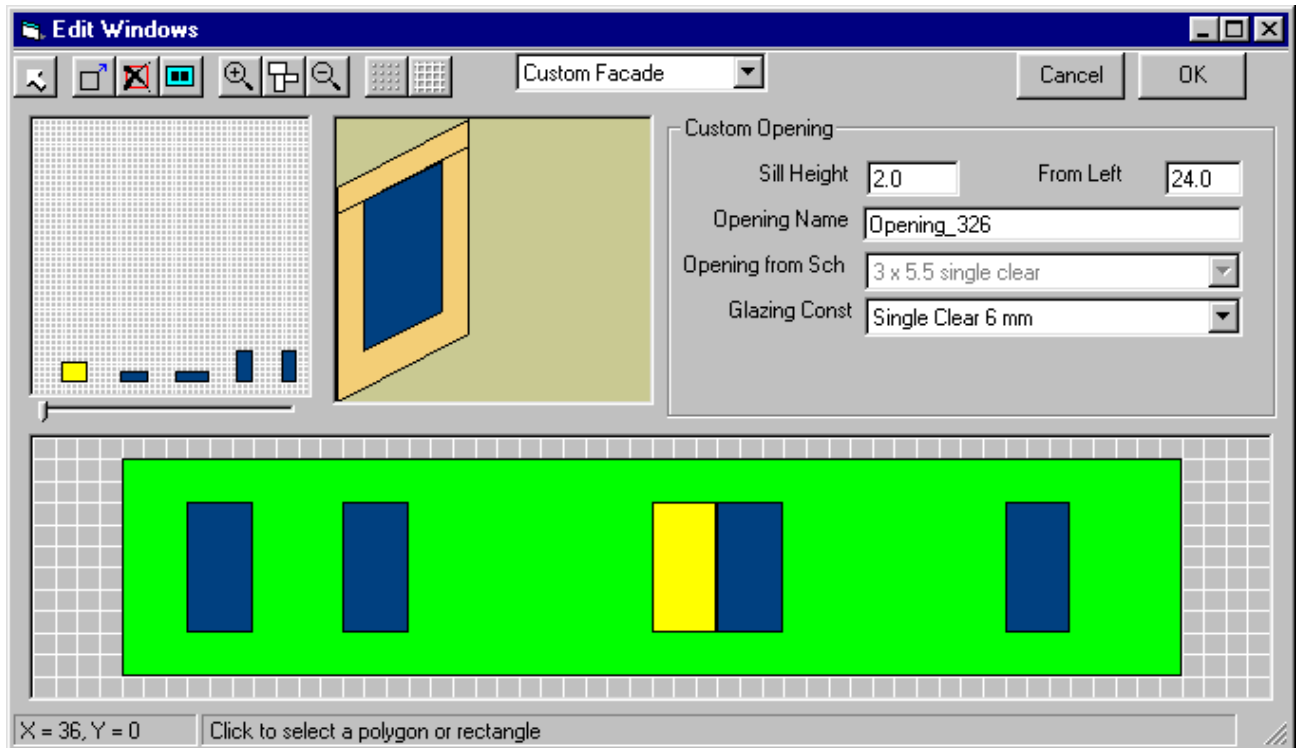
The openings editor is used to add openings to an exterior façade. An elevation view of the façade is displayed showing the sizes and positions of the current openings

The upper left view displays all the openings in the project schedule. The openings can be selected by double clicking on the figure. The selected opening is highlighted and a detailed view appears in the adjacent box.

Openings can be added to the façade by dragging them from the schedule view and dropping them on the façade view. Once an opening is added to the façade, it can be repositioned by using the 'Move' tool from the toolbar or by specifying its "Sill Height" and "From Left" properties. You can also select a different glazing type for a selected opening.

- ▪ **Specification Method**. Select one of the two choices, Custom Façade and No Openings, in the combo box.

- ▪ **OK**. Click this button to save changes made and close the form.

- ▪ **Cancel**. Click this button to discard any changes made and close the form.

Tool Bar

Select. Use this tool to select a single opening. When you select an opening, its properties are displayed. These properties of the selected window can then be edited. For each opening you can edit the sill height, the distance from the left side of the wall/surface, the opening object and the glazing.

Move Opening. Use this tool to reposition an opening by dragging it to a new location with the mouse.

Delete Opening. Use this tool to delete the selected opening from the façade or surface.

Refresh Drawing. This tool refreshes the view of the façade/room. Usually the view is automatically refreshed.

Zoom In. Use this tool to zoom in on a portion of the façade/room. Drag the mouse pointer over the area that you want to zoom to and release the button.

Zoom Out. This tool zooms out to the previous view. If there are no previous views, then one grid spacing is added in each direction.

Zoom Extents. This tool zooms so that the extents of the façade/room is wholly contained within the visible drawing space.

Display Grid. This toolbar button toggles display of the grid lines.

Grid Setup. This toolbar button opens the Grid Settings form. Use this tool to change the snap to grid

5.5 Systems Folder

 Overview

The Systems folder has fewer controls than the other folders and is relatively simple to use. The folder consists of four option buttons in the upper left corner where you indicate how you want to make zone to system assignments. To the left of the option buttons is a list of the systems in your model. If you have chosen custom zone assignments, a list of zones will appear as well. When you click on a system, the zones that are served by that system are highlighted both in the list box and in the plan views. When you first move to the Systems folder, however, assignments will not have been made and the systems list will be empty.

System assignment rules:

- All zones/rooms have to be assigned to a system.

- An unconditioned zone can't serve as the control zone for a system.

- A system needs to have at least one conditioned zone assigned to it.

If you have an unconditioned zone, you can't assign one system per zone. If a zone requires any kind of heating, cooling or air-flow, it has to be modeled as a conditioned zone. For example a ventilated toilet, which borrows air from the adjoining zones and exhausts it, should be modeled as a conditioned zone.

Assignments. The first step in using the Systems folder is to choose one of the option boxes for assigning zones to HVAC systems. When you choose one of these option buttons, one or more systems will appear in the systems list box. The systems list box will be empty until assignments are made. Four option buttons are provided, as described below:

- **One System for the Building**. Your model will have only one HVAC system and this system will serve all zones in your model. The systems list will include just one entry.

- **One System for Each Block**. The zones in each block will be served by a separate system. If you have five blocks in your model, the systems list will include five systems.

- **One System for Each Zone**. Each zone in your model will be served by its own system. This choice is appropriate for water-loop heat pump systems, four-pipe fan coil systems, and other "single zone" systems. The systems list will include a system for each zone. The systems list will be a one-to-one match of the zones list. If you use this approach it will be necessary to separately define the properties of each system. There is a shortcut for unitary equipment, however, if the equipment assigned to multiple zones has the same performance characteristics. If you meet these conditions, you can define just one system and assign multiple zones to this system. DOE-2 will then model a separate system for each of the zones assigned. If you checked "Let Program Size", then a separate system will be sized for each zone.

- **Custom**. With this choice, you can create systems to suit your particular needs and assign zones through a drag and drop procedure.

Use Smart HVAC Defaults. If this box is checked, the HVAC systems are assigned automatically based on the building size, predominant occupancy and era. These defaults are intended to provide a starting point for users unfamiliar with HVAC systems and should be used only when you have no information/knowledge of the actual HVAC systems being used in the building.

HVAC System Editor. The process of defining an HVAC system is a little more complicated than setting the properties of a zone or facade so instead of including all the system properties on the folder, a separate button is provided which brings up the 'VisualDOE HVAC Systems Editor'. To define a system, (1) select a system in the systems list box and (2) click the HVAC Systems Editor command button. A diagram of the system you have selected will appear in a form above VisualDOE.

Central Plant Editor. Your model can have only one central plant for providing chilled water and hot water to the HVAC systems. Click the Central Plant Editor command button and a diagram of the central plant in your model will appear in a form above VisualDOE. Use this form to define the central plant.

Water Heating System Editor. Click the Water Heating System Editor and a form will appear that will enable you to define the loads, schedules and equipment used to provide service hot water. The water heating system is defined for the entire building, and because of limits of DOE-2, you can have just one water heating system.

Water Loop HP Plant Editor. This command button is only visible when at least one of the systems is a water loop heat pump system. Use this command button to bring up the Water Loop HP Plant Editor, which can be used to view and edit the central plant for the water loop heat pump.

Systems Folder Custom Assignments

Custom System Assignments. When you choose the option button labeled Custom, a list of the zones appears and a couple of additional command buttons appear on the folder labeled Add System and Delete System. With the Custom option you can create as many systems as you need. You then assign zones to these systems by selecting the zones from the zones list box and dropping them onto a system. The following procedure is recommended when you make custom system assignments.

Step	VisualDOE Response
1. From the Systems folder, click the Custom option in the Assignments frame.	A system will be created and all the zones will be assigned to this system. This is essentially the same as choosing "One system for whole building" except that you can add additional systems and reassign zones. You can change the name of this system; it starts off with the name "custom system."

2. From the Systems folder, click the Add System command button.

A second system will be created.

3. Give your new system a unique name in the text box above the systems list. The first 12 characters of the names should be unique.

Your newly created system will appear in the systems list box with no zones assigned to it. All zones are still assigned to the original system.

4. Repeat steps 2 and 3 until you have created as many systems as you need.

The systems list will be updated each time you add a system.

5. Select a zone in the zones list box, drag it over to the systems list and drop it on the system that you want to serve the zone.

This reassigns zones from one system to another.

6. Repeat step 5 until all zones are served by one and only one system.

Zones are reassigned.

5.5.1 Water Heating System Editor

This form is called from the Systems Folder of the Graphic Editor when you click the Water Heating System Editor command button. It is organized on two folders. The first folder is used to specify hot water consumption and equipment performance characteristics such as type, tank loss coefficient, etc. The second folder is used to display the names of the part load performance curves. At the top of the form, select a template from the choices in the library. You can use the Equipment Editor to add templates to the library. When you select a template, all the properties of the water heating system are initialized. You can then modify them if you choose.

On the Specification folder, enter the following data:

Type. Drop down list box. Choose one of four types of water heaters: gas, electric, heat pump or desuperheater.

Schedule. Choose a water heating schedule by selecting a fractional schedule.

Auto Size. Checkbox. Check this if you want DOE-2 to size the water heating equipment to meet the peak load.

Capacity. Units are kBtu/h (W). If Auto Size is not checked, then this text box is enabled so you can enter the capacity of the equipment. If multiple water heaters exist in the building, the total capacity of all pieces of equipment should be entered.

Peak Consumption. Units are gpm (l/s). This value is modified for each hour by the hot water schedule associated with the occupancy. ASHRAE Standard 90.1-1989 and other codes specify hot water consumption in terms of Btu/h-person. When working with this data you may use the following conversions:

$$\frac{gal}{min} = 10000 ft^2 \cdot \left(\frac{per}{175 ft^2}\right) \cdot \left(\frac{215 Btu}{h - per}\right) \cdot \left(\frac{lb \cdot F}{.999 \cdot Btu}\right) \cdot \left(\frac{ft^3}{62.32 \cdot lb}\right) \cdot \left(\frac{7.48 \cdot gal}{ft^3}\right) \cdot \left(\frac{h}{60 \cdot min}\right) \cdot \left(\frac{1}{60 \cdot F}\right)$$

In the above equation you will need to substitute the appropriate values for the delta-T (60F), the building size (10000 ft²), the water heating per person (215 Btu/h-per), and the occupant density (175 ft²/per). Of course a separate (but simpler set of conversions are needed if you are working in SI units.

Supply Temperature. Units are °F (°C). Enter the leaving water temperature from the heater.

Tank Loss Coefficient. Units are Btu/h-F (W/C). Enter the rate of heat loss from the tank.

Circulating Pump. Checkbox. Indicate by checking the box whether a circulation pump is used to distribute hot water. If checked, then enter the horsepower (kW) of the pump. The pump is assumed to operate according to the schedule indicated above.

Fuel Meter. This list box is shown when multiple fuel meters exist and the water heating system is gas (fuel).

5.5.2   HVAC Systems Editor
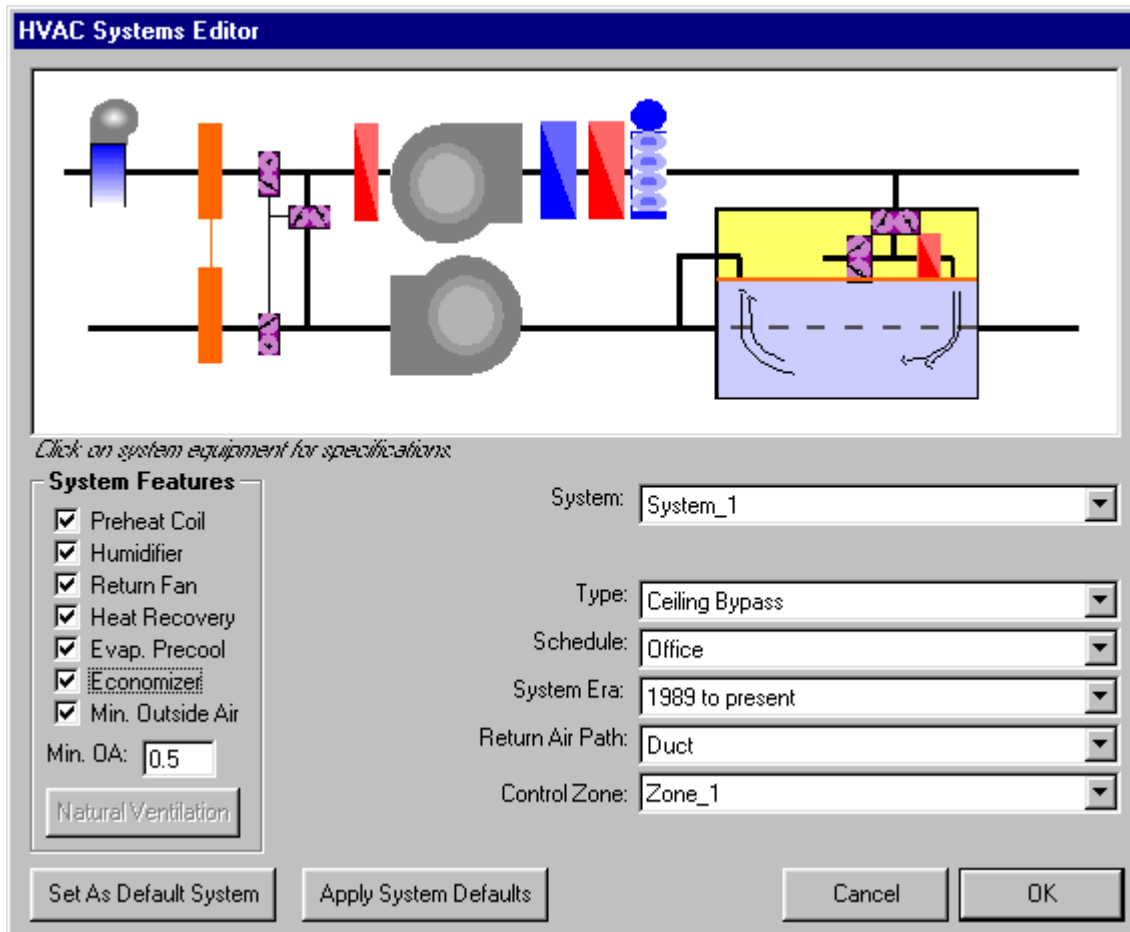
When you click the HVAC System Editor command button from the Graphic Editor Systems Folder, the HVAC Systems Editor comes up displaying a diagram of the HVAC system you selected. This diagram and the associated controls provide a metaphor for editing and defining the HVAC system. The diagram shows the major components of the system such as the supply fan, cooling and heating coils as well as optional features such as an economizer, preheat coil, humidifier, return fan, heat recovery coils, and an evaporative precooler. The system diagram changes in response to the type of system you select and the system features you specify. You indicate whether the system has any or all of the optional features by checking the boxes in the systems features section of the form. You will see graphic icons representing the optional features appear or disappear as you make your selections. The available systems features depend on the type of system you have selected.

Much of the information about the system is specified in the drop-down list boxes in the lower right portion of the form. These list boxes are used to specify the type of system (most of the systems supported by DOE-2.1E are included in this list), the schedule of operation, when the system was built or last renovated, the return air path and the name of the control zone. With this information specified, you can click the Defaults button and VisualDOE will specify all system and plant components using appropriate default values.

Like other portions of the Graphic Editor, there are many ways to define an HVAC system. For first time users, however, the following steps are recommended:

1.   In the Systems Folder of the Graphic Editor, make the correct assignments between zones and systems. Some of the defaults that are applied later depend on the floor area served by the system so it is important to perform this step first.

2.   In the Systems Folder select a system in the list box and press the HVAC System Editor button. The HVAC Systems Editor will appear.

3.   Begin defining the system by making selections from the drop-down list boxes in the lower right portion of the form. Choose system Type, Era, Schedule, etc.

4.   Identify the optional system features by clicking the appropriate checkboxes in the System Features frame. Not all features will be available for all systems. The ones that are not available are grayed out.

5.   Press the Defaults command button. This will assign default values to the fan(s), cooling coils, and other system components based on the information entered in steps 1 through 4.

6.   Edit each of the system components by clicking on the component and, if appropriate, modifying the default information assigned in step 5.

7.   Repeat steps 1 through 6 for the other systems in your model. Hint: you do not have to leave this form to edit another system; simply select the other system from the System list box.

System Properties

System (list box). This list contains all the systems that were created on the Systems Folder of the Graphic Editor. After you have finished editing a system you can move to another system by selecting another system in this list box.

Type (list box). This list box contains all the applicable system types. This is the most important information that you specify for the system. The available system types are listed below.

- Ceiling Bypass
- Ceiling Induction
- Constant Volume Reheat Fan
- Dual Duct Fan
- Evaporative Cooling
- Floor Panel Heating.
- Four-Pipe Fan Coil
- Four-Pipe Induction Unit
- Heating and Ventilation
- Multi-Zone Fan
- Packaged Gas Solid Desiccant *(Not Avail in VisualDOE)*
- Packaged Multi-Zone Fan
- Packaged Single Zone
- Packaged Terminal Air Conditioner
- Packaged Vari.-Volume Vari.-Temp
- Packaged Variable Air Volume
- Powered Induction Unit
- Residential Vari.-Volume Vari.-Temp
- Residential

- Single-Zone Variable Temperature
- Two-Pipe Fan Coil
- Two-Pipe Induction Unit
- Unit Heater, Unit Ventilator
- Variable Air Volume
- Water Loop Heat Pump

Schedule (list box). Select an occupancy type from this list box and the HVAC fan and temperature schedules associated with this occupancy will be used for the system you are editing. It is not necessary that the zones served by the system have the same occupancy. VisualDOE will use the lighting, people, equipment and infiltration schedules for loads input. The fans schedule is used for systems input, and the cooling temperature and heating temperature schedules are used in the system zone descriptions. The default HVAC occupancy is the predominant occupancy for the zones that are served by the system. If zones served by the system have different occupancies, the predominant occupancy is the largest area served. VisualDOE has standard ASHRAE 90.1-1989 schedules for ten occupancy types. These schedules address the operation of the fans, the heating and cooling setpoint temperatures and outside air supply. You can also create your own occupancy type if the standard ASHRAE schedules are not acceptable.

System Era (list box). The default system era is the building era entered on the General Folder of the Graphic Editor. However, sometimes the system will have been renovated or remodeled after the initial construction of the building. You should enter the era when the majority of the system components were purchased and installed in the building. The choices are 1950 and before, 1951 - 1977, 1978 - 1988, and 1989 to present. The System Era along with the floor area served by the system, the system type, etc. is used when you Apply Defaults.

Return Air Path (list box). The choices are ducted return, plenum return and return through the space, although not all choices will be available for all system types. Your choice in this list box will determine how may unconditioned zones are created in your model. If a plenum exists, then one unconditioned zone or plenum will be created for each system.

Control Zone (list box). This list box contains all the zones that are served by the selected system. Select one of the zones as the control zone. The control zone is extremely important when multiple zones are served by "single zone" systems since the system will try to maintain comfort conditions in the control zone. With VAV systems, the control zone is used to set certain system level properties such as the minimum supply air ratio.

Standard System Components

Standard system components always appear in the system diagram. These include the Supply Fan, Cooling Coil, and Heating Coil. The properties of these standard components are set when you press the Defaults button. You can review these properties or make additional changes by clicking on the component in the diagram. For additional information about system component properties, click on the underlined terms above.

Optional System Components

The optional system components appear in the system diagram only if they are checked in the Systems Features frame. The optional system components include, a Preheat Coil, Humidifier, Return Fan, Heat Recovery, Evaporative Precooler, Economizer, and the Minimum Outside Air fraction. The properties of the optional system components are set when you press the Defaults button. You can review and edit the properties by clicking on each component in the diagram. For additional information about system component properties, click on the underlined terms above.

Special System Types and Components

Some system types have special forms for entering data other than the standard and optional system components forms. These special systems include the Evaporative Cooler, Water Cooled Condenser, Air-

to-Air Heat Pump, and the Water Source Heat Pump. Click on the underlined terms for more information on the specification forms for these special system types.

Cooling System, Overview

The cooling form is activated when you click on the cooling coil from the HVAC Systems Editor. This form is used to describe the properties of the cooling coil for chilled water systems or the cooling system for packaged equipment. This form has a list box at the top where you can select a template. The remainder of the information is organized on three folders. The first folder, labeled Specification is used for all types of systems. The second folder, labeled DX Specification is used only for HVAC systems that have their own compressor, evaporator and condenser. The third folder is for part-load curves and is appropriate for all HVAC system types.

Template (list box). This list box contains all cooling systems that have been entered in the library. Cooling systems in the library fall in two categories: those for cooling coils with chilled water supplied by a central plant and cooling systems such as direct expansion system that include a compressor, evaporator and condenser. The type that appears in this list box depends on the type of system. When you make a choice from this list all cooling system properties are updated appropriately, including part load curves. Once you have selected a fan type and initialized all the properties, you can still edit the properties. Using the Equipment Editor, you can create new cooling systems and add them to the library.

Cooling System, Specification Folder

Supply Temperature. Units are degrees °F (C). This is the temperature of air leaving the cooling coil at design conditions. Depending on the method of control (see below), this temperature may be reset under certain conditions.

Control (list box) There are three choices for air temperature control: Constant Temperature, Reset By Warmest Zone and Reset By Outside Air. If you choose Reset By Outside Air, you must enter data relating the supply air temperature to the outside air temperature (see below).

- **Reset Temperatures.** Units are degrees °F (C). This data needs to be entered only if the supply air temperature is Reset By Outside Air. You enter two data points that relate supply air

temperature to the outside air temperature. When the outside air temperature is equal to or less than the low temperature, the supply air temperature will be fixed (constant) at the corresponding supply temperature. When the outside air temperature is equal to or greater than the high value, the supply air temperature will be constant or fixed at the value associated with the upper limit. When the outside air temperature is between the limits the supply air temperature will be interpolated between the two limits.

Let Program Size (check box). When checked, the program will determine the capacity of the cooling system. You must, however, specify an oversizing ratio. When not checked then you must enter both the total capacity and the sensible capacity as described below.

- **Oversizing Ratio**. Unitless. If Let Program Size is checked then this control is active. A value of 1.0 should be entered if you want the cooling system to be sized exactly to meet the peak load. A value of 1.5 represents 50% oversizing, etc.

- **Total Capacity**. Units are Btu/h (kW). This control is visible only when Let Program Size is not checked. This is the total capacity of the cooling system, including both sensible and latent.

- **Sensible Capacity**. Units are Btu/h (kW). This control is visible only when Let Program Size is not checked. This is the sensible capacity of the system.

Dehumidification (check box). When checked, the cooling system will be operated to control humidity in the space. When checked it is necessary to enter the Maximum Relative Humidity.

- **Maximum Relative Humidity**. When Dehumidification is checked, then the cooling system will be operated to limit relative humidity to this maximum.

Coil Bypass Factor. Used to characterize the performance of the cooling coil.

Cooling System, DX Specification Folder

This folder is active only if the system is a packaged unit with its own compressor, evaporator, condenser, etc.

Energy Efficiency Ratio. Units are Btu/h of output per Watt of input determined at American Refrigeration Institute (ARI) conditions. The units are the same for both inch-pound and SI (metric) units. If you selected "Include in EER" as the method of modeling fan energy, then this text box is active; otherwise you enter the Energy Input Ratio (see below).

Energy Input Ratio. Unitless. This is the input power divided by the output capacity, both in the same units. EIR should be determined at full load ARI conditions. Only compressor, condenser fan, and cooling related energies should be included in the ratio. Make sure not to include fan energy since it is modeled separately.

Desuperheater (check box). If checked, the cooling system is modeled with a <u>desuperheater</u> (available only for packaged equipment). When checked you must enter the Fraction of Load Recoverable and the Waste Heat Use.

- ▪ **Fraction of Load Recoverable**. Enter a fraction representing the ratio of recovered heat to the cooling capacity.

- ▪ **Waste Heat Use** (list box). Choose a use of the heat that is recovered. Choices are Space Heating or Space Heating and Water Heating.

Evaporative Condenser (check box). If checked, you enter the rated effectiveness of the air flow over the condenser to reach the wetbulb temperature. You also enter the energy used by the evaporative condenser in kW per Btu/h (kW) of cooling capacity. This option is available only for packaged equipment.

Water Cooled Condenser. When checked, a command button becomes visible labeled "Define Water Cooled Condenser". Click this button to review and edit the water cooled condenser properties, which is essentially a cooling tower. This option cannot be used in combination with <u>water loop heat pumps</u>.

Cooling System, Curves Folder

This folder or tab is available for review only. The family of curves that are displayed are determined by your choice of Template (see above). If you want to create a piece of equipment with special curves, you must choose Tools|Equipment Editor and add the equipment to the library. It will then appear in the list box and you may select it and the associated part load curves.

Heating Form, Overview

The form is activated when you click on the heating coil from the HVAC Systems Editor. This form is used to describe the properties of the heating coil for central systems or the heating system for packaged equipment. Information is organized on two folders. The first folder, labeled Specification, is used to specify heating system properties. The second folder displays information about part-load curves.

Template (list box). This list box contains all heating system templates that can be used to initialize all the properties of heating systems. When you make a choice from this list all heating system properties are updated appropriately, including part-load curves. Once you have selected a heating system template type, you can still edit the properties in case the template does not exactly match your model. Templates can be used to save time. Using the Equipment Editor, you can create new heating system templates and add them to the library.

Heating Form, Specification Folder

Supply Temperature. Units are degrees °F (C). This is the temperature of air leaving the heating coil when the system is in a heating mode.

Temperature Control (list box). For DDS, MZS, PMZS, and HVSYS systems you select how the supply air temperature is controlled. The control options are Constant Temperature, Reset by Coldest Zone or Reset by Outside Air.

- **Reset by Outside Air**. This data needs to be entered only if the supply air temperature is reset in response to the outside air temperature. You enter two data points that relate supply air temperature to the outside air temperature. The outside air temperature for the first point should be lower than the second point. When the outside air temperature is between the limits the supply air temperature will be interpolated.

Let Program Size (check box). When checked, VisualDOE will size the heating system using the oversizing ratio specified below. When not checked, you enter the capacity of the equipment.

- **Capacity.** Units are Btu/h (kW). This is the rated heating capacity at ARI conditions for heat pumps. When you do not Let Program Size, you should make sure that the heating loads are being satisfied in all the zones. You can verify this by choosing Simulation|Diagnostics from the pull-down menu of the Graphic Editor.

- **Oversizing Ratio**. This is the ratio of the rated heating equipment capacity at ARI conditions divided by the design load calculated by DOE-2. A value of 1.5 would mean that the heating equipment is 50% oversized. The assumptions used when DOE-2 calculates the heating loads are different from the assumptions used in most sizing programs, resulting in smaller equipment than is typically installed. For this reason, it is common to use an oversizing ratio of at least 1.5 when you Let Program Size.

Heating Source (list box). The choices are Hot Water from a Central Plant, Electric Resistance, Electric Heat Pump or a Furnace. If you choose heat pump, a command button becomes activated so that you can define the properties of the heat pump. If you choose furnace, additional boxes become visible on the form so you can enter the characteristics of the furnace.

- **Define Heat Pump**. This is active only if you select Electric Heat Pump as the Heating Source.

- **Thermal Efficiency**. If the heating source is furnace, you enter the peak thermal efficiency of the furnace. For part-load conditions, VisualDOE will calculate the efficiency based on standard DOE-2.1E performance curves.

- **Auxiliary Power**. This is active only if you select Furnace as the Heating Source. If the furnace has electric auxiliaries, you enter these as a total kW. This might include energy used by a powered combustion unit.

- **Pilot Light**. This is active only if you select Furnace as the Heating Source. If the furnace has a pilot light, you enter the energy used by the pilot in Btu/h.(kW).

- **Fuel Meter**. This list box is shown when multiple fuel meters exist and if the Heating Source selected is Furnace.

Heating Form, Curves Folder

This folder is available for review only. The family of curves that are displayed are determined by your choice of Template (see above). If you want to create a piece of equipment with special curves, you must choose Tools|Equipment Editor and add the equipment to the library. It will then appear in the list box and you may select it and the associated part-load curves.

Supply Fan Form

The supply fan form is activated when you click on the supply fan from the HVAC Systems Editor.

Template (list box). This list box contains all fan types that have been entered in the library. When you make a choice from this list all fan properties are updated appropriately, including part load curves, fan and motor efficiency, etc. Using the Equipment Editor, you can create new fan types. Once you have selected a fan type and initialized all the properties, you can still edit the properties.

Method. Supply fan energy use can be modeled using one of three methods. For packaged equipment, the energy use of the supply fan is sometimes included in the overall energy efficiency ratio (EER) for the equipment. This is typical of packaged single-zone systems, packaged terminal air conditioners, water source heat pumps and residential type equipment. If you choose this method to model fan energy use, no additional information about the fan needs to be specified. In the reports, fan energy shows as zero since it is included in the cooling end-use category. For other system types, there are two ways to model fan energy: the Pressure/Efficiency method and the fan Power/Delta-T method. These are described below.

Fan Pressure/Efficiency. The Pressure/Efficiency method requires that you enter the static pressure in inches of water gauge (Pa), the mechanical efficiency of the fan, the drive efficiency and motor efficiency. The static pressure is a function of the size and configuration of the ductwork, the type of diffusers, the coils, and the filters.

Power/Delta-T. The fan Power/Delta-T method requires that you enter the power requirement per unit of air flow (bhp/cfm) and the temperature rise across the fan. If the fan is not located in the air stream, the delta-T across the fan can be entered as zero.

Let Program Size (check box). If checked, the DOE-2 program will determine the fan size necessary to meet the requirements in all zones served by the system. If unchecked, then a text box appears where you enter the size of the supply fan in cfm (l/s).

On-Hours Control (list box). The method of controlling the fan is selected from this drop down list box. The choices are <u>constant volume</u>, <u>variable speed</u>, <u>inlet vanes</u>, <u>discharge dampers</u>, <u>cycle with loads</u> and <u>two-speed</u>. DOE-2.1E assumes constant volume control for many system types including <u>heating and ventilation systems</u>, <u>unit heaters</u> and <u>ventilators</u>, <u>induction systems</u>, <u>ceiling bypass VAV</u> systems and <u>packaged VVT </u>systems. In these cases, the list box for on-hours control is not available. For <u>packaged terminal air conditioners</u>, only two choices are available: constant volume and two speed. For <u>water source heat pumps </u>and <u>residential systems</u> the choices are constant volume and cycle-with-loads. All fan control options described above are available for other systems. VisualDOE makes it easy for you to make the right choice by displaying only those choices that are appropriate for the system type you have selected.

Off-Hours Control (list box). There are four possible options for off-hours fan control, although not all options are available for all system types. For residential systems and residential VVT systems, there are no options for off-hour controls. For other systems, the choices are stay-off, cycle-on-first and cycle-on-any. An additional choice is available for power induction units, which is cycle only zone fans.

Use DOE-2 Part Load Curves (check box). Check if you want your model to use the DOE-2 default part load curves. If not checked you need to select a fan curve from the drop-down list box. See Tools|Equipment Editor for more information on part load curves.

Low-Speed Ratios. This data is required only when two-speed on-hours fan control is selected in combination with a PTAC system. For the low fan speed, you enter the fraction of maximum air volume while the fan is operating at the low speed. In the power input box, enter the ratio of the efficiency at low speed to the efficiency at high speed. You also enter fraction of maximum heating capacity and cooling capacity at low-speed fan operation.

Motor Placement. If the motor is located in the air steam (the more common configuration), heat from the motor raises the air temperature as it passes through the fan. The motor contributes no heat if it is located outside the air stream.

Fan Placement. Choose draw-through if the coils are located at the fan inlet. Choose blow-through if the coils are down stream of the fan. Blow through is always used by DOE-2.1E for dual duct systems, unit heaters and ventilators, multi-zone systems, packaged multi-zone systems, packaged terminal air conditioners, fan coil systems, water source heat pumps, and residential systems.

Return Fan Form

This form is activated when you click on the return fan from the HVAC Systems Editor. If the return fan is not displayed, first click on the Return Fan check box in Systems Features and it will become visible. This form is used to describe the properties of the return fan. This form has a list box at the top where you can select template (see below).

Template (list box). This list box contains all fan templates that can be used to initialize the properties of return fan. When you make a choice from this list the return fan properties are appropriately initialized, including part-load curves. Once you have selected a return fan template, you can still edit the properties in case the template does not exactly match your model. Templates can be used to save time. Using the Equipment Editor, you can create new heating system templates and add them to the library.

Method. Return fan energy use can be modeled using one of two methods: the Pressure/Efficiency method and the Fan Power/Delta-T method. These are described below.

Fan Pressure/Efficiency. These inputs are visible only if the Pressure/Efficiency method is used. You enter the static pressure in inches of water gauge (Pa in SI), the mechanical efficiency of the fan, the drive efficiency and motor efficiency.

Power/Delta-T. The Power/Delta-T method requires that you enter the power requirement per unit of air flow (bhp/cfm or kW/(l/s) in SI) and the temperature rise across the fan. The temperature rise is due to turbulence and friction in the fan (F or C in SI). A typical value is about 2 F.

Evaporative Precooler Form

If the system has an evaporative precooler, this form appears when you click on the precooler object on the system screen. This feature is only available for packaged equipment.

Template (list box). This list box contains evaporative precooler templates, which may be used to initialize all the properties. When you make a choice from this list all evaporative precooler properties are updated appropriately, including part load curves. Once you have selected an evaporative precooler template, you can still edit the properties in case the template does not exactly match your model. Templates can be used to save time. The Equipment Editor may be used to create new evaporative precooler templates and add them to the library.

Type. Select indirect if the precooler uses only an indirect evaporative cooler (no moisture is added to the air stream). Choose indirect/direct if the precooler has both capabilities.

Indirect Air Stream. Specify the source of the indirect air stream. If you choose return air, the evaporative cooler will add moisture to the return air and this air stream will be used in a heat exchanger to cool the supply air stream. If you choose outside air, the evaporative cooler will add moisture to the outside air, which will be used in a heat exchanger to cool the supply air stream.

Outside Air Fraction. The fraction of the supply air volume that passes through the evaporative cooler. If you choose minimum outside air, the volume of outside air will be the same as if the evaporative precooler

were not installed. If you choose specified fraction and enter 1.0, then 100% of the supply air would pass through the evaporative precooler.

Electric Power. The electric power used per unit of supply air flow. Units are bhp/cfm or in SI kW/(l/s).

Direct and Indirect Effectiveness. Enter the effectiveness for both the direct and indirect portions of the evaporative cooler. The effectiveness is the ability of the evaporative cooler to reduce the drybulb temperature to the wetbulb temperature. A value of 1.0 would means 100% effectiveness.

Maximum Outside Air Temperature. Units are degrees °F (C). Above this temperature the evaporative precooler does not operate and the volume of outside air returns to the minimum position.

Control. Choose the first option if you want the precooler to operate only when it can satisfy the entire load. Choose the second option if you want the evaporative precooler to operate simultaneously with the refrigeration equipment.

Part-Load Curves. These are for display purposes only. These curves are activated when you choose a template (see above). You can use the Equipment Editor to create new evaporative coolers with custom part-load curves. See the Equipment Editor for more documentation on the part-load curves.

Humidifier Form

If the system has a humidifier, you specify the minimum relative humidity that will be tolerated before the humidifier begins to add moisture to the air stream and indicate the source for humidification. The choices for a humidification source are Hot Water from Plant and Electric Resistance. You can add a humidifier to the system by checking Humidifier in the Systems Features frame. If a humidifier is not applicable to the system the check box will be inactive (gray).

Economizer Form

This form is used to describe the properties of the Economizer. This form is activated when you click on the outside air dampers from the HVAC Systems Editor. If the dampers are not displayed, first click on the Economizer check box in Systems Features, since this form is only available if you check economizer as an optional feature on the HVAC systems form.

Template (list box). This list box contains templates that can be used to initialize the properties. When you make a choice from this list the economizer properties are appropriately initialized. Once you have selected a template, you can still edit the economizer properties in case the template does not exactly match your model. The idea with templates is to save time. Using the Equipment Editor, you can create new economizer templates and add them to the library.

Control Type. Three types of economizers may be selected, based on whether drybulb temperature, enthalpy or both is used as the basis of the control. Temperature should be selected if the position of the outside air dampers is controlled based on a measurement of the outside air drybulb temperature. Enthalpy should be selected if outside air volume is based on the enthalpy of the outside air. Temperature and Enthalpy should be selected if the control uses both inputs.

Enthalpy Limit. The outside air enthalpy above which the outside air damper returns to the minimum position. Applicable only when type is enthalpy or temperature and enthalpy (see above). Units are Btu/lb (kJ/kg).
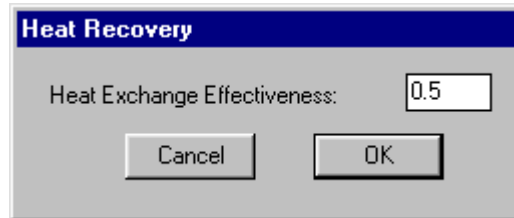
Lower Temperature Limit. The outside air drybulb temperature below which the outside air damper returns to the minimum position. This may be used to minimize the amount of moisture needed for humidification. Units are °F (°C).

Upper Temperature Limit. Only applicable for temperature control. There are two basic options: to base the position of the outside air damper on the return air temperature or on outside air temperature. If you

choose return air, the outside air dampers are fully opened for each hour that the outside air temperature is below the return air temperature. If "Specify" is selected, you enter the outside air drybulb temperature *above* which the outside air damper returns to the minimum position. Units are °F (°C).

Compressor Operation. This option is available only for packaged equipment. When you choose non-integrated, the refrigeration equipment is not capable of operating concurrently with the economizer. If you choose integrated, then the refrigeration equipment is "integrated" with the economizer controls so that both can operate concurrently. With a non-integrated economizer, the upper limit temperature should be set near the supply air temperature (about 60°F).

Heat Recovery Form

You may add heat recovery to a system by checking Heat Recovery in the Systems Features frame of the HVAC System Editor. Heat recovery coils are shown on the system diagram connecting the exhaust air stream with the outside air supply stream. To bring up this form, click on the heat recovery coils. Only one input is needed for heat recovery, the heat exchanger effectiveness. This is the ratio of energy exchanged to that which would occur if the return air were cooled to the outside air conditions.

Natural Ventilation

- *Method*. Select one of the two methods. If S-G method is selected, the form shows more data entries.

- *Air Changes per Hour*. This is the maximum air changes per hour based on the Outside Air schedule.

- *Maximum Air Changes per Hour*. This only applies to S-G method.

- *Fraction of Venting Area*. Enter the fractions of windows and skylights related to ventilation.

- *Schedule of opening probability*. This schedule defines when the opening can be opened.

- **Schedule of venting temperature**. This schedule defines temperatures that control the ventilation on/off.

- **Schedule of venting ON/OFF**. This schedule defines when the ventilation is on/off.

- **OK**. Click this button to save data and close the form.

- **Cancel** Click this button to discard changes and close the form.

Air-to-Air Heat Pump Form

This form is activated by (1) clicking on the heating coil from the HVAC Systems Editor, (2) choosing Electric Heat Pump as the heating source, and (3) clicking the Define Heat Pump button. This form is used to describe the properties of the air-to-air heat pump system (a different form is used for water loop heat pumps). This form has a list box at the top where you select a template. The remainder of the information is organized on two folders. The first folder, labeled Specification, is used to enter information about the heat pump. The second folder displays information about part-load curves.

Template (list box). This list box contains templates for use in initializing heat pump properties. When you choose a template, all properties are initialized appropriately, including part-load curves. However, you can still edit the properties. Using the Equipment Editor, you can create new heat pump templates and add them to the library.

Coefficient of Performance. Unitless. Enter the coefficient of performance of the heat pump if you are modeling fan energy as part of the equipment (see supply fan specification).

Energy Input Ratio. If fans are being modeled with the Pressure/Efficiency or Power/Delta-T methods, you enter the energy input ratio, which is the electric input (not counting the fans) at rated ARI conditions

divided by the capacity at ARI conditions. Efficiency should be specified for peak load conditions. The program makes internal adjustments for part loads.

Shut-Off Temperature. Units are °F (°C). Below this temperature it is assumed that the heat pump cycle is no longer effective and is not operated.

Supplemental Heat

- **Source** (list box). The choices are Electric Resistance and Hot Water from Plant. The most common choice is electric resistance.

- **Capacity**. Units are Btu/h (kW). Enter the capacity of the supplemental heat.

- **On Temperature**. Units are °F (°C). Enter the outside air drybulb temperature below which the supplementary heat is allowed to operate.

Crankcase Heater

- **Power.** The electric energy in kW used to heat the crankcase of the compressor. The crankcase heater is assumed to be on only when the compressor is *not* operating.

- **Temperature**. You also enter the outdoor drybulb temperature below which the crankcase heater is allowed to operate.

Defrost

- **Type.** Specify the method of defrosting the evaporator coils. The choices are reverse cycle (most common) or electric resistance.

- **Control**. You also indicate how the defrost cycle is controlled. The choices are on-demand and timed.

Temperature. Finally, you specify the outdoor drybulb temperature below which defrosting is allowed to occur.

Compressor. You may choose one of three compressor types: single speed (most common), dual speed and variable speed. If you choose variable speed, you must enter data on the minimum and maximum compressor speeds for heating and cooling modes. DOE-2.1E uses only the ratio of these values.

Evaporative Cooler Form

The evaporative cooler form is activated by (1) selecting Evaporative Cooler as the system type on the HVAC System Editor and (2) clicking on the cooling coil. The form is used to specify the properties of the evaporative cooler. This form is used for direct and indirect/direct evaporative coolers. A separate form is used for an evaporative precooler, which is an add-on to many types of HVAC systems.

Template (list box). This list box contains templates for use in initializing evaporative cooler properties. When you choose a template, all properties are initialized appropriately, including part-load curves. However, you can still edit the properties. Using the Equipment Editor, you can create new evaporative cooler templates and add them to the library.

Type. Select indirect if the evaporative cooler uses only the indirect method of cooling. Choose indirect/direct if the precooler has both capabilities.

Electric Power. The brake horsepower per unit of supply air flow. Units are bhp/cfm.

Effectiveness. Enter the effectiveness for both the direct and indirect portions of the cooler. The effectiveness is the ability of the evaporative cooler to reduce the drybulb temperature to the wetbulb temperature.

Indirect Air Stream. Specify the source of the indirect air stream. If you choose return air, the evaporative cooler will add moisture to the return air and this air stream will be used in a heat exchanger to cool the supply air stream. If you choose outside air, the evaporative cooler will add moisture to the outside air which will be used in a heat exchanger to cool the supply air stream.

Water Cooled Condenser Form

This form is activated by clicking on the Define Water Cooled Condenser command button from the Cooling Form. A water cooled condenser is an option for many packaged air conditioning equipment. This is essentially a cooling tower, so similar data must be entered. Please note that a water cooled condenser may not be used in combination with water source heat pump systems. This is a limitation of DOE-2.1E.

Hydronic Heat Pump Form

This form is activated when you choose "Water Loop Heat Pump" as the system type and click on the heating or cooling coils of the HVAC System Editor. This form is used to define the properties of water loop (hydronic) heat pumps. The form is organized on two folders labeled Specification and Curves. The first folder is used to enter the capacity and efficiency of the equipment. The second folder is used to display information on the part load curves. With this system type you must also define the boiler and cooling tower that is used to maintain the loop temperature. See Water Loop HP Plant Editor

Template. The first step in defining a hydronic heat pump is to select a template. The template initializes all data and sets the part load curves. After data has been initialized you can change information on the specifications folder. The curves are set by your choice of template, however. To enter a new set of curves, you must use the Equipment Editor to define a new template.

Specification Folder

Let Program Size. If you want DOE-2 to calculate the size of the heat pump, then you should check this box. When you check this box the text boxes for total and sensible cooling capacity and heating capacity are disabled.

Oversizing Ratio. When you let the program size the equipment, this entry tells DOE-2 how much to oversize. The oversizing ratio is multiplied times the calculated capacity to provide a safety margin.

Capacity. Values are entered for the total cooling capacity, the sensible cooling capacity and the heating capacity. These data are commonly available from equipment manufacturers.

Coefficient of Performance. This is the heat delivered by the heat pump divided by the electric energy used by the machine, in the same units. This entry is enabled when you specify "Include in EER" as the method of identifying fan performance.

Energy Efficiency Ratio. The rate of heat removed by the equipment in Btu/h divided by the rate of energy use in kW. This entry is enabled when you specify "Include in EER" as the method of identifying fan performance.

Energy Input Ratios. If you use a method other than "Include in EER" when you specify the fan, these controls will be enabled instead of coefficient of performance and energy efficiency ratio. The energy input ratio is the electric energy input divided by the heating or cooling capacity, both at ARI conditions. The electric energy should not include fans since this is modeled separately.

Curves Folder

This folder is for display purposes only. These curves are activated when you choose a template (see above). You can use the Equipment Editor to create new hydronic heat pump templates with custom part-load curves. See the Equipment Editor for more documentation on the part-load curves.

5.6   Central Plant Editor

When you click the Central Plant Editor command button from the Graphic Editor Systems Folder, the Central Plant Editor appears. The Central Plant Editor can also be called from the Plant Only Runs program module. A diagram of the central plant is displayed which provides a metaphor for editing and defining the central plant. The diagram shows the major plant components such as the chiller(s), boiler(s), cooling tower, and circulation pumps. The VisualDOE central plant editor is organized on three folders labeled: General, Cooling Load Management and Heating Load Management.

There are many ways to define the plant, but for first time users, the following steps are recommended:

1.   In the Systems Folder of Graphic Editor, create all the systems for your model and press the Central Plant Editor command button. This will cause the Central Plant Editor to appear on top of the Graphic Editor.   (You can also bring up the editor from the Plant Runs Only module)

2.   Indicate the number of chillers and boilers in the central plant using the option buttons. The plant diagram will change in response.

3.   Select the Plant Era from the drop-down list box. You should pick an era when the majority of the plant components were purchased and installed. The choices are 1950 and before, 1951 - 1977, 1978 - 1988, and 1988 to present.

4.   Click the apply Defaults command button. This will set the properties of all the plant components based on the information given in steps 1 through 4.

5.   Click on each of the plant components to review and edit their properties.

6.   If you have multiple chillers or boilers select the Cooling Load Management and/or Heating Load Management folders to specify the sequence of operation for multiple pieces of equipment. (See below.)

For more information see General Folder, Cooling Load Management and/or Heating Load Management

5.6.1   General Folder
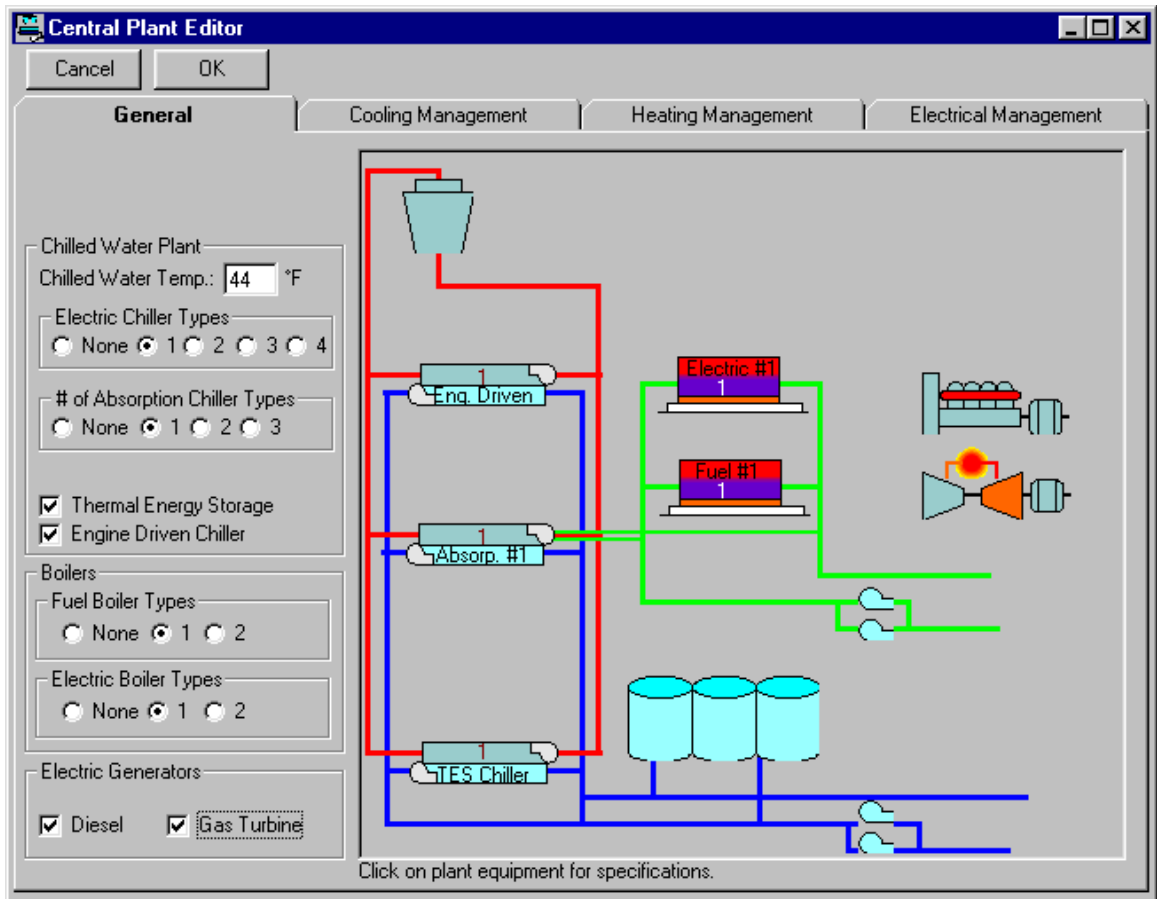
Chilled Water Plant

- ▪ **Electric Chiller Types.** Up to four different types of electric chillers can be modeled. The properties of each chiller include its efficiency, part-load performance, etc. Once a chiller type is defined, you can specify more than one size for the type (up to six). Each chiller type is defined by clicking it on the plant diagram.

- ▪ **Chilled Water Temp.** The chilled water supply temperature (CHWS) used in the plant simulation is entered on the Central Plant form. This is the temperature of the water delivered to the coils. Note, when chiller efficiencies are specified on the Chiller form, the CHWS and CWS temperatures are also entered, but these values are for referencing the chiller's efficiency and are not used in the simulations.

- ▪ **Thermal Energy Storage.** When this check box is clicked, thermal storage is shown on the diagram. Click on this equipment to specify its properties, including type (ice-on-coil, brine, etc.).

Boilers. You enter the type and number of boiler included in the plant. DOE-2 can model two fuel and two electric boilers. As you change the number of boilers the plant diagram is updated.

Defaults. This command button sets the default plant properties based on the era and other information.

Icons on the Diagram. You can click on chillers, boilers, cooling towers, and pumps in the plant diagram to further define their properties.

- ▪ **Cooling Tower**. If any one of the chiller types is water cooled, then a cooling tower will appear in the diagram. Click on the tower to define its properties. One of the properties is the number of

> cells. When you close the cooling tower form, the number of cells changes on the diagram. All cells are assumed to be the same. When you define the tower properties, including size, you are specifying information for a single cell.

- **Pumps**. Both chilled water and hot water supply pumps are specified by clicking on the pump icons. The information entered is for the secondary chilled water pumps only (the pumps that circulate water through the building coils). The primary pumps are specified when you define the chiller. The hot water pumps, on the other hand, should include the pressure drops (head) through the boilers and associated piping as well as the building coils.

- **Electric Chiller Types.** Click on a chiller to define its properties.

Boilers. Click on a boiler to define its properties.

5.6.2   Cooling Load Management Folder
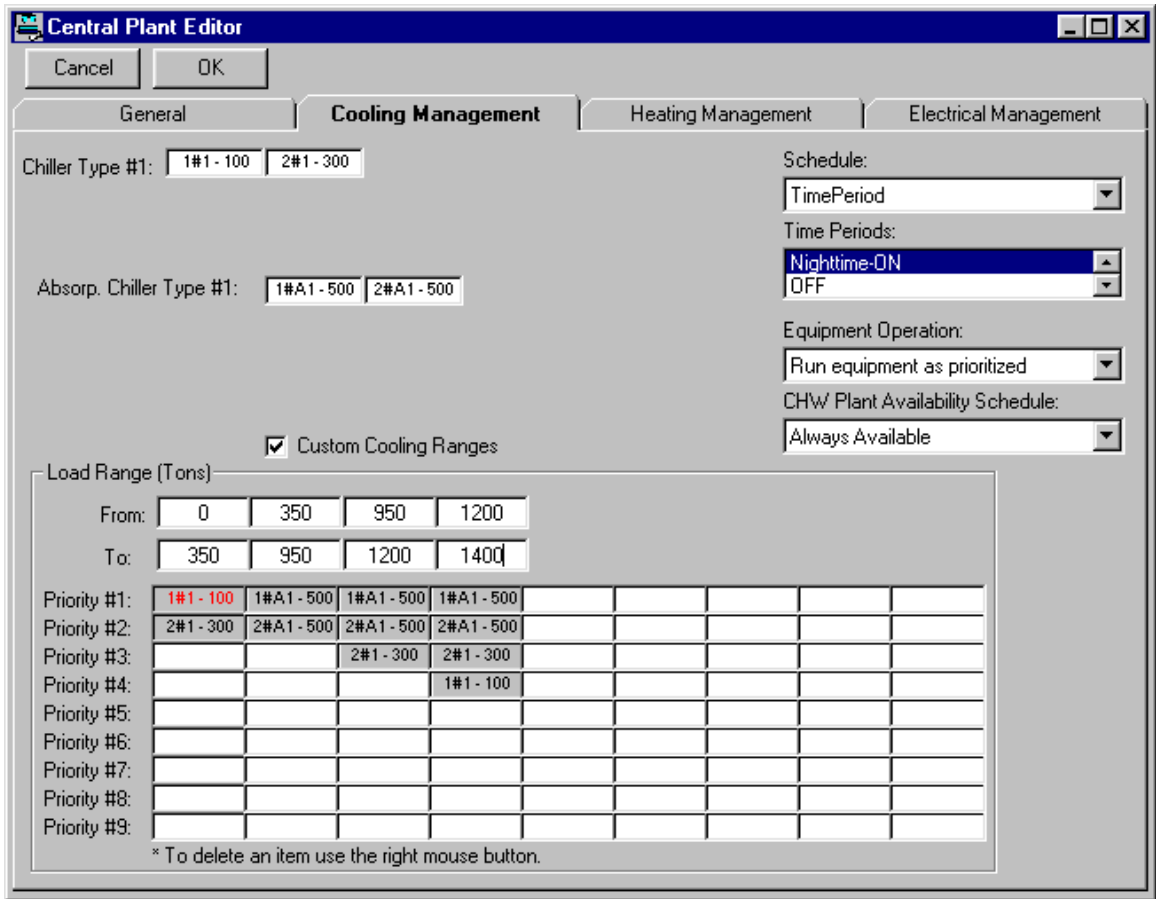
This folder is used to define how you want multiple chillers to be sequenced. Boxes appear in the upper left corner of the folder for each chiller in the central plant. Each chiller type is shown as a row. When there are multiple chillers of a particular type, these are shown in additional columns. The sizes of each chiller are also indicated. For instance "#2 - 100" means chiller type #2 with a size of 100 tons.

Load ranges are shown as columns in the table at the bottom of the folder. To create a load management scheme, you drag and drop chillers to one or more of these columns. Suppose that you have two chillers: a 100 ton (#1) and a 200 ton (#2). You might want a load management scheme where the #1 chiller operates if the loads are less than 100 tons, the #2 chiller operates when the loads are between 100 tons

and 200 tons, and both the #1 and #2 chillers are operated when loads are greater than 200 tons. To achieve this scheme you would drag and drop the #1 chiller to the first column; the heading would read "From 0 To 100". Drag and drop the #2 chiller to the second column; the heating would read "From 100 to 200". Drag the #1 and #2 chillers to the third column; the heading would read "From 200 to 300".

Custom Cooling Ranges: If custom cooling range option is selected then you can overwrite the default range for

Time period schedules can be selected using the drop-down list box in the upper-right hand corner of the folder. When a time period schedule is selected each time period in the schedule is listed below the schedule. When you use a time period schedule, you must construct a unique load management scheme for a time period, select that time period and construct the load management scheme. Do this for all the time periods listed.

CHW Plant Availability Schedule: This list shows all the on/off type schedules in your project. The default "Always Available" means that the central chilled water plant will be available whenever there is a demand for cooling. To add new schedules to the list or to edit existing schedules use the schedule organizer.

5.6.3 Heating Load Management Folder
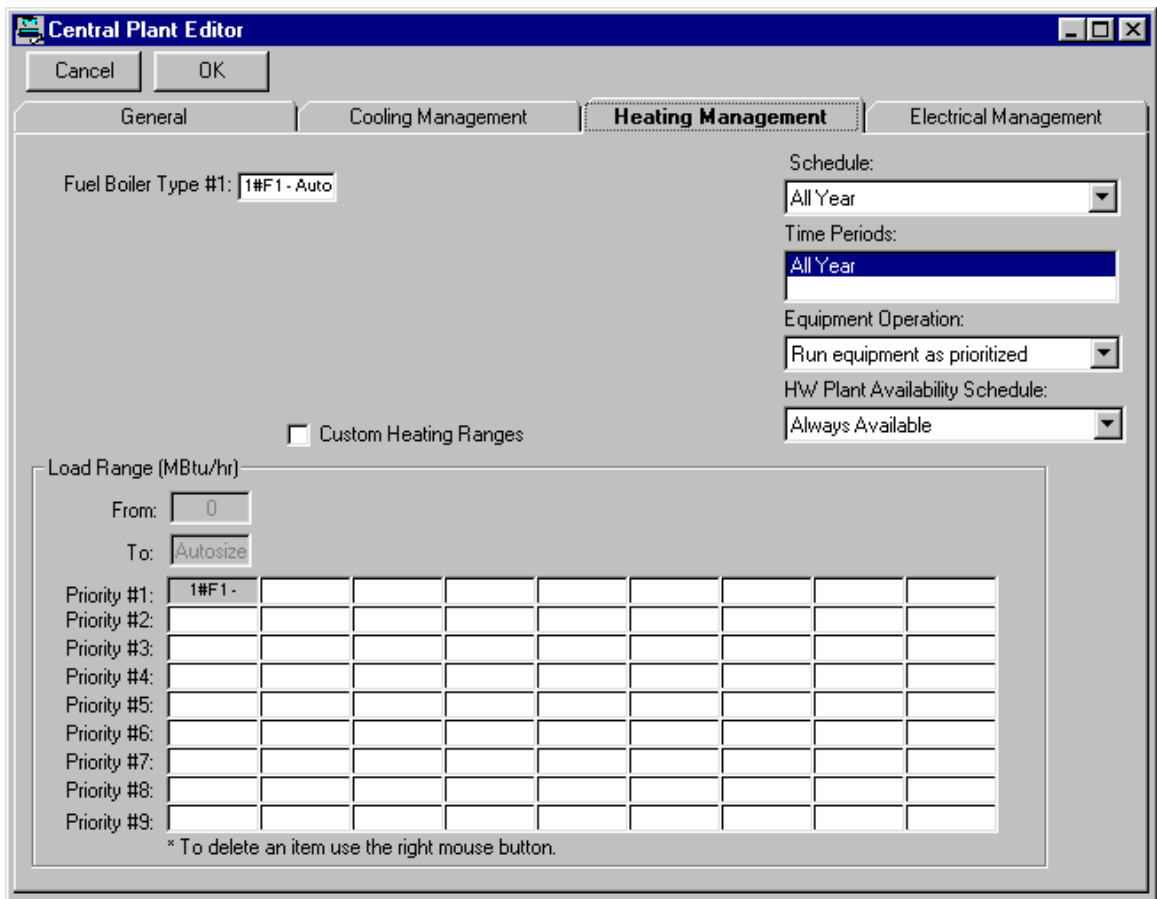
This folder works the same as the Chiller Load Management form. Equipment icons at the top include each of the boilers.

This folder is used to define how you want multiple boilers to be sequenced. This folder is enabled only when more than one boiler is specified. Icons appear in the upper left corner of the folder for each boiler in the central plant. Each boiler type is shown as a row. When there are multiple boilers of a particular type,

these are shown in additional columns. The sizes of each boiler is also indicated. For instance "#2 - 1" means boiler type #2 with a size of 1 million Btu/h.

Load ranges are shown as columns in the table at the bottom of the folder. To create a load management scheme, you drag and drop boilers to one or more of these columns. Suppose that you have two boilers: a 1 MBtu/h (#1) and a 2 MBtu/h (#2). You might want a load management scheme where the #1 boiler operates if the loads are less than 1 million Btu/h, the #2 boiler operates when the loads are between 1 million Btu/h and 2 million Btu/h, and both the #1 and #2 boilers are operated when loads are greater than 2 million Btu/h. To achieve this scheme you would drag and drop the #1 boiler to the first column; the heading would read "From 0 To 1". Drag and drop the #2 boiler to the second column; the heating would read "From 1 to 2". Drag the #1 and #2 boilers to the third column; the heading would read "From 2 to 3".

Time period schedules can be selected using the drop-down list box in the upper-right hand corner of the folder. When a time period schedule is selected each time period in the schedule is listed below the schedule. When you use a time period schedule, you must construct a unique load management scheme for a time period, select that time period and construct the load management scheme. Do this for all the time periods listed.

HW Plant Availability Schedule: This list shows all the on/off type schedules in your project. The default "Always Available" means that the central hot water plant will be available whenever there is a demand for heating. To add new schedules to the list or to edit existing schedules use the schedule organizer.

5.6.4 Electrical Load Management
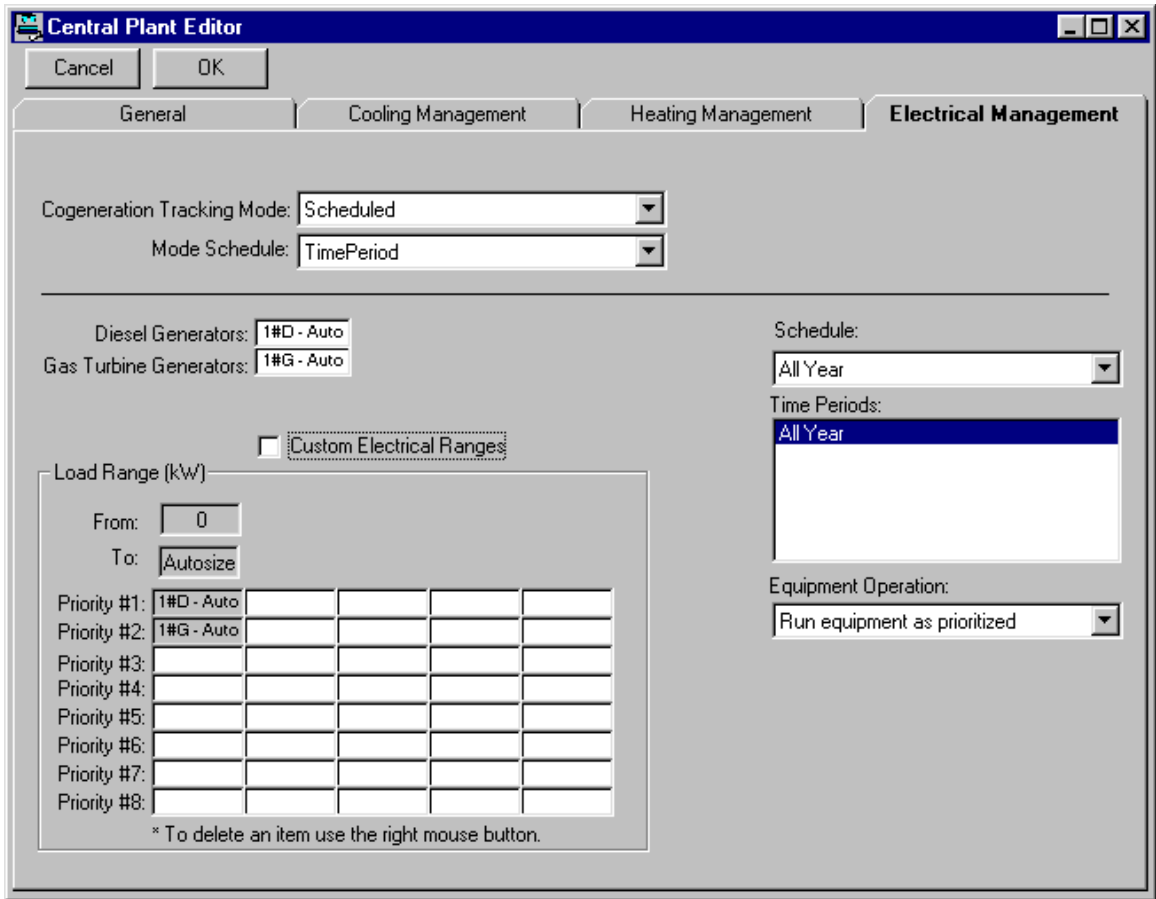
5.6.5   Boiler Form

The boiler form is activated by clicking on the boiler icon from the Central Plant Editor. It can also be activated by clicking on the boiler icon from the Water Loop HP Editor. The content of the form changes depending on how the form is opened. The boiler form is organized on three folders: General, Sizes and Curve The folders are described in more detail below. The boiler form defines a specific boiler performance type.

General Folder. The general folder is used to specify the boiler type and efficiency.

- ▪ **Type.** The choices vary depending on how the form is activated. If it is an electric boiler activated from the Central Plant Editor, you indicate whether the boiler is steam or hot water. If it is a fuel boiler activated from the Central Plant Editor, you indicate whether it has a power burner and whether or not it is steam or hot water. If it is activated from the Water Loop HP Editor, then you can choose between gas, electric, atmospheric

- ▪ **Efficiency.** Enter the thermal efficiency of the boiler at 100% load. The program will modify this efficiency at part loads according to the part-load curve associated with the template you selected. For electric boilers, the efficiency should be near 1.00.

- ▪ **Setpoint.** Enter the temperature of water that will leave the boiler. This is only applicable when the boiler form is opened from the Water Loop HP Editor.

- ▪ **Throttle Temperature.** The throttling temperature around the setpoint. The setpoint is assumed to be in the center of the throttling range. This is only applicable when the boiler form is opened from the Water Loop HP Editor.

- ▪ **Minimum Ratio.** The minimum operating condition, expressed as a fraction of the rated capacity of the boiler.

- ▪ **Maximum Ratio.** The maximum operating condition. A number greater than one can be entered under certain circumstances.

- ▪ **Fuel Meter.** This list box is shown when multiple fuel meters exist and a fuel boiler is selected.

Sizes Folder. The sizes folder is used to specify the number of boilers of this type. Up to four boilers can be specified. Each boiler specified can have a different size. All boilers of a particular type, however, must have the same specification (see the General folder). The first step is to indicate the number of boilers by making a choice from the drop-down list box. When you make a choice, text boxes appear for each boiler. Enter a value to indicate the size of each boiler. If you are working in IP units enter the size in millions Btu/h. If you are working in SI units, enter the size in kW. In both cases, positive values should be entered.

If you want DOE-2 to calculate the size of your boiler, you must specify only one boiler type and the number for this boiler type must be one. In this event, the Let Program Size checkbox is activated. Any time your central plant has more than one boiler type or any time a single boiler type has multiple pieces of equipment, the Let Program Size checkbox is not activated.

Curve Folder. The curve folder is for display purposes only unless the boiler form is opened through the Equipment Editor. Only one performance curve is used with boilers. For fuel boilers the curve gives the heating input ratio (HIR) as a function of the part-load ratio (PLR). The thermal efficiency entered on the general folder is for 100% loading conditions. This value is modified through this curve for other loading conditions.

5.6.6   Thermal Energy Storage Form

This form is activated from the Central Plant Editor when you click on the thermal energy storage icon. Using this form you specify the properties of the thermal energy storage system. When your model includes thermal energy storage, you may not let the program size the chillers. Define the thermal energy storage system by giving values to the following properties.

Type. Select the storage type from the following selections: Ice on Coil, Ice Harvester, Brine, Ice Slurry, or Eutectic.

Storage Location. Choose the location of the storage tanks (either Outdoors or In Conditioned Space). VisualDOE will assume an appropriate ambient temperature for the choice you make.

Charging of Storage. Enter the time of day when charging of storage begins and ends. A limit of DOE-2.1E does not allow this to be specified on an hourly schedule.

Percent Stored. Enter a value between zero and 100 percent to indicate the percent of the design day load that you want to store. A large Percent Stored implies a large storage capacity. Separate engineering calculations should be performed to determine the percent stored based on the type and size of storage that is used.

Tank Loss Coefficient. Enter the heat loss coefficient from the tanks in Btu/h-F (W/C).

5.6.7   Chiller for Thermal Energy Storage Form

When you include thermal energy storage in central plant, the first electric chiller is designated as the thermal energy storage (TES) chiller. This chiller is used to charge the thermal energy storage tanks or to make ice, depending on the type of thermal energy storage that you define. The form you use to define the TES chiller is essentially the same other electric chillers, except that an additional command button is included on the general folder titled Define TES Settings. When you click this command button, an additional form appears where you can enter some additional information about how the chiller will perform in conjunction with thermal storage. The information that you need to enter depends on the type of thermal storage you specified (see the Thermal Energy Storage Form. The table below shows the information that is needed for each type of thermal storage.

	Ice on Coil	Ice Harvest	Brine	Ice Slurry	Eutectic
Starting Chiller Efficiency	•				
Ending Chiller Efficiency	•				
Time Fraction for Ice Making		•			
Suction Temperature at Storage While Making Brine			•		
Suction Temperature at Beginning of Ice Making	•	•		•	
Suction Temperature at Phase Change					•
Drop in Suction Temperature	•				

Starting Chiller Efficiency. For ice-on-coil systems, you enter the efficiency of the chiller at the beginning of ice making. The efficiency will generally be greater at the beginning of ice making and less at the end after ice has built up on the coils.

Ending Chiller Efficiency. For ice-on-coil systems, you enter the efficiency of the chiller at the end of ice making.

Time Fraction for Ice Making. For ice harvesting systems, you must enter the fraction of time that the chiller makes ice. After ice is made, the refrigeration cycle is usually reversed briefly so that the ice falls off the evaporator into the storage tank. A reasonable default is 0.75.

Suction Temperature at Storage While Making Brine. For brine systems, you must specify the suction temperature when the brine is charged.

Suction Temperature at Beginning of Ice Making. For Ice harvesting and ice slurry systems, you must specify the suction temperature during the process of making ice.

Suction Temperature at Phase Change. For eutectic systems, you must specify the suction temperature of the chiller when the eutectic material is changing phase.

Drop in Suction Temperature. For ice-on-coil systems, you specify the drop in suction temperature between the beginning and the ending of ice making.

5.6.8　　Electric Chiller Form

The electric chiller form is activated when you click on one of the electric chillers on the Central Plant Editor. The form is used to define all chiller properties, including pumps on the evaporator and condenser sides of the chiller. The form is organized on five folders or tabs labeled: General, Sizes, Evaporator, Condenser and Curves. The information that is defined on each of these tabs is described in greater detail below. The chiller form defines a specific chiller performance type.

The electric chiller form works in two modes:

- You can select a template from the library. To exercise this option, check Use Templates. With this option, the chiller part-load curves and chiller type associated with the selected template is used in the simulation. Other data is initialized based on the template, but can be modified. With this option it is only necessary to enter the APLV efficiency at 100% load. The APLV controls for 75%, 50% and 25% are disabled.

- The second way to bring up the chiller form is through the Equipment Editor. In this mode, you can create, delete and edit chiller templates, including the specification of part-load curves. This is the only way to modify the information on the Curves folder.

For more information see General Folder, Sizes Folder, Evaporator or Condenser Folders, or Curves Folder.

Chiller Form, General Folder

Type. When Use Template is not checked, this control is active and you choose either reciprocating/scroll, screw or centrifugal. These data are part of the information used to select a set of chiller part load curves. This control is for display only when the Use Template is checked.

Chilled Water Supply Temperature (CHWS). The evaporator leaving temperature (along with the CWS temperature) at which the chiller efficiency values are specified. The chilled water temperature that is used in the simulations is specified on the Central Plant Editor.

Condenser Water Supply Temperature (CWS). The condenser water entering temperature (tower leaving temperature) at which the chiller efficiency values are specified. The tower setpoint temperature used in the simulations is specified on the Tower Form.

Air Cooled. Indicate if the chiller is air cooled. When checked, the condenser water temperature text box changes to design outdoor drybulb temperature.

APLV Efficiency at 100% Load. The efficiency of the chiller at the CHWS and CWS specified above. This data is generally available from chiller manufacturers.

APLV Efficient at 75%, 50% and 25% Load. These values are only needed when Use Template is not checked. These data are available from the chiller manufacturer's spec sheet. These data are used by VisualDOE along with the 100% APLV efficiency to select a set of chiller curves.

Minimum Operating Point. The loading condition at which the equipment begins to cycle when hot gas bypass is not checked. Not used when Hot Gas Bypass is checked.

Hot Gas Bypass. Indicate if the chiller has hot gas bypass as a means to control low load conditions.

Minimum Operating Point (with hot gas bypass). The operating point (fraction of full load) at which hot gas bypass begins. A typical value is about 0.20. Used when Hot Gas Bypass is checked.

Minimum Operating Point (without hot gas bypass). The operating point (fraction of full load) at which the chiller begins to cycle. A typical value is about 0.05. Used when Hot Gas Bypass is checked.

Chiller Form, Sizes Folder

The sizes folder is used to specify the number of chillers of this type. Up to six, four for engine-driven and absorption, chillers can be specified. Each chiller within the type can have a different size. All chillers of a particular type, however, must have the same specification (see the General folder). The first step is to indicate the number of chillers by making a choice from the drop-down list box. When you make a choice, text boxes appear for each chiller. Enter a value to indicate the size of each chiller. If you are working in IP units enter the size in tons. If you are working in SI units, enter the size in kW. In both cases, positive values should be entered.

If you want DOE-2 to calculate the size of your chiller, you must specify only one chiller type and the number for this chiller type must be one. In this event, the Let Program Size checkbox is activated. Any time your central plant has more than one chiller type or any time a single chiller type has multiple pieces of equipment, the Let Program Size checkbox is not activated.

Chiller Form, Evaporator and Condenser Folders

Electric Chiller Type #1

Med Eff WC

| General | Sizes | Evaporator Pump | Condenser Pump | Curves |

Flow: 3 gpm/ton

Primary Loop Pressure Drop: 30 ft

Impeller Efficiency: 0.77

Motor Efficiency: 0.9

Chilled Water dT: 8.0 °F

Cancel   OK

Electric Chiller Type #1

Med Eff WC

| General | Sizes | Evaporator Pump | Condenser Pump | Curves |

Flow: 3 gpm/ton*

CW Loop Pressure Drop: 25 ft

Impeller Efficiency: 0.77

Motor Efficiency: 0.9

Condenser Water dT: 9.8 °F

*Per evaporator capacity

Cancel   OK

The same information appears on both the Evaporator and Condenser folders.

- **Flow.** Enter the evaporator or condenser in gpm/ton if you are working in IP units or in (l/min)/kW if you are working with SI.

- **Pressure Drop.** Enter the efficiency of the pressure drop across the evaporator or condenser. Be sure to include piping and fittings through the tower (condenser) or the primary piping circuit (evaporator).

- **Impeller Efficiency**. Enter the efficiency of the pump impeller.

- **Motor Efficiency**. Enter the efficiency of the motor.

The primary pumps on the evaporator and condenser sides of the chiller are modeled separately based on the pressure drop, flows and efficiencies entered on this form. This energy shows up in the Heat Rejection end use category since both the evaporator and condenser pumps are included with the condenser pump. Weighted averages are taken for two groups of chillers, compression type chillers and absorption chillers, and specified seperately in DOE2.

Entering and leaving temperatures are displayed based on the CHWS and CWS temperature data entered on the General folder and the flow. This calculation uses the following equation (in IP units).

$$Flow(gpm) = [Capacity(MBtu/h) * 12000] / [500 * \{EnteringTemp(F) - LeavingTemp(F)\}]$$

Chiller Form, Curves Folder

The Curves folder is for display purposes only when the Chiller form is opened from the Central Plant Editor. When opened from the Equipment Editor, you can select various types of curves to assign to the chiller template. Alternatively, you can check Use DOE-2 Default Curves, which is recommended for all but advanced DOE-2 users. Consult the DOE-2 documentation for further information.

5.6.9   Absorption Chillers

The Plant Editor supports absorption chillers in addition to the electric chillers, boilers and cooling towers. Several tabs on the absorption chiller form are very similar to the electric chillers.   These include the Sizes, Evaporator & Condenser, and Curves tabs.

Type. Three types of absorption chillers are supported; direct-fired, single, and two-stage. Only one direct-fired type of absorption chiller can be specified with VisualDOE (this is a DOE2 constraint). Single and two-stage types of absorption chillers can have two unique types in VisualDOE. This control is only for display purposes. If you want to change the type of absorption chiller choose the appropriate template to begin with.

Chiller Water Supply Temperature. The chilled water supply temperature at which the chiller efficiency values are specified. The chilled water temperature that is used in the simulations is specified on the Central Plant Editor.

Entering Condenser Water Temperature. The condenser water entering temperature (tower leaving temperature) at which the chiller efficiency values are specified. The tower setpoint temperature used in the simulations is specified on the Tower Form.

Heat Input Ratio. This is the ratio of the amount of heat energy input to the chiller to the amount of cooling capacity at full load and standard (ARI) conditions. This ratio is unitless, so the heat energy and cooling capacity must be in the same units.

Heat Capacity Ratio. This value specifies the direct-fired aborption chiller's heating capacity as a ratio to its nominal cooling capacity. This is not applicable to the single or two-stage absorption chillers.

Heating Hot Water HX Effectiveness. This is effectiveness of the hot water heat exchanger used during heating mode for the direct-fired absorption chiller. This is not applicable to the single or two-stage absorption chillers.

Electrical Usage. This is the amount of electical power input for each unit of cooling capacity. This amount should be specified for the nominal cooling capacity.

Minimum Operating Point. This is the lowest part-load ratio the chiller is allowed to operate.

Fuel Meter. This list box is shown with the direct-fired absorption chiller when multiple fuel meters exist.

5.6.10 Engine-driven Chillers

The Plant Editor supports engine-driven chillers in addition to the other chillers. An engine-driven chiller is a regular compression chiller that is driven by an internal combustion engine. Several tabs on the engine-driven chiller's form are similar to the electric chiller's. These include the Sizes, Evaporator & Condenser, and Curves tabs.

The engine-driven chiller also has heat recovery capabilities from its engine jacket and exhaust for use with space heating and absorption chillers. Two demands can be specified for heat recovery. The first must be fully satisfied before the second is attempted.

Chiller Water Supply Temperature. The chilled water supply temperature at which the chiller efficiency values are specified. The chilled water temperature that is used in the simulations is specified on the Central Plant Editor.

Engine Coefficient of Performance. The engine's coefficient of performance is the amount energy produced at the shaft relative to the amount of fuel energy input.

Compressor Coefficient of Performance. The compressor's coefficient of performance is the amount of cooling energy produced relative to the amount of shaft energy input.

Idle Speed Ratio. This is the idle speed of the engine defined as the ratio to full speed.

Electrical Usage. This is the amount of electrical power input for each unit of cooling capacity. This amount should be specified for the nominal cooling capacity.

Minimum Operating Point. This is the lowest part-load ratio the chiller is allowed to operate.

Fuel Meter. This list box is shown when multiple fuel meters exists

5.6.11   Circulating Pumps Form

General Use

The circulating pumps form can be activated from either the Equipment Editor or from the Central Plant Editor. The form works a little differently depending on how it is activated. These differences are described below. To activate:

▪   From the Central Plant Editor, click on the cooling or heating circulation pump.

- From the Equipment Editor, (1) choose Pumps from the Equipment Type drop-down list box, (2) select a pump from the Templates list box, and (3) click the Define Template command button. Alternatively you can double click on a pump in the Templates list box.

Primary and Secondary Pumping. For cooling circulation systems, it is common practice to have a primary pump that circulates water through the chiller and a secondary pump that circulates water through the air handlers or other system equipment. This feature is supported by VisualDOE. Specify the primary pumps when you specify information about the chiller. The secondary pump should be specified in this form.   For heating, however, primary and secondary pumping is not supported and information about the entire hot water loop should be specified on this form.

Template. When used with the Central Plant Editor, a Template drop-down list box appears at the top of the form that contains all the pump templates in the library. When you choose a template, all the pump properties are initialized. You can still make modifications, however.

Properties Reference

- *Control.* You may model either fixed speed or variable speed pumps. Choose the one that is appropriate for your model.

- *Pump Head.* Units are ft (Pa). The head in feet that the pump must work against. Include the sum of the pumping head for both the primary and secondary loops when applicable (see above).

- *Motor Efficiency.* The efficiency of the pump motor.

- *Impeller Efficiency.* The pump mechanical efficiency or impeller efficiency.

- *Minimum Part-Load Ratio.* Only applicable when Control is Variable Speed. For primary/secondary pumping arrangements, the primary pump will typically operate at full speed any time the chillers are operating, while the secondary pump will operate at variable speed. Recommended value for primary/secondary pumping arrangements is 0.60.

5.6.12   Cooling Tower

The cooling tower form can be activated from either the Equipment Editor, Central Plant Editor or the Water Loop HP Editor. The form works a little differently depending on how it is activated. These differences are described below. To activate:

■ From the Central Plant Editor or the Water Loop HP Editor, (1) check Cooling Tower and (2) click on the cooling tower icon.

■ From the Equipment Editor, (1) choose Cooling Tower from the Equipment Type drop-down list box, (2) select a cooling tower from the Templates list box, and (3) click the Define Template command button. Alternatively you can double click on a cooling tower in the Templates list box.

The cooling tower form is organized on two folders labeled Specification and Curves. When opened from the Central Plant Editor, the Curves folder is for information only.

Template. When used from with the Central Plant Editor, a Template drop-down list box appears at the top of the form that contains all the pump templates in the library. When you choose a template, all the pump properties are initialized. You can still make modifications, however. When used from the Equipment Editor, the template drop-down list box is inactive, showing the name of the template that is being edited.

For more information see Specification or Curves

Cooling Tower, Specification Folder

Type (list box). Specify either open or closed. A closed tower is often called a fluid cooler.

Efficiency. Enter the efficiency of the tower fan. Units are brake horsepower per ton of rating cooling capacity in IP units. Both values should be at peak conditions.

Approach Temperature. The approach temperature used in peak cooling load calculations. This value relates to the size of the cooling tower.

Design Wetbulb Temperature. The wetbulb temperature used for peak cooling load calculations.

Let Program Size (list box). You may allow the program to size the equipment or you may enter the size for each cell.

Capacity per Cell. Enter the capacity of each cell. The total capacity of the tower is the capacity per cell times the number of cells.   Units are MBtu/h (Million Btu/hr) or in SI, kW.

Water Economizer. Check if the system has a water economizer. A water economizer uses water from the tower for direct cooling, bypassing the refrigeration system. Usually a heat exchanger is used, except perhaps for fluid coolers. With this option, you must specify the minimum delta-T, which is the temperature difference between the condenser water loop and the entering air. The delta-T must be greater than this minimum in order to reduce the unit's cooling coil load.

Cells. Enter the number of cooling tower cells. The total capacity is the number of cells times the capacity per cell. Select the method of controlling the cells from the drop-down list box. The choices are Minimum Cells Needed and All Cells.

Temperature Control. Enter the tower setpoint temperature, the throttling temperature, the minimum water temperature, and the design range. Also enter the method of temperature control. The choices are fixed drybulb temperature and wetbulb reset. With fixed control, the tower tries to maintain a CWS temperature at the tower setpoint. With wetbulb reset, the tower setpoint varies depending on the wetbulb conditions for each hour.

Capacity Control. Define the method of controlling the capacity of the tower fan. The control methods include one-speed fan, two-speed fan, variable-speed fan and fluid bypass. If you choose variable speed, you need to enter the minimum fan speed ratio. If you choose two-speed control, you need to enter the minimum cfm ratio and the power ratio at the lower fan speed.

Cooling Tower, Curves Folder

The Curves folder is for display purposes only when the Tower form is opened from the Central Plant Editor. When opened from the Equipment Editor, you can select curves to assign to the chiller template. Alternatively, you can check Use DOE-2 Default Curves, which is recommended for all but advanced DOE-2 users. Consult the DOE-2 documentation for further information.

5.6.13   Electric Generators

VisualDOE supports two types of electric generators a diesel driven and a gas turbine driven. The electric generator form is activated by selecting either the diesel generator or gas turbine generator icons on the plant editor form or using the equipment editor form. The information in the electric generator form changes based on the type of generator chosen.

A separate electric meter can be defined to sell electrical energy back to a utility. This is defined by choosing the Add Cogen Sale Meter for the electric rate on the projects tab in both the Graphic Editor and Plant Only Runs.

Electric Generation Efficiency. The efficiency of the generator, fuel energy/electrical energy, for generating electricity at full load.

Minimum Operating Point. This is the lowest part-load ratio the generator is allowed to operate.

Maximum Operating Point. This is the highest part-load ratio the generator is allowed to operate.

Operating Point. This is the optimum operating part-load ratio for the generator. DOE-2 attempts to operate the equipment at this point.

Fuel Meter. This list box is shown when multiple fuel meters exist.

Electric Generators Heat Recovery

Engine Jacket/Lube Oil Heat Recovery Efficiency. The conversion efficiency for fuel to recovered energy from the jacket and lube-oil at full load. This is only visible (applicable) for diesel generators.

Exhaust Heat Recovery Efficiency. The conversion efficiency for fuel to recovered energy from the jacket and lube-oil at full load.

Thermal Tracking Control Source. If heat recovery is specified, by placing a heat recovery demand on this generator, thermal tracking can occur with either or both heat source. This allows you to specify which one to use. This is only visible (applicable) for diesel generators.

Heat Recovery Primary and Secondary Demands. Recovered heat can be used for space heat or single or two-stage absorption chillers, if present.

Electric Generators Curves

Curves, Diesel

Curves, Gas Turbine

The Curves folder is for display purposes only when the generator form is opened from the Central Plant Editor. When opened from the Equipment Editor, you can select various types of curves to assign to the generator template. Alternatively, you can check Use DOE-2 Default Curves, which is recommended for all but advanced DOE-2 users. Consult the DOE-2 documentation for further information.

5.6.14   Water Loop HP Plant Editor
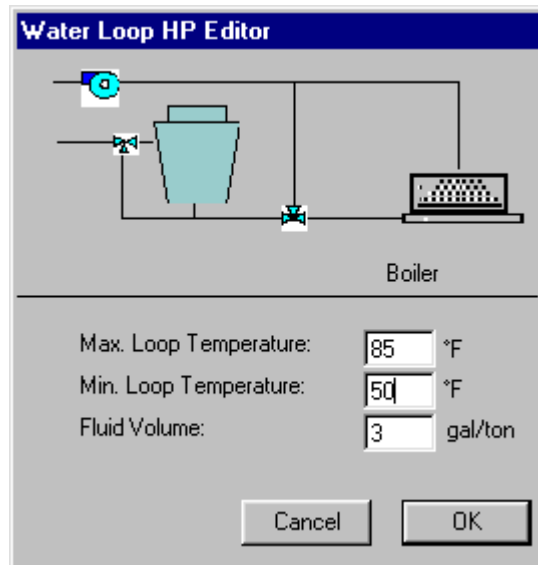
This form is called from the Systems Folder of the Graphic Editor when you click the Water Loop HP Plant Editor command button. This button is visible on the Systems Folder only when at least one of the systems in the systems list box is a water loop heat pump system. This editor enables you to directly enter information about the loop temperature, fluid volume and pumps. A cooling tower and boiler are displayed in the diagram. Click on these components to review or edit their properties.

- **Loop Temperature.** Units are °F (°C). Enter the maximum and minimum loop temperatures. The boiler will come on if necessary to maintain the low temperature. If the loop temperature goes above the upper limit, the cooling tower will operate to reject heat.

- **Fluid Volume.** Units are gal/ton of installed capacity (liters/kW). The fluid volume refers to the water in the piping system.

To define the properties of the plant equipment, click on the pump, cooling tower and/or boiler.

- **Pump.** Data on the circulation pump is specified in a similar manner to the chilled water and hot water circulation pumps. Click on the pump icon to bring up the pump form.

- **Cooling Tower Properties**. Click on the cooling tower in the diagram and a form will appear for you to use

- **Boiler Properties**. Click on the boiler in the diagram and a form will appear for you to use in specifying properties. Click on the underlined term for more information.

5.7   Zones Folder
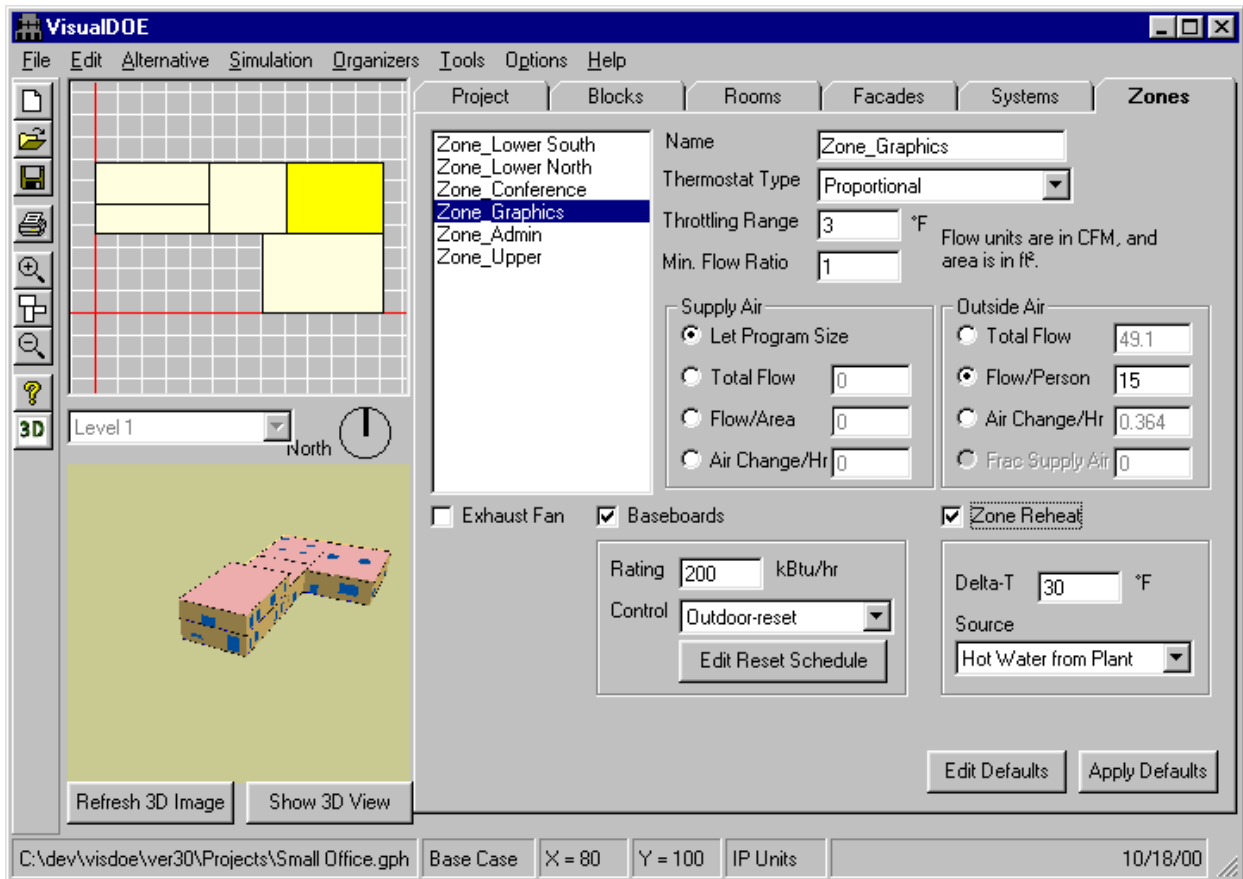
Overview

The Zones folder is used to specify zone-level HVAC information such as the type of thermostat, supply air volume, outside air volume, exhaust fans and zone level heating systems such as baseboards and reheat coils in variable air volume boxes. The Zones folder has a zone list similar to the Rooms folder. To specify data, you select one or more zones in the zones list (hold down the shift or control keys to select more than one zone). After you have selected one or more zones, enter the data for the zone(s). This data will be saved when you select another zone or leave the Zones folder.

Some information in the Zones folder depends on the type of system that serves the zone, so it is best to specify the systems first and assign all the zones to the systems before you specify information at the Zones level. If a zone is served by a power induction unit (fan powered VAV box), for instance, you specify the terminal type and other necessary information. Similarly, it is necessary to specify the minimum cfm ratio for zones served by VAV systems.

You can select more than one zone at a time and perform group editing. To select more than one zone, hold down the control key and click an additional zone. All selected zones will be highlighted. You can also use the shift key to select a continuous range of zones. When you select more than one zone, you can see if the zones have the same properties or different properties. If the selected zones all have the same property, a value will be displayed in the text box or drop down list box. If any one of the selected zones has a different value, the text box or drop-down list box will be shown as blank. If you do not make changes to a blank control while doing group editing, the selected zones will retain their original (different) values after you have completed editing.

Before you create your zones, it is good practice to set the default Zones properties for the most common conditions. As you add zones to your model, the zones will automatically take on the default properties and this will reduce the amount of editing that you will need to perform on individual zones. The Zones folder has two command buttons in the tool bar labeled "Apply Defaults" and "Edit Defaults." Click the Edit Defaults button and values you enter become the default Zones properties. When you are finished editing the default facade properties, click the OK button. Any time zones are created they will have the default properties. Zones are created any time a block is dragged and dropped onto one of the plans or anytime a new zoning pattern is dropped on a block.

5.7.1   Zones Folder

Supply Air (frame). The Supply Air frame has four methods of specifying the supply air to be delivered to a zone: Let Program Size, Total Flow (cfm or l/s), Flow/Area (cfm/ft^2 or (l/s)/m^2), and Air Change/Hour (unit less). You may choose only one of these methods. For all methods except Let Program Size, you will be required to enter a value. If you choose Flow/Area for instance you will be asked to enter the cfm/ft^2 if you are working in IP units. When you enter this value, VisualDOE will calculate the value for Total Flow and Air Change/Hour based on this value and the size of the zone. Flow units are cubic feet per minute (cfm) in inch-pound units and liters/second (l/s) in SI (metric) units. Area units are ft^2 (m^2).

Outside Air (frame). The amount of outside air that is delivered to the zone through the HVAC system can be specified four ways: Total Flow (cfm or l/s), Flow/Person (cfm/person or (l/s)/person), Air Change/Hour, and/or Fraction Supply Air. You may choose just one method. When you select a method the text box next to the method will be enabled so you can enter a value. For instance if you select Flow/Person, you will be asked to enter the cfm/person if you are working in IP units. When you enter this value, VisualDOE will automatically calculate the other values for you and display them in the text boxes. If you specify outside air as a fraction of the supply air volume, you may not let the program size the total supply air. The air-changes-per-hour method can be used to specify outside air as a function of the floor area. The California energy efficiency standards, for instance, require a minimum outside air volume of 0.15 cfm per square foot of floor area. Taking into account the ceiling height, this requirement can be converted to air changes per hour. If you specify absolute cfm, this value should apply for the entire zone. Flow units are cubic feet per minute (cfm) in inch-pound units and liters/second (l/s) in SI (metric) units. Area units are ft^2 (m^2).

Thermostat Type (list box) The choices are proportional, two position and reverse-action. With a proportional thermostat, the capacity of the system is adjusted in linear proportion to the temperature difference between the setpoint and the temperature of the space. A two-position thermostat is typical of residential applications where the heating and/or cooling equipment is fully on or fully off. A reverse-action thermostat is typical with many variable air volume systems, especially those with power induction units. For VAV systems, a reverse action thermostat allows the air flow rate to go above the design air flow. The thermostat setpoint is assumed to be in the middle of the throttling range.

Throttling Range. Units are °F (°C). The temperature range around the setpoint that temperature is allowed to vary. The thermostat setting for each hour is determined from the schedules associated with the selected occupancy.

Minimum Flow Ratio. For variable air volume systems this is the minimum allowed flow rate specified as a fraction of the maximum flow rate. A typical value is 0.30. This means that if a zone needs 1,000 cfm at peak design conditions, at least 300 cfm will be delivered at any other time. In the DOE-2 input file, this value is specified for each zone and also for the system. VisualDOE uses the value assigned to the control zone for the system level specification.

Zone Reheat (check box). Many multi-zone systems have reheating capabilities at the zone. These include constant volume reheat and variable air volume systems. When equipment at the zone level has the capability to reheat the supply air, check the box for zone reheat. When you do, two additional controls will become visible: A text box labeled "Reheat Delta-T" and a list box labeled "Heat Source". Enter information in these controls as described below. Please note that due to a limitation of DOE-2.1E, if any zone has zone reheat then all the zones served by that system have zone reheat.

- **Reheat Delta-T**. Units are °F (°C). Visible only when Zone Reheat is checked. This is the temperature rise at the terminal unit. For instance if supply air is delivered at 55 F and the reheat coils at the VAV box are capable of lifting the temperature to 100 F, the Reheat Delta-T would be 45 F.

- **Heat Source** (list box). Visible only when Zone Reheat is checked. Use this control to specify the heating source for zone reheat. The choices are: Hot Water from Plant and Electric Resistance. If the reheat source is hot water from plant, be sure to specify the properties of the boiler in the Central Plant Editor. Please note that due to a limitation of DOE-2.1E, the reheat source for all zones in a system must be the same. VisualDOE uses the reheat source specified for the control zone for all zones in the system. If no reheat is specified for the control zone, then the heat source for the system is used.

Exhaust Fan (check box). When Exhaust Fan is checked, the Define Exhaust command button becomes visible. Click this button to define the exhaust fan for the zone or zone(s). This command button causes another form to appear so that information can be entered about the exhaust air. Exhaust air is assumed to operate on the same schedule as the supply air, i.e. the HVAC system. Information on the sub-form is described below:

- **Specification Method** (list box). The exhaust fan can be specified in one of two ways: Static Pressure/Efficiency or Power/Unit Volume. With the first method you specify the pressure that the fan must work against along with the efficiency of the fan, drive and motor. With the second method, you specify the power of the fan per unit of supply volume. For both methods the volume of exhaust air must be specified.

- **Air Volume**. Units are cfm (l/s). When a zone has exhaust air, a value must be entered for either of the specification methods.

- **Static Pressure**. Units are inches or water (Pascals). Only applicable for Pressure/Efficiency specification method. Ductwork, dampers, etc. should be taken into account when determining this value.

- **Mechanical Efficiency** (unit less). Only applicable for Pressure/Efficiency specification method.

- **Drive Efficiency** (unitless). Only applicable for Pressure/Efficiency specification method.

- **Motor Efficiency** (unitless). Only applicable for Pressure/Efficiency specification method.

- **Power**. Units are bhp/cfm (kW/(l/s)). This value should represent the brake horsepower or working kW required to operate the fan, not the nameplate rating of the motor. The value is the ratio of the power divided by the air volume specified above.

Define PIU (command button). This command button becomes visible when you select a zone(s) that is served by a power induction unit (PIU). Click this button to define the PIU for the zone(s). This command button causes another form to appear so that information can be entered about the PIU.

- **Type** (list box). Choices are Series, Parallel, Standard VAV, and No-PIU.

- **Zone Air Volume**. Units are cfm (l/s). Enter the volume of air that is delivered by the zone fan.

- **Fan Power**. Units are bhp/cfm (kW/(l/s)). Enter the ratio of fan power to air volume delivered. The power should be the brake horsepower or working kW rather than the nameplate rating of the motor. The static pressure method may not be used with zone fans.

- **Induced Zone.** Select the zone from which the induced air is drawn. Usually this will be the plenum zone directly above the zone you are defining.

Baseboards (check box). Check this if the zone has supplementary baseboard heating. If Baseboards is checked, you must enter the baseboard rating. Units are Btu/h (kW). Baseboards are assumed to have thermostatic control using the heating temperature schedule. You can also specify baseboard control. The available options are "thermostatic" and "outdoor air reset". When a reset schedule is specified, it applies to all the zones that are served by the system.

6   Menus and Editing Forms

6.1   File
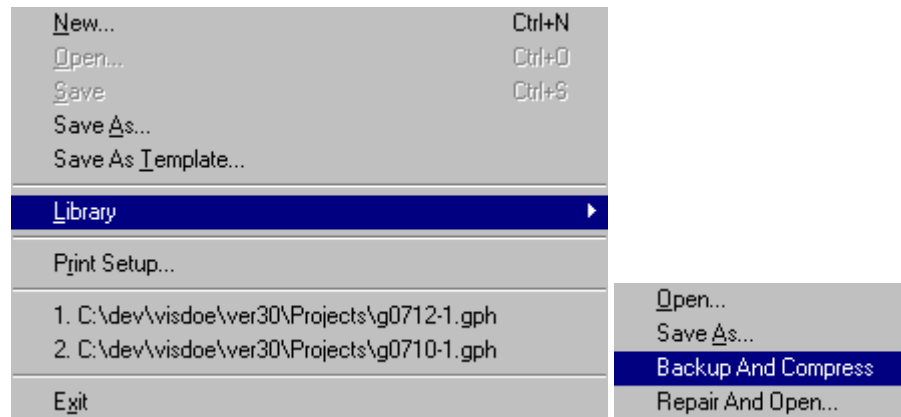
New. This command starts a new project and clears all data from memory. If there are any unsaved changes in the editing area, VisualDOE asks if you want to save the changes. If you want to change from inch-pound units to SI (metric) units you must do it immediately following a File|New command.

Open. This command opens a Windows dialog box so you can select a project to edit or run. When you double-click the name of a project in the list, VisualDOE opens that selected project. VisualDOE uses the file type *.GPH.

Save. This command saves changes made to the project. If the Title bar shows that the project is untitled, you must first use Save As to give the project file a name.

Save As. This command allows you to save your project under a different name. The first case and all the defaults settings for it are saved as a template with a "*.gSI" extension for SI unit template and "*.gIP" for a template in IP units. The template saves all the items in the project schedule, the default project, block, room, façade, system, and zone properties. If you want to create a default template that opens up when the program is launched, overwrite the "standard.gIP" or the "standard.gSI" files for IP and SI unit templates respectively.

Save As Template. This command allows you to save your project as a template file. This may be handy if you want to create a copy to use in starting another project.

Library: Open, Save As. This command allows you to open a library file or to save the library file you have created under a new file name. This is useful if a colleague sends you a VisualDOE project file that makes reference to user defined constructions, utility rates, etc. To replicate your colleague's results you would have to open his/her project file and library file. Every project has the name and path of the library stored with it. When you open a project, VisualDOE tries to open the associated library file as well as the project file. If VisualDOE cannot find the library file, a dialog box will appear where you can select a library file to use with the project.

Library: Backup And Compress. The current library is backed up to a "*.lbk" file, the process also cleans up the library by removing void entries.

Library: Repair And Open. When this menu item is select, a dialog box appears that enables users to select a library backed up earlier to be opened for use. Make sure to select "*.lbk" file format from the fie-type selection in the open dialog box.

Print Setup. This option is used to select a printer.

Exit. This command shuts down VisualDOE If a project has unsaved changes, VisualDOE prompts the choice to exit anyway or to cancel the Exit command.

6.2   Edit

Copy Block
Paste Block
Delete Block

Edit Custom Block ...
Billing History...
Exterior Shading...
Miscellaneous Energy Use...

Copy Graphics   ▶
Copy Reports   ▶
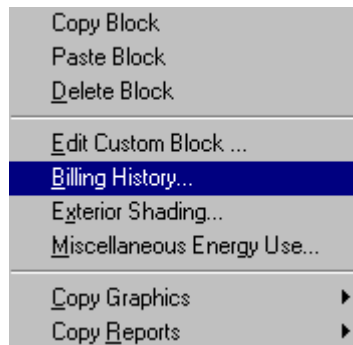
The editing commands that are available in VisualDOE depend on the folder you are using. The Delete Block(s), Select All and Custom Block commands are available only when you are in the block folder.

Copy Block. Available only when the block folder is active. Enables you to copy blocks to be pasted as new blocks on the block folder.

Paste Block. Available only when the block folder is active. Enabled only when a block has been copied.

Delete Block. Available only when the block folder is active. You may delete a block on any level. If blocks are located at a higher level, those blocks move down when a lower block is deleted. Note: To insert a block, drop it on the plan view where you want it inserted.

Custom Block. This option is available only when you select a custom block. The Custom Block Editor is opened when you choose this option so that you can modify the dimensions of a custom block.

Billing History. Displays a form where you can enter monthly energy use and demand for existing buildings. The form also has graphic controls that compare the billing history to the base case simulation results. If you want to compare the billing history to other design alternatives, see Simulation|View Results|Graphs.

Exterior Shading. This menu option opens a form where you can specify the dimensions of exterior shades. Exterior shades may be separately specified for each alternative. To specify exterior shades for a particular design alternative, first select the design alternative and then choose Edit|Exterior Shading.

Miscellaneous Energy Use. This menu option opens a form where you can specify miscellaneous energy uses for exterior lighting, process hot water or cold water demands, elevator energy and other miscellaneous energy use. Miscellaneous energy use is specified separately for each design alternative. To specify miscellaneous energy for a particular design alternative, select the design alternative and then choose Edit|Miscellaneous Energy Use.

Copy Graphics. When you make this menu choice, you are asked to select what you want to copy from the following choices: Bottom Plan, Middle Plan, Top Plan, Front Elevation, Left Elevation, Back Elevation, Right Elevation. The drawing you select is placed on the Windows clipboard where you can paste it into your report or letter. This option makes it easy to include zoning diagrams and elevation sketches in your reports.

Electrical Use Summary
Fuel Use Summary
Energy Cost Summary
Monthly Electrical Usage (kWh)
Monthly Electrical Power (kW)
Monthly Fuel Usage
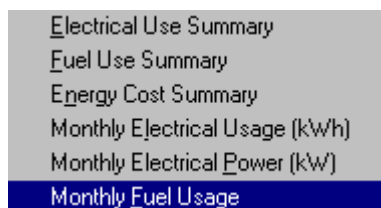
Copy Reports. When you choose this option you are asked to choose Electrical Use Summary, Fuel Use Summary, Energy Cost Summary, Monthly Electrical Usage, Monthly Electrical Power, or Monthly Fuel Usage. This information is placed on the Windows clipboard so that you can paste it into a spreadsheet or text processor. The information that is placed on the clipboard is similar to the information printed in the VisualDOE reports.

6.2.1 Billing History

Monthly electricity and gas energy use and peak demand for each month is entered on this form. For existing buildings, this data is obtained from utility bills. This data should be left blank for new buildings. Electricity energy is entered as kWh/month, gas energy as therms(MJ)/month, and peak demand as peak kW/month. The simulation results for the base case building are compared to this data. If there are significant differences between the billing history and the simulation results for the base case building, then the base case model should be modified to achieve better agreement. The billing history form has four folders.

The billing data for the selected utility can be entered for a calendar year. Select Fuel to enter gas usage data. The beginning and end dates for each utility bill can also be entered if they are different from the default values. The program adjusts the usage based on the number of billing days in the month.

- **Billing Data**. The first folder has controls where the user enters billing history data. The other folders display a graphic comparison of the billing history to the base case simulation results.

- **KWh and kW Graphs.** The graph tabs compare the billing history against the base case simulation results. For new buildings where there is no billing history, you can still look at a graph of the simulation results.

6.2.2 External Shading
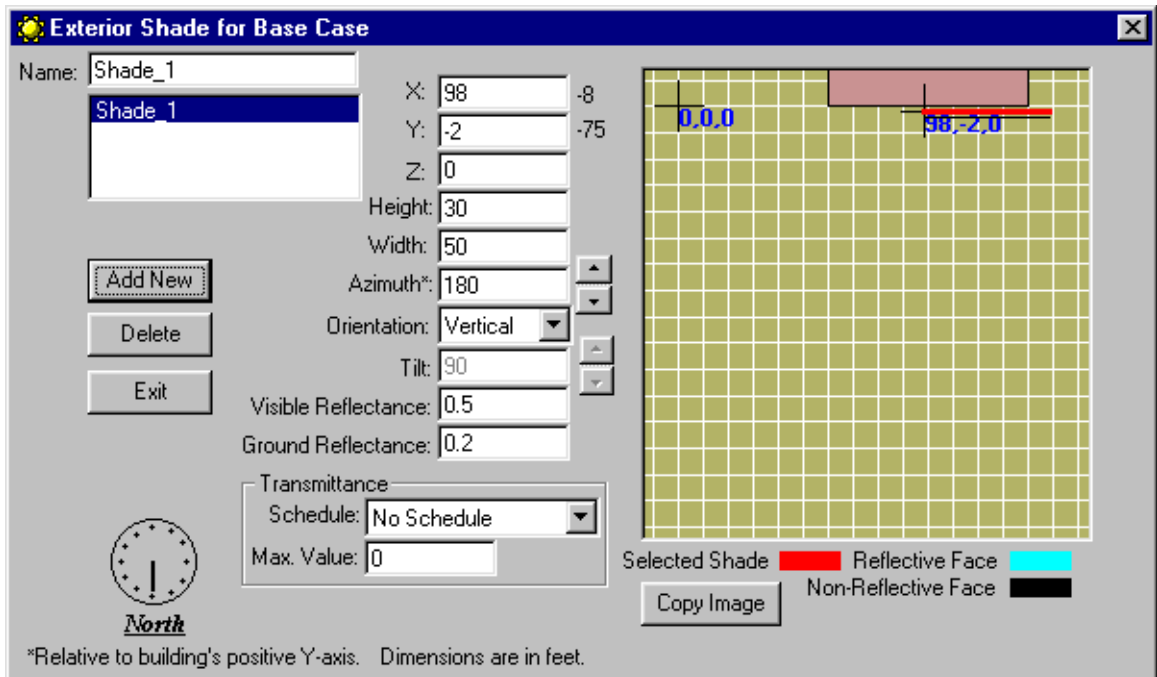
You may enter any number of exterior shades for the simulation of adjacent buildings, trees, or land masses. The Exterior Shade form displays a footprint of your model and shows the size and position of shades as they are entered. Exterior shades are also displayed by the 3d Viewer. To enter an exterior shade, click the Add New button. A new shading surface will be added to the list box and shown on the drawing with default properties. Use the controls to the right of the list box to modify the properties of the selected exterior shade.

Exterior shades are specific to the current design alternative. To enter exterior shades for another design alternative, select that design alternative before you choose Edit|Exterior Shades. Exterior shades in DOE-2 cast a shadow no matter which way they face. However, if you want to accurately model sunlight bouncing off an adjacent building, you must correctly position the reflective surface toward the model. Only one side on an exterior shade is reflective.

The following is a list of the properties that can be defined for each exterior shade.

- **X, Y, Z.** Enter the coordinates of the lower left corner of the shading surface. As you change the coordinates you can see the position of the shade move on the diagram. The lower left corner is determined as you view the shading surface looking at the reflective surface.

- **Height, Width.** Enter the height and width of the exterior shade in ft (m). DOE-2 models all exterior shades as rectangular shaped surfaces.

- **Azimuth.** Enter the azimuth of the exterior shade relative to the plan views of your model. If a surface shades the front of the model and faces the back, it has an azimuth of zero. From this reference, the azimuth is measured in a clockwise direction in degrees. shade faces

- **Orientation, Tilt**. Enter the orientation by making a selection from the list box. The choices are vertical, horizontal and other. If you choose other, then the Tilt text box becomes active and you enter the tilt of the surface in degrees. A tilt of zero means that the reflective surface faces down. A tilt of 90 degrees is vertical and a tilt of 180 degrees means that the reflective surfaces face the sky.

- **Visible Reflectance**. Enter the reflectance of the exterior shade. This is only relevant when you are modeling daylighting and you want to consider light bouncing off adjacent objects. A white surface has a reflectance of about 0.8 while a very dark surface has a reflectance of about 0.3.

- **Ground Reflectance**. Enter the reflectance of the ground in front of the reflective surface. This is only relevant when daylighting is being modeled.

- **Transmittance Schedule, Max. Value**. You can model deciduous trees or other shades with variable transmission using these features. Opaque objects have a transmission of zero and no transmission schedule need be specified. When a transmittance schedule is selected the maximum transmittance value is ignored and the transmittance is the value given by the fractional schedule. The transmittance schedule only modifies direct solar it does not modify diffuse. Diffuse and direct are modified if the maximum transmittance is specified.

6.2.3 Miscellaneous Energy Use

The Miscellaneous Energy Use form enables you to include exterior lights and two additional miscellaneous energy uses in your model. For exterior lights, you enter the peak kW and choose a fraction schedule that modifies this peak value for each hour. There are four types of energy that you can choose from for the two additional energy uses: electrical, fuel, hot water and chilled water. The additional energy types are defined the same as exterior lighting with the exception of specifying the type of energy use.

Electrical and fuel types may be used to model say elevators and Bunsen burners in a laboratory. Hot water and chilled water place a load on the central plant, in addition to the load placed by the HVAC systems. If multiple fuel meters have been defined and fuel is a type of energy use selected then a fuel

meter list box will appear. By including miscellaneous energy uses, you can better calibrate your model against billing history or other monitored data.

6.3   Alternative
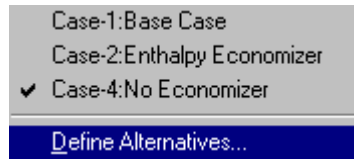
This option is used to select the base case or one of the design alternatives to edit. Only one alternative can be edited at a time. When you start a new project only "Base case" appears in this list. You add to the list by choosing Define Alternatives (see below). The list also displays the ID of the cases in the project. These ID are used to distinguish the DOE-2 input, output and BDL files when a simulation is run. You must save your project and give it a name before creating design alternatives. For more information see the topic Define **Define Alternatives**. This menu option is used to create, modify and delete design alternatives. A design alternative can be based on the base case or any design alternative previously created. All design alternatives begin as a clone of the base case or another design alternative. However, you can subsequently select the alternative and make modifications.

6.3.1   Define Alternatives
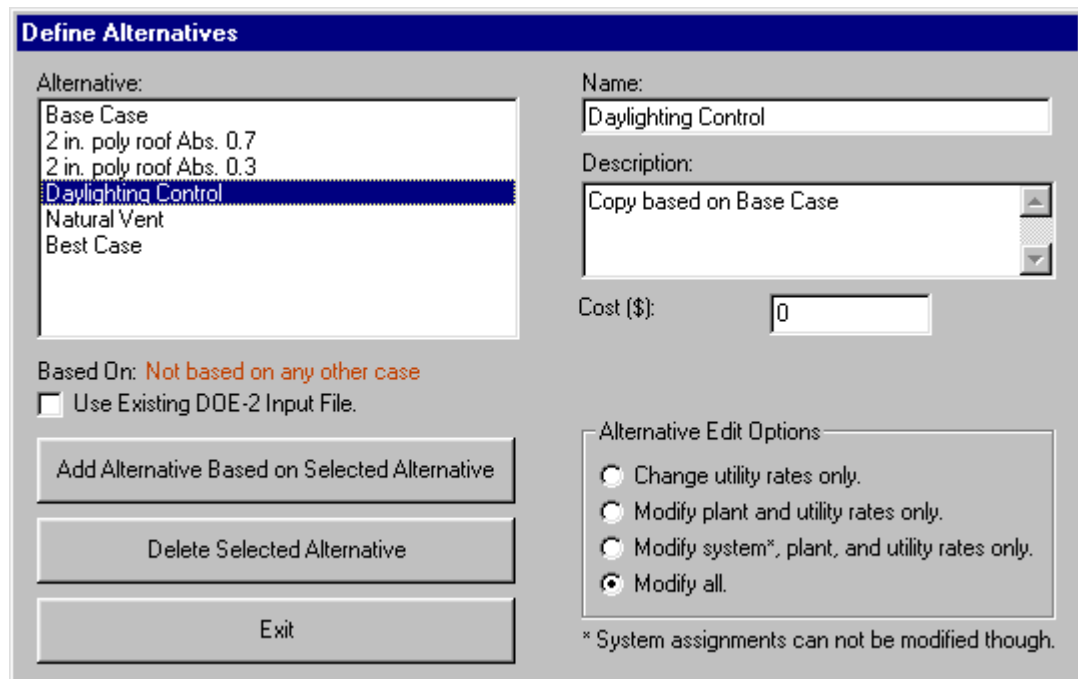
This from is activated from VisualDOE when the user selects Edit|Define Alternatives. It is used to create, modify and delete design alternatives. A design alternative can be based on the base case or any design alternative previously created. All design alternatives begin as a clone of the base case or another design alternative. However once created, you can select the alternative and make modifications. For each design alternative, you specify the following information:

- **Name.** This name will appear as one of the pull-down menu options when you select Alternatives in VisualDOE. The name will also appear in the heading of reports. Take care to use words that describe the alternative. Spaces are OK but you can't use more than 40 characters.

- **Description.** This field may be used to provide a more detailed description of the alternative. This field will accept a maximum of 120 characters. The description appears in some of the VisualDOE reports.

- **Cost.** This field is used for the relative cost of the design alternative. VisualDOE performs life-cycle cost calculations based on this and other information.

- **Alternative Edit Options:** There are several ways that you can modify your design alternative. DOE-2 simulations consist of four sets of independent calculations: loads, systems, plant, and economics. VisualDOE sorts the simulations in a way so as to minimize the time required for simulations. Plant simulations that depend on previous systems runs, etc. would follow the system simulation that they depend on. Keep in mind that when you use these options, a copy of the "Based on" design alternative is copied when you create the alternative. If you make subsequent changes to the Based on" design alternative, the new alternative will not automatically be updated.

- **Alternative Based On.** This label shows the alternative upon which you originally based the new alternative. This may not be changed after you have created a new alternative (see below).

The following command buttons are used on the form. Their use is described below.

- **Add Alternative Based on Selected Alternative.** This command button creates a new alternative. The new alternative is a clone of the alternative that is highlighted when you click this button.

- **Delete Selected Alternative.** This command button deletes the highlighted alternative.

- **Exit.** This command button exits the Define Alternatives form.

For existing buildings, it is recommended that the base case building be completely described and calibrated with the billing history before you create the alternative designs. This will make it easier to keep track of the differences between the proposed design and the base case building. If your base case model has an error, this error will be copied to all the design alternatives, so it is best to get the base case model right before alternatives are created.

Use Existing DOE-2 Input File: For advanced DOE-2 modelers, there is a checkbox on the define alternatives form called "Use Existing DOE-2 Input File". When checked, VisualDOE will not recreate the DOE-2 input file for this alternative if it already exists. Instead, VisualDOE will use an existing DOE-2 input file. This enables you to edit the input file and then run the modified input file through VisualDOE.

6.4   Simulation
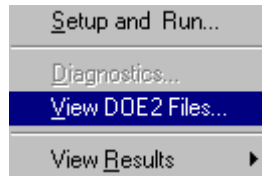
Setup and Run. When you choose Simulation|Setupa form comes up where you can select the alternatives you want to include in your simulations, choose the standard DOE-2 reports that you want to generate, and assign hourly report variable sets. Once the simulations are complete, VisualDOE will extract a summary of end use energy, monthly electricity use, monthly gas use, and peak demand by month, annual gas cost, annual electricity cost and the source energy use in kBtu/y-ft^2. These data will be placed in the project file for subsequent graphing or reporting.

Diagnostics. The diagnostics form shows you information to help you evaluate your runs and determine if they are reasonable. The diagnostics form applies to the selected alternative, so first choose the design alternative you want to diagnose.

View DOE-2 files. Launches a separate viewer with the Input, Output and BDL files for the currently selected case. This feature also allows you to modify input files, search for errors in BDL, and view DOE-2 output reports conveniently.

View Results. Graphs, Reports. This option allows you to display and print any of the standard VisualDOE output reports. When you select this option, another form appears where you can select the reports and design alternatives for which you want to print or preview. See the help topic VisualDOE Reports for a description of the reports and how to use the form.

6.4.1   Run Setup

The Run Setup form is activated from either VisualDOE or VisualPlant program module when you select Simulation|Setup from the pull-down menus choices. The form is organized on three folders. The first folder controls the simulations that you want to make. The second folder is used to select the DOE-2 reportsthat you want to produce when the simulations are made. The third folder is used to assign hourly report variable sets to zones, systems and other project components.
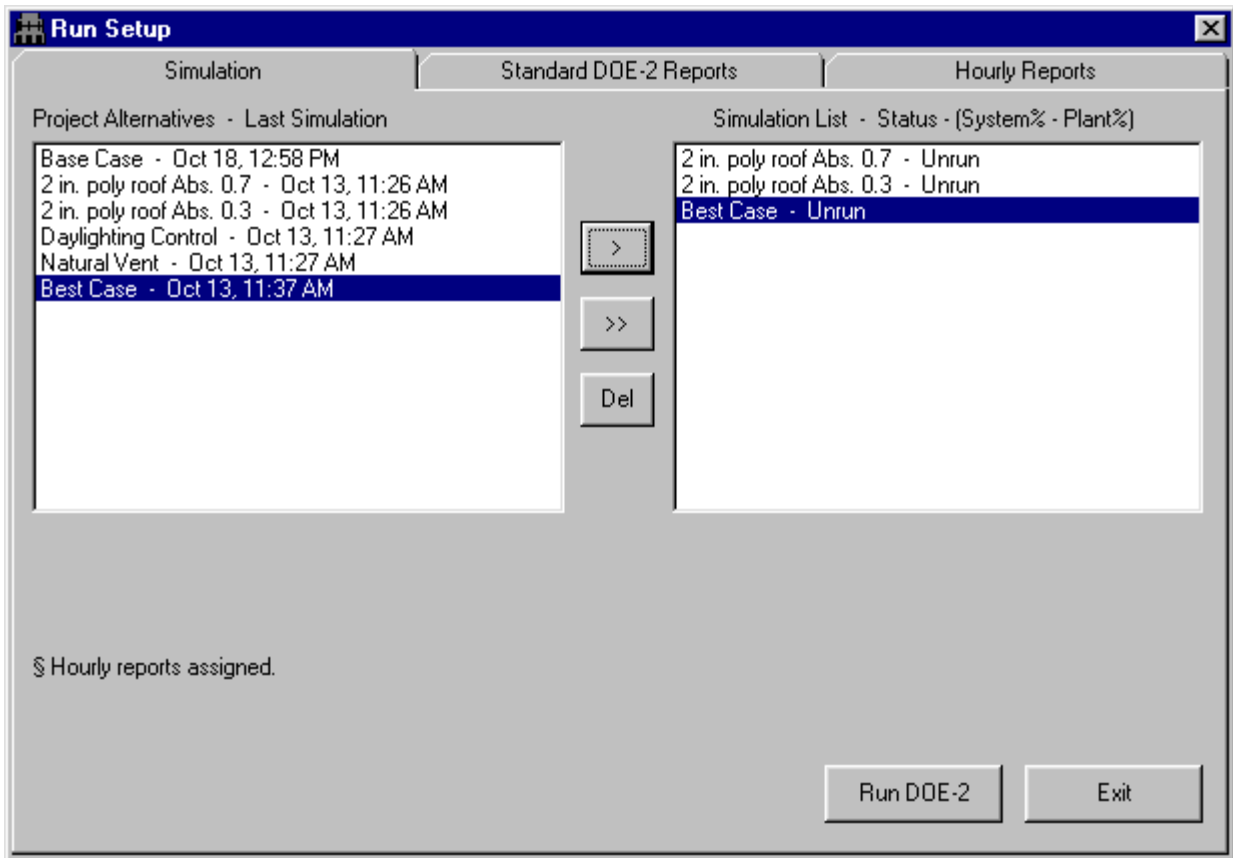
Simulation Folder. The simulation folder is used to select the alternatives that you want to include in your simulations. The form consists of two list boxes. The list box on the left contains the base case and each of the design alternatives that have been created. The list box on the right contains the cases that you want to include in the runs you are about to make. To add the base case or one of the design alternatives to the simulation DOE list, (1) select the case from the list box on the left and (2) press the ">" command button. Alternatively, you can double click on the design alternative an it will be added to the simulation list. To add all design alternatives to the simulation list, press the ">>" command button. To remove a design alternative from the simulation list, select the design alternative and press the "Del" command button.

If a simulation has already been made, the Project Alternatives list includes the date of the last simulation. After each successful run VisualDOE extracts information from the DOE-2 output files, which can be viewed by selecting VisualDOE reports or graphs from the Simulation|ViewResults menu.

When a simulation is successfully made, the percent of hours that any system zone or plant loads are not satisfied is displayed. If the percent is high (generally more than 5%), the system or plant equipment is undersized and loads are not being satisfied. You may choose Simulation|Diagnostics to check zone airflows and temperatures.

If you want to create a central plant hourly load profile to use in VisualPlant Program, click the checkbox "Create plant load profile". This check box is visible only when the simulation list contains just one entry. When this is checked, additional controls appear.

VisualDOE allows you to assign hourly reports to any or all of the design alternatives. Even through you have assigned hourly reports to design alternatives, you can choose not to generate the hourly reports when you make your simulations. You may want to do this to save disk space, since the hourly reports can take considerable space, especially if you generate them for an entire year.
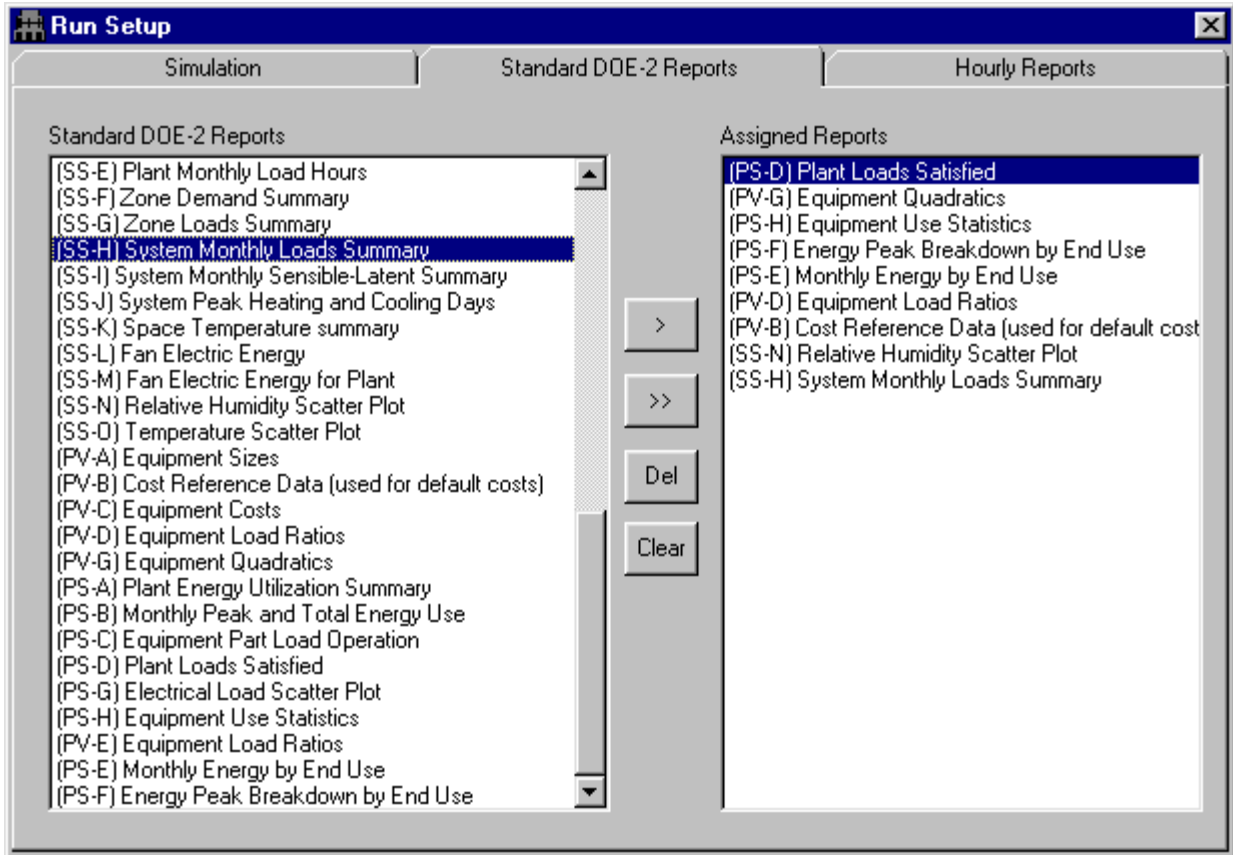
Standard DOE-2 Reports. The Standard DOE-2 Reports folder is used to select the DOE-2 reports that you want produced for your simulations. The standard DOE-2 Reports are listed on the left side of the form. Double click on one to add it to the project reports list on the right. Alternatively, you can select the report you want to add to the list and click the ">" command button. The ">>" command button adds all reports to the project reports list. The "Del" command button removes the highlighted project report from the list. Your choice of DOE-2 reports is saved in the preferences file.

Hourly Reports. Use this form to generate hourly reports for the selected components. These reports are produced when the simulation is made. The hourly report files have the same file name as the project with the extension *.h1 for the base case, *.h2 for the first alternative, etc. These files can be opened in a text processor so that data can be pasted into spreadsheets or other applications.

The hourly report folder is organized with a series of list boxes and other miscellaneous controls. A list of the design alternatives is displayed at the top left corner of the form. Alternatives with a "§" character infront of them have hourly reports assigned to them. Just to the right is a list of the hourly reports that are assigned to the selected alternative.

To assign an hourly report to a design alternative, carry out the following steps.

Step	VisualDOE Response / Notes
1. Select the design alternative from the list box in the upper left corner of the folder.	Any hourly reports already assigned to the alternative will show in the Assigned Hourly Reports list box. The hourly report type list box is refilled with hourly report types available for this alternative.
2. Choose an hourly report type from the drop down list box.	The Components and Hourly Report list boxes will be refreshed for the selected hourly report type.
3. Choose a Component from the list box.	This list will often have just one choice, however, the list will be filled with all the building components that can have the hourly report type selected assigned to them.
4. Select an Hourly Report from the list box.	This list box contains a list of the hourly report defined for the selected variable type. If none exist, you will be advised. You can add variable sets by opening the

Hourly Reports Editor.

5.	Click the Assign Report command button.	The hourly report variable set is assigned to the selected component and added to the Assigned Hourly Reports list box.
6.	Specify the first and last days the reports will be printed.	Try to avoid specifying the entire year because a very large file will be produced. The reports can only be specified for the year 1995 at this time.
7.	Repeat steps 1 through 6 until you have assigned hourly reports as desired.	

6.5   Organizers

Openings...
Glazings...
Construction...
Materials...
Occupancies...
Schedules...
Utility Rates...

Occupancy Data Library and Schedule

Current Occupancy Data Library

Assembly
Health Institution
Hotel
Light Manufacturing
Multi-family High-Rise
Office
Office test
Restaurant
Retail
School
T24LowRiseRes

< Copy
Delete
Rename
Edit
Add New

Current Occupancy Data Schedule

Default Office
Restaurant

Selected Item Description

Property	Value	
Name	Restaurant	
Schedule ID 0	115	
Schedule Name 0	People_Sch5	
Schedule Type 0	0	
Schedule ID 1	113	
Schedule Name 1	Lights_Sch9	
Schedule Type 1	0	
Schedule ID 2	109	

Exit

VisualDOE 3.0 uses organizers to manipulate the items in the project and the library. The Organizer allows you to store items in the VisualDOE library for later use. You can copy items from the library for your project when needed. VisualDOE uses organizers for openings, glazings, constructions, materials, occupancies, schedules and utility rates.

The Organizer has two list boxes located at the top of the form. The list box on the left contains items from your library, while the one on the right contains items in your project. To copy an item from the library to your project, first select it and then click the Copy button. Alternatively, you can simply double click on an

item in the library to copy it to your project and double click on an item in your project to copy it to the library.

You can delete an item from either the library or your project by selecting it and then clicking the Delete button. You can rename an item by selecting it and then clicking the Rename button. To edit an item, first select it in either the library or project list and then click the Edit button.

To add a new item to your project, you must first select an existing item and then click the Add New button. The new item will be a clone of the item you had previously selected. You can then edit the newly created item by selecting it and clicking the Edit button.

The lower portion of the form has a table that displays information about the object that is selected. You can select an object on only one side at a time. When you select an object for the project file, nothing is selected from the other source and *vice versa*.

6.5.1   Construction Editor Overview

The Constructions Editor is a VisualDOE program module for reviewing and modifying the list of construction assemblies in the library and project schedule. To activate, choose Organizer|Constructions Organizer from the VisualDOE pull-down menus.

Constructions Organizer

Constructions Organizer provides interfaces for users to edit, create, and delete a construction from the library or project schedule.
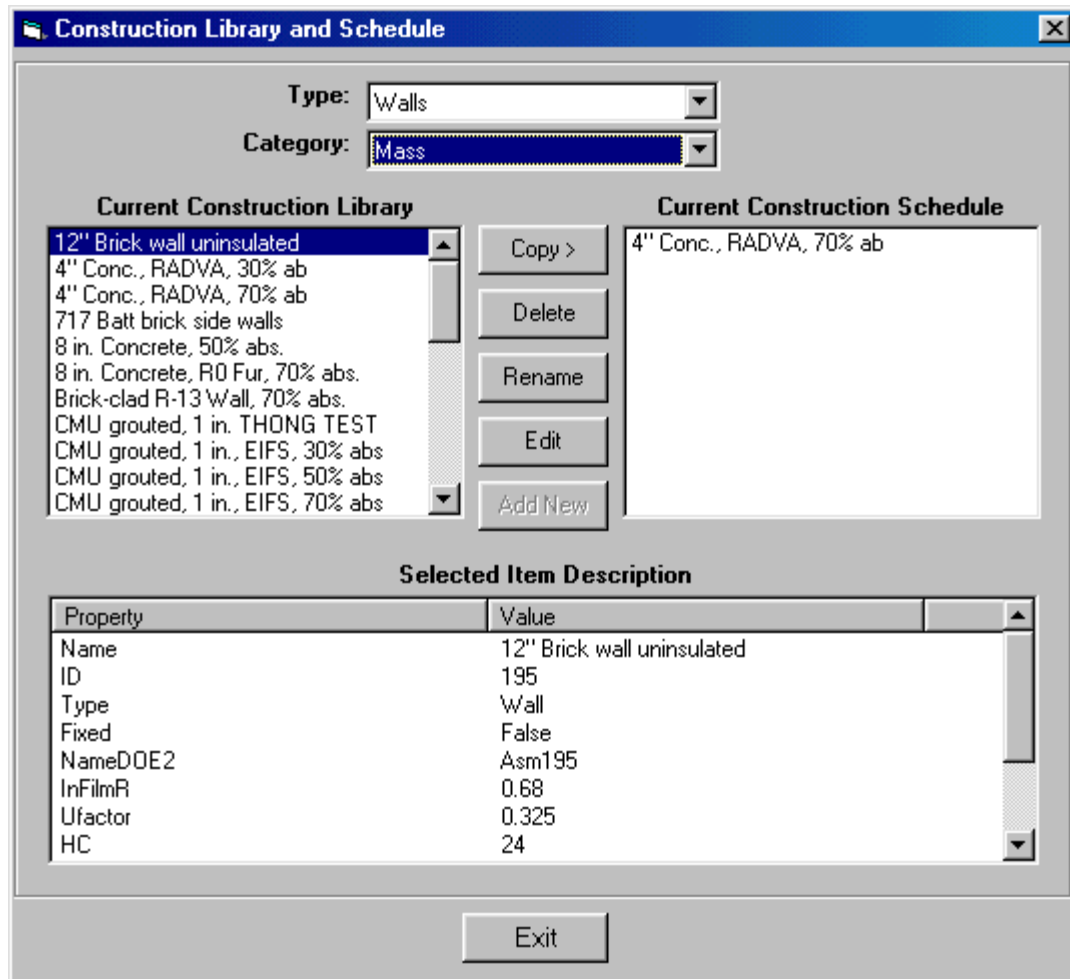
- **Type**. Choices are Wall, Roof, Floor, Slab, Below-Grade Wall, Partition, Ceiling, and Door.
- **Category**. Choices are Light and Mass.
- **Current Material Library**. Shows all construction of the specified type and category in the library.
- **Current Material Schedule**. Shows all construction of the specified type in the project schedule.
- **Copy >**. Copy a construction from the library to the project schedule.
- **Copy <**. Copy a construction from the project schedule to the library.
- **Delete**. This deletes the highlighted construction.
- **Rename**. This shows a form for user to rename the construction.
- **Edit**. This command will launch the Construction Editor.
- **Add New**. Click this to create a new construction based on the current highlighted one.

Selected Item Description. Properties of the selected construction are listed.

Construction Editor

User can right mouse click the material layers of the construction to delete a layer, edit a layer by launching the Material Editor, and add a layer by drag-and-drop a material layer from the Sketch of Selected Material box.
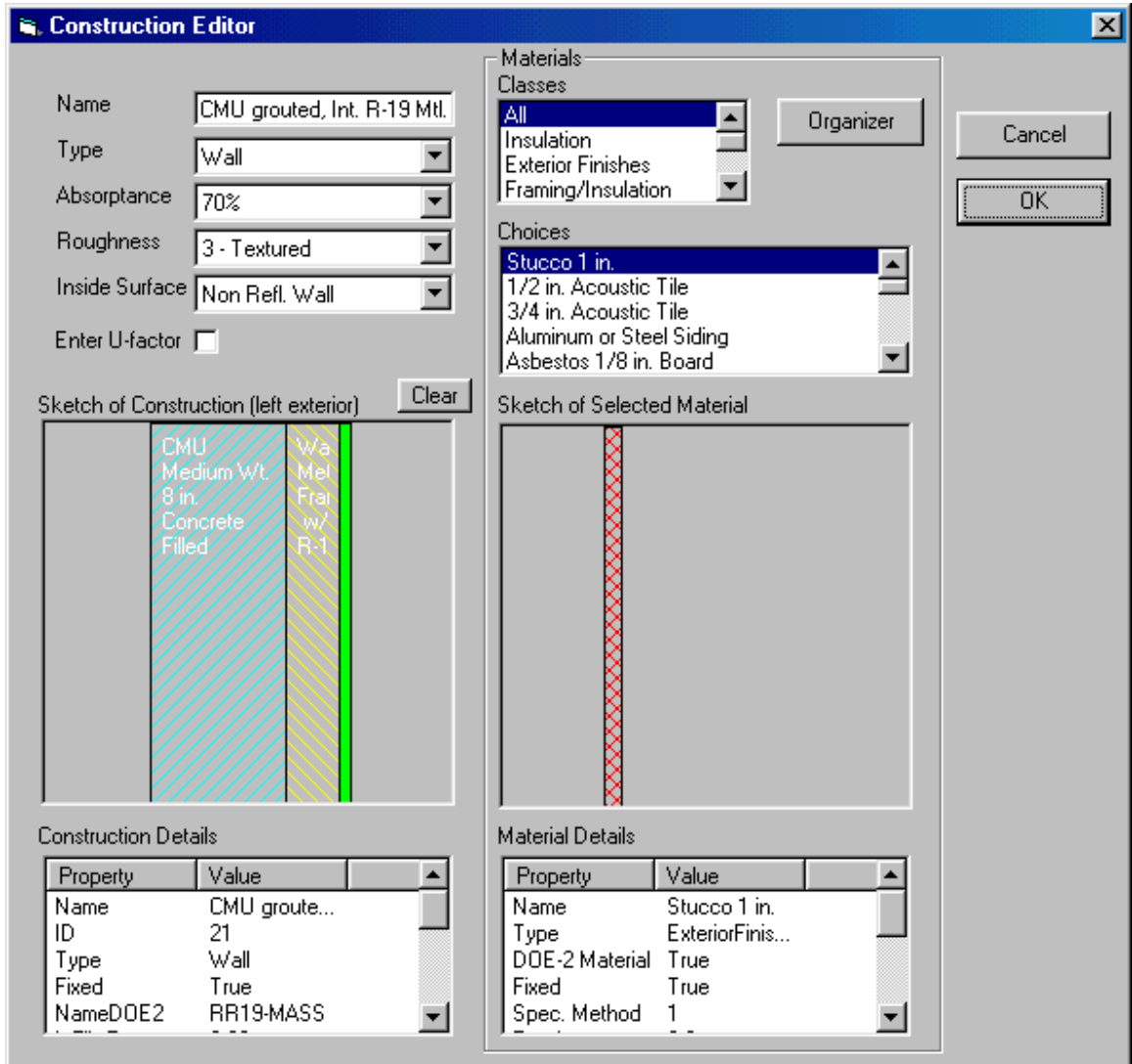
- **Name**. Name of the construction should be unique and less than 16 characters.

- **Type**. Choices are Wall, Roof, Floor, Slab, Below-Grade Wall, Partition, Ceiling, Door.

- **Absorptance.** The absorptance is the fraction (or percent) of solar radiation that is absorbed by the exterior surface of the construction assembly when sunlight strikes the surface. Dark colors have a high absorptance, 70% or higher. Light colors have an absorptance between about 30% and 50%. For more information see the definition of Absorptance.

- **Roughness**. The roughness of the finished outside surface of a wall. Used only for exterior walls (or roofs). DOE-2 uses this value and the hourly wind speed to determine the contribution of the exterior air film to the overall U-Value of the wall. Generally, the effective U-Value of the door is higher when the wind speed is lower, and when the surface is more rough (i.e., the effective U-Value of the door is higher for stucco walls than it is for glass or paint on pine). There are six

choices representing integers between 1 and 6. The following are some examples of surfaces that fall in the six categories.

1 Very Rough. e.g. stucco walls, wood shingle roofs, or built-up roof with stones

2 Rough. e.g. brick or plaster.

3 Textured. e.g. poured concrete walls, or asphalt shingle roofs.

4 Flat. e.g. painted wood siding.

5 Smooth. e.g. unpolished marble, smooth plaster, or metal.

6 Polished. e.g. glass, polished marble, or chrome finished metal.

- **Inside Surface**. For specifying the inside surface air film resistance. The inside surface condition affects the overall U-factor of the construction assembly. Make a selection from this list box that is appropriate for the assembly you are defining.

- **Enter U-factor**. Check this box to enter a construction in U-factor method.

- **Clear**. This command clears the Sketch of Construction

- **Construction Details**. Properties of the construction are listed here.

- **Sketch of Construction**. For walls, the most left layer is the exterior layer. For Roofs and Ceilings, the top layer is the exterior layer. For Floors, the bottom layer is the exterior layer.

- **Material Classes**. Choices are Insulation, ExteriorFinishes, FramingInsulation, InteriorFinishes, Concrete, Masonry, and AirLayers.

- **Choices**. Materials of the selected class are listed. Select a material to display it in the Sketch box. Double click the material to launch the Material Editor.

- **Organizer**. This command launches the Materials Organizer.

- **Material Details**. Properties of the material are listed here.

- **OK**. This command updates the construction and closes the form.

- **Cancel**. This command closes the form and discards all changes to the construction

6.5.2 Material Editor

This form is used to edit materials. Materials are the building blocks of construction assemblies. User uses this form to input a material in two methods, R-Value and Material Properties.

- **Name**. Name of the material should be unique and less than 16 characters.
- **Class**. Choices are Insulation, Exterior Finishes, Framing/Insulation, Interior Finishes, Concrete, Masonry, and Air Layers.
- **DOE-2 Code**. DOE-2 Code is shown if the material is a standard DOE-2 material.
- **Method**. Select a method to input properties of material.
- **Thickness**. Thickness of the material layer.
- **R-Value**. R-Value of the layer.
- **Conductivity**. Conductivity of the material.
- **Density**. Density of the material.
- **Specific Heat**. Specific heat of the material.
- **Color**. Color of the material when shown in the construction sketch.
- **Fill Style**. Fill Style of the material when shown in the construction sketch.
- **Fixed**. This has to be unchecked before changes can be made.
- **Cancel**. This command cancels changes made and closes the form.
- **OK**. This saves changes made and closes the form.

Materials Organizer

Materials Organizer provides interfaces for users to edit, create, and delete a construction from the library or project schedule.
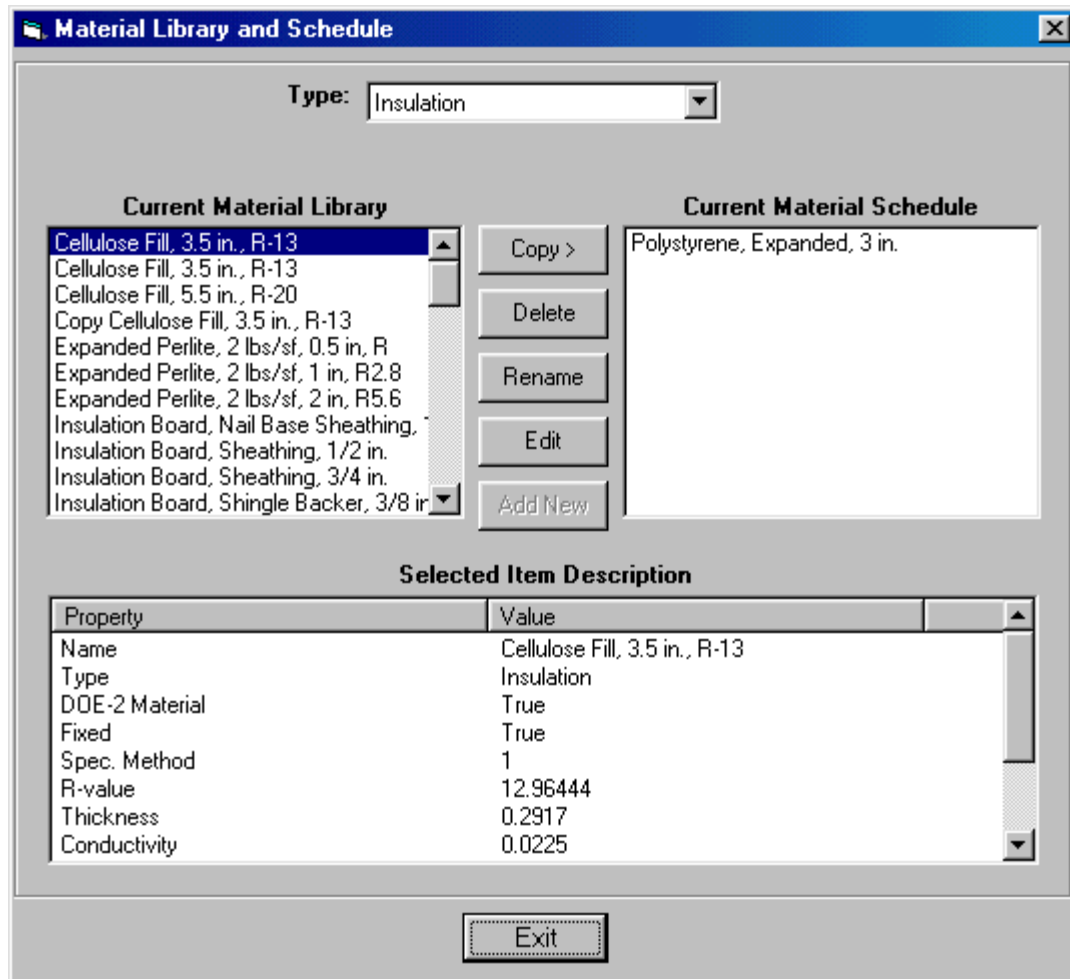
- **Type**. Choices are Insulation, Exterior Finishes, Framing/Insulation, Interior Finishes, Concrete, Masonry, and Air Layers.
- **Current Material Library**. Shows all materials of the specified type in the library.
- **Current Material Schedule**. Shows all materials of the specified type in the project schedule.
- **Copy >**. Copy a material from the library to the project schedule.
- **Copy <**. Copy a material from the project schedule to the library.
- **Delete**. This deletes the highlighted material.
- **Rename**. This shows a form for user to rename the material.
- **Edit**. This command will launch the Material Editor.
- **Add New**. Click this to create a new material based on the current highlighted one.
- **Selected Item Description**. Properties of the selected material are listed.

Absorptance. The fraction of total solar radiation incident on a surface that the surface absorbs (i.e., that gets converted to heat). Used only for exterior walls (or roofs). The table below provides typical values for the absorptance of different types of surfaces and paints.

Material	Absorptance	Paint	Absorptance
Aluminum	0.12	Aluminum paint	0.40
Asphalt pavement, weathered	0.82	Black, flat	0.95
Brick, buff, light	0.55	Black, lacquer	0.92
Brick, red	0.88	Black, oil	0.90
Brick, Stafford blue	0.89	Black, optical flat	0.98
Brick, white glazed	0.25	Blue, azure lacquer	0.88
Cement, uncolored asbestos	0.75	Blue, dark	0.91
Cement, white asbestos	0.61	Blue, medium	0.51
Cement, black	0.91	Blue-gray, dark	0.88
Concrete, brown	0.85	Brown, dark	0.88
Concrete, uncolored	0.65	Brown, lacquer	0.79
Film, Mylar aluminized	0.10	Brown, medium	0.84
Felt, bituminous	0.88	Brown, medium light	0.80
Felt, bituminous, aluminized	0.40	Gray, dark	0.91
Gravel	0.29	Gray, light oil	0.75
Iron, white-on-galvanized	0.26	Green, lacquer	0.79
Lab vapor deposited coatings	0.02	Green, lacquer, dark	0.88
Marble, white	0.58	Green, light	0.47
Roof, white built-up	0.50	Green, medium dull	0.59
Roofing, green	0.86	Green, medium Kelly	0.51
Slate, blue-gray	0.87	Olive, dark drab	0.89
Tin	0.05	Orange, medium	0.58
Wood, smooth	0.78	Red, oil	0.74
		Rust, medium	0.78
		Silver	0.25
		White, gloss	0.25
		White, lacquer	0.21
		White, semi-gloss	0.30
		Yellow	0.57

Adapted from Passive Solar Design Analysis, by J.D. Balcomb, 1979.

Construction Assembly. A construction assembly is an opaque wall, roof, floor, slab, below-grade wall, partition, or ceiling. Construction assemblies generally consist of layers, e.g. an outer layer of stucco, a middle layer of metal studs in combination with insulation, and an inner layer of gypsum board.

Roughness. The roughness of the finished outside surface of a wall. Used only for exterior walls (or roofs). DOE-2 uses this value and the hourly wind speed to determine the contribution of the exterior air film to the overall U-Value of the wall. Generally, the effective U-Value of the door is higher when the wind

speed is lower, and when the surface is more rough (i.e., the effective U-Value of the door is higher for stucco walls than it is for glass or paint on pine). There are six choices representing integers between 1 and 6. The following are some examples of surfaces that fall in the six categories.

1   *Very Rough*. e.g. stucco walls, wood shingle roofs, or built-up roof with stones

2   *Rough*. e.g. brick or plaster.

3   *Textured*. e.g. poured concrete walls, or asphalt shingle roofs.

4   *Flat*. e.g. painted wood siding.

5   *Smooth*. e.g. unpolished marble, smooth plaster, or metal.

6   *Polished*. e.g. glass, polished marble, or chrome finished metal.

6.5.3   Schedules Editor Overview

The Schedules Editor is a tool for creating and editing patterns of building operation. A schedule is an hourly time series that describes the operation of systems or equipment in buildings. Examples of things that need to be scheduled in energy simulations include lights, plug loads, miscellaneous equipment, thermostat settings, fans, occupants, and outside air ventilation. The concept of schedules is used with all simulation programs including DOE-2, EnergyPlus, and BLAST.

Creating a set of schedules in one of the first things you need to do with VisualDOE and other simulation programs. Since many objects in your model need schedules, such as rooms, systems, etc., you will not be able to completely specify these objects if the schedules do not exist when you create the objects. In VisualDOE, some list boxes will appear empty if you do not first create schedules. When you start a new VisualDOE project, you can select a template and the template will set up a preliminary list of schedules for you to use. The Schedules Editor also has an organizer that can be used to copy schedules from other projects, libraries or other files.

Simulation programs use several different types of schedules. Fraction schedules are used for lights, plug loads, and occupants. For each hour of the year, the fraction schedule produces a value, generally between zero and one that represents the fraction of people that are in the space, the fraction of lights that are on, or the fraction of plug load watts that are activated. Temperature schedules are used for heating and cooling thermostat settings. On/off schedules are used for fans and other equipment. Time period schedules identify the pattern of utility charges that apply for a given hour, or to schedule the operation of equipment like gas generators or thermal storage systems.

The basic building block for simulation programs is the day schedule. The day schedule represents a 24-hour period of operation. Each value can represent a temperature, a fraction is a day schedule, which is a hour patterns of use. Day schedules can be combined into overall schedules, which provide seasonal and weekly variations.

VisualDOE has the Schedules Editor is incorporated as a part of it. However, the Schedules Editor is also available as a stand-alone program. As a stand-along program, the Schedules Editor reads in schedules from either DOE-2 or EnergyPlus input files and provides an interface to edit existing schedules, add new schedules and perform other editing functions. The modified set of schedules can then be written back to the input file. This help system supports both the stand-alone and integrated versions of the Schedules Editor. See the topic, Stand-Alone Editor, for more information.

Another feature of the Schedules Editor is its ability to read in an 8,760 time series of values and convert the time series to a schedule that can be used with energy simulation programs. This requires a little judgment on the part of the user, but is a powerful tool that saves considerable time when you need to convert monitored data into schedules to be used in simulations. The feature also works in the opposite way; if you have a simulation schedule, you can write it as an 8,760 time series.

The Schedules Editor is used by the Utility Rates Editor to identify periods during the year when different utility charges apply. Many utilities have different charges for Summer On-Peak, Summer Mid-Peak, etc. In order to accurately apply these rates, each hour of the year must be assigned to one of the time-charge accounts. Since this requires accounting for weekends, holidays and other factors, the Schedules Editor is the ideal tool for performing this function.

This help system includes reference information that is context sensitive to the form you are working in. For instance, if you are using the day schedules editing form and you press the F1 key (for help), Information will be displayed to help you through the process. In addition to the context sensitive help topics, there are a few more general help topics to get you started and to introduce you to concepts that you may not be familiar with.

You can work in either SI or IP units in the Schedules Editor. However, all data is stored in the library in IP units. It is simply converted when displayed. For this reason, you can change units at any time.

The Schedules Organizer

No one ever wants to start from scratch when they begin a new simulation program. To save time, you always want to start with components from other projects and reuse them. The Schedules Organizer is a handy tool for doing this. It allows you to store schedules in the VisualDOE library for later use. You can copy schedules from the library for your project and attend to other details.

The Schedules Organizer has two list boxes located at the top of the form. The list box on the left contains schedules from your library, while the one on the right contains schedules in your project. To copy a schedule from the library to your project, first select it and then click the Copy button. Alternatively, you can simply double click on a schedule in the library to copy it to your project and double click on a schedule in your project to copy it to the library.

You can delete a schedule from either the library or your project by selecting it and then clicking the Delete button. You can rename a schedule by selecting it and then clicking the Rename button. To edit a schedule, first select it in either the library or project list and then click the Edit button.

To create a new schedule in your project, you must first select an existing schedule and then click the Add New button. The new schedule will be a clone of the schedule you had previously selected. You can then edit the newly created schedule by selecting it and clicking the Edit button.

The lower portion of the form has a table that displays information about the object that is selected. You can select an object on only one side at a time. When you select an object for the project file, nothing is selected from the other source and *vice versa*.

Schedules Editor
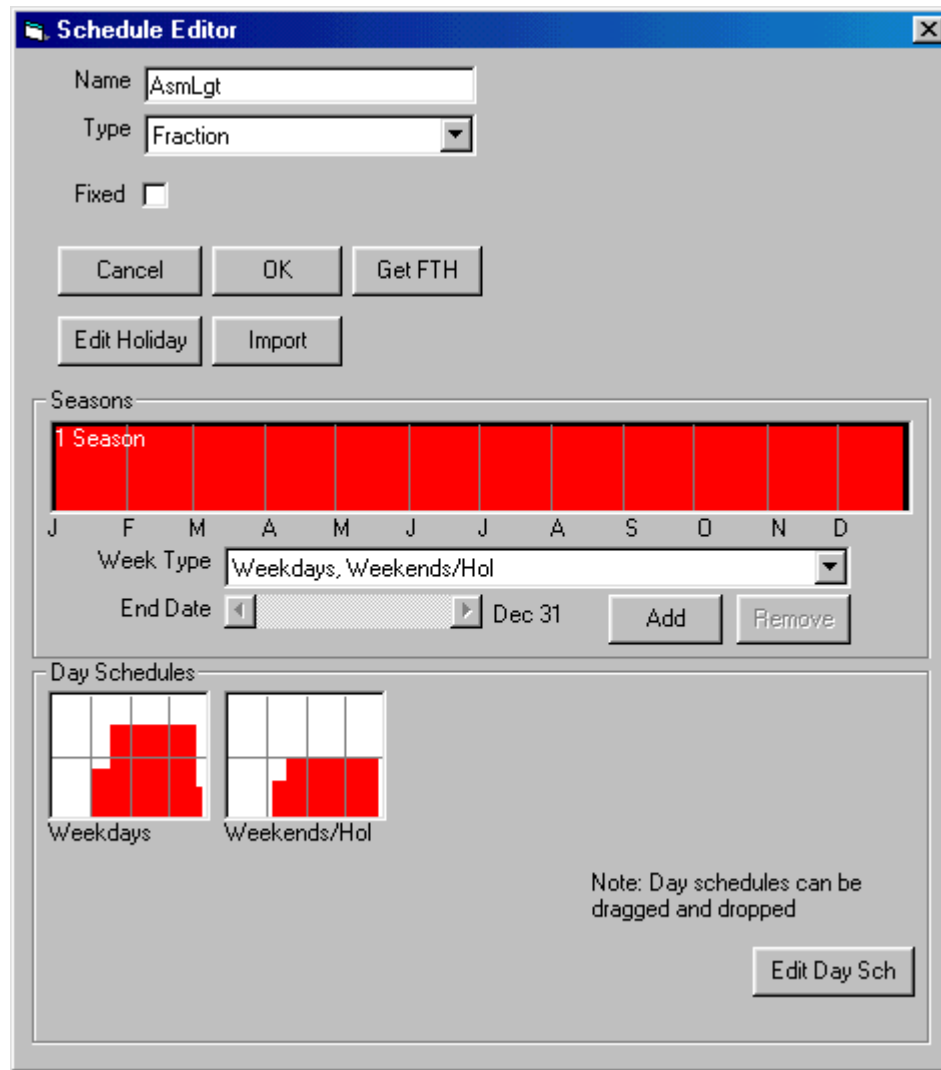
The schedules editor is used to edit an individual schedule. The editor can be launched from the Schedules Organizer when you click Edit. A schedule can have up to eight seasons or periods during the year that have different conditions. In each season, every day of the week is assigned a day schedule. A completed schedule will represents a time series of 8,760 hours (365 days x 24 hours/day). Day schedules are the key building blocks in constructing a schedule; more detail is provided in the topic Day Schedules Editor.

Each schedule has a name and a type. The name is a character string that describes the schedule. You may want to develop a convention for naming your schedules, since they appear in alphabetically in the list boxes. The Type field describes the type of schedule you are creating or editing. See Schedule Types for more information.

When you are creating a schedule, you can divide the year into seasons. This may be appropriate for a school that is shut down in summer or a retail store that has longer hours during the holidays. The Seasons frame has a horizontal calendar that shows the seasons in your schedule. The number of seasons in the schedule appears in white letters over the top of the calendar. The seasons are divided with heavy black vertical lines. The current season is highlighted in red. The other seasons are shown in gray. To select a season, just click on it and it will be come highlighted. If the schedule has only one season (the most common case), the entire calendar will appear in red (highlighted).

To add a season. Click Add button to add a new season. Week Type and day schedules of the added season need to be specified.

To delete a season. Click Remove button to delete a season.

Each season has two properties associated with it. The first is the way that days are grouped for the purpose of assigning day schedules. The choices are described below:

Mon, Tue, Wed, Thu, Fri, Sat, Sun, Hol	A separate day schedule is assigned to every day of the week and an additional day schedule for holidays (8 day schedules in all are assigned)
Mon, Tue, Wed, Thu, Fri, Weekends/Hol	A separate day schedule is assigned to each weekday, but a single day schedule is assigned for Saturdays, Sundays and Holidays (6 day schedules are assigned)
Weekdays, Sat, Sun, Hol	One day schedule is assigned to all week days, but separate day schedules are assigned to Saturdays, Sundays and Holidays (4 day schedules are assigned)
Weekdays, , Weekends/Hol	One day schedule is assigned for weekdays and a separate day schedule is assigned for weekends and holidays (3 day schedules are assigned)
All	Every day has the same day schedule (only one day schedule is assigned)

Each season has an end date (its beginning date is the day following the end date of the previous season). There are a couple of ways to change the end date for a selected season: (1) you can hold down the right mouse button and drag the horizontal bar or (2) you can use the horizontal scroll bar labeled "End Date". Depending on how days are grouped (see above), up to eight day schedules are assigned to each season. the type of day schedules that are assigned depend on the schedule type, e.g. if the schedule is a fraction schedule, then only fraction type day schedules can be assigned.

The day schedules associated with the seasons are represented as graphic icons located beneath the seasons frame. Double click on one of the day schedules to edit it. Alternatively, you can right mouse click and choose Edit. Either or these operations will launch the Day Schedules Editor.

- **Get FTH**. For fraction and on/off schedules, this gets the full equivalent hours of the schedule.
- **Edit Holiday**. Click this to edit the holiday. The holiday applies to all schedules in a project.
- **Import**. Click this to launch a form for importing a time series to create a schedule.
- **OK**. This saves data and closes the form.
- **Cancel**. This closes the from without saving any changes.

Day Schedule Editor

The Day Schedule Editor is launched by double clicking on one of the day schedule icons located on the Schedules Editor. The Day Schedule Editor looks a little differently depending on the type of schedule that is being edited. The following form is for a fraction type schedule.
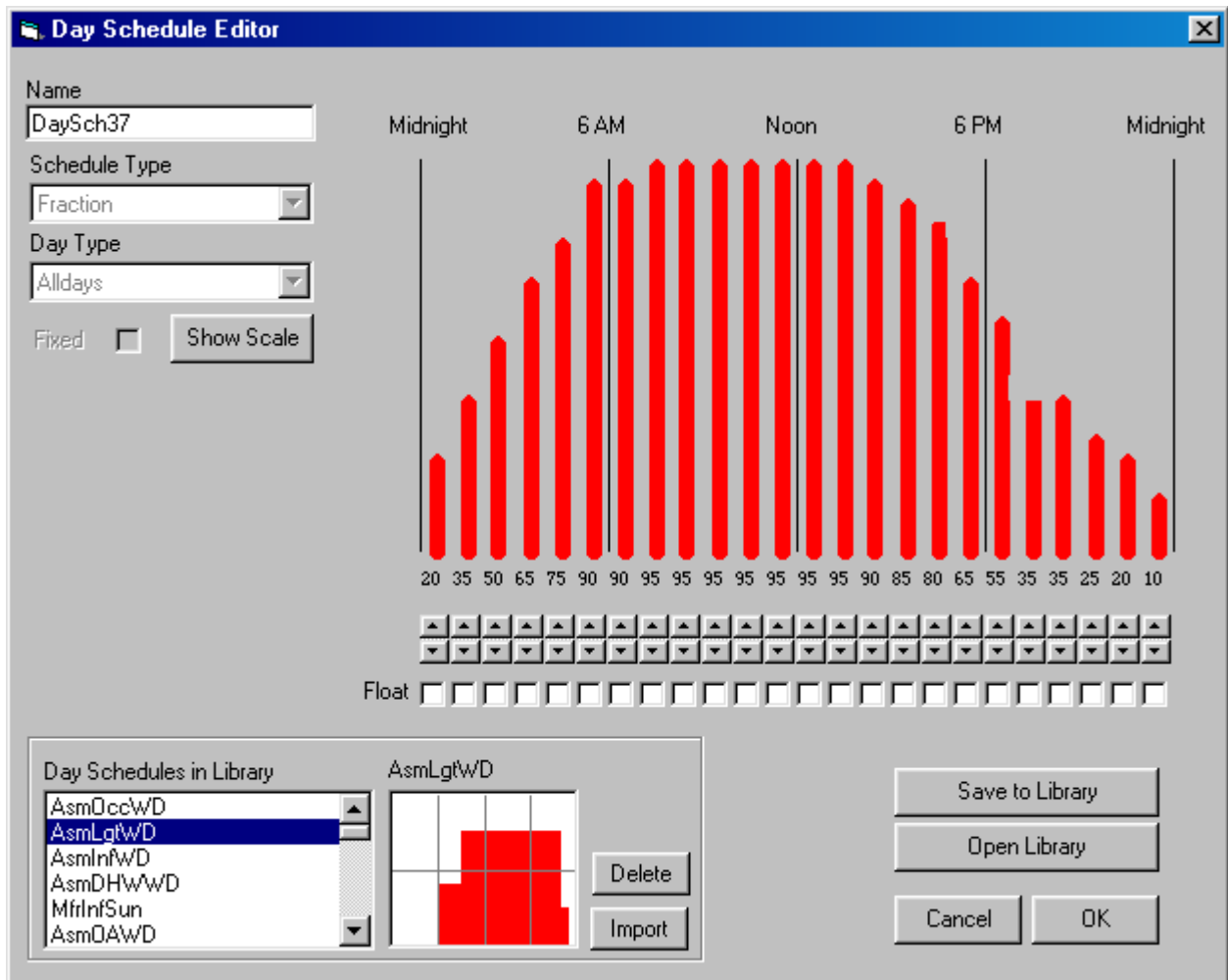
The Day Schedule Editor is used to build day schedules, which are 24-hour patterns of use. There are four types of day schedules: Fraction, On/Off, Temperature and Time Period, but you can generally not change the type from the Day Schedule Editor. The schedule type is generally set by the parent Schedule Editor.

You can edit the selected day schedule by using the up and down arrows beneath each bar. The amount of change associated with each click will depend on the type of schedule you have selected. On/Off schedules jump between zero and 100%, while fraction schedules jump in 5% increments (but this default can be changed by clicking Show Scale button). Temperature schedules jump in 1 degree increments.

On/off and fraction type day schedules can have a special condition for a given hour called Float. When Float is checked, the value for that hour is calculated by DOE-2 based on other information. In the DOE-2 input file, this usually means that a -999 is assigned to that hour. When float is checked, the numeric value for that hour is not relevant.

You can also edit a day schedule by using the mouse. When you position the mouse over the red bars, the cursor changes to cross hairs and a small number is displayed representing the position of the mouse. A click with the left mouse button changes the bar to the value on the cursor. You can also hold down the left mouse button and drag the cursor across the bars and the value will be changed across all the hours.

- **Show Scale**. This shows a frame where user can set the maximum, minimum and step before editing the day schedule. Click Set Scale to active changes.

- **Open Library**. This opens the library and listed all day schedules of the current type in the library for user to view or import.

- **Save to Library**. This save the edited day schedule to the library. This button is visible after the library is opened.

- **Import**. This imports the day schedule from the library to the edited day schedule.

- **Delete**. This deletes the selected day schedule form the library.

- **OK**. This saves day schedule and closes the form.

- **Cancel**. This cancels all changes made and the day schedule is not changed.

Day Schedule Editor, Time Periods

This shows a time period schedule.
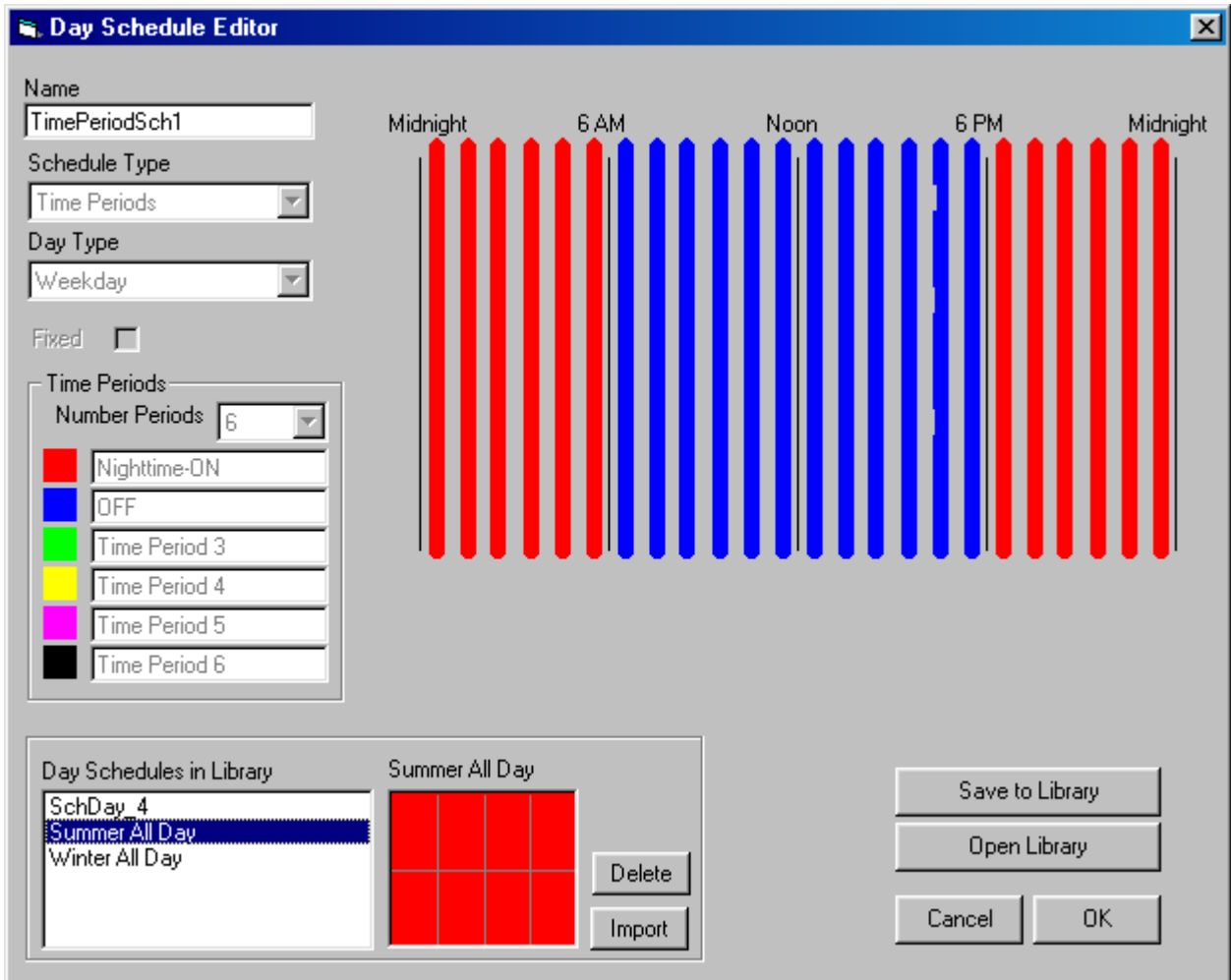
Importing and saving a day schedule from and to the library is the same as of other types of schedule.

Editing begins with selecting a color (corresponding to a time period) by clicking the color box and dragging mouse over the graph area.

Occupancies Editor

The Occupancy Editor is used to edit an <u>occupancy</u> in the library. An occupancy is a collection of schedules and other data that characterize an occupancy such as a school, office, or retail store.

- ▪ **Name**. Enter a name to describe the occupancy. The name will appear in list boxes for you to choose, so it should be descriptive and distinguishable from other occupancies.

- ▪ **Room/Zone and System Schedules**. The drop-down list boxes for people, lights, etc. only contain the appropriate schedule types. The most common schedule type is the Fraction schedule which is used for people, lights, equipment power, infiltration, domestic hot water, and outside air. On/Off schedules are used for fans, and Temperature schedules are used for heating temperatures, cooling temperatures and PIU temperatures.

Each occupancy also has a default heating and cooling design temperature, lighting power density, equipment power density, and occupant density. These values are optionally assigned to rooms when you change the occupancy type.

- ▪ **Edit Selected Schedule**. Select a schedule and click this button to edit it.

- ▪ **OK**. This saves changes and closes the form.

- ▪ **Cancel**. This discards changes and closes the form.

Import Schedule

This form provides the interface to import a time series data for creating a schedule later.

- **Ignore first lines**. This specifies number of lines to skip before valid data begins.

- **Time Step**. Specifies how many data points in an hour.

- **Column Delimiter**. Specifies delimiters that separate columns in the file. Choices are comma, tab and spaces. Multiple spaces are ignored.

- **Data at Column**. Specifies the data column to be read.

- **Filename**. Specifies the file with data to be read.

- **Import**. This reads the data and closes the form.

- **View File**. This displays the content of the file.

- **Exit**. This closes the form.

After the data is imported, the Convert button will be visible in the schedule form. User has to define a dummy schedule with type, seasons, week type, etc, and specifies the threshold for determining the 100% for fraction type schedule and ON for On/Off type schedule, then clicks the Convert button to match the dummy schedule to the imported time series data.

Schedule Types

The schedule editor supports four types of schedules:

- **Fraction**. This type of schedule is used to schedule the operation of lights, plug, occupants and other items where the hourly operation can be specified as a fraction of the maximum.

- **On/Off**. On/off schedules are used to specify the operation of fans, the availability of air conditioning and other simulation factors that are either on or off.

- **Time Period**. A time period schedule is a special case of an on off schedule where more than two states can be specified. Up to six states can be specified for time-period schedules. The time-period schedule can be used to specify the on-peak, shoulder and off-peak periods for both the summer and winter. The time-period schedule would also specify when winter ends and summer ends.

- **Temperature**. Temperature schedules are used to specify thermostat settings, chilled water supply temperatures, hot water supply temperatures, and other hourly temperature specifications used in energy simulations.

- **Any Number**. This is a generic schedule type introduced with EnergyPlus. The only requirement is that the value associated with each hour be a number

Day Schedules. The day schedule represents a 24-hour period of operation. Each value can represent a temperature, a fraction is a day schedule which is a hour patterns of use. Day schedules can be combined into overall schedules which provide seasonal and weekly variations. The properties of a day schedule are its Name, Type (Fraction, On/Off, Temperature, or Time Period), and the 24-hour time series. The first element in the time series represents the hour between midnight and 1 AM, the second between 1 AM and 2 AM, etc. The fraction day schedule is a list of 24 numbers between zero and 1.0. The temperature day schedule is a list of 24 numbers representing a thermostat setpoint or other temperature information. The on/off day schedule is a list of 24 zeros or ones. The Time Period schedule is a list of 24 time periods.

On/off and fraction type day schedules can have a special condition for a given hour called Float. When Float is checked (true), the value for that hour is calculated by DOE-2 based on other information. For instance, it is common practice to construct outside air schedules (which are fraction day schedules) with float set to true for the hours when the HVAC system is expected to operate, e.g. DOE-2 will calculate for each hour the quantity of outside air necessary to provide the specified cfm/person or other stated criteria.

Schedules. A schedule is a group of <u>day schedules</u> that describe for an entire year how some building function such as lighting, occupant density or equipment is operated. A schedule accounts for both seasonal and weekly variations (daily variations are accounted in day schedules). The properties of a schedule are its Name, Type (Fraction, On/Off, Temperature, Time Period, Any Number), and Number of Seasons. For each season, the properties are the ending date, Days (typical weekday variations), and for each unique day, an associated day schedule. All together a schedule represents a 8,760-hour time series of values.

Day Types

In building a schedule, the year is divided into seasons and the weeks in each season are divided into *day types*. The day types for each season depend on your choice from the Days drop-down list box. The choices in this list box include.

Description in List Box	Number Day Types	Description
Mon, Tue, Wed, Thu, Fri, Sat, Sun, Hol	8	Every day of the week plus holidays has a different schedule.
Mon, Tue, Wed, Thu, Fri, Weekends/Hol	6	Weekdays have different schedules but weekends and holidays are treated the same.
Weekdays, Sat, Sun, Hol	4	Weekdays are treated the same, but Saturdays, Sundays and holidays have separate schedules
Weekdays, Weekends/Hol	2	Weekdays are treated the same and weekends and holidays are treated the same.
All	1	Every day of the week has the same schedule.

Holiday Set. A holiday set is a group of days that will be observed as holidays. DOE-2 has a standard set of holidays that are appropriate for the U.S. These are normally used in simulations unless you specify an alternative set. Other countries observe different holidays and so it is important to correctly identify days when the building will be operated differently.

Fraction Schedule. This type of schedule is used to schedule the operation of lights, plug, occupants and other items where the hourly operation can be specified as a fraction of the maximum. For instance, you might specify that a room has a maximum occupancy of 10 persons. The fraction schedule referenced by the room adjusts the maximum occupancy for each hour of the year. If the fraction for a particular hour is 0.2 and the maximum occupancy is 10, then 2 persons would be assumed to occupy the room for that hour. Fraction schedules work in a similar manner for lights and plug loads, except that the maximum is specified in watts and the fraction represents the fraction of those watts that operate for the hour.

Temperature Schedule. Temperature schedules are used to specify thermostat settings, chilled water supply temperatures, hot water supply temperatures, and other hourly temperature specifications used in

energy simulations. Unlike fraction schedules the value in temperature schedules is directly used in the calculations.

On/Off Schedule. On/off schedules are used to specify the operation of fans, the availability of air conditioning and other simulation factors that are either on or off. Conceptually, an on/off schedule is just a fraction schedule which is limited to two values (zero and one).

Time-Period Schedule. A time period schedule is a special case of an on off schedule where more than two states can be specified. Up to six states can be specified for time-period schedules. Consider, for instance, a thermal storage system. During some periods, you will want the chillers to operate to make ice or chilled water. During other periods, you want the system to melt the ice to provide cooling. During other periods, you may want the cooling equipment to operate to provide cooling without using the thermal storage system. And, in some periods you want the system to be shut down. A time period schedule allows you to specify these different states (up to six). Another common application for time period schedules is for utility rates when the cost of electricity depends on when it is used. The time-period schedule can be used to specify the on-peak, shoulder and off-peak periods for both the summer and winter. The time-period schedule would also specify when winter ends and summer ends.

Occupancy. An occupancy is a collection of schedules that characterize how a building or a portion of a building is used. An occupancy includes fraction schedules for people, lights equipment and infiltration. It also includes an on/off schedule for fans, temperature schedules for heating and cooling thermostat schedules, and fraction schedules for hot water use and outside air ventilation.

Hourly Profile. An hourly time series of data representing energy use or load data for one or more parameters. If the hourly time series is for an entire year, it will have 8,760 records of information (365 days times 24 hours/day). Hourly profiles can be processed by the schedules editor to create DOE-2 or EnergyPlus style schedules. Also the schedules editor can export to an hourly load profile format.

6.5.4 Utility Rates Editor Overview

The Utility Rates Editor is used to add, delete and modify Utility Rates. The utility rates editor deals with all types of electric, gas, steam and chilled water utility rates. Electric rates can account for demand charges, time-of-use charges as well as ratchets.

Utility Rates Organizer

Utility Rates Organizer provides interfaces for users to edit, create, and delete a utility rate from the library or project schedule.
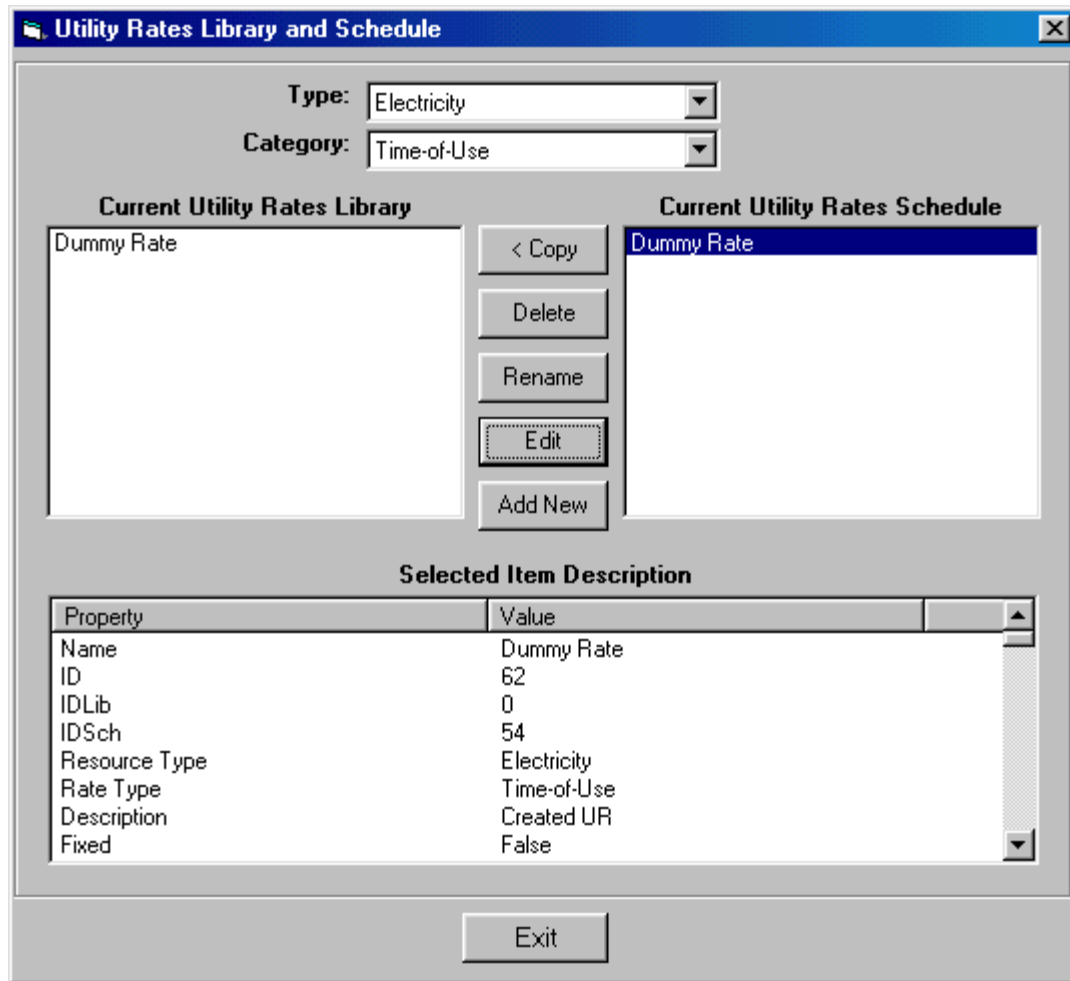
- **Type**. Choices are Electricity, Natural Gas, etc.
- **Category**. Choices are Flat and Time-of-Use.
- **Library Items**. Shows all rates of the specified type and category in the library.
- **Project Items**. Shows all rates of the specified type in the project schedule.
- **Copy >**. Copy a rate from the library to the project schedule.
- **Copy <**. Copy a rate from the project schedule to the library.
- **Delete**. This deletes the highlighted rate.
- **Rename**. This shows a form for user to rename the rate.
- **Edit**. This command will launch the Utility Rate Editor.
- **Add New**. Click this to create a new rate based on the current highlighted one.

Selected Item Description. Properties of the selected rate are listed.

Utility Rate Editor

The utility rates editor is used to modify the electricity, gas or other energy charges that apply to the project. The following form shows editing of a flat type electricity rate.

- **Name**. Name of the utility rate.

- **Service Provider**. Name of the service provider like PG&E.

- **Description**. Description of the utility rate.

- **Resource Type**. Choices are Electricity, Diesel Oil, Natural Gas, Fuel Oil, Steam, Chilled Water, LPG, Coal, and Methanol.

- **Effective Date**. Date the rate starts to be effective.

- **Rate Type**. Type of rate, flat or time-of-use.

- **Billing Day**. Billing day each month.

- **Service Charge**. Monthly service charge or customer charge.

- **Demand Charge**. Demand charge in $/kW.

- **Energy Charge**. Energy charge in $/kWh.

- **Demand Ratchet**. Check this box if this rate has demand ratchet.

- **Edit Ratchet**. Click this button to edit demand ratchet.

- **Rate Limit**. Checked this box if this rate has a limit charge.

- **Maximum Rate**. Enter the maximum charge in $/kWh.
- **Fixed**. If this box is checked, no changes can be made. Uncheck this box before making any changes.
- **OK**. This saves data and closes the form.
- **Cancel**. This discards changes and closes the form.

The following form is for editing a time-of-use type utility rate.

Time-of-use type utility rate consists of some common properties of a flat type rate and a time period schedule and charge periods.

Edit. Click this to launch the Schedule Editor to edit the time period schedule.

Utility Charges. This frame shows all charge periods and details of the selected charge period. A charge period can be renamed here.

Edit Charge Period. Click this to launch the Charge Period Editor to edit the selected charge period.

The procedure to create a new time-of-use rate is to,

1. Input name, service provider, description, resource type, effective date, rate type, billing day, service charge, demand charge, rate limit and maximum rate.

2. Create the time period schedule by clicking the Edit button.

3. Create demand ratchet if applicable by clicking Edit Ratchet button.

4. Edit charge periods by clicking Edit Charge Period.

5. Click OK button to save the rate data.

Charge Period Editor

This form is for editing a charge period.

- **Name**. Name of a charge period should be unique and less than 16 characters.
- **Charge Type**. Choices are Energy, and Energy and Demand
- **Demand Ratchet**. Check this box if a demand ratchet applies to the demand charge.
- **Edit Ratchet**. This launches a form to describe demand ratchet.
- **Number of Blocks**. Up to 5 blocks can be specified for both types of charges.
- **Units**. This shows the units for energy and demand dependent upon the resource type.
- **OK**. Save changes to the day schedule and closes the form.
- **Cancel**. Discard changes and closes the form.

Energy Charges

- **Number of Blocks**. The block number, an integer between 1 and 5.
- **Size**. Size of each block. The units depend on the selected Resource and whether you are working in SI units, e.g. kWh for electricity, therms for gas in inch-pound units, MJ for gas in SI units, etc. No block size is specified for the last block.

- **Range**. This column is for display only. It shows the range for each block. You will notice that the information in this column is updated as you change one of the block sizes.

- **Cost**. This is the cost per unit of energy. A separate cost is entered for each block. The units change depending on the selected Resource and whether you are working in SI units.

Demand Charges. This block of information is visible only when you select Charge Type of Energy and Demand. The first thing that you define is the Number of Blocks by making a choice from the drop-down list box. This changes the size of the demand charges table to provide a row for each block. The demand charges table has four columns, although you enter data in only two of the columns (Size and Cost).

- **Size**. Size of each block. The units depend on the selected Resource and whether you are working in SI units, e.g. kWh for electricity, therms/hour for gas in inch-pound units, etc. No block size is specified for the last block.

- **Range**. This column is for display only. It shows the range for each block. You will notice that the information in this column is updated as you change one of the block sizes.

- **Cost**. This is the cost per unit of demand. A separate cost is entered for each block. The units change depending on the selected Resource and whether you are working in SI units.

Demand Ratchet Editor

This editor is used to define a ratchet that may apply to a utility rate.

- **Name**. Name of the demand ratchet.

- **Type**. Choices are Highest-Peak and Average. Highest-Peak means the ratchet to be calculated on the basis of the highest monthly peak of the ratchet period.

- **Number of Months**. This specifies the period over which the ratchet is calculated. A value of 12 implies that the ratchet will be calculated over all months of the year.

- **Fraction**. A numeric value between 0 and 1 that is multiplied against the demand.

- **Offset**. A numeric value between –100,000,000 to 100,000,000 kW that is added to the demand.

The adjusted demand is: Adj. Demand = (Peak Demand – Offset) * Fraction

Schedule Editor

The schedule editor is used to define the time charge periods that apply.
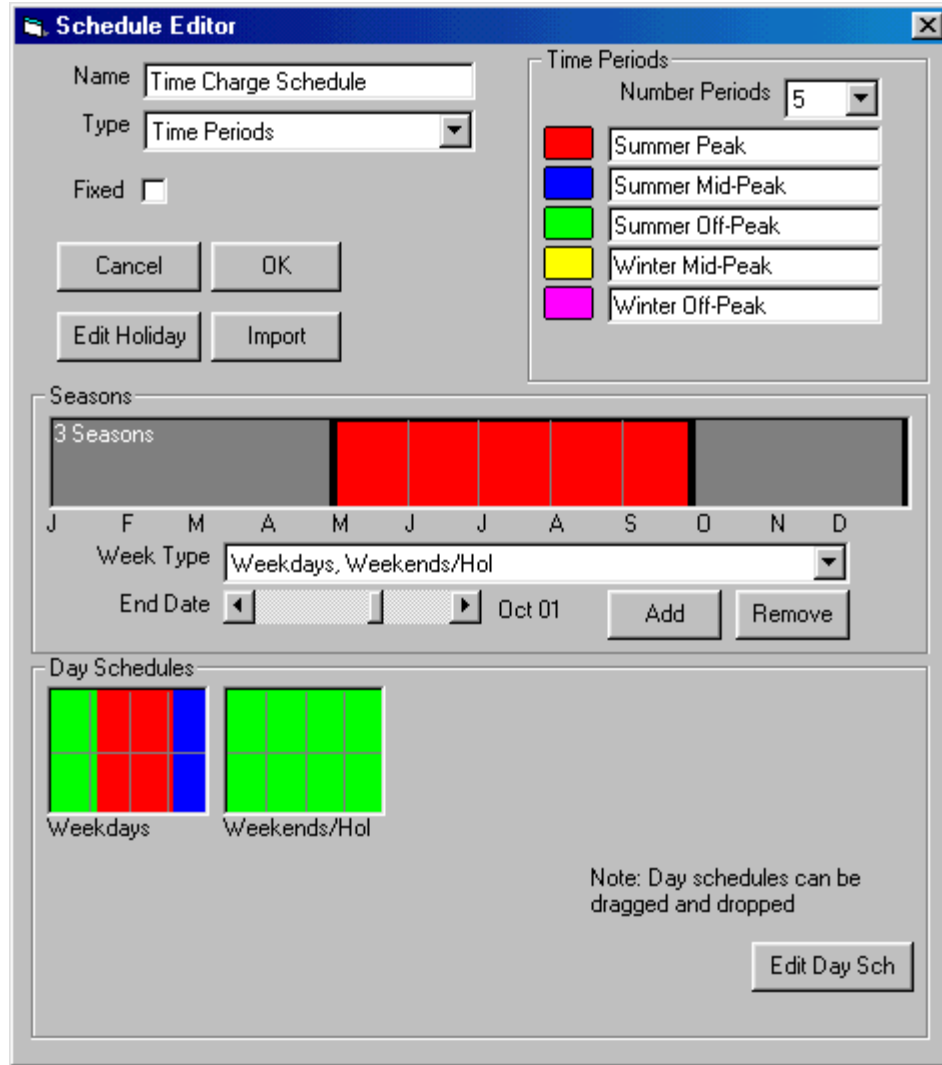
A schedule contains seasons and a season contains day schedules. Each season has two properties associated with it. The first is the way that days are grouped for the purpose of assigning day schedules. The choices are described below:

Mon, Tue, Wed, Thu, Fri, Sat, Sun, Hol	A separate day schedule is assigned to every day of the week and an additional day schedule for holidays (8 day schedules in all are assigned)
Mon, Tue, Wed, Thu, Fri, Weekends/Hol	A separate day schedule is assigned to each weekday, but a single day schedule is assigned for Saturdays, Sundays and Holidays (6 day schedules are assigned)
Weekdays, Sat, Sun, Hol	One day schedule is assigned to all week days, but separate day schedules are assigned to Saturdays, Sundays and Holidays (4 day schedules are assigned)
Weekdays, , Weekends/Hol	One day schedule is assigned for weekdays and a separate day schedule is assigned for weekends and holidays (3 day schedules are assigned)
All	Every day has the same day schedule (only one day schedule is assigned)

Each season has an end date (its beginning date is the day following the end date of the previous season). There are a couple of ways to change the end date for a selected season: (1) you can hold down the right mouse button and drag the horizontal bar or (2) you can use the horizontal scroll bar labeled "End Date". Depending on how days are grouped (see above), up to eight day schedules are assigned to each season. the type of day schedules that are assigned depend on the schedule type, e.g. if the schedule is a fraction schedule, then only fraction type day schedules can be assigned.

The day schedules associated with the seasons are represented as graphic icons located beneath the seasons frame. Double click on one of the day schedules to edit it. Alternatively, you can right mouse click and choose Edit. Either or these operations will launch the Day Schedules Editor

- **Name**. Name of the schedule should be unique and less than 16 characters.

- **Type**. Choices are Fraction, On/Off, Temperature, Time Period, and Any Number. Type should be specified before creating seasons and day schedules.

- **Fixed**. If this is checked, none of schedule properties can be changed.

- **Time Periods**. Applies only to Time Period type schedules. Number of time periods and name of each time period needs to be entered.

- **Seasons**. Click Add and Remove button to add and remove a season. User can specify the Week Type and End Date of a season.

- **Day Schedules**. Day Schedules can be drag and drop. Double click a day schedule or click the Edit Day Sch to launch the Day Schedule form. Right click a day schedule will popup a menu to copy the image of the day schedule.

- **Edit Holiday**. This launches the holiday editor.

- **Import**. This launches a form to import a schedule from time series data in an external file

- **OK**. Save changes to the schedule and closes the form.

- **Cancel**. Discard changes and closes the form.

Day Schedule Editor

This form is for editing a day schedule of type time period.
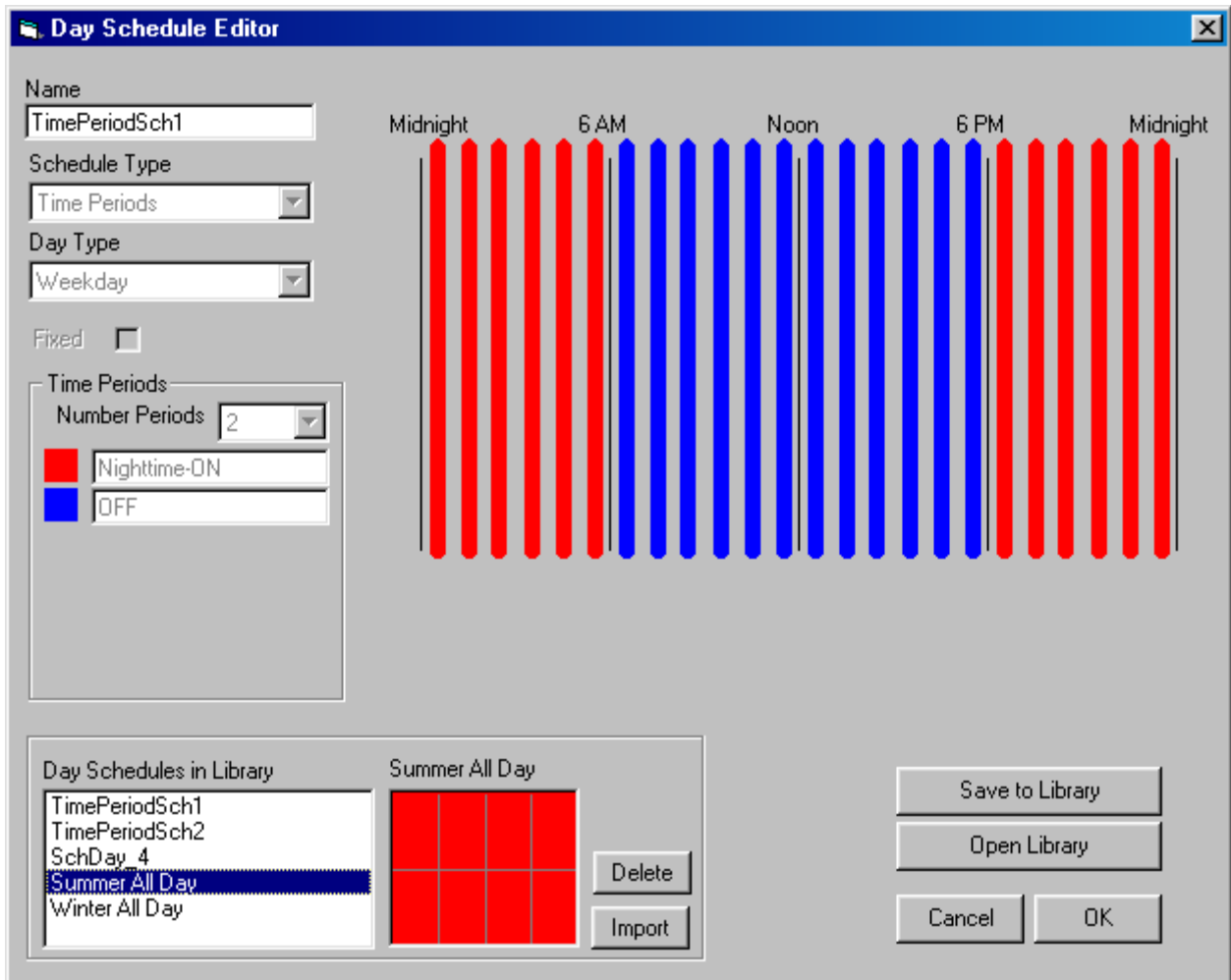
- **Name**. Name of the day schedule should be unique and less than 16 characters.

- **Type**. Choices are Fraction, On/Off, Temperature, Time Period, and Any Number. User can't change Type here, it has to be changed at the schedule level.

- **Fixed**. If this is checked, none of day schedule properties can be changed.

- **Time Periods**. Applies only to Time Period type schedules. For display only. Click the color filled box to pick up a color and paint the drawing area.

- **Open Library**. This command opens the VisualDOE library and lists all the day schedules of specified type. Click any one of the Day Schedules in Library to import it.

- **Save to Library**. This saves the current day schedule to the library to be reused later.

- **Import**. This imports the selected day schedule from the library to be the current day schedule being edited.

- **Delete**. This deletes the selected schedule from the library.

- **OK**. Save changes to the day schedule and closes the form.

- **Cancel**. Discard changes and closes the form.

Definitions

Time Period. A category of time created for the purposes of calculating gas or electric utility charges. For example, the "Summer On-Peak" time period might be defined as summer weekdays between noon and 6:00 PM. Each time period has a set of <u>time period charges</u> associated with it.

Time Period Charges. A pattern of charges associated with a utility <u>time period</u>. For electricity, time period charges can include charges for energy use (kWh), demand (kW), the ratio of kWh/kW or certain combinations of these three. Charges can vary for different <u>blocks</u>.

Utility Rate Block. A range of energy consumption, demand, etc. for which the charges vary. For instance, a residential electric rate might have a "life-line" block for the first 500 kWh/month of consumption with a charge of say $0.05/kWh. Consumption over 500 kWh/month might be charged at a higher rate. As many as five blocks can be defined for each <u>Time Period Charge</u>.

Utility Rate Schedule. A collection of <u>time periods</u> and associated <u>time period charges</u> for an <u>energy resource</u> such as electricity or gas. DOE-2 uses the utility rate schedule to calculate the utility bill for each billing period, usually a month.

Energy Resource. An energy resource that must be purchased from a utility. Energy resources include electricity, gas, oil, etc.

Monthly Demand Charge. The monthly demand charge applies at the rate schedule level and is added to any other demand charges that might apply. Suppose that (a) the monthly demand charge is $2/kW, (b) that the monthly peak occurred during the "On-Peak" time period, and (c) that the demand charge for the "On-Peak" time period is $5/kW; then the total demand charge would be $2/kW + $5/kW or $7/kW.

6.6   Openings Editor

Window Folder

Height. Enter height of the window including the frame width.

Width. Enter width of the window including the frame width.

Exterior Shade. Check the box if the opening has exterior shading. Enter more data at the Exterior Shade tab.

Interior Shade. Check the box if the opening has interior shading. Enter more data at the Interior Shade tab.

Model Frame. Check the box if the opening has detailed frame data. Enter more data at the Frame tab.

Glazing Construction. Select one the glazing from the drop down list.

Organizer. Click this button to import more glazing constructions.

Redraw. Click this button to redraw the image of the opening.

Cancel. Click this button to discard changes and closes the form.

OK. Click this button to save changes made and closes the form.

Exterior Shade
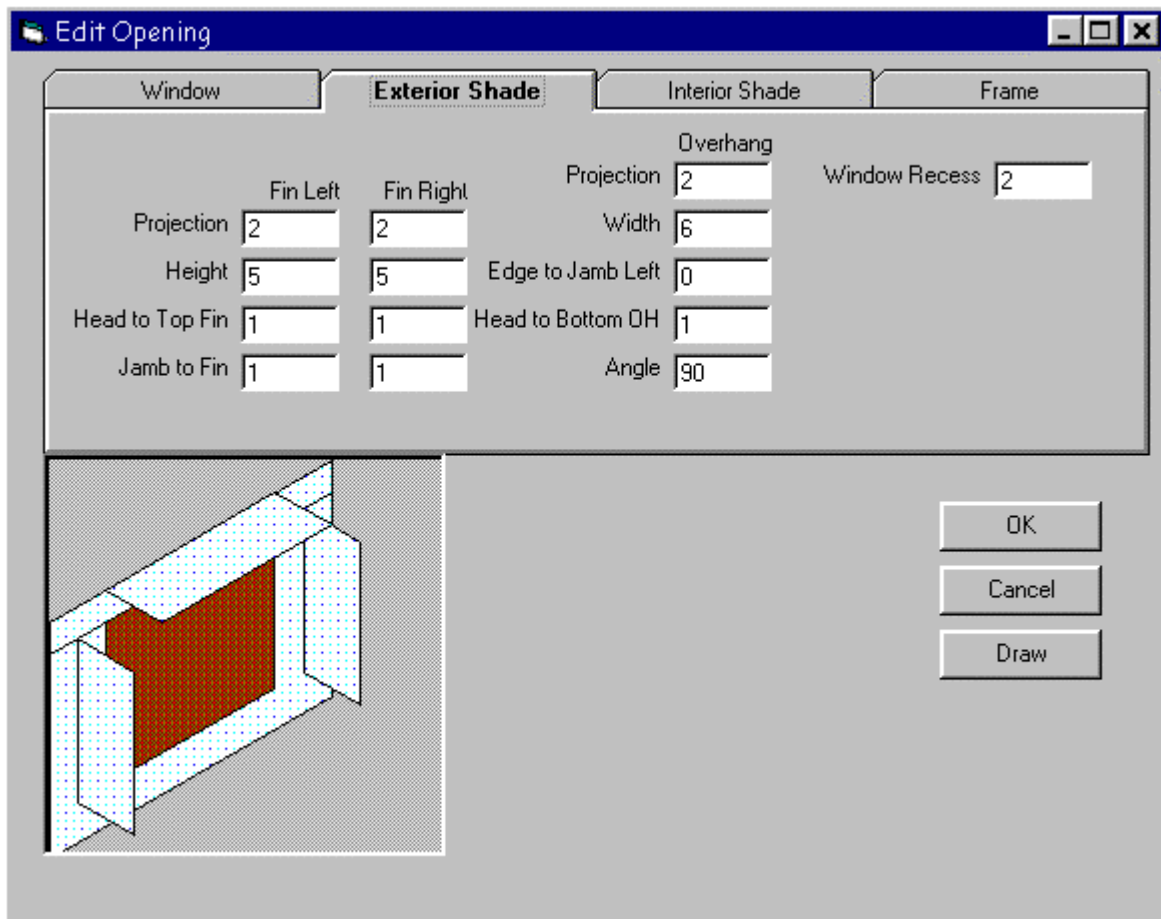
When checked, exterior shading will be modeled. Exterior shading includes overhangs and sidefins. When checked, additional controls become visible for you to enter the overhang projection and distance as well as the side-fin projection and distance (see drawing above). Exterior shading should be checked if you have either sidefins or an overhang. These shading surfaces are attached to the wall where the window is located and thus shade both the window and the wall. Note that overhangs and fins are assumed to be opaque. Non-opaque shades can be specified as building-shades at the case level.
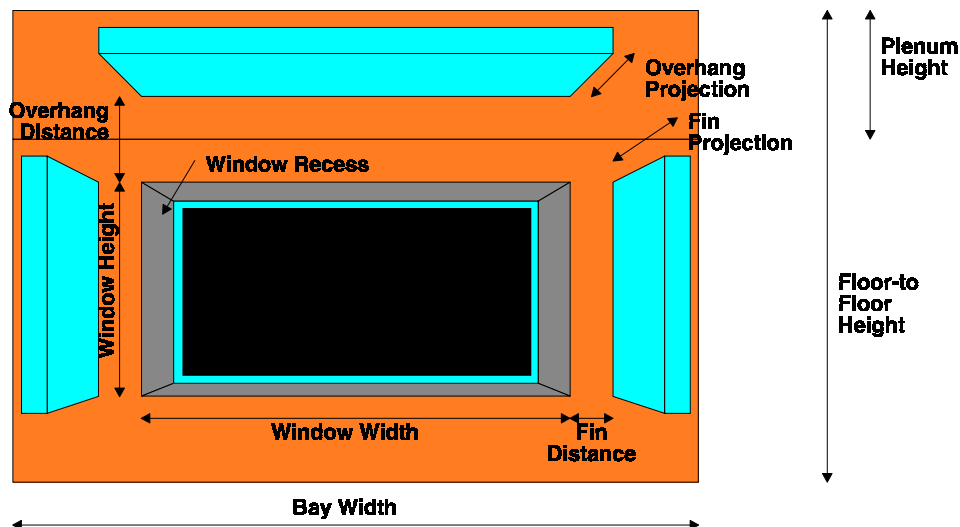
Overhang Projection and Distance. Units are ft (m). The Projection is the horizontal distance from the surface of the window to the outward edge of the overhang. If you have sidefins, but not an overhang, enter an overhang projection of zero. The Distance is measured from the top of the window to the bottom of the overhang. (See drawing above.)

Side-Fin Projection and Distance. Units are ft (m). The Projection is the distance from the surface of the wall to the outward edge of the overhang. If you have overhangs, but not sidefins, enter a side-fin projection of zero. The Distance is measured from the window jamb to the side-fin. (See drawing above.)

Angle (9*0.0*; 0.0 to 180 degrees) This is the angle between the overhang and the window. When set at 90, the overhang is perpendicular to the window. If less than 90 it is tilted down; if greater than 90, it is tilted up.

Window Recess (*0.0*; 0.0 to 10.0 ft) (*0.0*; 0.0 to 3.0 m) This is the distance that the window is recessed into the wall; i.e., the distance from the outside surface of the wall to the outside surface of the window glass. If a window has a frame, the frame is also set back.

Interior Shade Folder

Interior Shade: If unchecked, windows in the facade will be modeled with no interior shade. If checked, then your model will include an interior shade for all windows in the facade. The interior will have an effect about equal to a medium colored blind. The blind will be open any time solar gains through the window are less than 30 Btu/h-ft2. When solar gains exceed this threshold, the interior shade will be closed.   If you include interior shades in your model, you may want to request the LS-L DOE-2 report (Management and Solar Summary for Space). This will report the hours each month that the interior shade is closed.

Type Takes a code-word giving the type of shading device when a shading device is present on the window for

sun and/or glare control. If SHADING-SCHEDULE is not assigned to a window, the window will be considered to have no shading device and WIN-SHADE-TYPE will be ignored.

> *MOVABLE-INTERIOR* (the default) interior shade that can be retracted, such as drapes or Venetian blinds.
>
> *MOVABLE-EXTERIOR* exterior shade that can be retracted.
>
> *FIXED-INTERIOR* interior shade that cannot be retracted.
>
> *FIXED-EXTERIOR* exterior shade that cannot be retracted.

SHGC Multiplier. When closed the shading coefficient is reduced to by this fraction (default 80%) f its unshaded value.

Tvis Multiplier. When closed the light transmission is reduced to this fraction (default 60%) of its unshaded value.

Control Probablity (0.0 to 1.0) May be specified if the sun control device on a window is manually operated. Gives the probability that the occupants of a space will deploy the shading device if the incident solar radiation exceeds

Close blinds when solar gain exceeds. The occupants of a space will deploy the shading device if the incident solar radiation exceeds this value.

Close blinds when glare index exceeds. The occupants of a space will deploy a shading device when this value is exceeded

Frame Folder
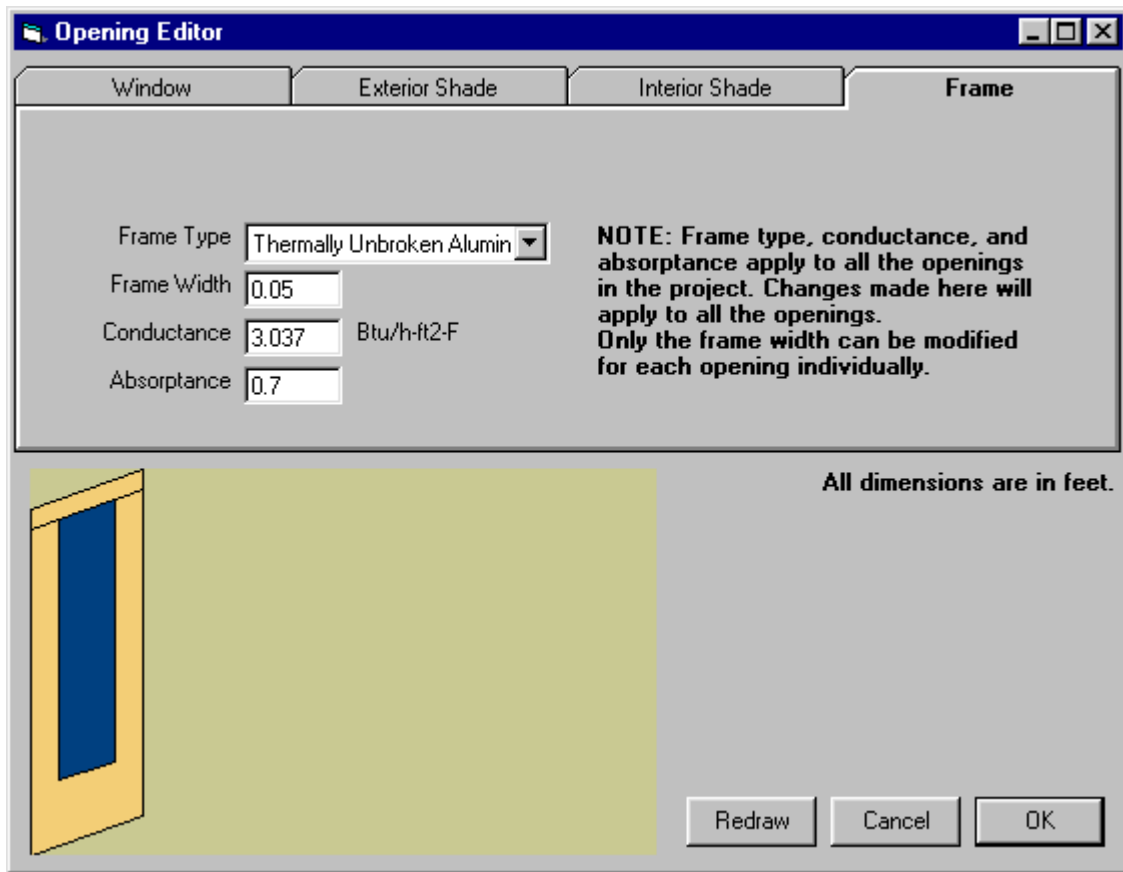
Frame Type. Select a frame type from the list. The default values given below can be overwritten. The frame width can be varied for each opening, but the frame type remains the same for all openings in the project.

Frame Type	FRAME-CONDUCT (excludes OA film)		U-value	
	IP (Btu/ft 2 -F-h)	SI (W/m 2 -K)	IP (Btu/ft 2 -F-h)	SI (W/m 2 -K)
Thermally unbroken aluminium	3.037	17.24	1.9	10.79
Thermally broken aluminium	1.245	7.07	1	5.68
External flush glazed	0.812	4.61	0.7	3.97
Wood with or without cladding	0.434	2.46	0.4	2.27
Vinyl	0.319	1.81	0.3	1.7

Frame Width (0.0 to 2.0 ft) Projected width of the frame in the plane of the glazing. The program assumes that the frame width is the same on all sides of the window. If this is not the case, use the average frame width.

Conductance. (0.0 to 1.0 Btu/ft2-F-h) (*2.46*; 0.0 to 56.8 W/m2-K) Conductance of the frame, *excluding* the outside air film but including the inside air film.

Absorptance (0.0 to 1.0) The solar absorptance of the outside surface of the frame.

Notes:

1. In DOE-2, you can define frames only for exterior windows, not for interior windows.

2. DOE-2 will do a frame calculation only if you enter FRAME-WIDTH. Otherwise, the frame area will be zero.

3. DOE-2 automatically removes the overall window area, including frame, from the associated exterior wall area.

4. The conductances in the table below are effective values that take two-dimensional conduction effects into account.

5. Each hour, DOE-2 adds the effect of a wind speed-dependent outside air film to the user specified FRAME-CONDUCT.

6. If a window has dividers (such as mullions or muntins), then HEIGHT, WIDTH, and FRAME-WIDTH should be chosen so that (HEIGHT) x (WIDTH) = total area of the glazed parts of the window; and [HEIGHT + 2x (FRAME-WIDTH)] x [WIDTH + 2x (FRAME-WIDTH)] - (HEIGHT) x (WIDTH) = total area of frame (perimeter plus dividers)

7. The various elements of a frame (top, bottom, side, dividers, etc.) may have different conductances. In this case, FRAME-CONDUCT should be an area-weighted average of the different elements.

8. DOE-2 finds the overall window conduction by adding frame, edge-of-glass, and center-of-glass contributions. Thus, all three of these contributions are included in each of the following report quantities: "Window Conduction" in summary reports LS-B, LS-C, LS-E, and LS-F; "Window U-Value" and "Window Area" in verification report LV-D; WINDOW hourly report variable #1, "Window U-Value".

9. A WINDOW multiplier also multiplies the frame.

10. Window fins and overhangs shade the frame as well as the glazing.

11. Shading devices, like blinds and drapes, that you specify using the WINDOW keywords SHADING-SCHEDULE and CONDUCT-SCHEDULE, affect only the glazed part of the window. They do not effect the heat conduction through the frame.

12. If the window has a setback, the frame is also set back by the same amount.

6.7   Glazing Organizer
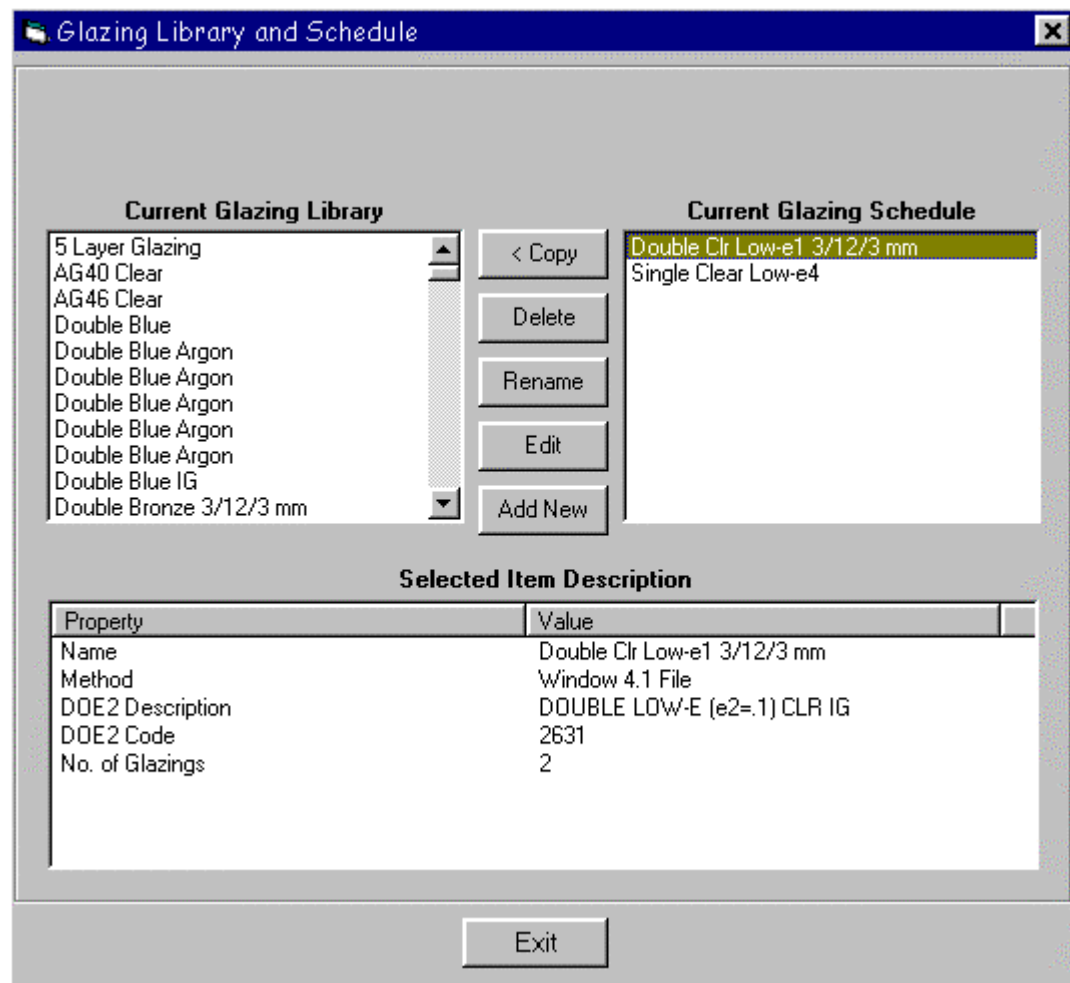
6.7.1   Glazing Editor
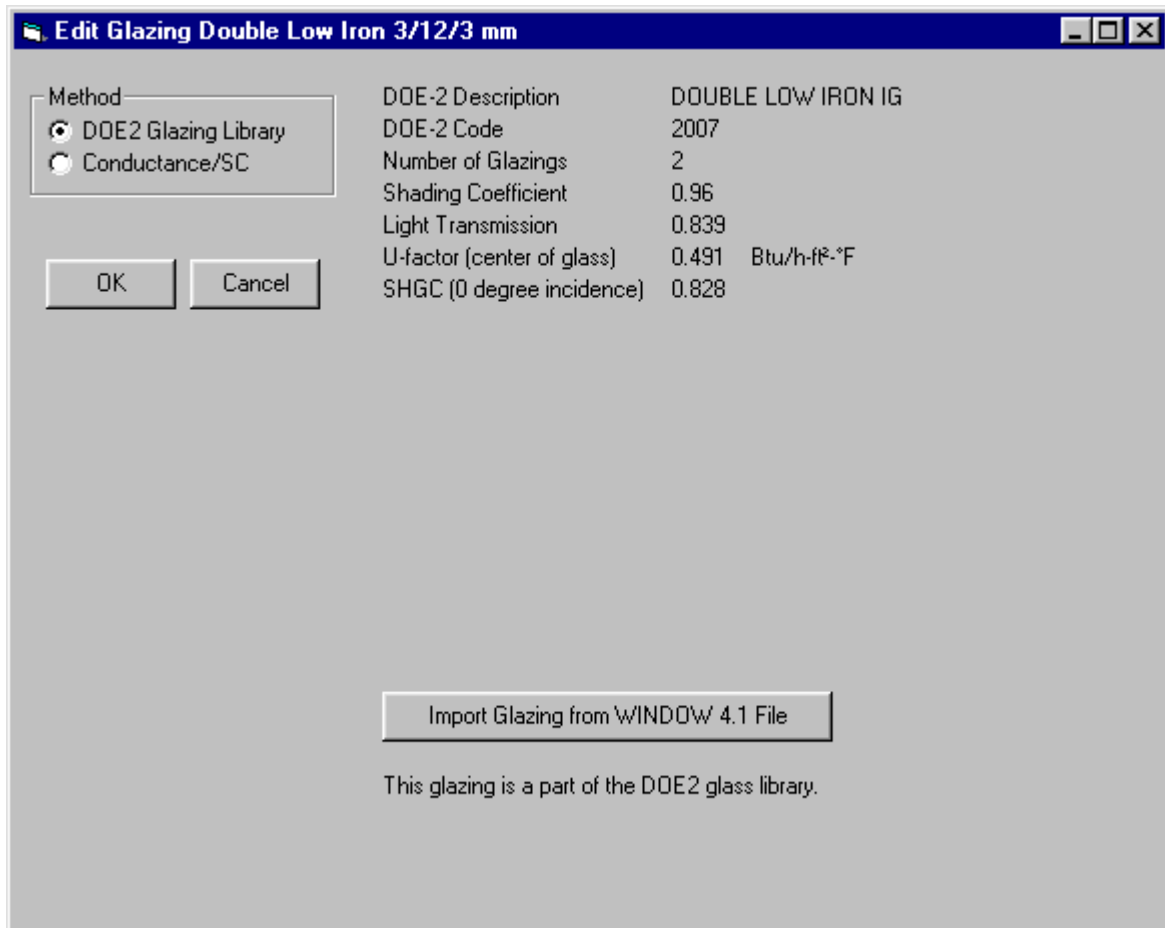
Detailed information about the selected glazing is displayed on the screen. The detailed data is read from the W4Lib.dat file, which is a part of the VisualDOE library. The following is a description of the information displayed about the selected fenestration construction.

- *Name*. The name is what appears in list boxes where you are asked to select a fenestration construction. This is the only piece of information that you are able to directly edit using the Fenestrations Editor. The remainder of the information is read from the W4Lib.dat file.

- *DOE-2 Description*. This description is part of the W4Lib.dat file. This description will appear in some of the DOE-2 reports.

- *DOE-2 Code.* This code number is used in the DOE-2 input file to identify a construction in W4Lib.dat. This code should be unique.

- *Number of Glazings*. The number of physical layers in the fenestration construction. Number of glazings is two for double glass, etc.

- *Shading Coefficient*. The shading coefficient is the ratio of heat gain through the selected fenestration construction to the heat gain through the same area of 3mm (1/8 inch) double strength clear glass.

- *Light Transmission*. The fraction of solar radiation in the visible spectrum that passes through the glazing material, with no consideration of the window frame. The reported value is for a normal

incidence, e.g. light is striking the window perpendicular to the plane of the window. The W4Lib.dat file has light transmission data for other incidence angles.

- *U-factor (center of glass).* The heat transmission through the glazing calculated at the center of the glass. Units are Btu/h-F-ft² (W/m2-K). The center-of-glass U-factor is used by DOE-2 to calculate the overall U-factor of each window, based on the dimensions of the window and the frame type. The Graphic Editor assumes a metal-thermally broken frame with a width of 2 in.

- *Solar Heat Gain Coefficient*. The fraction of total solar radiation that passes through the glazing material, with no consideration of the window frame. SHGC data is displayed at three incidence angles: normal or 0 degrees, 30 degrees and 60 degrees. The W4Lib.dat file has SHGC data for other incident angles.

- *Emmissivity*. This information is provided for the front and back sides of each layer in the fenestration construction. The front emmissivity is the outside of the layer (number one surface of the outer pane) and the back emmissivity is the inside of the layer (number two surface of the outer pane). Uncoated glass has an emmissivity of about 0.84. So called low-emmissivity coatings will have an emmissivity of less than 0.3, with the lowest emmissivities in the range of 0.05.

- *Thickness*. The thickness of the layer in inches (mm). This information is provided for each layer in the fenestration construction.

- *Gap Thickness*. The thickness of the space between the layers in inches (mm). This information is provided for each gap in the fenestration construction.

- *Gap Gas*. The type of gas that is used in the gap. The most common gas is air, but argon and krypton are also used to improve thermal performance. This information is provided for each gap in the fenestration construction.

Glazing Conductance/SC Specification Method

Glass Conductance. *(center of glass).* The heat transmission through the glazing calculated at the center of the glass. Units are Btu/h-F-ft² (W/m2-K). The center-of-glass U-factor is used by DOE-2 to calculate the overall U-factor of each window, based on the dimensions of the window and the frame type. The Graphic Editor assumes a metal-thermally broken frame with a width of 2 in.

SC The shading coefficient is the ratio of heat gain through the selected fenestration construction to the heat gain through the same area of 3mm (1/8 inch) double strength clear glass.

Light transmission. The fraction of solar radiation in the visible spectrum that passes through the glazing material, with no consideration of the window frame. The reported value is for a normal incidence, e.g. light is striking the window perpendicular to the plane of the window. The W4Lib.dat file has light transmission data for other incidence angles.

All data in the W4Lib.dat file is stored in SI units. Also the VisualDOE data base table only uses SI units. You can choose to covert data to inch-pound units for display purposes by selecting Options|Inch-Pound Units from the pull-down menus. Note that many of the properties in the fenestration library are unitless and the same for both SI and inch-pound, e.g. emmissivity, shading coefficient, light transmission and solar heat gain coefficient.

Adding New Glazing

You may add to the fenestration constructions in the library. In order to do this you must modify not only the VisualDOE library file, but also the W4LIB.dat file that is used by DOE-2. The procedure requires that you have a copy of a computer program called Window 4.1. This program is available at no cost from Lawrence Berkeley National Laboratory. Run Window 4.1 and create a DOE-2 window file. Click on Import Window 4.1 button to launch the dialog box, which will allow you to select the drive, path and name of the file you want to read. If the file is valid, information about the fenestration construction will be displayed. Otherwise, an error message will appear.

The program will search through the VisualDOE library database to see if the DOE-2 code number for the file you just read is already used. If it is, you will be warned that duplicate code numbers are not allowed, and the process of adding to the library will be aborted.

> **Window 4.1 Computer Program**. A computer program developed by Lawrence Berkeley National Laboratory and widely used in the fenestration industry. The program allows the user to build up construction assemblies from components. This program is used with VisualDOE to produce a DOE-2 Window File that can be appended to the W4Lib.dat filefile.

DOE-2 Window File

W4Lib.dat. This is a large text file that is used by DOE-2 when simulations are performed. The file is located in the DOE2 directory. The file contains a hundred or more DOE-2 window files, one after the other. If you are curious, you can open this file with a text processor and review it (be careful not to make any changes or save it in a non-text format). The best way to review the file, however, is to use the glazing organizer. The W4Lib.dat file is a component of the VisualDOE library.

A new glazing file exported by Window 4.1 program contains detailed information about a fenestration construction that can be added to the W4Lib.dat file. The following is an example of such a file.

```
WINDOW 3.2  Data File : Single Band Calculation


Unit System: SI
Name        : DOE2 WINDOW LIB
Desc        : TRIPLE LOW-E FILM (33) TINT IG
Window ID   : 9999
Tilt        : 90.0
Glazings    : 3
Frame       : 3   Alum, flush        3.970
Spacer      : 1   Aluminum        1.310   0.736   0.000
Total Height: 1828.8 mm
Total Width : 1219.2 mm
Glass Height: 1714.5 mm
Glass Width : 1104.9 mm
Mullion     : None
Gap        Thick   Cond  dCond   Vis   dVis   Dens   dDens    Pr     dPr
1 Air       12.7 0.02410  7.600  1.730 10.000  1.290 -0.0044  0.720 0.00180
2 Air       12.7 0.02410  7.600  1.730 10.000  1.290 -0.0044  0.720 0.00180
3 Air        0.     0.     0.     0.     0.     0.     0.      0.     0.
4 Air        0.     0.     0.     0.     0.     0.     0.      0.     0.
5 Air        0.     0.     0.     0.     0.     0.     0.      0.     0.
Angle   0.  10.  20.  30.  40.  50.  60.  70.  80.  90. Hemis
```

```
Tsol  0.073 0.073 0.071 0.068 0.064 0.058 0.048 0.032 0.012 0.000 0.055
Abs1  0.637 0.638 0.644 0.654 0.666 0.675 0.673 0.638 0.505 0.000 0.643
Abs2  0.042 0.043 0.043 0.043 0.042 0.041 0.040 0.037 0.022 0.000 0.040
Abs3  0.015 0.015 0.015 0.014 0.014 0.014 0.013 0.010 0.006 0.000 0.013
Abs4   0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.
Abs5   0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.
Abs6   0.    0.    0.    0.    0.    0.    0.    0.    0.    0.    0.
Rfsol 0.233 0.231 0.227 0.220 0.214 0.212 0.226 0.283 0.455 1.000 0.239
Rbsol 0.540 0.537 0.534 0.529 0.525 0.523 0.529 0.559 0.653 1.000 0.534
Tvis  0.168 0.169 0.165 0.159 0.151 0.138 0.115 0.077 0.029 0.000 0.130
Rfvis 0.227 0.224 0.220 0.216 0.212 0.214 0.232 0.294 0.469 1.000 0.240
Rbvis 0.567 0.564 0.562 0.563 0.566 0.575 0.595 0.647 0.761 1.000 0.586
SHGC  0.149 0.149 0.148 0.145 0.141 0.134 0.122 0.100 0.059 0.000 0.128
SC: 0.17


Layer ID#          6       605       3        0        0        0
Tir              0.000    0.000    0.000      0.       0.       0.
Emis F           0.840    0.035    0.840      0.       0.       0.
Emis B           0.840    0.720    0.840      0.       0.       0.
Thickness(mm)     6.0      0.1      6.0       0.       0.       0.
Cond(W/m2-C)     150.0   2755.9    150.0      0.       0.       0.
Spectral File    None     None     None     None     None     None


Overall and Center of Glass Window U-values (W/m2-C)
Outdoor Temperature                 -17.8 C       15.6 C       26.7 C       37.8 C
Solar     WdSpd  hcout hrout  hin
(W/m2)    (m/s)      (W/m2-C)
   0       0.00  12.25  3.23  7.48  1.74 1.16  1.74 1.17  1.77 1.19  1.81 1.24
   0       6.71  25.47  3.20  7.50  1.78 1.20  1.77 1.20  1.80 1.23  1.84 1.28
 783       0.00  12.25  3.83  7.28  1.77 1.20  1.85 1.29  1.88 1.33  1.91 1.37
 783       6.71  25.47  3.54  6.50  1.78 1.21  1.85 1.30  1.89 1.34  1.91 1.37
```

6.8   Tools

Climate Editor...
Equipment Editor...

```
Climate Editor                                                    × 
File  Help
                      Weather Statistics
     Climate Name CZO3RV2              ▼              Copy


  CZO3RV2 WYEC2          MONTHLY WEATHER DATA SUMMARY


            LATITUDE =  37.70                LONGITUDE =  122.20




                                JAN    FEB    MAR    APR    MAY    JUN    JUI
AVG. TEMP. (F) (DRYBULB)        50.4   53.2   54.6   56.0   58.3   61.4   62.4
AVG. TEMP. (F) (WETBULB)        47.3   48.8   49.5   51.2   53.6   56.6   57.9

AVG. DAILY MAX. TEMP.           58.1   61.8   63.2   66.0   69.3   72.1   73.7
AVG. DAILY MIN. TEMP.           42.6   45.3   46.5   47.1   49.9   52.6   54.3

HEATING DEG. DAYS (BASE 65)    454.0  320.5  314.0  252.5  171.0   86.5   40.5
                  (BASE 60)    299.0  180.5  160.0  109.5   39.5    8.5    0.0
                  (BASE 55)    146.5   52.5   37.5   11.0    0.0    0.0    0.0
                  (BASE 50)     33.5    2.0    0.0    0.0    0.0    0.0    0.0
```

Climate Editor. This launches the "Climate Editor" which displays the weather statistics for the weather files in the project. This data can be copied to the Windows clipboard for pasting in other programs.

Equipment Editor. This launches the "Equipment Editor", which can be used to view and edit the HVAC equipment templates.

6.8.1   Equipment Editor, Overview

The Equipment Editor is used to add, delete and modify equipment templates in the library. It is also used to create and modify equipment curves. The Equipment Editor is activated by selecting Tools|Equipment Editor from VisualDOE. The equipment editor is organized in three folders. The first folder labeled Equipment Library is used to edit the equipment templates. The second folder labeled Curves Library is used to edit equipment curves. The third folder labeled Curve Graph displays a graph of the currently selected curve.

For more information see:

        Equipment Library Folder

Curves Library Folder

Curves Graph Folder

The Equipment Editor is one of several program modules that are used to edit the library. Others include the Constructions Builder, Fenestrations Editor, Schedule Maker, Climate Editor, and the Utility Rates Editor.

Equipment Editor, Equipment Library
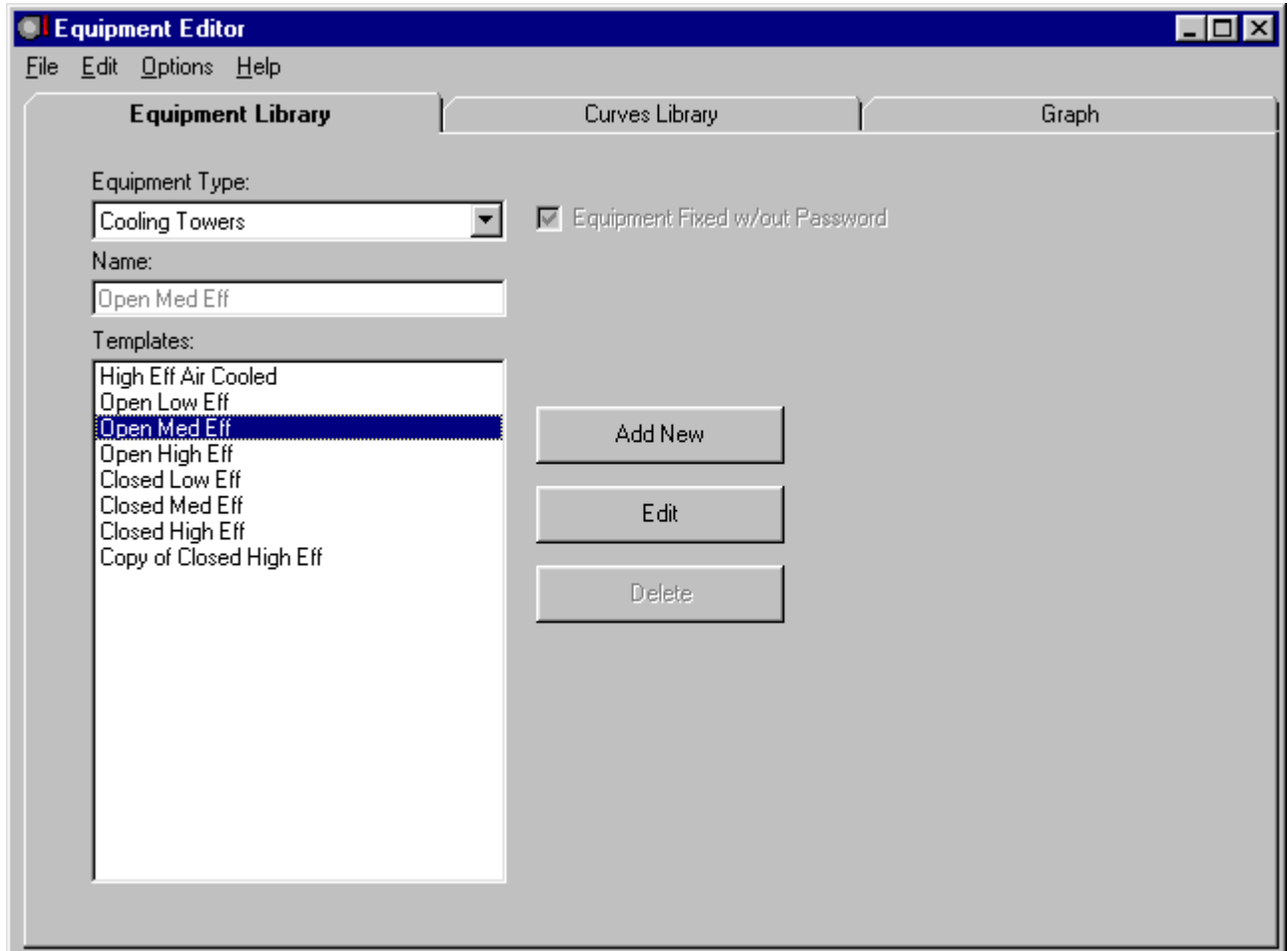
Templates can be developed for a number of equipment types including: chillers, boilers, cooling towers, circulation pumps, water heaters, DX (direct expansion) cooling systems, cooling coils, furnaces, heat pumps, and heating coils . You indicate the type of equipment you want to edit by making a selection from the Type drop-down list box. This causes the Template list box to be refreshed with all the templates in the library for the equipment type you selected.

To edit one of the templates, (1) select a template in the Templates list box and (2) click the Edit Template command button. Alternatively, you can double click on one of the templates in the Templates list box. This causes an editing form to appear above the Equipment Library form. The editing form is the same form that is used when you specify equipment from the Central Plant Editor or the HVAC Systems Editor. However, when you open an equipment form from the Equipment Editor, you are able to modify the part-load curves. Otherwise, the part-load curves are for display purposes only.

For more information about how to use each editing form, see the following topics.

Chiller Form

Boiler Form

Cooling Tower Form

Heating System Form

Cooling System Form

Circulation Pump Form

Water Heater Form

Economizer Form
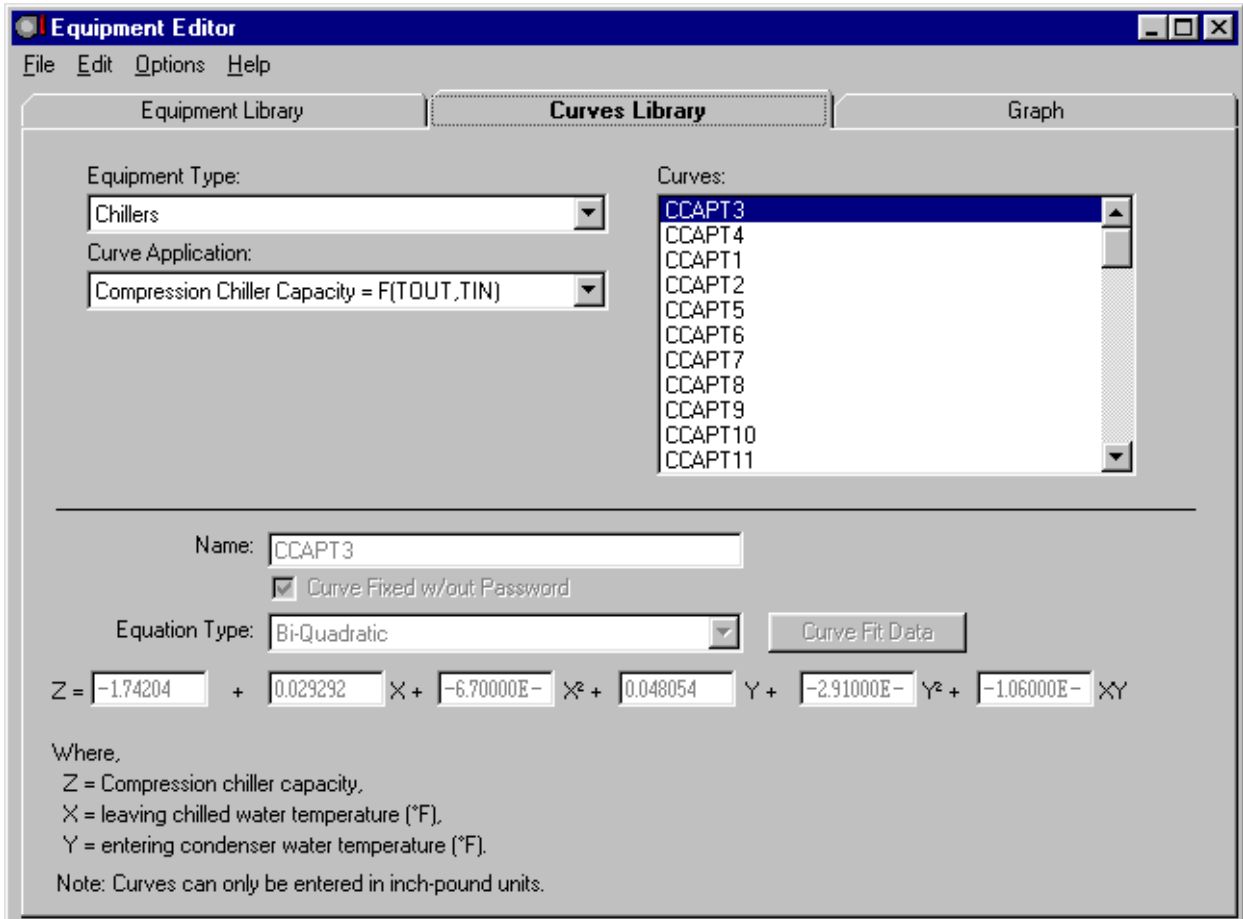
Just above the Templates list box is the Name text box. Each time you make a choice in the Templates list box, information in the Name text box is updated. If you change information in the Name text box, wording in the Templates list box will be updated. This enables you to edit the name of the template without opening the template for editing.

The pull-down menus enable you to add and delete templates.

- To add a new template, (1) select an existing template that is similar to the one you want to create and (2) choose Edit|Copy . . from the pull-down menus. This will make a copy of the selected template which you can subsequently edit as described above.

- To delete a template, (1) select a template in the Templates list box and (2) choose Edit|Delete . . from the pull-down menus.

Some of the templates are fixed. These are generally templates that are distributed with VisualDOE. Since the fixed templates are used in VisualDOE's system of defaults, you may not modify or delete fixed templates without special authorization. When you select a fixed template, you can open the editing form just as you can with a template that is not fixed. You can even make changes on the form. You just won't be able to save the changes, since the only way to leave the editing form is with the Cancel command button. To edit fixed templates, choose Options|Edit Fixed Templates and enter the password. When you are finished editing the fixed templates, you should choose Options|Edit Fixed Templates again to keep others from editing the fixed templates.

Equipment Editor, Curves Library

The equipment editor enables you to add, delete or edit equipment curves. Custom curves can then be assigned to cooling towers, chillers, fans and other equipment types which are supported by VisualDOE.

When you select an Equipment Type from the drop down list box, the Curve Application drop-down list box is refreshed with applications for the selected equipment type. When you select a Curve Application, the Curves list box is refreshed with the curves in the library for that application. Click on one of these curves and its properties will be displayed at the bottom of the form. You can then edit the properties of the curve.

The curve properties include the curve type (Linear, Bi-Linear, Cubic, Quadratic and Bi-Quadratic), the curve Name, and up to six coefficients (depending on the curve type). The curve types that you may choose will be limited by the selected Equipment Type and Curve Application.

Many of the curves are fixed. When you select a fixed curve, you will not be able to edit or delete fixed curves since they are part of the VisualDOE system of defaults.

The Curves folder is for display purposes only. It displays the curves that are associated with the template you selected.

Only advanced DOE-2 users should modify the curves library. Even advanced users should carefully consult the DOE-2.1E documentation.

Equipment Editor, Curve Graph
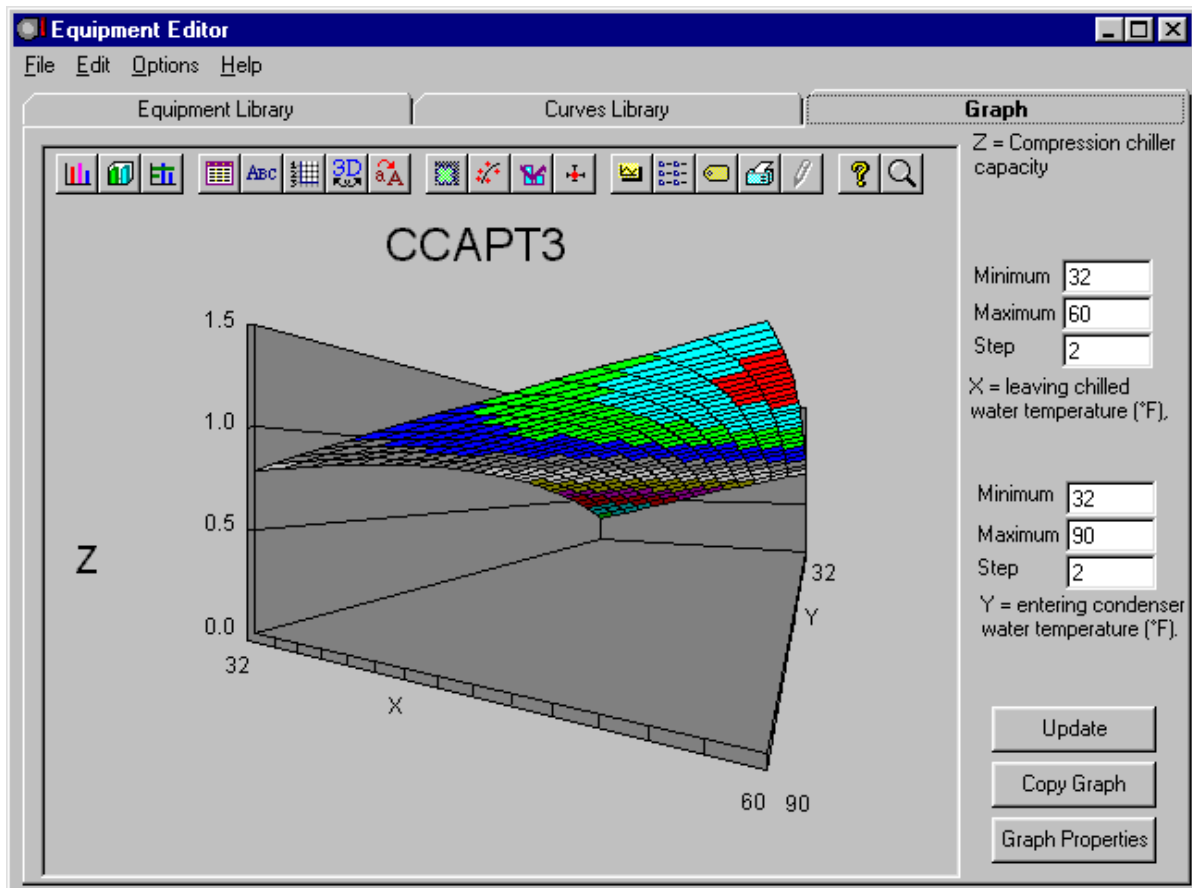
When you open the Curve Graph folder, a graph of the curve selected on the Curves Library form is displayed. You may not change any of the curve properties on this form. The form is for display purposes only. You may not change any of the curve properties. You may, however, change the minimum range, the maximum range and the step for the independent variables. VisualDOE defaults these to an appropriate range, but through the controls, you can narrow or expand the range. You can also increase or reduce the detail by modifying the step. When you reduce the step, it takes a little longer to generate the graph, but the detail is improved. There are some limits on the step. VisualDOE can plot a maximum of 8,000 data points. If the detail of the graph that you request exceeds this limit you are given a warning. The usual remedy is to increase the step or reduce the range.

Depending on the type of graph that is selected on the Curves Library form, the either a line graph or a surface graph will be plotted. A line graph has only one independent variable, while a surface plot has two independent variables. If there is only one independent variable, a description of the "X" variable will be displayed. The dependent variable is always the "Z" variable. A description of this variable is also displayed. If there are two independent variables, A description of both the X and Y variables will be shown on the folder. If you wish to change the range of one of more of the independent variables, simply enter new values and click on the Update Graph command button.

6.9 Options
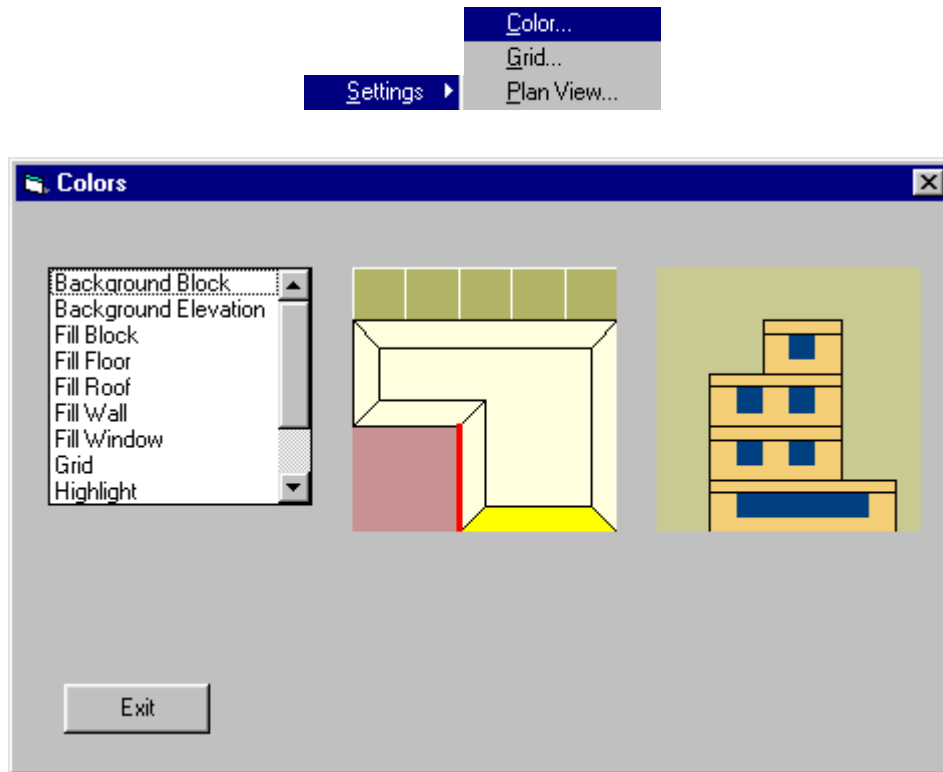
Colors. This menu choice activates a form that allows you to select the colors you want to use in your plan views and elevation views. When the form comes up, a list box shows the items for which you can assign a color. Double click on an item and a color palette appears where you choose a color. Repeat this process until you have defined all colors. Your choices are saved in a preferences file so the next time you use VisualDOE, your choice of colors will be used.
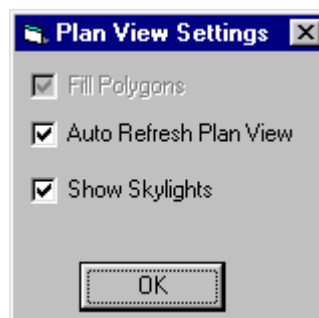
The plan view settings are useful to speed up the input process as you move from tab to tab or when new selections are made in VisualDOE. The process of updating the graphics can be slow for large models. Unchecking the selections disables the automatic updates and frees up the processor memory for other tasks.

Auto Refresh Plan View. This option is turned on and off by selecting it in the pull-down menu. If the option is on, a check mark appears next to the option. If it is off, no check mark appears. When **Auto**

Refresh Plan View is on, the plan view of your model are automatically refreshed when you change a selection.

Show Skylights. Uncheck this to prevent the skylights from being displayed.
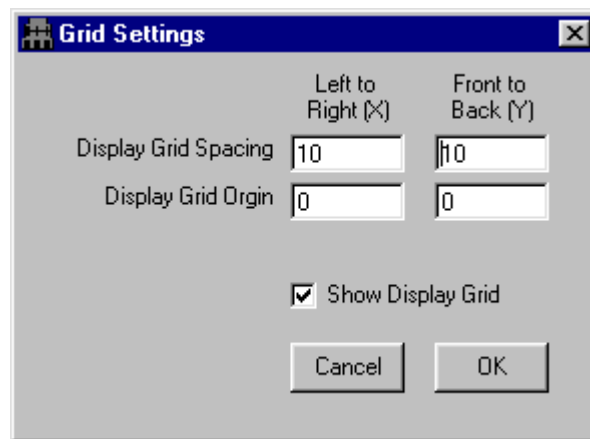
Grid Setup. This pull-down menu option activates a form that allows you to specify the properties of the display grid and whether or not you want it displayed on the plan views. The properties include the origin of the grid and you can specify the grid spacing in the front-to-back and side-to-side directions. The color of the grid lines is specified in Options|Colors. The display grid used in VisualDOE is the default for the Custom Block Editor, but can be temporarily modified on that form. **Facade Draw Alternative.** This option is turned on and off by selecting it in the pull-down menu. If the option is on, a check mark appears next to the option. If it is off, no check mark appears. This option affects the way that the isometric facade drawing is displayed on the Facades folder.

Set Scale. When you select this menu option, VisualDOE evaluates the overall width, depth and height of your model and sets the scale in the plan and elevation views so that the images fit and yet fill the space allocated for them. You will need to select this option as you add blocks to your model, especially if you add multi-floor blocks.

Footprint. This menu choice refreshes the plan views of your model. This is done automatically if Options|AutoDraw is checked (see options). Sometimes, however, you will find it useful to manually refresh the plan views.

6.10   Help
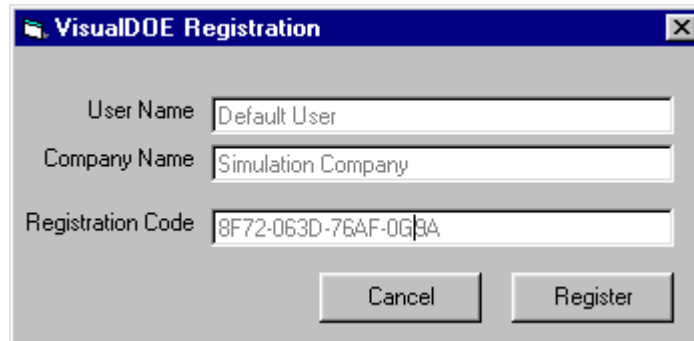
You can activate the VisualDOE help system by pressing the F1 function key or by choosing Help from the pull-down menu. The pull-down menu choices include:

Contents. This menu option opens the help system with the table of contents shown. From the table of contents you can move to other help topics.

Search for Help On. This menu option opens the help system in the search mode so you can quickly make a keyword search.

About VisualDOE. This menu option displays information about VisualDOE. If you call for technical support, you will need to choose Help|About VisualDOE so you will know the version of the VisualDOE you are using. You can also use this feature to see the name and path of the library you are using as well as other useful information.

Register VisualDOE. Enter user name, company name, and registration code, then click Register button to register the VisualDOE program. This information should come with the sale receipt of VisualDOE CD.

7 VisualDOE Results

7.1   Overview

Simulating the energy performance of buildings is a complex process. VisualDOE makes it easy for you to create a DOE-2 input file and to perform simulations. It does not, however, guarantee reliable results. Care must be taken to evaluate the simulation output files to assure that the results are valid. It is important that you carefully review the results of your simulation before making decisions.

- The easiest way to review and evaluate your results is to look at the VisualDOE reports. These reports contain a summary of information you entered and a summary of the results.

- You may also want to look at one or more of the DOE-2 reports. These are produced by DOE-2 following each successful simulation.

- If your simulation failed, you should review the project DOE-2 input (INP) file, which can be accessed by selecting Simulation|View DOE-2 Files menu. This file includes a listing of problems that may have occurred when attempting to create the DOE-2 input file.

- Finally you may want to look at the BDL files. These files report problems that DOE-2 discovered with the input file.

After each simulation, select Simulation|Diagnostics from the pull-down menu bar. This will bring up a form that will report the total supply air, the outside air, hours outside the throttling range and space temperatures for each zone. Data is presented on a monthly basis. If temperatures are outside the throttling range for a significant percentage of hours, this indicates that comfort conditions are not being maintained. Usually this is because one or more of the system components are undersized for the peak loads of the zone.

For more information see:

VisualDOE Reports

7.2   VisualDOE Reports
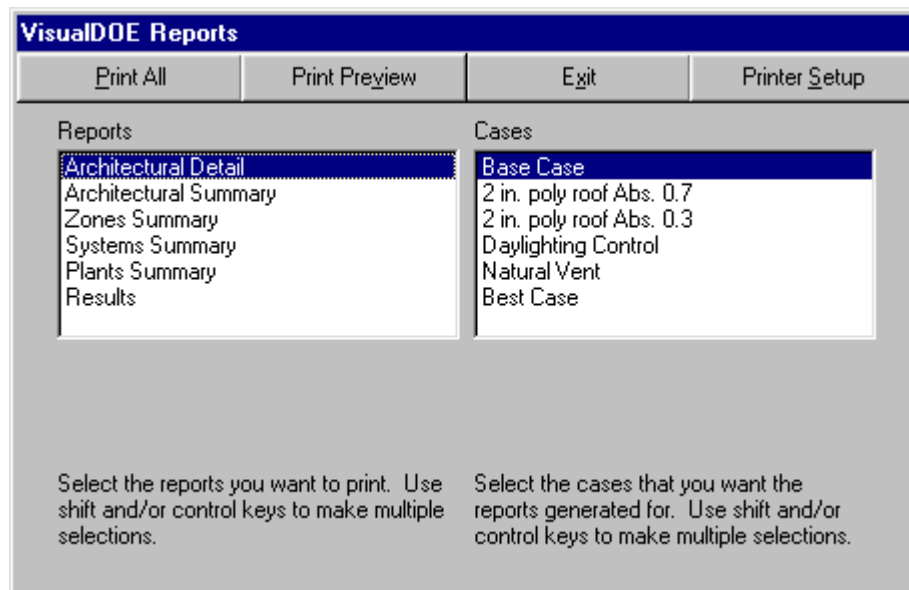
These reports can be generated for any or all of the design alternatives or cases that you have defined for your project. In addition to the reports produced by DOE-2, the VisualDOE interface produces some summary reports as described below. You can generate these reports for viewing on the screen or for printing while you are developing your model. The results report will of course, be incomplete until you have performed a simulation. To generate VisualDOE reports:

1   Select 'Simulation|View Results|Reports' from the pull-down menu.

2   This will cause a form to appear with two list boxes. The form has a listing of the VisualDOE reports on the left side and a list of design alternatives or cases on the right side. Select the report(s) and alternative(s) for which you wish to generate reports. You can make multiple selections from both lists.

3   Choose the Print or Print Preview command buttons. If you want to choose a different installed printer, choose Printer Setup.

The following is a brief description of each of the VisualDOE reports. You can also simply view the reports on the screen to evaluate their content.

1   *Architectural Summary*. This report is a summary of the surface areas and window areas in the building broken down by construction type.

2   *Architectural Detail*. This report summarizes the information that you entered about the construction materials size and shape of the building along with details about the windows on each <u>facade</u>.

3   *Zones Summary* This report summarizes information about the zones in the building, including internal loads, supply air volumes and outside air volumes.

4   *Systems Summary.* This report summarizes information about each of the systems.

5   *Plant Summary.* This report summarizes information about the central plant components.

6   *Results.* Once the simulations are complete, VisualDOE will extract a summary of end-use energy, monthly electricity use, monthly gas use, and peak demand by month, annual gas cost, annual electricity cost and the source energy use in kBtu/y-ft². These data will be displayed and then placed in the project data base for either the base case or the proposed design, depending on

the type of simulation you performed. You can display or print this information by choosing File|Print.

The Print Preview form also enables you to export the reports either as an Adobe Acrobat (PDF) document or as an RTF file, which can be read by most word processing software like Microsoft Word.

7.2.1 Graphs

This form is activated by choosing 'Simulation|View Results |Graphs'. This form is used to graph simulation results, weather data or hourly reports. Graphs fall into three categories. The available graph names for each are shown in the columns below.

Category	Graph Name	Notes
Hourly Graphs	Depend on hourly reports that have been generated	In order to make hourly graphs, you must first generate an hourly report file for one or more of the design alternatives. See Simulation|Setup.
Summary Graphs	Electricity End Uses Fuel End Uses	You must make a successful simulation for one or more of the design alternatives before you can

	All End Uses Monthly Electricity Use Monthly Electricity Demand Monthly Fuel Use Month Elect. and Fuel Use Energy Costs	display the summary graphs.
Weather Data Graphs	Average Temperatures Degree Days Wind Speed Skycover Relative Humidity Daily Solar Hourly Solar Temperature Surface Plot	Weather data can be plotted even before simulations are completed. You must, however, create a statistics file for the climate you have selected. See Tools|Climate Editor.

To print the graph or copy it to the Windows clipboard, move the mouse over the graph and click with the right mouse button. A form will appear above the graph with several tabs or folders. Go to the Systems folder on this form and take the appropriate action.

Hourly Graphs

When you choose Hourly Data in the graphs list box, a list box will appear with each of the design alternatives in your project. To generate an hourly graph, carry out the following steps.

Step	**VisualDOE Response**
Choose Hourly Data in the graphs list box	The design alternatives list box will appear just below the graphs list box
Choose one of the design alternatives	If hourly reports have been generated for the selected design alternative, a list of the reports will appear in the Hourly Reports list box.
Choose one of the hourly reports	The list box titled Variables to Plot will be updated. This list box will contain up to eight hourly report variables which are included in the hourly report.
Choose a graph type from the available choices, using the drop-down list box just below the hourly reports list box. The choices are time series, XY, or surface.	Use a time series to plot one or more variables against time. Use an XY to plot one variable against another. Use a surface plot to show how a single variable changes by time of day and day of the week.
Choose one or more of the variables to plot	For time series graphs, you may select as many as eight variables to plot. For XY graphs you must select two and only two variables. For surface plots, you may select only one variable.
Click the Update Graph command button	The graph will be displayed.
To customize the graph, move the mouse over the graph and click the right mouse button.	A form will appear on top of the graph were you can change the graph type, set labels and take other measures. For more information on customizing graphs, see Customizing Graphs.

Summary Graphs
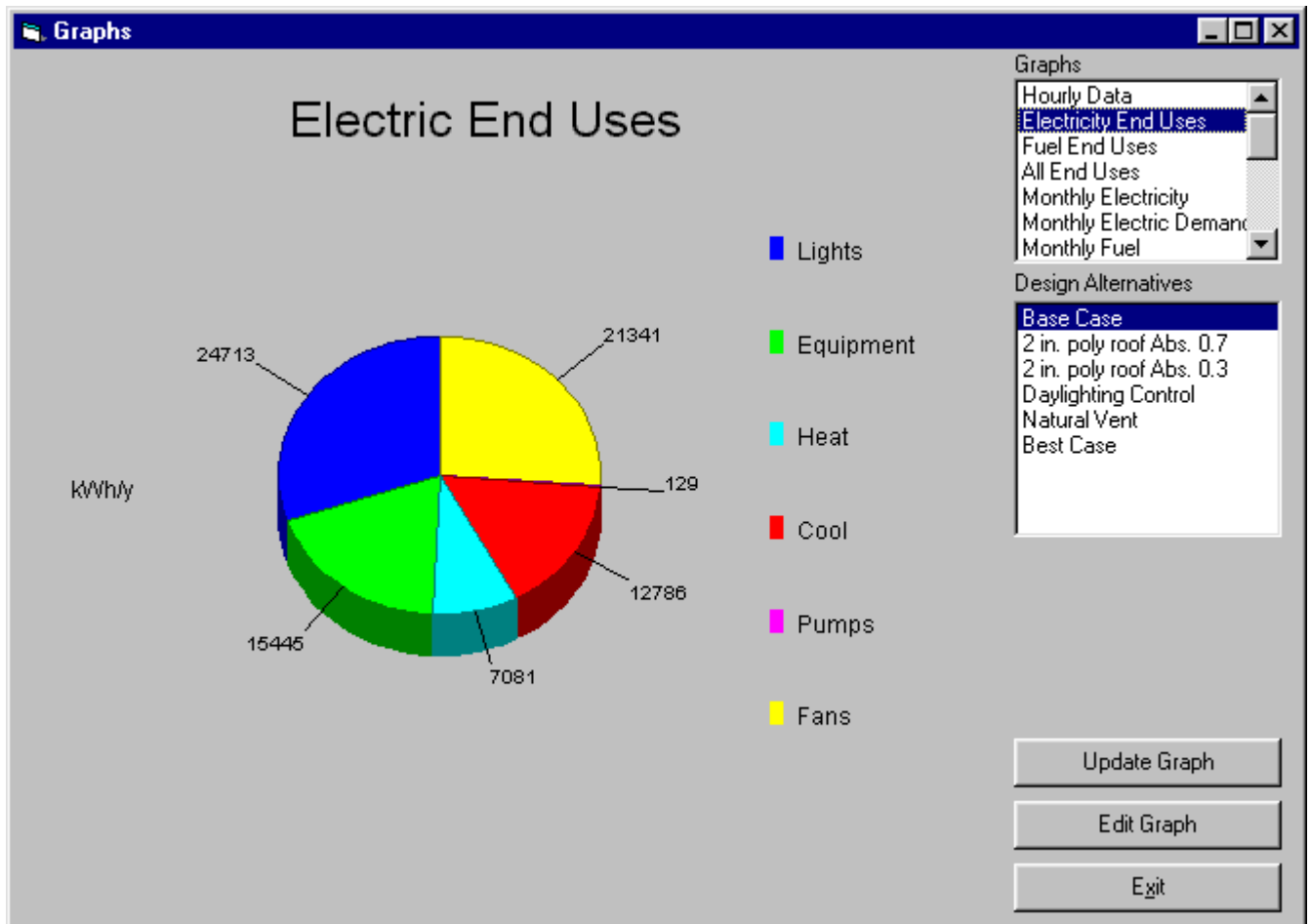
The summary graphs are useful in showing the differences between the energy use of various design alternatives and billing history (for existing buildings only). Generating a summary graph is a simple three step process: (1) select the graph type from the list below, (2) select one or more design alternative, and (3) click the Update Graph command button. If only one design alternative is selected, the default graph type is usually a pie chart, otherwise a 3d bar chart is produced. Once generated, you may customize the graph it my moving the mouse over the graph and clicking on the right mouse button. The following bullets describe the summary graphs.

- **Electricity End Uses.** This graph shows the annual energy use in kWh for electrical end uses for the selected alternatives. Typical end uses are interior lights, interior equipment, cooling (chillers), tower, pumps, fans, and miscellaneous electric uses. The data displayed is consistent with information on the BEPU report produced by DOE-2.

- **Fuel End Uses.** This graph shows the annual fuel end uses for the selected alternatives. Typical fuel end uses include heating, domestic hot water and miscellaneous uses. The end uses that are graphed are taken from the BEPU report.

- **All End Uses.** This graph shows all end uses, converted to annual operating cost. End uses are converted to operating cost based on the virtual utility rates, which take demand and time of use into account.

- **Monthly Electricity Use.** This graph has months along the horizontal axis and total electricity use for each of the selected design alternatives on the Y axis. This graph is especially useful in calibrating your base case model to metered energy use.

- **Monthly Electricity Demand.** This graph has months along the horizontal axis and peak electricity demand for each of the selected design alternatives on the Y axis. This graph is especially useful in calibrating your base case model to metered energy use.

- **Monthly Fuel Use.** This graph has months along the horizontal axis and total electricity use for each of the selected design alternatives on the Y axis. This graph is especially useful in calibrating your base case model to metered energy use.

- **Month Elect. and Fuel Use.** This graph has months along the horizontal axis and total electricity use for each of the selected design alternatives on the Y axis. Electricity and fuel use are combined to annual operating cost, based on the virtual rates of electricity and fuel.

- **Energy Costs.** This graph is useful to compare the energy costs of various design alternatives. The default format is a stacked bar chart with fuel use shown over electricity use.
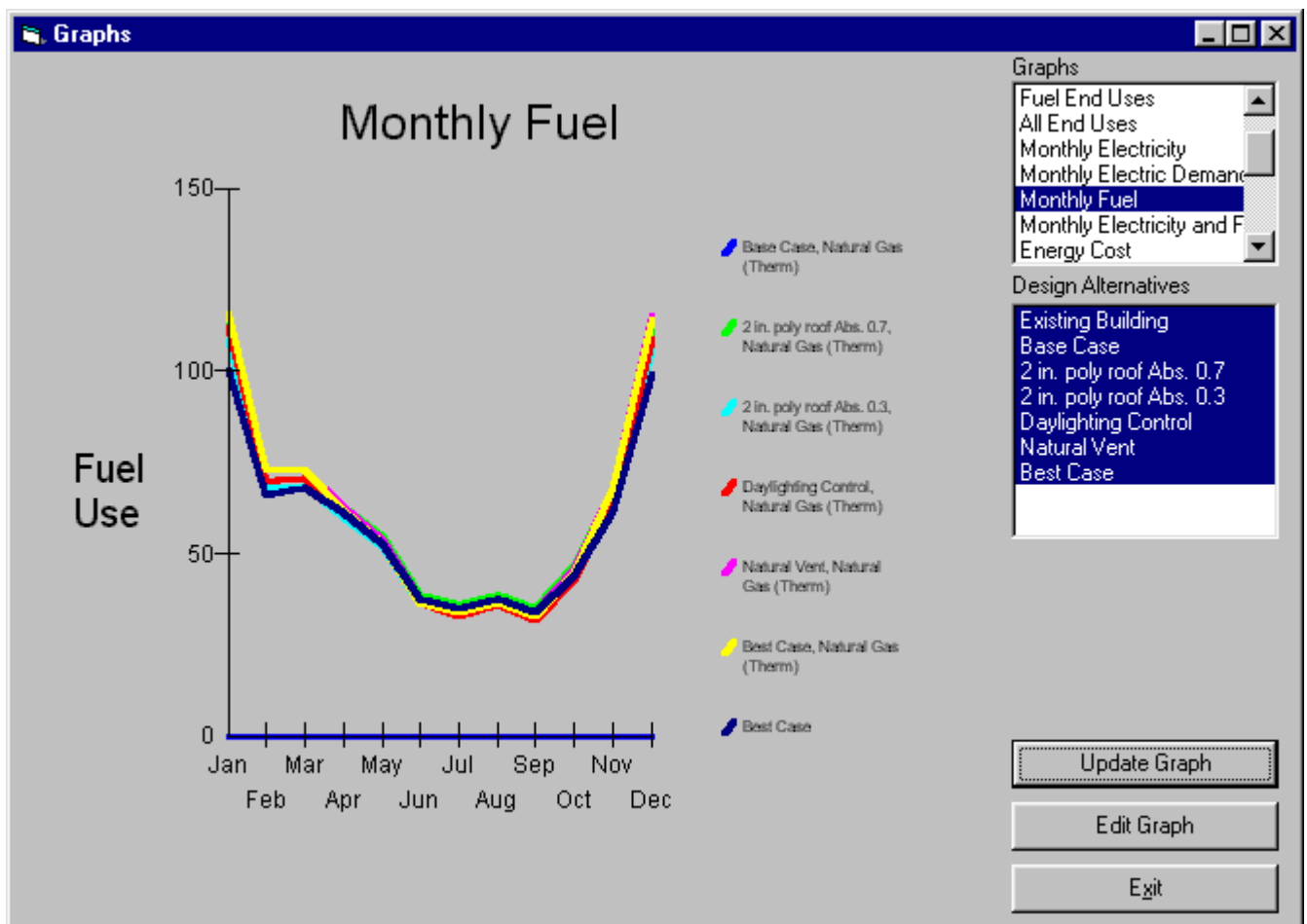
Weather Data Graphs.

The weather data graphs are useful in analyzing the climate conditions of a particular locality. In order to graph weather data, you must first generate a weather statistics file for the climate you have selected for your simulation. See Tools|Climate Editor. Generating a weather data graph is a simple three step process: (1) select the graph type from the list below, (2) select the variables you want to plot from the Variables List,

, and (3) click the Update Graph command button. If only one design alternative is selected, the default graph type is usually a pie chart, otherwise a 3d bar chart is produced. Once generated, you may customize the graph it my moving the mouse over the graph and clicking on the right mouse button.

- **Average Temperatures.** This graph shows average monthly temperatures. To generate this graph, choose Average Temperatures from the graphs list box. Select the variables you want to

- **Degree Days.** This graph enables you to display heating and cooling degree days (or degree hours) at various base temperatures.

- **Wind Speed.** This graph shows wind speed. You can choose to plot the monthly average, the average during the day or the average during the night.

- **Skycover.** This graph shows the average cloud cover in tenths. You can choose to plot the average or the average during the day (or both). A ten means that the sky is completely overcast.

- **Relative Humidity**. This graph shows the average relative humidity at up to four times during the day.

- **Daily Solar.** This graph enables you to plot average, maximum or minimum daily solar radiation. You can also plot the data by orientation.

- **Hourly Solar**. This graph enables you to plot average or maximum hourly solar radiation by orientation.

- **Temperature Surface Plot**. There are no variables to select with this graph. This is a 3d graph with hour of the day on one dimension and month of the year on the other. The graph shows the variation of average monthly temperature.

7.3   DOE-2 Files Viewer
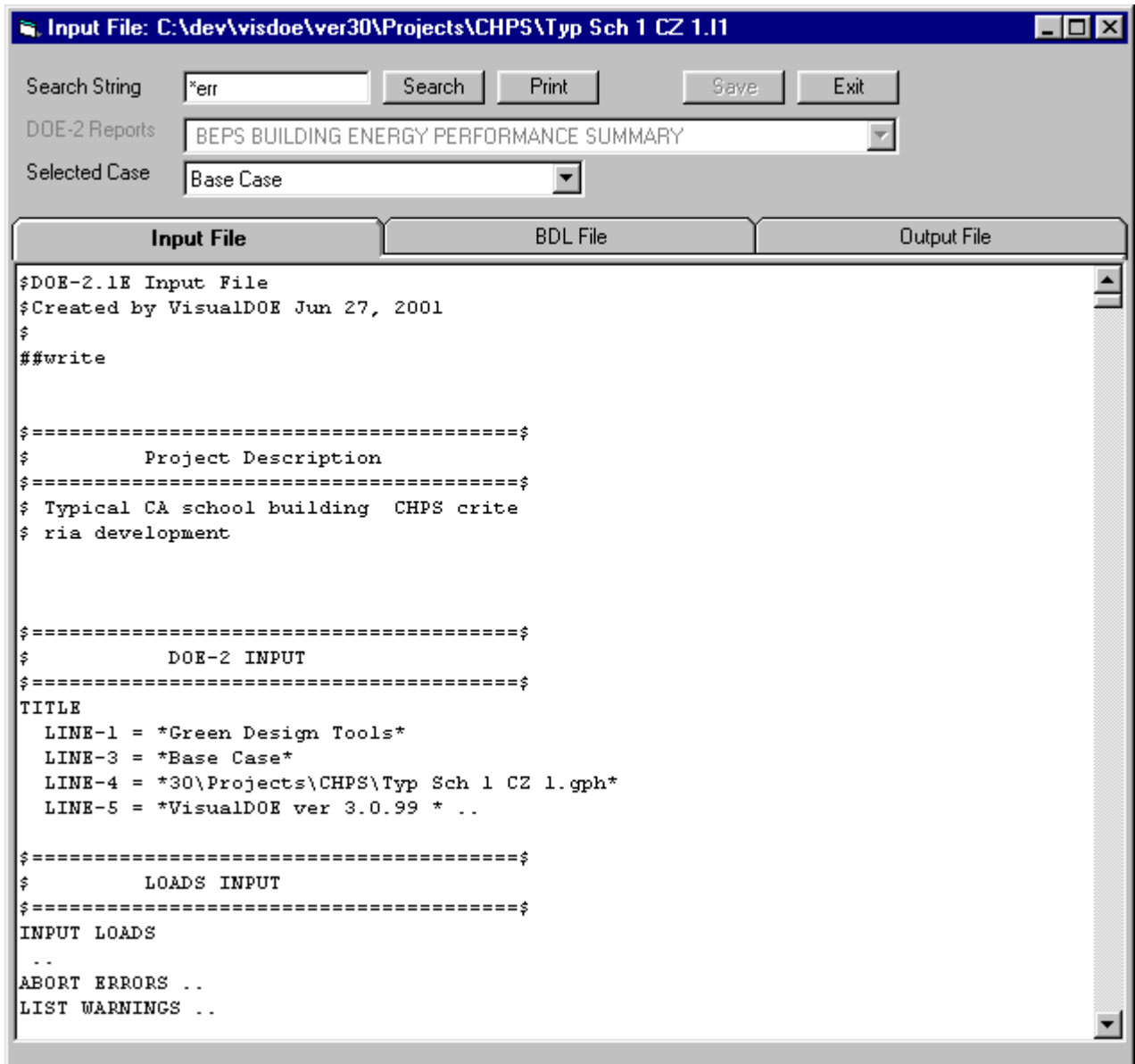
The DOE-2 input, BDL, and output files for the current case can be viewed and edited through this form. If the simulation was unsuccessful, or the case has not been run, one or more of the tabs might be disabled. The BDL file lists all the warnings and errors that DOE-2 produces during the simulation. The errors can be easily searched by clicking on the search button with the default search string "*err". When on the input tab, the DOE-2 input file can be edited and saved. If the "Run Existing File" box on the "Edit Alternative" form is checked for the case, the modified file is used for the simulation. When the output file is selected, the "DOE-2 Reports" list is filled with all the reports in the file, and you can jump to a specific report by selecting it from the list. The "Print" button will bring up the default print window with options for printing the whole file or the selected text. The print option will not work if the printer has not been configured to print from DOS applications.

7.3.1   Simulation Engine Errors

```
 BDL File: C:\dev\visdoe\ver30\Projects\CHPS\Typ Sch 1 CZ 1.B1          _ □ ×

Search String    *err          Search     Print          Save       Exit

DOE-2 Reports    BEPS BUILDING ENERGY PERFORMANCE SUMMARY        ▼

Selected Case    Base Case                          ▼

   ┌──────── Input File ────────┬──────── BDL File ────────┬──────── Output File ────────┐

1                                                                                    ▲


                     ****    ***   *****         ***       *
                     *  *   *  *   *            *   *     **
                     *  *   *  *   *****  ***      *       *
                     *  *   *  *   *             **        *
                     ****    ***   *****       *****  *  ***


                  B U I L D I N G   E N E R G Y   A N A L Y S I S   P R


                                DEVELOPED BY


                 LAWRENCE BERKELEY LABORATORY/UNIVERSITY OF CALIFO
                 WITH THE ASSISTANCE OF HIRSCH & ASSOCIATES, CAMARI


                              WITH MAJOR SUPPORT FROM


                     UNITED STATES DEPARTMENT OF ENERGY
              ASSISTANT SECRETARY FOR ENERGY EFFICIENCY AND RENEWAB
                       OFFICE OF BUILDING TECHNOLOGIES
                     BUILDING SYSTEMS AND MATERIALS DIVISION         ▼
```

To search for errors in simulation, select the BDL File folder and click on the Search button.

7.4   Simulation Diagnostics

Simulation Diagnostic Data

Alternative - (System% - Plant%):

Base Case - (58.6% - 55.4%)	
2 in. poly roof Abs. 0.7 - (1.4% - 0%)	
2 in. poly roof Abs. 0.3 - (1.4% - 0%)	
Daylighting Control - (2.6% - 0%)	
Natural Vent - (2.8% - 0%)	

Zone

Zone:

Zone_Lower South	
Zone_Lower North	
Zone_Conference	
Zone_Graphics	
Zone_Admin	
Zone_Upper	

	Zone Temperatures Maximum	Minimum	Hours Under Heated	Hours Under Cooled
January	75.8	45.1	294	0
February	75.6	47.4	223	0
March	75.3	46.9	269	0
April	74.9	51	219	0
May	75.2	51.9	233	0
June	74.9	55	213	0
July	74.8	56.2	183	0
August	75	55.7	195	0
September	76.2	56.6	172	0
October	76.1	54.1	191	0
November	75.7	45	239	0
December	74.9	42.7	282	0

Max. Supply Air: 1000.0 cfm

Outside Air: 34.0 cfm

OK

Once a simulation is complete, you should choose Simulation|Diagnostics to verify that the zone loads are being satisfied. When you exercise this option a form appears that displays the alternatives in a list box. Select the base case of one of the alternatives for which you have completed a simulation. If no simulation has been completed, then no data will be displayed.

Then select a zone and information will be displayed on the temperature range for the zone and the hours each month that the zone is under-heated or under-cooled. Information will also be displayed on the total and outside air volumes delivered to the zone.

8   DOE-2 Reports

8.1   Contents

Information is included in the help system to help VisualDOE users in understanding the output reports produced by DOE-2. Much of the material is adapted from the DOE-2 program documentation and references are sometimes made to DOE-2 keywords and commands. The reports are all generated in IP units and most of the explanations are in terms of IP units. Please refer to report LV-M which is the conversion table used by DOE-2 for all unit conversions.

Reports are listed in four groups: loads, systems, plant and economics. Most reports also fall into one of two categories: (a) *verification reports* may be used to "verify" that the building model has been correctly constructed and (b) *summary reports* that present summary data about zones, systems, or plant equipment.

Loads		System		Plant		Economics
Verification	**Summary**	**Verification**	**Summary**	**Verification**	**Summary**	**Summary**
LV-A	*LS-A*	*SV-A*	*SS-A*	*PV-APV_A*	*PS-A*	*ES-D*
LV-B	*LS-B*	*SV-BSV_B*	*SS-B*	*PV-B*	*PS-B*	*ES-E*
LV-C	*LS-C*		*SS-C*	*PV-C*	*PS-C*	*ES-F*
LV-D	*LS-D*		*SS-D*	*PV-DPV_D*	*PS-D*	
LV-E	*LS-E*		*SS-E*	*PV-G*	*PS-E*	
LV-F	*LS-F*		*SS-F*		*PS-F*	
LV-G	*LS-G*		*SS-G*		*PS-G*	
LV-H	*LS-H*		*SS-H*			
LV-I	*LS-I*		*SS-I*		*BEPS*	
LV-J	*LS-J*		*SS-J*		*BEPU*	
LV-K	*LS-K*		*SS-K*			
LV-L	*LS-L*		*SS-L*			
LV-M			*SS-M*			
			SS-N			
			SS-O			
			SS-P			
			SS-P			
			SS-Q			

The following is a listing of the report titles. You may click on these for more information (just as above).

LOADS Verification Reports

LV-A   General Project and Building Input

LV-B   Summary of Spaces Occurring in the Project

LV-C   Details of Space

LV-D   Details of Exterior Surfaces in the Project

LV-E   Details of Underground Surfaces in the Project

LV-F   Details of Interior Surfaces in the Project

LOADS Summary Reports

SYSTEMS Verification Reports

SYSTEMS Summary Reports

PLANT Verification Reports

PV-C   Equipment Costs

PV-D   Equipment Load RatiosPV_D

PV-G   Equipment Quadratics

PLANT Summary Reports
PS-A   Plant Energy Utilization Summary
PS-B   Monthly Peak and Total Energy Use
PS-C   Equipment Part Load Operation
PS-D   Plant Loads Satisfied
PS-E   Monthly Energy End Use Summary
PS-F   Energy Resource Peak Breakdown By End Use
PS-G   Electrical Load Scatter Plot
PS-H   Equipment Use Statistics
BEPS   Building Energy Performance Summary

BEPU   Building Energy Performance Summary (utility units)

ECONOMICS Summary Reports
ES-D   Energy Cost Summary
ES-E   Summary Of Utility-Rate for <rate>
ES-F   Block-Charges And Ratchet Summary

8.2   Loads Reports

8.3   LV-A - General Project and Building Input

The LV-A report contains some general information about the beginning and ending date for the simulation, information about the site such as latitude, longitude and elevation, and the building azimuth. The elevation is taken from the climate in the VisualDOE library. The latitude, longitude, and time zone are taken from the weather file associated with the climate.

```
REPORT- LV-A  GENERAL PROJECT AND BUILDING INPUT                                              WEATHER FILE- CZ01RV2 WYEC2

-----------------------------------------------------------------------------------------------------------------------

PERIOD OF STUDY

     STARTING DATE    ENDING DATE    NUMBER OF DAYS

       1 JAN 1994    31 DEC 1994               365

SITE CHARACTERISTIC DATA

                                                                BUILDING

     STATION          LATITUDE  LONGITUDE   ALTITUDE    TIME    AZIMUTH

      NAME              (DEG)     (DEG)       (FT)       ZONE     (DEG)

CZ01RV2 WYEC2            40.8     124.2         0.    8  PST      180.0
```

8.4 LV-B - Summary of Spaces Occurring in the Project

This report is a listing of all the spaces (or thermal zones) in the project. This listing includes both conditioned spaces as well as unconditioned spaces and plenums. In reviewing this report, pay special attention to the column labeled "space*floor multiplier". The total area and volume for each space is this value times the area and volume listed in the last two columns. The building totals row includes the effect of these multipliers, but the area includes plenums and unconditioned spaces as well.

```
                         BASECASE                         VisualDOE for Windows

REPORT- LV-B  SUMMARY OF SPACES OCCURRING IN THE PROJECT                  WEATHER FILE- CZ01RV2 WYEC2
      -----------------------------------------------------------------------------------------------------
------
NUMBER OF SPACES   30        EXTERIOR  26    INTERIOR   4
                                      LIGHTING          EQUIP
           SPACE*FLOOR  SPACE           (WATT /         (WATT /  INFILTRATION  AIR CHANGES      AREA       VOLUME
SPACE      MULTIPLIER   TYPE  AZIMUTH   SQFT )  PEOPLE  SQFT )     METHOD      PER HOUR        (SQFT )     (CUFT )
SPACE0          10.0    EXT      0.0    1.50    0.5     1.00     AIR-CHANGE       0.18         127.50      1276.28
SPACE1          10.0    EXT     90.0    1.50    0.5     1.00     AIR-CHANGE       0.18         127.50      1276.28
SPACE2          10.0    EXT    180.0    1.50    0.5     1.00     AIR-CHANGE       0.18         127.50      1276.28
SPACE3          10.0    EXT    270.0    1.50    0.5     1.00     AIR-CHANGE       0.18         127.50      1276.28
SPACE4           1.0    EXT      0.0    1.50   19.6     1.00     AIR-CHANGE       0.00        4900.00     49049.00
PLEN0            1.0    EXT      0.0    0.00    0.0     0.00     NO-INFILT.       0.00        1275.00      5112.75
PLEN1            1.0    EXT     90.0    0.00    0.0     0.00     NO-INFILT.       0.00        1275.00      5112.75
   [ROWS DELETED FOR BREVITY]
                                                -------                                     ---------   ----------
BUILDING TOTALS                                  120.0                                     60000.00    420600.00
```

8.5   LV-C - Details of Space < Name>

The LV-C report is produced for each space (or thermal zone) in your project. The number of spaces in your model will depend on the number and types of blocks, the zoning patterns you selected and whether or not you have plenums. This report is generated for all spaces including plenums and unconditioned spaces. For each space, it contains detailed information about the internal loads in the space, but also includes information about the surfaces that enclose the space. Multiple pages are generally produced for each space, so when you ask for this report, considerable volume will be added to the DOE-2 output file (s).

```
                             BASECASE                              VisualDOE for Windows

REPORT- LV-C DETAILS OF SPACE                          SPACE2                     WEATHER FILE- CZ01RV2 WYEC2

-----------------------------------------------------------------------------------------------(CONTINUED)--------

LIGHTING

                                          LOAD                          FRACTION

                        LIGHTING          (WATTS/          LOAD          OF LOAD
      SCHEDULE          TYPE              SQFT )           (KW)          TO SPACE
      OFF-LIGHTS        REC-FLUOR-NV      1.50             0.00          0.90

ELECTRICAL EQUIPMENT

                        ELEC LOAD         ELEC          FRACTION OF LOAD TO SPACE

                        (WATTS/           LOAD
      SCHEDULE          SQFT )            (KW)          SENSIBLE          LATENT
      OFF-EQUIP         1.00              0.00          1.00              0.00


INTERIOR SURFACES (U-VALUE INCLUDES BOTH AIR FILMS)

                                                        U-VALUE

                        AREA
      SURFACE           (SQFT )    CONSTRUCTION    (BTU/HR-SQFT-F)    ADJACENT SPACE    SURFACE-TYPE
      SRF1              127.50     CEILING              0.381         PLEN2             DELAYED STANDARD
      SRF2              70.07      PARTITION            0.296         SPACE4            DELAYED STANDARD
      SRF3              30.03      AIRWALL              2.600         SPACE4            QUICK   AIR
      SRF4              127.63     HALFPART             0.356                           DELAYED ADIABATIC
      SRF5              127.63     HALFPART             0.356                           DELAYED ADIABATIC


EXTERIOR SURFACES (U-VALUE EXCLUDES OUTSIDE AIR FILM)

                                                                                       U-VALUE

                              AREA     WIDTH    HEIGHT                                            SURFACE
      SURFACE     MULTIPLIER  (SQFT )  (FT)     (FT)      CONSTRUCTION    (BTU/HR-SQFT-F)  TYPE
      SRF6        1.0         127.50   10.00    12.75     EXTFLOOR             0.433       DELAYED
      SRF7        1.0         100.10   10.00    10.01     EXTWALL              0.078       DELAYED

                                 LOCATION OF ORIGIN IN            LOCATION OF ORIGIN IN

                                 BUILDING COORDINATES             SPACE COORDINATES

                   AZIMUTH   TILT
      SURFACE      (DEG)     (DEG)      XB (FT)  YB (FT)  ZB (FT)       X (FT)  Y (FT)  Z (FT)
      SRF6         0.0       180.0      -10.00    0.00    0.00          10.00   0.00    0.00
      SRF7         0.0       90.0       -10.00   -12.75   0.00          10.00   12.75   0.00


EXTERIOR WINDOWS (U-VALUE INCLUDES OUTSIDE AIR FILM)

                              GLASS    GLASS   NUMBER  GLASS    SET-  GLASS  GLASS    CENTER-OF-     GLASS

                              AREA     SHADING   OF    TYPE     BACK  WIDTH  HEIGHT   GLASS U-VALUE  VISIBLE
      WINDOW      MULTIPLIER  (SQFT )  COEFF   PANES   CODE     (FT)  (FT)   (FT)  (BTU/HR-SQFT-F)   TRANS
```

```
BCKBTMWIN              1.0       35.44     1.00     1   1000   1.00   9.67   3.67          1.003    0.898

                                          LOCATION OF ORIGIN IN                  LOCATION OF ORIGIN IN
                                          BUILDING COORDINATES                   SURFACE COORDINATES

                          LOCATED IN
WINDOW                    SURFACE         XB (FT)  YB (FT)  ZB (FT)               X (FT)    Y (FT)
BCKBTMWIN                                   -9.83   -12.75    3.17                 0.17      3.17
```

8.6 LV-D - Details of Exterior Surfaces in the Project

This report is produced in two sections and generally extends to multiple pages. The first section is a listing of all the exterior surfaces in the project. The number of rows depends on the complexity of your model. The second section is a summary by orientation and type. The second section is useful to verify that the wall area to floor area ratio is within a reasonable range, etc.

```
                              BASECASE                            VisualDOE for Windows

REPORT- LV-D  DETAILS OF EXTERIOR SURFACES IN THE PROJECT                 WEATHER FILE- CZ01RV2 WYEC2
----------------------------------------------------------------------------------------------(CONTINUED)--------


                        - - - W I N D O W S - - -   - - - - W A L L - - - -   - W A L L + W I N D O W S-

SURFACE       SPACE         U-VALUE       AREA      U-VALUE       AREA       U-VALUE       AREA    AZIMUTH

                          (BTU/HR-SQFT-F)  (SQFT)  (BTU/HR-SQFT-F)  (SQFT)  (BTU/HR-SQFT-F)  (SQFT)

SRF1          SPACE2          0.000        0.00     0.369       1275.00      0.369       1275.00  FLOOR

SRF2          SPACE1          0.000        0.00     0.369       1275.00      0.369       1275.00  FLOOR

SRF3          SPACE3          0.000        0.00     0.369       1275.00      0.369       1275.00  FLOOR

SRF4          SPACE0          0.000        0.00     0.369       1275.00      0.369       1275.00  FLOOR

SRF5          SPACE4          0.000        0.00     0.369       4900.00      0.369       4900.00  FLOOR

SRF6          PLEN12          0.000        0.00     0.045       1275.00      0.045       1275.00  ROOF

SRF7          PLEN11          0.000        0.00     0.045       1275.00      0.045       1275.00  ROOF

SRF8          PLEN13          0.000        0.00     0.045       1275.00      0.045       1275.00  ROOF

SRF9          PLEN10          0.000        0.00     0.045       1275.00      0.045       1275.00  ROOF

SRF10         PLEN14          0.000        0.00     0.045       4900.00      0.045       4900.00  ROOF
[ROWS DELETED FOR BREVITY]


                              BASECASE                            VisualDOE for Windows

REPORT- LV-D  DETAILS OF EXTERIOR SURFACES IN THE PROJECT                 WEATHER FILE- CZ01RV2 WYEC2
----------------------------------------------------------------------------------------------(CONTINUED)--------

               AVERAGE          AVERAGE        AVERAGE U-VALUE     WINDOW        WALL        WINDOW+WALL

             U-VALUE/WINDOWS   U-VALUE/WALLS   WALLS+WINDOWS        AREA         AREA          AREA

             (BTU/HR-SQFT-F)  (BTU/HR-SQFT-F)  (BTU/HR-SQFT-F)    (SQFT)       (SQFT)        (SQFT)

NORTH            0.948            0.076            0.283         1000.00      3206.00       4206.00

EAST             0.948            0.076            0.283         1000.00      3206.00       4206.00

SOUTH            0.948            0.076            0.283         1000.00      3206.00       4206.00

WEST             0.948            0.076            0.283         1000.00      3206.00       4206.00

FLOOR            0.000            0.369            0.369            0.00     10000.00      10000.00

ROOF             0.000            0.045            0.045            0.00     10000.00      10000.00

ALL WALLS        0.948            0.076            0.283         4000.00     12824.00      16824.00

   WALLS+ROOFS   0.948            0.062            0.195         4000.00     22824.00      26824.00

BUILDING         0.948            0.156            0.242         4000.00     32824.00      36824.00
```

8.7 LV-E - Details of Underground Surfaces in the Project

This report is not needed for models created by the VisualDOE Graphic Editor since no underground surfaces are created.

```
                                BASECASE                            VisualDOE for Windows
REPORT- LV-E  DETAILS OF UNDERGROUND SURFACES IN THE PROJECT                       WEATHER FILE- CZ01RV2 WYEC2
-----------------------------------------------------------------------------------------------------------------
NUMBER OF UNDERGROUND SURFACES   0
```

8.8   LV-F - Details of Interior Surfaces in the Project

This report is a listing of all interior surfaces in the project. Interior surfaces are surfaces that separate spaces from each other, as opposed to separating them from the outdoors. For each interior surface, the report shows the name of the surface, the area, the construction, the surface type, the U-factor, and the spaces that the surface connects (Space 1 and Space 2).

```
                             BASECASE                              VisualDOE for Windows

REPORT- LV-F  DETAILS OF INTERIOR SURFACES IN THE PROJECT                    WEATHER FILE- CZ01RV2 WYEC2
-------------------------------------------------------------------------------------------------------------

NUMBER OF INTERIOR SURFACES  85

(U-VALUE INCLUDES BOTH AIR FILMS)

ADJACENT SPACES

SURFACE            AREA       CONSTRUCTION    SURFACE TYPE              U-VALUE

NAME               (SQFT )    NAME                                 (BTU/HR-SQFT-F)    SPACE-1         SPACE-2

SRF1               127.50     CEILING         DELAYED STANDARD           0.514         SPACE0          PLEN0

SRF2                70.07     PARTITION       DELAYED STANDARD           0.371         SPACE0          SPACE4

SRF3                30.03     AIRWALL         QUICK   AIR                2.600         SPACE0          SPACE4

     [ROWS DELETED FOR BREVITY]
```

8.9   LV-G - Details of Schedules Occurring in the Project

This report includes information about each schedule used in the project. There are several types of schedules. Fraction schedules affect lights, equipment and people densities. Temperature schedules control the simulation of HVAC equipment and systems. On/off schedules affect the operation (availability) of fans, chillers, etc.

```
                              BASECASE                              VisualDOE for Windows

REPORT- LV-G  DETAILS OF SCHEDULES OCCURRING IN THE PROJECT                    WEATHER FILE- CZ01RV2 WYEC2
---------------------------------------------------------------------------------------------------------------
NUMBER OF SCHEDULES   9              ( NON DIMENSIONLESS SCHEDULES ARE GIVEN IN ENGLISH UNITS )

   SCHEDULE  OFF-PEOPLE

       THROUGH 31 12

         FOR DAYS  SUN HOL

       HOUR  1    2    3    4    5    6    7    8    9    10   11   12   13   14   15   16   17   18   19   20   21   22   23   24

             0.00 0.00 0.00 0.00 0.00 0.00 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.05 0.00 0.00 0.00 0.00 0.00 0.00

         FOR DAYS  MON TUE WED THU FRI

       HOUR  1    2    3    4    5    6    7    8    9    10   11   12   13   14   15   16   17   18   19   20   21   22   23   24

             0.00 0.00 0.00 0.00 0.00 0.00 0.10 0.20 0.95 0.95 0.95 0.95 0.50 0.95 0.95 0.95 0.95 0.30 0.10 0.10 0.10 0.10 0.05 0.05

         FOR DAYS  SAT

       HOUR  1    2    3    4    5    6    7    8    9    10   11   12   13   14   15   16   17   18   19   20   21   22   23   24

             0.00 0.00 0.00 0.00 0.00 0.00 0.10 0.10 0.30 0.30 0.30 0.30 0.10 0.10 0.10 0.10 0.10 0.05 0.05 0.00 0.00 0.00 0.00 0.00

   [ADDITIONAL SCHEDULES DELETED FOR BREVITY.]
```

8.10   LV-H - Details of Windows Occurring in the Project

This report contains a listing of all windows in the project with detailed information about each. Note, the common way used by VisualDOE to specify the performance of windows is to use the glass type code. Refer to the BDL file for information about the glass type code.

```
                          BASECASE                          VisualDOE for Windows

REPORT- LV-H  DETAILS OF WINDOWS OCCURRING IN THE PROJECT                 WEATHER FILE- CZ01RV2 WYEC2
-------------------------------------------------------------------------------------------------------------

NUMBER OF WINDOWS  12         RECTANGULAR  12     OTHER   0

    RECTANGULAR WINDOWS (U-VALUES INCLUDE OUTSIDE AIR FILM)

                                                             LOCATION OF ORIGIN

                                 GLASS     GLASS  GLASS         IN SURFACE    FRAME          FRAME

            WINDOW                 AREA    HEIGHT  WIDTH         COORDINATES    AREA         U-VALUE

            NAME      MULTIPLIER  (SQFT )    (FT)   (FT)      X (FT)   Y (FT)  (SQFT ) (BTU/HR-SQFT-F)

            GTFBTMWIN        1.0    35.44    3.67   9.67        0.17     3.17     4.56         0.908

            LFTBTMWIN        1.0    35.44    3.67   9.67        0.17     3.17     4.56         0.908

            BCKBTMWIN        1.0    35.44    3.67   9.67        0.17     3.17     4.56         0.908

            RHTBTMWIN        1.0    35.44    3.67   9.67        0.17     3.17     4.56         0.908

    [ROWS DELETED FOR BREVITY.]

                                            GLASS    NUMBER   GLASS    INFILTRATION    CENTER-OF-     GLASS

            WINDOW         SETBACK          SHADING     OF     TYPE          FLOW    GLASS U-VALUE   VISIBLE

            NAME             (FT)  X-DIVISIONS  COEFF   PANES   CODE         COEFF  (BTU/HR-SQFT-F)   TRANS

            GTFBTMWIN        1.00         10    1.00       1    1000          0.0           1.003    0.898

            LFTBTMWIN        1.00         10    1.00       1    1000          0.0           1.003    0.898

            BCKBTMWIN        1.00         10    1.00       1    1000          0.0           1.003    0.898

            RHTBTMWIN        1.00         10    1.00       1    1000          0.0           1.003    0.898

    [ROWS DELETED FOR BREVITY.]
```

The following is an example of the information that is included in the BDL file when glass type codes are used. This is an echo of information in the W4Lib.dat file which is also displayed in the VisualDOE Fenestrations Editor.

```
    *1181 * GT11  = GLASS-TYPE  F-C  =  1.245   GLASS-TYPE-CODE = fn11[]   ..

        GLAZING SELECTED FROM WINDOW LIBRARY--

        TYPE: SINGLE CLEAR

        G-T-C  LAYERS  U-SI  U-IP   SC  SHCG  TSOL  TVIS  GAP(mm)  GAS-FILL

         1000       1  6.31  1.11  1.00  0.86  0.84  0.90      0.0
```

8.11 LV-I - Details of Constructions Occurring in the Project

This report is a listing of each type of wall, roof or floor construction that occurs in the project, showing the U-factor, surface type, etc.

```
                              BASECASE                            VisualDOE for Windows

REPORT- LV-I  DETAILS OF CONSTRUCTIONS OCCURRING IN THE PROJECT                WEATHER FILE- CZ01RV2 WYEC2
-----------------------------------------------------------------------------------------------------------
NUMBER OF CONSTRUCTIONS  9        DELAYED  7    QUICK   2
                       U-VALUE              SURFACE            NUMBER OF
       CONSTRUCTION                  SURFACE  ROUGHNESS   SURFACE    RESPONSE
       NAME          (BTU/HR-SQFT-F) ABSORPTANCE   INDEX   TYPE      FACTORS
       EXTWALL              0.078        0.70       1    DELAYED        6
       EXTROOF              0.046        0.70       1    DELAYED        4
       EXTFLOOR             0.433        0.40       1    DELAYED        4
       AIRWALL              2.600        0.70       3    QUICK          0
       ADIABWALL            0.000        0.70       3    QUICK          0
       PLNFLOOR             0.358        0.40       1    DELAYED        4
       PARTITION            0.371        0.50       5    DELAYED        4
       HALFPART             0.469        0.50       5    DELAYED        4
       CEILING              0.514        0.50       5    DELAYED        3
```

8.12   LV-J - Details of Building Shades in the Project

This report is a listing of the building shades that occur in the project. Building shades are not supported by the VisualDOE Graphic Editor, but may be added to your input file with a text editor.

```
                              BASECASE                               VisualDOE for Windows



                              BASECASE                               VisualDOE for Windows
REPORT- LV-J  DETAILS OF BUILDING SHADES IN THE PROJECT                              WEATHER FILE- CZ01RV2 WYEC2
--------------------------------------------------------------------------------------------------------------------
NUMBER OF BUILDING SHADES   0          RECTANGULAR   0     OTHER   0

[INCLUDE A REPORT THAT HAS SOME BUILDING SHADES.]
```

8.13   LV-K - Weighting Factor Summary

This report has weighting factors for each space defined in your project. Refer to the DOE-2 Engineering Manual for details on weighting factors and how they are used in the calculations. This report is contained in the BDL file.

```
REPORT- LV-K  WEIGHTING FACTOR SUMMARY
-----------------------------------------------------------------------------------------------------------------


SP NAME--   UNCOND1       COND2         COND3         COND4         COND5         COND6
WF NAME--


SOLAR
-----
V0          0.19700       0.41315       0.41315       0.41315       0.41315       0.44626
V1         -0.06700      -0.43752      -0.43752      -0.43752      -0.43752      -0.49435
V2          0.00000       0.05396       0.05396       0.05396       0.05396       0.07861
W1          0.87000       1.47430       1.47430       1.47430       1.47430       1.48601
W2          0.00000      -0.50812      -0.50812      -0.50812      -0.50812      -0.51858


GENERAL
LIGHTING
--------
V0          0.53000       0.65622       0.65622       0.65622       0.65622       0.66478
V1         -0.40000      -0.57615      -0.57615      -0.57615      -0.57615      -0.57814
V2          0.00000       0.08976       0.08976       0.08976       0.08976       0.08910
W1          0.87000       1.04633       1.04633       1.04633       1.04633       1.03287
W2          0.00000      -0.23150      -0.23150      -0.23150      -0.23150      -0.21585


TASK
LIGHTING
--------
V0          0.50000       0.63570       0.63570       0.63570       0.63570       0.64476
V1         -0.37000      -0.54808      -0.54808      -0.54808      -0.54808      -0.55100
V2          0.00000       0.08130       0.08130       0.08130       0.08130       0.08153
W1          0.87000       1.04633       1.04633       1.04633       1.04633       1.03288
W2          0.00000      -0.23150      -0.23150      -0.23150      -0.23150      -0.21585


PEOPLE-
EQUIPMENT
---------
V0          0.68100       0.64083       0.64083       0.64083       0.64083       0.64977
V1         -0.55100      -0.55510      -0.55510      -0.55510      -0.55510      -0.55778
V2          0.00000       0.08341       0.08341       0.08341       0.08341       0.08342
W1          0.87000       1.04633       1.04633       1.04633       1.04633       1.03288
W2          0.00000      -0.23150      -0.23150      -0.23150      -0.23150      -0.21585


CONDUCTION
----------
V0          0.68100       0.68680       0.68680       0.68680       0.68680       0.69501
```

```
V1        -0.55100      -0.61797      -0.61797      -0.61797      -0.61797      -0.61915
V2         0.00000       0.10236       0.10236       0.10236       0.10236       0.10053
W1         0.87000       1.04633       1.04633       1.04633       1.04633       1.03287
W2         0.00000      -0.23150      -0.23150      -0.23150      -0.23150      -0.21585


AIR
TEMP    (BTU/HR-SQFT-F   )
----
G0*        1.81000       1.03300       1.03300       1.03300       1.03300       0.83902
G1*       -1.89000      -1.71421      -1.71421      -1.71421      -1.71421      -1.41754
G2*        0.08000       0.69278       0.69278       0.69278       0.69278       0.59056
G3*        0.00000      -0.01157      -0.01157      -0.01157      -0.01157      -0.01204
P1        -0.87000      -1.26102      -1.26102      -1.26102      -1.26102      -1.34797
P2         0.00000       0.36654       0.36654       0.36654       0.36654       0.43066
```

8.14   LV-L - Daylight Factor Summary

This detailed report is produced for each space in the project that has daylighting. It includes most of the detailed information used by DOE-2 in making daylighting calculations.

```
BASECASE                          VisualDOE for Windows
REPORT- LV-L  DAYLIGHT FACTOR SUMMARY FOR          SPACE0
---------------------------------------------------------------------------------------------------------------
SPACE--SPACE0            WINDOW--GTFBTMWIN                         REF PT NO.--1
AREA(SQFT)    127.5      SC 1.00   GTC 1000  VIS-TRANS  0.90       X(FT)    5.0  Y(FT)    7.5  Z(FT)    2.5
AV REFL        0.48      H(FT)       3.7  W(FT)      9.7           ZONE-FRACTION      0.80
MAX-GLARE     20.0       AZIM(DEG)   180.0  TILT(DEG) 90.0         LTG-SET-POINT(FC)    50.0
VW-AZ(DEG)    270.0      DAY-X-DIV      8  DAY-Y-DIV    8          LTG-CTRL-TYPE      CONTINUOUS
                        X(FT)    9.8  Y(FT)   12.8  Z(FT)    3.2
                        WIN-SHADE-TYPE    MOVABLE-INTERIOR
                          EXT    EXT    DIR   REFL    DIR   REFL    DAY    DAY    WIN    WIN   BACKG  BACKG
SUN     WIN  SUN  SUN     ILL    ILL    ILL    ILL    ILL    ILL    ILL    ILL    LUM    LUM    LUM    LUM
POS DAY SHD  ALT  AZIM   -SKY   -SUN   -SKY   -SKY   -SUN   -SUN    FAC    FAC    FAC    FAC    FAC    FAC   GLARE
NO. TYP IND (DEG)(DEG)   (FC)   (FC)   (FC)   (FC)   (FC)   (FC)   -SKY   -SUN   -SKY   -SUN   -SKY   -SUN  INDEX
 1   1   1   10.  290.  1093.6  299.8   48.7   22.7    0.0    1.6  0.0653 0.0055 0.5346 0.0000 0.0100 0.0026   9.6
 1   1   2   10.  290.  1093.6  299.8   46.1   27.1    2.2    1.3  0.0670 0.0119 0.5113 0.0906 0.0120 0.0021   9.6
 1   2   1   10.  290.   366.9    0.0   13.6    5.8    0.0    0.0  0.0528 0.0000 0.4015 0.0000 0.0077 0.0000   2.5
 1   2   2   10.  290.   366.9    0.0   11.4    6.7    0.0    0.0  0.0493 0.0000 0.3761 0.0000 0.0088 0.0000   2.1
 2   1   1   10.  235.  1093.6  299.8   92.3   42.9    0.0   29.2  0.1236 0.0975 1.0379 0.0000 0.0189 0.0470  11.8
 2   1   2   10.  235.  1093.6  299.8   91.9   54.0   64.9   38.1  0.1334 0.3436 1.0182 2.6227 0.0238 0.0614  13.5
 3   1   1   10.  180.  1093.6  299.8  233.6   62.8  299.8   60.5  0.2711 1.2017 2.4879 0.0000 0.0277 0.0973  14.5
 3   1   2   10.  180.  1093.6  299.8  137.2   80.6  135.8   79.8  0.1992 0.7192 1.5203 5.4890 0.0356 0.1284  14.9
 4   1   1   10.  125.  1093.6  299.8   92.3   42.9    0.0   29.2  0.1236 0.0975 1.0379 0.0000 0.0189 0.0470  11.8
   [ROWS DELETED FOR BREVITY]
NOTE -- Above values assume VISIBLE TRANSMITTANCE = 1.0
        for WINDOW glass and SHADING DEVICE.
        Actual transmittances are used in the hourly calculation.
```

8.15 LV-M - DOE-2 English/Metric Conversion Table

This report is a listing of the conversion factors used in DOE-2 when conversions are required between inch-pound (English) units and SI (metric) units. This report is only produced when your project uses SI (metric) units.

```
                        DOE-2   UNITS   TABLE
                        --------------------


        ENGLISH    MULTIPLIED BY  GIVES   METRIC    MULTIPLIED BY   GIVES   ENGLISH


   1                      1.000000                        1.000000
   2                      1.000000                        1.000000
   3    BTU               0.293000   WH                   3.412969   BTU
   4    BTU/HR            0.293000   WATT                 3.412969   BTU/HR
   5    BTU/LB-F       4183.830078   J/KG-K               0.000239   BTU/LB-F
   6    BTU/HR-SQFT-F     5.674460   W/M2-K               0.176228   BTU/HR-SQFT-F
   7    DEGREES           1.000000   DEGREES              1.000000   DEGREES
   9    SQFT              0.092903   M2                  10.763915   SQFT
  10    CUFT              0.028317   M3                  35.314724   CUFT
  11    LB/HR             0.453592   KG/HR                2.204624   LB/HR
  12    LB/CUFT          16.018459   KG/M3                0.062428   LB/CUFT
  13    MPH               0.447040   M/S                  2.236936   MPH
  14    BTU/HR-F          0.527178   W/K                  1.896893   BTU/HR-F
  15    FT                0.304800   M                    3.280840   FT
  16    BTU/HR-FT-F       1.729600   W/M-K                0.578168   BTU/HR-FT-F
  17    BTU/HR- SQFT      3.152480   WATT /M2             0.317211   BTU/HR- SQFT
  18    IN                2.540000   CM                   0.393701   IN
  19    UNITS/IN          0.393700   UNITS/CM             2.540005   UNITS/IN
  20    UNITS             1.000000   UNITS                1.000000   UNITS
  21    LB                0.453592   KG                   2.204624   LB
  22    FRAC.OR MULT.     1.000000   FRAC.OR MULT.        1.000000   FRAC.OR MULT.
  23    HOURS             1.000000   HRS                  1.000000   HOURS
  24    PERCENT-RH        1.000000   PERCENT-RH           1.000000   PERCENT-RH
  25    CFM               1.699010   M3/H                 0.588578   CFM
  26    IN-WATER         25.400000   MM-WATER             0.039370   IN-WATER
  27    LB/SQFT           4.882400   KG/M2                0.204817   LB/SQFT
  28    KW                1.000000   KW                   1.000000   KW
  29    W/SQFT           10.763920   W/M2                 0.092903   W/SQFT
  30    THERMS           25.000000   THERMIES             0.040000   THERMS
  31    KNOTS             0.514440   M/SEC                1.943861   KNOTS
  32    HR-SQFT-F /BTU    0.176228   M2-K /W              5.674467   HR-SQFT-F /BTU
  33    $DOLLARS          1.000000   $DOLLARS             1.000000   $DOLLARS
  34    MBTU/HR           0.293000   MWATT                3.412969   MBTU/HR
  35    YEARS             1.000000   YEARS                1.000000   YEARS
  36    $/HR              1.000000   $/HR                 1.000000   $/HR
  37    HRS/YEARS         1.000000   HRS/YEARS            1.000000   HRS/YEARS
  38    PERCENT           1.000000   PERCENT              1.000000   PERCENT
  39    $/MONTH           1.000000   $/MONTH              1.000000   $/MONTH
  40    GALLONS/MIN/TON   1.078000   LITERS/MIN/KW        0.927644   GALLONS/MIN/TON
```

41	BTU/LB	0.645683	WH/KG	1.548748	BTU/LB
42	LBS/SQIN-GAGE	68.947571	MBAR-GAGE	0.014504	LBS/SQIN-GAGE
43	$/UNIT	1.000000	$/UNIT	1.000000	$/UNIT
44	BTU/HR/PERSON	0.293000	W/PERSON	3.412969	BTU/HR/PERSON
45	LBS/LB	1.000000	KGS/KG	1.000000	LBS/LB
46	BTU/BTU	1.000000	KWH/KWH	1.000000	BTU/BTU
47	LBS/KW	0.453590	KG/KW	2.204634	LBS/KW
48	REV/MIN	1.000000	REV/MIN	1.000000	REV/MIN
49	KW/TON	1.000000	KW/TON	1.000000	KW/TON
50	MBTU	0.293000	MWH	3.412969	MBTU
51	GAL	3.785410	LITER	0.264172	GAL
52	GAL/MIN	3.785410	LITERS/MIN	0.264172	GAL/MIN
53	BTU/F	1897.800049	J/K	0.000527	BTU/F
54	UNITS/HR	1.000000	UNITS/HR	1.000000	UNITS/HR
55	$/UNIT-HR	1.000000	$/UNIT-HR	1.000000	$/UNIT-HR
56	KW/CFM	0.588500	KW/M3/HR	1.699235	KW/CFM
57	BTU/SQFT-F	20428.400391	J/M2-K	0.000049	BTU/SQFT-F
58	HR/HR	1.000000	HR/HR	1.000000	HR/HR
59	BTU/FT-F	6226.479980	J/M-K	0.000161	BTU/FT-F
60	R	0.555556	K	1.799999	R
61	INCH MER	33.863800	MBAR	0.029530	INCH MER
62	UNITS/GAL/MIN	0.264170	UNITS/LITER/MIN	3.785441	UNITS/GAL/MIN
63	(HR-SQFT-F/BTU)2	0.031056	(M2-K /W)2	32.199585	(HR-SQFT-F/BTU)2
64	KBTU/HR	0.293000	KW	3.412969	KBTU/HR
65	KBTU	0.293000	KWH	3.412969	KBTU
66	CFM	0.471900	L/S	2.119093	CFM
67	CFM/SQFT	18.288000	M3/H-M2	0.054681	CFM/SQFT
68	1/R	1.799900	1/K	0.555586	1/R
69	1/KNOT	1.943860	SEC/M	0.514440	1/KNOT
70	FOOTCANDLES	10.763910	LUX	0.092903	FOOTCANDLES
71	FOOTLAMBERT	3.426259	CANDELA/M2	0.291864	FOOTLAMBERT
72	LUMEN / WATT	1.000000	LUMEN / WATT	1.000000	LUMEN / WATT
73	KBTU/SQFT-YR	3.152480	KWH/M2-YR	0.317211	KBTU/SQFT-YR

8.16   LS-A - Space Peak Loads Summary

This report is a listing of the spaces in the project with a summary of the peak heating and cooling loads for each. The report also shows the number of times each space is repeated (based on the keywords MULTIPLIER and FLOOR-MULTIPLIER). All spaces are included in this report, including plenums and unconditioned spaces.

A row is included for each space. For each space, the peak sensible cooling load and heating load are displayed. The month, day and hour of the peak is also displayed. These space level loads are non-coincident, which means that they may not all occur at the same time. More detail on each of these space loads is presented in the LS-B report.

The building level heating and cooling loads are shown at the bottom. These figures are the coincident load, which means that all loads are determined for the same hour. The month, day and hour of the building coincident loads is displayed as well. More detail of the building level loads is presented on the LS-C report.

Both loads are calculated for the space temperature specified with the DOE-2 keyword TEMPERATURE associated with the DOE-2 command SPACE-CONDITIONS. This may be different than the time-varying temperature specified for thermostat settings. Also be warned that these loads do not include outside air ventilation, which is calculated later when the systems simulation is performed.

```
REPORT- LS-A SPACE PEAK LOADS SUMMARY                                                WEATHER FILE- CZ01RV2 WYEC2
-------------------------------------------------------------------------------------------------------------------

               MULTIPLIER    COOLING LOAD       TIME OF    DRY- WET-   HEATING LOAD       TIME OF    DRY- WET-
SPACE NAME    SPACE  FLOOR    (KBTU/HR)          PEAK      BULB BULB    (KBTU/HR)          PEAK      BULB BULB

SPACE0         10.    1.         4.121    FEB  3  2 PM    60.F 55.F       -3.134    DEC 31  6 AM    32.F 30.F

SPACE1         10.    1.         4.185    APR 13  6 PM    67.F 56.F       -3.157    DEC 31  6 AM    32.F 30.F

SPACE2         10.    1.         1.936    JUL  8  3 PM    74.F 69.F       -3.165    DEC 31  6 AM    32.F 30.F

SPACE3         10.    1.         3.634    SEP  8 11 AM    79.F 62.F       -3.144    FEB 27  6 AM    34.F 33.F

SPACE4          1.    1.        38.670    JUL 20  5 PM    72.F 66.F      -60.589    FEB 27  7 AM    33.F 32.F

PLEN0           1.    1.         1.565    NOV  1  2 PM    67.F 59.F       -1.262    DEC 31  7 AM    32.F 30.F

PLEN1           1.    1.         1.463    JUL  9  7 PM    66.F 61.F       -1.291    JAN 20  7 AM    32.F 32.F

[ROWS DELETED FOR BREVITY]

PLEN13          1.    1.         3.668    AUG  1  2 PM    71.F 66.F       -4.283    JAN 20  6 AM    32.F 32.F

PLEN14          1.    1.        11.627    JUL 19  4 PM    69.F 63.F      -11.499    JAN 20  6 AM    32.F 32.F

                                ---------                                 ---------

SUM                             567.944                                  -332.514

BUILDING PEAK                   399.117    SEP  8  5 PM    75.F 61.F     -291.933    DEC 31  6 AM    32.F 30.F
```

8.17   LS-B - Space Peak Load Components

This report breaks down the heating and cooling peak loads, according to the source of the load. A separate report is produced for each space. A "load", for the purposes of this report, is the heat that must be added or removed from the space air each hour in order to maintain a *constant* air temperature equal to the TEMPERATURE keyword value in SPACE -CONDITIONS (default 70 F). These loads are modified in the SYSTEMS program to account for time-varying thermostat setpoints. The following is a description of the components that are included in the report.

1.   WALL CONDUCTION is the load due to conduction through exterior walls (TILT$\geq$ 45°)

2.   ROOF CONDITION is the load due to conduction through roof sections (exterior walls with TILT < 45°).

3.   WINDOW GLASS+FRM COND is the conductive load (UAxΔT) due to heat gain through exterior windows (glass plus frames) *plus* solar energy absorbed by the glass and frames and conducted into space.

4.   WINDOW GLASS SOLAR is the load caused by direct and diffuse solar radiation transmitted by the window glass into space. Note that all sensible loads are calculated as *delayed in time with weighting factors* so that it is possible to have load contributions from WINDOW GLASS SOLAR at night.

5.   DOOR CONDUCTION is the load due to conduction through exterior doors in the space.

6.   INTERNAL SURFACE COND is the load due to conduction through INTERIOR-WALLs such as partitions and drop ceilings. Most of the time, these loads will be zero in this report since both spaces are assumed to be at the same temperature. VisualDOE uses a temperature of 74F for conditioned spaces and 85F for plenums and unconditioned spaces. This means that INTERNAL SURFACE COND will be non-zero if there is an adjacent plenum. If all the surrounding spaces are conditioned, then a zero value will be displayed.

7.   UNDERGROUND SURF COND is the load due to conduction through basement floors and walls or slabs on grade.

8.   The next five entries are the internal loads due to occupants, lighting, equipment, process and infiltration.

Internal Load	Associated DOE-2 Keywords
occupants	PEOPLE-SCHEDULE, NUMBER-OF-PEOPLE, AREA-PERSON, and PEOPLE-HEAT-GAIN
lighting	LIGHTING-SCHEDULE, LIGHTING-TYPE, LIGHTING W/SQFT, TASK-LT-W/SQFT, etc.
equipment	EQUIP-SCHEDULE, EQUIPMENT-W/SQFT, etc.
process	SOURCE-SCHEDULE, SOURCE-TYPE, SOURCE-BTU/HR, etc.
infiltration	INF-SCHEDULE, INF-METHOD, AIR-CHANGES/HR, etc.

9.   The RUN number in the upper right hand corner refers to the number of the pass through the LOADS program. For example, if you were doing parametric runs as part of the same job, successive passes through LOADS would be recorded as RUN 1, RUN 2, RUN 3, etc.

```
                              BASECASE                           VisualDOE for Windows

REPORT- LS-B SPACE PEAK LOAD COMPONENTS                SPACE0                  WEATHER FILE- CZ01RV2 WYEC2

-----------------------------------------------------------------------------------------------------------

SPACE   SPACE0
```

```
SPACE TEMPERATURE USED FOR THE LOADS CALCULATION IS   74 F /  23 C
                    MULTIPLIER      10.0        FLOOR MULTIPLIER      1.0
                    FLOOR  AREA     128  SQFT        12   M2
                    VOLUME         1276  CUFT        36   M3
                              COOLING  LOAD                    HEATING  LOAD
                         =========================      =========================
    TIME                         FEB  3  2PM                   DEC 31  6AM
    DRY-BULB TEMP             60 F           16 C          32 F            0 C
    WET-BULB TEMP             55 F           13 C          30 F           -1 C
    TOT HORIZONTAL SOLAR RAD  159 BTU/H.SQFT  501 W/M2      0 BTU/H.SQFT   0 W M2
    WINDSPEED AT SPACE        5.4 KTS         2.8 M/S       3.3 KTS        1.7 M S
    CLOUD AMOUNT 0(CLEAR)-10      0                            0
                          SENSIBLE        LATENT                    SENSIBLE
                        (KBTU/H)  ( KW ) (KBTU/H)  ( KW )        (KBTU/H)  ( KW )
                        --------  ------ -------- ------         --------  --------
     WALL CONDUCTION    -0.309   -0.090   0.000   0.000          -1.782   -0.522
     ROOF CONDUCTION     0.000    0.000   0.000   0.000           0.000    0.000
     WINDOW GLASS+FRM COND -0.034 -0.010  0.000   0.000          -1.233   -0.361
     WINDOW GLASS SOLAR   3.942   1.155   0.000   0.000           0.003    0.001
     DOOR CONDUCTION      0.000   0.000   0.000   0.000           0.000    0.000
     INTERNAL SURFACE COND 0.000  0.000   0.000   0.000           0.000    0.000
     UNDERGROUND SURF COND 0.000  0.000   0.000   0.000           0.000    0.000
     OCCUPANTS TO SPACE   0.091   0.027   0.092   0.027           0.000    0.000
     LIGHT    TO SPACE    0.093   0.027   0.000   0.000           0.027    0.008
     EQUIPMENT TO SPACE   0.337   0.099   0.000   0.000           0.020    0.006
     PROCESS   TO SPACE   0.000   0.000   0.000   0.000           0.000    0.000
     INFILTRATION         0.000   0.000   0.000   0.000          -0.169   -0.050
                        --------  ------- ------- ------         --------  --------
     TOTAL               4.121    1.207   0.092   0.027          -3.134   -0.918
     TOTAL / AREA        0.032    0.102   0.001   0.002          -0.025    0.000
     TOTAL LOAD          4.213 KBTU/H    1.234  KW      -3.134 KBTU/H    -0.918  KW
     TOTAL LOAD / AREA   33.04  BTU/H.SQFT 104.202  W/M2   24.580 BTU/H.SQFT  77.521  W M2
                   **************************************************************
                   *                                                          *
                   *  NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR   *
                   *  ----    LOADS                                            *
                   *        2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION    *
                   *           IN CONSIDERATION                               *
                   *        3)THE ABOVE LOADS ARE CALCULATED ASSUMING A       *
                   *           CONSTANT INDOOR SPACE TEMPERATURE              *
                   *                                                          *
                   **************************************************************
```

8.18 LS-C - Building Peak Load Components

This report is similar in format to LS-B. The difference is that LS-C generated at the "building level", i.e., the reported loads are for the month, day and hour of the building peak (the coincident load).

"Floor area" in this report includes only conditioned spaces (ZONE-TYPE=CONDITIONED) ; it *excludes* plenums and other unconditioned spaces (ZONE-TYPE=PLENUM or UNCONDITIONED). "Volume" also only includes conditioned spaces and plenums, but *excludes* unconditioned spaces (ZONE-TYPE=UNCONDITIONED).

The building coincident peak load does not include plenums (ZONE-TYPE=PLENUM) or other unconditioned spaces (ZONE-TYPE=UNCONDITIONED).

The sensible portion of infiltration loads is treated as an instantaneous heat gain or loss. The latent portion is reported in LOADS, but is passed to SYSTEMS as an air flow and an associated humidity ratio for each hour. The contribution of the latent heat (negative or positive in relation to room humidity) is calculated from a mass balance of moisture in the space, to determine the return air humidity ratio. In dry climates the infiltration may actually result in a decreased space latent load and thus a decreased total SYSTEMS load. The opposite is true in humid climates where infiltration acts to increase the SYSTEMS load.

The heat gain or loss that occurs in plenums, including heat due to lights, is accounted for in the SYSTEMS simulation and causes a temperature change in the return air flowing through the plenum. Therefore, you should **not** specify plenums unless they are actually return air plenums. Unconditioned, non-return-air spaces should be specified in the SPACE command with ZONE-TYPE=UNCONDITIONED.

```
                          BASECASE                                    VisualDOE for Windows

REPORT- LS-C BUILDING PEAK LOAD COMPONENTS                                    WEATHER FILE- CZ01RV2 WYEC2

----------------------------------------------------------------------------------------------------------------

*** BUILDING ***

                FLOOR  AREA     30000  SQFT      2787   M2

                VOLUME         300300  CUFT      8504   M3

                                COOLING  LOAD                           HEATING  LOAD

                            ==========================           ==========================

     TIME                            SEP  8  5PM                      DEC 31  6AM

     DRY-BULB TEMP                 75 F              24 C         32 F              0 C

     WET-BULB TEMP                 61 F              16 C         30 F             -1 C

     TOT HORIZONTAL SOLAR RAD    159 BTU/H.SQFT    501 W/M2       0 BTU/H.SQFT      0 W M2

     WINDSPEED AT SPACE           0.0 KTS           0.0 M/S       2.8 KTS          1.4 M S

     CLOUD AMOUNT 0(CLEAR)-10         2                            0

                          SENSIBLE         LATENT                       SENSIBLE

                         (KBTU/H)  ( KW ) (KBTU/H)  ( KW )             (KBTU/H)  ( KW )

                         --------  ------ -------- ------             --------  --------

     WALL CONDUCTION      21.804   6.389   0.000   0.000            -151.007  -44.245

     ROOF CONDUCTION       0.000   0.000   0.000   0.000               0.000    0.000

     WINDOW GLASS+FRM COND 10.823   3.171   0.000   0.000            -128.825  -37.746

     WINDOW GLASS SOLAR  142.812  41.844   0.000   0.000               0.203    0.059

     DOOR CONDUCTION       0.000   0.000   0.000   0.000               0.000    0.000

     INTERNAL SURFACE COND 0.000   0.000   0.000   0.000               0.000    0.000

     UNDERGROUND SURF COND 0.000   0.000   0.000   0.000               0.000    0.000

     OCCUPANTS TO SPACE   24.297   7.119  21.660   6.346               0.050    0.015

     LIGHT    TO SPACE   113.084  33.134   0.000   0.000               4.561    1.336

     EQUIPMENT TO SPACE   86.297  25.285   0.000   0.000               3.377    0.989

     PROCESS   TO SPACE    0.000   0.000   0.000   0.000               0.000    0.000
```

```
INFILTRATION           0.000    0.000    0.000   0.000                 -20.291   -5.945
                     --------  -------  ------- ------                 -------- --------
TOTAL                 399.117  116.941   21.660   6.346                -291.932  -85.536
TOTAL / AREA            0.013    0.042    0.001   0.002                  -0.010    0.000
TOTAL LOAD            420.777 KBTU/H   123.288  KW        -291.932 KBTU/H  -85.536  KW
TOTAL LOAD / AREA      14.03  BTU/H.SQFT  44.235  W/M2       9.731 BTU/H.SQFT   30.690  W M2

            *****************************************************************
            *                                                              *
            *   NOTE  1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR     *
            *   ----    LOADS                                              *
            *         2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION      *
            *            IN CONSIDERATION                                  *
            *         3)THE ABOVE LOADS ARE CALCULATED ASSUMING A          *
            *            CONSTANT INDOOR SPACE TEMPERATURE                 *
            *                                                              *
            *****************************************************************
```

8.19   LS-D - Building Monthly Loads Summary

This report gives a summary of monthly cooling, heating, and electrical requirements plus annual total energy requirements and maximum monthly peak loads. Only conditioned spaces are included (ZONE-TYPE = CONDITIONED). Unconditioned spaces (ZONE-TYPE=UNCONDITIONED) or PLENUM) are not included in the reported monthly load.

You should be aware that these loads are based on a constant temperature within each SPACE as specified in the TEMPERATURE keyword in the SPACE-CONDITIONS command. Additionally, these loads do not account for outside ventilation air. Outside air ventilation and thermostat setpoint temperatures are accounted for later in the systems simulation.

The following is a description of the components that are reported.

1.   COOLING, HEATING, and ELEC are the three sections of this building level report.

2.   COOLING ENERGY(millions of Btu) is the monthly sensible cooling load for all spaces in the building.

3.   MAXIMUM COOLING LOAD (thousands of Btu/hr) is the peak sensible space cooling load. To the left of this column are the day and hour peak cooling load along with the outside dry-bulb and wet-bulb temperatures at the time of the peak.

4.   HEATING ENERGY(millions of Btu) is the monthly heating load.

5.   MAXIMUM HEATING LOAD (thousands of Btu/hr) is the peak space heating load. To the left of this column are the day and hour of the peak heating load along with the outside dry-bulb and wet-bulb temperatures at the time of the peak.

6.   ELECTRICAL ENERGY (kWh)is the monthly electrical consumption for lights, convenience, and non-HVAC equipment is the monthly electrical consumption for lights, convenience outlets, and non-HVAC equipment.

7.   MAXIMUM ELEC LOAD (kW)is the monthly peak electrical consumption in a one-hour period for lights, convenience outlets, and miscellaneous equipment input as SOURCE.

8.   TOTAL is the annual total for the cooling load, heating load, and electrical load of the building.

9.   MAX is the highest monthly peak cooling load, heating load, and electrical load.

Note that the units change if you used SI (metric) units to build your model.

```
                          BASECASE                              VisualDOE for Windows

REPORT- LS-D BUILDING MONTHLY LOADS SUMMARY                          WEATHER FILE- CZ01RV2 WYEC2
----------------------------------------------------------------------------------------------------------------
          - - - - - - - - C O O L I N G - - - - - - - -   - - - - - - - - H E A T I N G - - - - - - - -   - - - E L E C - - -
                                          MAXIMUM                                         MAXIMUM       ELEC-    MAXIMUM
          COOLING      TIME   DRY-  WET-   COOLING      HEATING      TIME   DRY-  WET-     HEATING       TRICAL     ELEC
          ENERGY     OF MAX   BULB  BULB    LOAD        ENERGY     OF MAX   BULB  BULB      LOAD         ENERGY     LOAD
MONTH     (MBTU)     DY  HR   TEMP  TEMP  (KBTU/HR)     (MBTU)     DY  HR   TEMP  TEMP    (KBTU/HR)      (KWH)      (KW)
JAN      42.60435    27  16   59.F  54.F   325.015     -84.510     18   6   35.F  35.F    -272.188      17636.    67.374
FEB      41.16670     3  16   55.F  53.F   328.632     -71.214     27   6   34.F  33.F    -289.506      15867.    66.786
MAR      50.63934    17  15   68.F  58.F   347.385     -73.602     13   6   37.F  36.F    -264.652      18825.    66.544
APR      56.56214    13  16   72.F  57.F   365.792     -63.995     24   4   37.F  35.F    -255.457      17481.    66.502
MAY      60.64134    31  16   62.F  56.F   292.543     -52.106     13   5   41.F  40.F    -213.374      17443.    66.123
JUN      67.81410    24  16   72.F  64.F   373.104     -38.641     17   4   46.F  44.F    -180.869      18027.    66.123
JUL      66.69934    21  16   74.F  67.F   374.425     -38.509     11   4   47.F  45.F    -164.726      16883.    66.123
AUG      66.67471     1  16   71.F  67.F   364.841     -36.971     29   5   47.F  46.F    -154.619      18803.    66.364
```

```
SEP    64.29835   8  16   75.F  61.F      399.117     -37.380  15   4   46.F  44.F     -168.410      17374.    66.670

OCT    54.00015  14  16   65.F  60.F      342.233     -50.723  23   7   40.F  40.F     -213.643      16923.    67.037

NOV    40.07349   1  15   66.F  59.F      347.952     -73.069  23   6   35.F  32.F     -255.289      16747.    67.500

DEC    40.36452   8  15   62.F  58.F      306.766     -86.322  31   6   32.F  30.F     -291.933      17645.    67.437

       ---------                        ----------   ---------                        ----------   --------   -------

TOTAL  651.539                                       -707.042                                       209653.

MAX                                       399.117                                       -291.933               67.500
```

8.20   LS-E - Space Monthly Load Components

This report is generated for each space in the project. This report gives a breakdown of loads for each space on a monthly basis, according to the source of the load. All entries are in millions of Btu/month. Each load is broken down into three types: heating (HEATING) , sensible cooling (SEN CL) , and latent cooling (LAT CL). Latent cooling loads are accumulated only for those hours in each month that have a net sensible cooling load. Positive entries correspond to heat gain, negative entries correspond to heat loss, and all sensible loads are calculated as *delayed in time with weighting factors.*

The load sources, listed across the top of the report, are described below. The corresponding headings from Report LS-B are given in brackets.

WALLS   [WALLS plus DOOR] is the heat conduction through exterior walls with TILT greater than 45°, plus conduction through doors located in exterior walls.

ROOFS   [ROOFS] is the heat conduction through exterior walls with TILT less than 45°.

INT SUR   [INTERNAL SURFACES] is the heat conduction through interior walls. This entry will be non-zero only if there are one or more adjoining spaces with a loads calculation temperature that is different from that of the space being reported.

UND SUR   [UNDERGROUND SURFACES] is the heat conduction through underground surfaces.

INFIL   [INFILTRATION] is the load due to air infiltration

WIN CON   [WINDOW CONDUCTION] is the sum of the UAxΔT load through the windows (glass plus frames) plus solar energy absorbed by the glass and frames and conducted into space.

WIN SOL   [WINDOW SOLAR] is the load from direct and diffuse solar radiation transmitted by the window glass.

OCCUP   [OCCUPANTS TO SPACE] is the heat gain from occupants.

LIGHTS   [LIGHT TO SPACE]is the heat gain from lights.

EQUIP   [EQUIPMENT TO SPACE] is the load resulting from equipment. These values are calculated from user-applied entries for EQUIP-SCHEDULE, EQUIPMENT-KW, EQUIPMENT-W/SQFT, EQUIP-SENSIBLE and EQUIP-LATENT.

SOURCE   [PROCESS TO SPACE] is the load resulting from internal heating loads other than people, lights, or equipment. These values are calculated from the user-supplied entries for SOURCE-SCHEDULE, SOURCE-TYPE, SOURCE-BTU/HR, SOURCE-SENSIBLE, and SOURCE-LATENT.

The LS-E Report is printed once for the combined DESIGN-DAY intervals (if one or more DESIGN-DAYs are specified) and once for the combined RUN-PERIOD intervals that use the weather file. For DESIGN-DAYs, the months will be printed in the same order as they appear in the DESIGN-DAY RUN-PERIOD intervals.

```
                                BASECASE                          VisualDOE for Windows

REPORT- LS-E  SPACE MONTHLY LOAD COMPONENTS IN MBTU FOR     SPACE0                    WEATHER FILE- CZ01RV2 WYEC2

----------------------------------------------------------------------------------------------------------------

(UNITS=MBTU)    WALLS    ROOFS   INT SUR   UND SUR    INFIL   WIN CON   WIN SOL    OCCUP    LIGHTS    EQUIP    SOURCE    TOTAL

              ----------------------------------------------------------------------------------------------------------

      HEATNG  -0.673    0.000    0.000    0.000    -0.037   -0.448    0.114    0.012    0.046    0.056    0.000   -0.929

JAN   SEN CL  -0.117    0.000    0.000    0.000    -0.002   -0.046    0.322    0.009    0.012    0.036    0.000    0.214

      LAT CL                                        0.000                      0.009             0.000    0.000    0.009

              ----------------------------------------------------------------------------------------------------------

      HEATNG  -0.594    0.000    0.000    0.000    -0.031   -0.387    0.121    0.011    0.036    0.051    0.000   -0.793
```

FEB	SEN CL	-0.104	0.000	0.000	0.000	-0.002	-0.046	0.297	0.008	0.010	0.032	0.000	0.195
	LAT CL					0.000			0.008		0.000	0.000	0.008
	HEATNG	-0.651	0.000	0.000	0.000	-0.032	-0.428	0.139	0.013	0.037	0.061	0.000	-0.862
MAR	SEN CL	-0.112	0.000	0.000	0.000	-0.002	-0.054	0.274	0.010	0.011	0.038	0.000	0.164
	LAT CL					0.000			0.009		0.000	0.000	0.010
	HEATNG	-0.559	0.000	0.000	0.000	-0.032	-0.378	0.132	0.010	0.027	0.047	0.000	-0.753
APR	SEN CL	-0.121	0.000	0.000	0.000	-0.001	-0.067	0.267	0.012	0.012	0.045	0.000	0.147
	LAT CL					0.000			0.011		0.000	0.000	0.011
	HEATNG	-0.495	0.000	0.000	0.000	-0.031	-0.330	0.137	0.009	0.024	0.044	0.000	-0.642
MAY	SEN CL	-0.106	0.000	0.000	0.000	-0.001	-0.066	0.187	0.012	0.013	0.047	0.000	0.087
	LAT CL					0.000			0.011		0.000	0.000	0.012
	HEATNG	-0.367	0.000	0.000	0.000	-0.024	-0.252	0.098	0.007	0.021	0.036	0.000	-0.481
JUN	SEN CL	-0.100	0.000	0.000	0.000	-0.001	-0.060	0.207	0.015	0.016	0.059	0.000	0.137
	LAT CL					0.001			0.014		0.000	0.000	0.014
	HEATNG	-0.347	0.000	0.000	0.000	-0.025	-0.243	0.085	0.006	0.020	0.032	0.000	-0.472
JUL	SEN CL	-0.096	0.000	0.000	0.000	-0.002	-0.058	0.223	0.014	0.016	0.057	0.000	0.154
	LAT CL					0.001			0.013		0.000	0.000	0.014
	HEATNG	-0.338	0.000	0.000	0.000	-0.023	-0.236	0.075	0.008	0.024	0.038	0.000	-0.453
AUG	SEN CL	-0.103	0.000	0.000	0.000	-0.001	-0.062	0.220	0.016	0.017	0.061	0.000	0.147
	LAT CL					0.001			0.014		0.000	0.000	0.015
	HEATNG	-0.313	0.000	0.000	0.000	-0.024	-0.227	0.060	0.006	0.025	0.032	0.000	-0.440
SEP	SEN CL	-0.085	0.000	0.000	0.000	-0.001	-0.045	0.299	0.015	0.017	0.059	0.000	0.259
	LAT CL					0.001			0.014		0.000	0.000	0.014
	HEATNG	-0.410	0.000	0.000	0.000	-0.027	-0.278	0.075	0.008	0.032	0.040	0.000	-0.562
OCT	SEN CL	-0.116	0.000	0.000	0.000	-0.002	-0.049	0.398	0.013	0.015	0.049	0.000	0.307
	LAT CL					0.001			0.012		0.000	0.000	0.013
	HEATNG	-0.601	0.000	0.000	0.000	-0.034	-0.401	0.106	0.012	0.043	0.054	0.000	-0.821
NOV	SEN CL	-0.092	0.000	0.000	0.000	-0.001	-0.035	0.232	0.009	0.011	0.033	0.000	0.157
	LAT CL					0.000			0.008		0.000	0.000	0.008
	HEATNG	-0.692	0.000	0.000	0.000	-0.037	-0.451	0.112	0.012	0.047	0.057	0.000	-0.952
DEC	SEN CL	-0.113	0.000	0.000	0.000	0.000	-0.047	0.294	0.009	0.014	0.036	0.000	0.192
	LAT CL					0.000			0.009		0.000	0.000	0.009
	HEATNG	-6.040	0.000	0.000	0.000	-0.358	-4.060	1.253	0.114	0.382	0.547	0.000	-8.161
TOT	SEN CL	-1.267	0.000	0.000	0.000	-0.016	-0.636	3.220	0.143	0.165	0.551	0.000	2.160
	LAT CL					0.005			0.132		0.000	0.000	0.137

8.21 LS-F - Building Monthly Load Components

This report is similar to the LS-E report, except that it is generated for the whole building rather than for each space. It gives a breakdown of loads on a monthly basis for the entire building, according to the source of the load. The loads in unconditioned spaces (ZONE-TYPE = UNCONDITIONED or PLENUM) are not included; all entries are in millions of Btu/month if you are working in IP units.

Like report LS-E, three types of loads are shown: heating (HEATING) ,sensible cooling (SEN CL) , and latent cooling (LAT CL). The reported sources of the load (WALLS, ROOFS, etc.) are defined in the LS-E report description. See the description of LS-E for details.

For multizone buildings, the load components are obtained by summing the corresponding load components for each conditioned space after multiplication by the space MULTIPLIER or FLOOR-MULTIPLIER.

The total monthly heating and sensible cooling loads in the last column of this report are the same as those given in Report LS-D, Building Monthly Loads Summary, under the headings HEATING ENERGY and COOLING ENERGY.

```
                            BASECASE                          VisualDOE for Windows

REPORT- LS-F BUILDING MONTHLY LOAD COMPONENTS IN   MBTU                    WEATHER FILE- CZ01RV2 WYEC2
-----------------------------------------------------------------------------------------------------------

   (UNITS=MBTU)    WALLS    ROOFS   INT SUR  UND SUR   INFIL   WIN CON  WIN SOL   OCCUP    LIGHTS    EQUIP   SOURCE    TOTAL
-----------------------------------------------------------------------------------------------------------

       HEATNG    -61.231   0.000   0.000    0.000    -4.540  -43.214    6.099    1.470    9.593    7.312    0.000   -84.510

JAN    SEN CL     -5.985   0.000   0.000    0.000    -0.155   -9.723   17.762    3.916   21.001   15.788    0.000    42.604

       LAT CL                                          0.000                     3.413             0.000    0.000     3.413
-----------------------------------------------------------------------------------------------------------

       HEATNG    -53.916   0.000   0.000    0.000    -3.794  -36.375    6.439    1.330    8.546    6.557    0.000   -71.214

FEB    SEN CL     -5.236   0.000   0.000    0.000    -0.183  -10.061   19.888    3.526   18.967   14.266    0.000    41.167

       LAT CL                                          0.011                     3.063             0.000    0.000     3.074
-----------------------------------------------------------------------------------------------------------

       HEATNG    -56.423   0.000   0.000    0.000    -3.898  -38.132    7.562    1.378    8.954    6.956    0.000   -73.602

MAR    SEN CL     -7.719   0.000   0.000    0.000    -0.225  -12.708   25.426    4.423   23.659   17.783    0.000    50.639

       LAT CL                                          0.022                     3.863             0.000    0.000     3.885
-----------------------------------------------------------------------------------------------------------

       HEATNG    -48.022   0.000   0.000    0.000    -3.726  -33.024    7.950    0.984    6.658    5.185    0.000   -63.995

APR    SEN CL     -8.825   0.000   0.000    0.000    -0.279  -13.667   33.501    4.391   23.623   17.819    0.000    56.562

       LAT CL                                          0.000                     3.814             0.000    0.000     3.814
-----------------------------------------------------------------------------------------------------------

       HEATNG    -39.188   0.000   0.000    0.000    -3.425  -26.862    7.598    0.687    5.072    4.011    0.000   -52.106

MAY    SEN CL    -10.614   0.000   0.000    0.000    -0.381  -13.966   36.887    4.663   25.114   18.938    0.000    60.641

       LAT CL                                          0.043                     4.066             0.000    0.000     4.109
-----------------------------------------------------------------------------------------------------------

       HEATNG    -28.744   0.000   0.000    0.000    -2.666  -20.591    5.577    0.524    4.056    3.203    0.000   -38.641

JUN    SEN CL     -9.537   0.000   0.000    0.000    -0.286  -11.505   36.431    5.037   27.145   20.528    0.000    67.814

       LAT CL                                          0.153                     4.387             0.000    0.000     4.540
-----------------------------------------------------------------------------------------------------------

       HEATNG    -27.871   0.000   0.000    0.000    -2.759  -20.345    5.293    0.460    3.761    2.952    0.000   -38.509

JUL    SEN CL     -8.365   0.000   0.000    0.000    -0.426  -10.209   36.249    4.705   25.472   19.273    0.000    66.699

       LAT CL                                          0.208                     4.094             0.000    0.000     4.302
-----------------------------------------------------------------------------------------------------------
```

	HEATNG	-26.736	0.000	0.000	0.000	-2.603	-19.986	4.379	0.526	4.171	3.279	0.000	-36.971
AUG	SEN CL	-9.830	0.000	0.000	0.000	-0.264	-10.402	32.068	5.273	28.376	21.453	0.000	66.675
	LAT CL					0.187			4.592		0.000	0.000	4.779
	HEATNG	-25.830	0.000	0.000	0.000	-2.766	-20.251	3.600	0.509	4.151	3.208	0.000	-37.380
SEP	SEN CL	-7.915	0.000	0.000	0.000	-0.247	-8.420	30.478	4.827	25.943	19.632	0.000	64.298
	LAT CL					0.136			4.205		0.000	0.000	4.341
	HEATNG	-36.329	0.000	0.000	0.000	-3.275	-26.223	4.447	0.742	5.608	4.306	0.000	-50.723
OCT	SEN CL	-8.643	0.000	0.000	0.000	-0.265	-9.687	26.544	4.421	23.721	17.909	0.000	54.000
	LAT CL					0.098			3.862		0.000	0.000	3.960
	HEATNG	-52.537	0.000	0.000	0.000	-4.122	-37.533	5.364	1.222	8.232	6.305	0.000	-73.069
NOV	SEN CL	-6.411	0.000	0.000	0.000	-0.131	-8.790	15.043	3.889	20.830	15.643	0.000	40.074
	LAT CL					0.001			3.407		0.000	0.000	3.408
	HEATNG	-62.899	0.000	0.000	0.000	-4.462	-44.271	5.886	1.567	10.144	7.713	0.000	-86.322
DEC	SEN CL	-5.575	0.000	0.000	0.000	-0.043	-9.404	15.657	3.824	20.499	15.407	0.000	40.365
	LAT CL					0.000			3.332		0.000	0.000	3.332
	HEATNG	-519.722	0.000	0.000	0.000	-42.038	-366.807	70.195	11.399	78.948	60.981	0.000	-707.044
TOT	SEN CL	-94.654	0.000	0.000	0.000	-2.885	-128.542	325.936	52.899	284.336	214.467	0.000	651.557
	LAT CL					0.859			46.083		0.000	0.000	46.942

8.22 LS-G - Space Daylighting Summary

This report gives monthly-average lighting energy reduction, illuminance, and glare for each daylit space. If only one lighting reference point is specified, the entries under REF PT 2 will be zero. Files constructed with the VisualDOE Graphic Editor use only one reference point in each space. Task lighting energy, as determined by TASK-LIGHTING-KW or TASK-LT-W/SQFT, is not considered.

1. PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (ALL HOURS) gives percentage by which electric lighting energy is reduced, due to daylighting, for the entire space (TOTAL ZONE), and for the lighting zones at each lighting references point (REF PT 1 and REF PT 2). In this section of the report, all hours of the day are taken into account, including nighttime hours when the lighting energy reduction due to daylighting is zero.

2. PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHTING (REPORT SCHEDULE HOURS) gives the percentage by which electric lighting energy is reduced, due to daylighting, for the entire space (TOTAL ZONE), and for the lighting zones at each lighting reference point (REF PT 1 and REF PT 2). In this section of the report, only those hours are taken into account for which the value of DAYLIGHT-REP-SCH for this space is non-zero (the default). If DAYLIGHT-REP-SCH is not defined the entries will be the same as those in Part 1 above. In the following four sections, only those hours are taken into account for which *the sun is up* and the value of DAYLIGHT-REP-SCH is non-zero (the default).

3. AVERAGE DAYLIGHT ILLUMINANCE gives the average illuminance due to daylight at each lighting reference point.

4. PERCENT HOURS DAYLIGHT ILLUMINANCE ABOVE SETPOINT gives the percentage of hours that the illuminance from daylight exceeds the required illuminance level as specified by LIGHT-SET-POINT1 at REF PT 1 and LIGHT-SET-POINT2 at REF PT 2. (See Report LS-J for the frequency of occurrence distribution for daylight illuminance.)

5. AVERAGE GLARE INDEX gives the average daylight glare index at each lighting reference point (REF PT1 and REF PT 2).

6. PERCENT HOURS GLARE TOO HIGH gives the percentage of hours at each lighting reference point that the daylight glare index exceeds the MAX-GLARE value (or a value of 22, the maximum recommended for general office work, if MAX-GLARE has not been specified).

```
                              BASECASE                                VisualDOE for Windows
REPORT- LS-G  SPACE DAYLIGHTING SUMMARY                                 WEATHER FILE- CZ01RV2 WYEC2
----------------------------------------------------------------------------------------------------------------
SPACE  SPACE0

                                                     ----------------REPORT SCHEDULE HOURS WITH SUN UP----------------
             PERCENT LIGHTING          PERCENT LIGHTING          AVERAGE      PERCENT HOURS
             ENERGY REDUCTION          ENERGY REDUCTION          DAYLIGHT        DAYLIGHT
              BY DAYLIGHTING            BY DAYLIGHTING          ILLUMINANCE     ILLUMINANCE         AVERAGE        PERCENT HOURS
                (ALL HOURS)          (REPORT SCHEDULE HOURS)   (FOOTCANDLES)   ABOVE SETPOINT     GLARE INDEX      GLARE TOO HIGH
             --------------------    ----------------------    --------------  --------------    --------------   --------------
             TOTAL  REF PT  REF PT   TOTAL  REF PT  REF PT     REF PT  REF PT   REF PT  REF PT    REF PT  REF PT   REF PT  REF PT
MONTH        ZONE     1       2      ZONE     1       2          1       2        1       2         1       2        1       2
-----        -----  ------  ------   -----  ------  ------     ------  ------   ------  ------    ------  ------   ------  ------
JAN          53.5    66.8    0.0     53.5    66.8    0.0       156.6    0.0      63.1    0.0       8.3     0.0      0.0     0.0
FEB          59.1    73.8    0.0     59.1    73.8    0.0       163.9    0.0      70.6    0.0       9.3     0.0      0.0     0.0
MAR          64.6    80.7    0.0     64.6    80.7    0.0       134.5    0.0      72.5    0.0       9.0     0.0      0.0     0.0
APR          68.2    85.3    0.0     68.2    85.3    0.0       135.5    0.0      77.2    0.0       9.3     0.0      0.0     0.0
MAY          70.1    87.6    0.0     70.1    87.6    0.0       120.4    0.0      75.3    0.0       9.1     0.0      0.0     0.0
```

JUN	71.2	88.9	0.0	71.2	88.9	0.0	117.0	0.0	71.7	0.0	8.9	0.0	0.0	0.0
JUL	70.1	87.6	0.0	70.1	87.6	0.0	118.2	0.0	73.1	0.0	9.1	0.0	0.0	0.0
AUG	69.0	86.2	0.0	69.0	86.2	0.0	125.1	0.0	73.7	0.0	8.9	0.0	0.0	0.0
SEP	65.8	82.2	0.0	65.8	82.2	0.0	165.9	0.0	74.6	0.0	9.4	0.0	0.0	0.0
OCT	61.0	76.3	0.0	61.0	76.3	0.0	167.4	0.0	73.1	0.0	9.3	0.0	0.0	0.0
NOV	53.7	67.2	0.0	53.7	67.2	0.0	149.2	0.0	63.8	0.0	8.3	0.0	0.0	0.0
DEC	51.6	64.5	0.0	51.6	64.5	0.0	157.5	0.0	63.2	0.0	8.5	0.0	0.0	0.0
	-----	------	------	-----	------	------	------	------	------	------	------	------	------
ANNUAL	63.3	79.1	0.0	63.3	79.1	0.0	140.0	0.0	71.5	0.0	9.0	0.0	0.0	0.0

[SIMILAR REPORT PRODUCED FOR ALL OTHER SPACES THAT HAVE DAYLIGHTING]

8.23   LS-H - Space Daylighting Summary Percent Lighting Energy Reduction By Daylight

For each daylit space this report gives the monthly lighting energy reduction due to daylighting for each hour of the day, and for all hours of the day combined (including nighttime hours). HOUR OF DAY is given in standard time, even if DAYLIGHT-SAVINGS = YES. Hour 1 is 12 pm to 1 am, hour 2 is 1 am to 2 am, etc. The schedule DAYLIGHT-REP-SCH has no effect on this report. Task lighting energy, as determined by TASK-LIGHTING-KW or TASK-LT-W/SQFT, is not considered. See Report LS-I for lighting energy reduction vs. Hour of day for the entire building.

```
                               BASECASE                          VisualDOE for Windows

REPORT- LS-H PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHT  SPACE0              WEATHER FILE- CZ01RV2 WYEC2
----------------------------------------------------------------------------------------------------------------

SPACE  SPACE0

                                          HOUR OF DAY

                                                                                                            ALL
MONTH    1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24     HOURS
-----  --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---    -----

JAN      0   0   0   0   0   0   0   1  55  74  79  80  80  80  79  73  38   0   0   0   0   0   0   0       53

FEB      0   0   0   0   0   0   0  12  69  79  80  80  80  80  80  80  64  17   0   0   0   0   0   0       59

MAR      0   0   0   0   0   0   5  64  79  80  80  80  80  80  80  80  78  47   1   0   0   0   0   0       65

APR      0   0   0   0   0   0  52  78  80  80  80  80  80  80  80  80  80  77  16   0   0   0   0   0       68

MAY      0   0   0   0   0  19  73  80  80  80  80  80  80  80  80  80  80  48   1   0   0   0   0   0       70

JUN      0   0   0   0   0  26  75  80  80  80  80  80  80  80  80  80  80  64   8   0   0   0   0   0       71

JUL      0   0   0   0   0  14  62  80  80  80  80  80  80  80  80  80  80  63   6   0   0   0   0   0       70

AUG      0   0   0   0   0   2  43  79  80  80  80  80  80  80  80  80  80  79  39   1   0   0   0   0       69

SEP      0   0   0   0   0   0  22  72  80  80  80  80  80  80  80  80  80  55   3   0   0   0   0   0       66

OCT      0   0   0   0   0   0   1  56  78  80  80  80  80  80  80  80  63   5   0   0   0   0   0   0       61

NOV      0   0   0   0   0   0   0  28  67  76  80  80  80  80  78  66  25   0   0   0   0   0   0   0       54

DEC      0   0   0   0   0   0   0   2  61  76  79  80  80  80  78  66  16   0   0   0   0   0   0   0       52

       --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---    -----
ANNUAL   0   0   0   0   0   5  37  65  74  79  80  80  80  80  80  77  59  38  20   1   0   0   0   0       63

NOTE- THE ENTRIES IN THIS REPORT ARE NOT

      SUBJECT TO THE DAYLIGHTING REPORT SCHEDULE
```

8.24 LS-I - Percent Lighting Energy Reduction By Daylight, Building

For the building as a whole this report gives monthly lighting energy reduction due to daylighting for each hour of the day and for all hours of the day combined (including nighttime hours). For each daylit space this report gives the monthly lighting energy reduction due to daylighting for each hour of the day, and for all hours of the day combined (including nighttime hours). HOUR OF DAY is given in standard time, even if DAYLIGHT-SAVINGS = YES. Hour 1 is 12 pm to 1 am, hour 2 is 1 am to 2 am, etc. The schedule DAYLIGHT-REP-SCH has no effect on this report. Task lighting energy, as determined by TASK-LIGHTING-KW or TASK-LT-W/SQFT, is not considered. See Report LS-H for lighting energy reductions for individual zones.

```
                                        BASECASE                              VisualDOE for Windows

REPORT- LS-I PERCENT LIGHTING ENERGY REDUCTION BY DAYLIGHT                        WEATHER FILE- CZ01RV2 WYEC2
---------------------------------------------------------------------------------------------------------------

*** BUILDING ***
                                          HOUR OF DAY

                                                                                                    ALL
MONTH   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24 HOURS

-----  --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- -----

JAN     0   0   0   0   0   0   0   0   2   3   3   3   3   3   3   3   2   0   0   0   0   0   0   0    2

FEB     0   0   0   0   0   0   0   1   3   3   3   3   3   3   3   3   3   1   0   0   0   0   0   0    3

MAR     0   0   0   0   0   0   0   3   3   3   3   3   3   3   3   3   3   2   0   0   0   0   0   0    3

APR     0   0   0   0   0   0   2   3   3   3   3   3   3   3   3   3   3   3   1   0   0   0   0   0    3

MAY     0   0   0   0   0   1   3   3   3   3   3   3   3   3   3   3   3   3   2   0   0   0   0   0    3

JUN     0   0   0   0   0   1   3   3   3   3   3   3   3   3   3   3   3   3   3   0   0   0   0   0    3

JUL     0   0   0   0   0   1   3   3   3   3   3   3   3   3   3   3   3   3   3   0   0   0   0   0    3

AUG     0   0   0   0   0   0   2   3   3   3   3   3   3   3   3   3   3   3   2   0   0   0   0   0    3

SEP     0   0   0   0   0   0   1   3   3   3   3   3   3   3   3   3   3   2   0   0   0   0   0   0    3

OCT     0   0   0   0   0   0   0   2   3   3   3   3   3   3   3   3   3   0   0   0   0   0   0   0    3

NOV     0   0   0   0   0   0   0   1   3   3   3   3   3   3   3   3   1   0   0   0   0   0   0   0    2

DEC     0   0   0   0   0   0   0   0   3   3   3   3   3   3   3   3   1   0   0   0   0   0   0   0    2

       --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- -----

ANNUAL  0   0   0   0   0   0   2   3   3   3   3   3   3   3   3   3   3   2   1   0   0   0   0   0    3

NOTE- THE ENTRIES IN THIS REPORT ARE NOT

      SUBJECT TO THE DAYLIGHTING REPORT SCHEDULE
```

8.25   LS-J - Daylight Illuminance Frequency Of Occurrence

For each daylit space this report gives the monthly daylight-illuminance frequency-of-occurrence distribution at each lighting reference point. If only one lighting reference point is specified, the entries under REF PT 2 will be zero.

1.   PERCENT OF HOURS IN ILLUMINANCE RANGE gives the percentage of hours (with sun up and DAYLIGHT-REP-SCH value non-zero) that the daylight illuminance falls in the indicated range: 0-10, 10-20, ..., 70-80, and greater than 80 footcandles. Note: because of round off, the sum of these percentages for any given month may not be exactly 100.

2.   PERCENT OF HOURS ILLUMINANCE LEVEL EXCEEDED gives the percentage of hours (with the sun up and DAYLIGHT-REP-SCH value non-zero) that the daylight illuminance is higher than the indicated illuminance level.

```
                                   BASECASE                          VisualDOE for Windows
REPORT- LS-J  DAYLIGHT ILLUMINANCE FREQUENCY OF OCCURRENCE  SPACE0              WEATHER FILE- CZ01RV2 WYEC2
--------------------------------------------------------------------------------------------------------------------

SPACE  SPACE0
                   PERCENT OF HOURS IN ILLUMINANCE RANGE           PERCENT OF HOURS ILLUMINANCE LEVEL EXCEEDED
                   -------------------------------------           -------------------------------------------

                     ILLUMINANCE RANGE (FOOTCANDLES)                    ILLUMINANCE LEVEL (FOOTCANDLES)
       REF
MONTH  PT  0 -- 10 -- 20 -- 30 -- 40 -- 50 -- 60 -- 70 -- 80 -ABOVE    0    10    20    30    40    50    60    70    80
JAN   -1-   19    4    5    3    6    8    3    2    50             100   81    77    72    69    63    56    52    50
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
FEB   -1-   13    3    5    6    3    1    4    5    61             100   87    85    79    74    71    70    65    61
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
MAR   -1-   15    3    1    3    4    3    4    4    62             100   85    81    80    76    72    69    66    62
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
APR   -1-   12    3    3    2    3    1    3    2    70             100   88    85    82    80    77    76    72    70
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
MAY   -1-   11    5    3    5    2    0    3    5    67             100   89    85    82    77    75    75    72    67
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
JUN   -1-   13    4    2    3    6    1    3    2    65             100   87    83    80    77    72    70    67    65
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
JUL   -1-   13    2    2    4    5    1    2    4    66             100   87    85    83    79    73    72    70    66
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
AUG   -1-   12    6    3    2    4    4    4    1    66             100   88    82    79    77    74    70    66    66
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
SEP   -1-   12    4    3    4    3    1    3    2    69             100   88    84    81    78    75    73    71    69
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
OCT   -1-   14    5    3    2    2    3    5    4    62             100   86    80    77    75    73    70    66    62
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
NOV   -1-   16    5    4    6    6    6    6    3    49             100   84    80    76    70    64    57    52    49
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
DEC   -1-   15    7    4    5    5    6    2    2    53             100   85    77    73    68    63    57    55    53
      -2-    0    0    0    0    0    0    0    0     0               0    0     0     0     0     0     0     0     0
           ----------------------------------------------------  -------------------------------------------------
ANNUAL -1-  14    4    3    4    4    3    3    3    62             100   86    82    79    76    72    69    65    62
```

```
     -2-      0      0      0      0      0      0      0      0      0         0      0      0      0      0      0      0      0      0
NOTE- THE HOURS CONSIDERED IN THIS REPORT ARE THOSE
      WITH SUN UP AND DAYLIGHTING REPORT SCHEDULE ON
```

8.26 LS-K - Space Input Fuels Summary

This report gives monthly summaries of the fuel inputs by each space for lighting, equipment, and processes. Following the reports for each space is a separate building level report that gives the sum of the input fuels for the building as a whole.

Lighting, equipment, and process are the three major sections of this report, which is printed once for each space and once for the building as a whole.

1.   TASK LIGHTING (kilowatt hours) is the electricity used by the space for all task lighting.

2.   TOTAL LIGHTING (kilowatt hours) is the electricity used by the space for all lighting including task and overhead.

3.   GENERAL EQUIPMENT (kilowatt hours) is the electricity used by the space for running all equipment (i.e., computers, typewriters, etc.). For the building report, this includes building equipment such as elevators which may not be included in any space. Units change for SI.

4.   PROCESS ELECTRIC (kilowatt hours) is all electricity used to maintain any of the processes in the space.

5.   PROCESS GAS (millions of Btu) is all gas used to maintain any of the processes in the space. Units change for SI.

6.   PROCESS HOT WATER (millions of Btu) is the total hot water used in all processes in the space. Units change for SI.

```
                              BASECASE                              VisualDOE for Windows

REPORT- LS-K  SPACE INPUT FUELS SUMMARY                 SPACE0                       WEATHER FILE- CZ01RV2 WYEC2
----------------------------------------------------------------------------------------------------------------

SPACE  SPACE0

         - - - - L I G H T I N G - - - -   E Q U I P M E N T  - - - - - - - - - P R O C E S S - - - - - - - - -

          TASK LIGHTING    TOTAL LIGHTING   GENERAL EQUIPMENT  PROCESS ELECTRIC   PROCESS GAS    PROCESS HOT WATER

            (KWH)            (KWH)             (KWH)             (KWH)            (MBTU)           (MBTU)

MONTH

JAN            0.00           212.16           303.96             0.00            0.0000           0.0000

FEB            0.00           168.16           273.87             0.00            0.0000           0.0000

MAR            0.00           172.78           325.38             0.00            0.0000           0.0000

APR            0.00           144.19           302.43             0.00            0.0000           0.0000

MAY            0.00           135.43           301.92             0.00            0.0000           0.0000

JUN            0.00           135.06           312.12             0.00            0.0000           0.0000

JUL            0.00           130.98           292.23             0.00            0.0000           0.0000

AUG            0.00           151.54           325.38             0.00            0.0000           0.0000

SEP            0.00           154.10           300.39             0.00            0.0000           0.0000

OCT            0.00           170.85           292.23             0.00            0.0000           0.0000

NOV            0.00           200.30           288.66             0.00            0.0000           0.0000

DEC            0.00           220.83           303.96             0.00            0.0000           0.0000

             -----------      ---------        ----------        ----------       -----------      -----------

ANNUAL         0.00          1996.41          3622.55             0.00            0.0000           0.0000


[REPEATED FOR EACH SPACE]
```

8.27   LS-L - Management And Solar Summary For Space

The following report gives monthly summaries of window shade management and solar radiation into the space.

1.   Column 1 is the count of the number of hours that window shade management would be employed in the space for each month. Management is employed under any of the following conditions: a) The shading schedules specifies management. b) If the transmitted direct solar gain into the space exceeds a pre-specified value MAX-SOLAR-SCH, then, with probability SUN-CTRL-PROB, shades will be in effect. If daylighting is requested (DAYLIGHTING = YES) and the daylight glare exceeds a pre-specified value MAX-GLARE, then the shades will be in effect.

2.   Column 2 is the average solar radiation into the space through all glazing areas in Btu per day.

3.   Column 3 is the maximum solar radiation into the space through al glazing areas for all hours in the month. The unit of measure is Btu per hour.

The entries in this report are solar heat gains, not solar loads; i.e., weighting factors which convert heat gains into delayed loads have not been applied. The solar heat gain is due to solar radiation transmitted through windows plus solar radiation absorbed by the windows and released into the space.

```
                              BASECASE                              VisualDOE for Windows

REPORT- LS-L  MANAGEMENT AND SOLAR SUMMARY FOR SPACE        SPACE0                      WEATHER FILE- CZ01RV2 WYEC2

-----------------------------------------------------------------------------------------------------------------

DATA FOR SPACE    SPACE0

        NUMBER OF HOURS   AVERAGE DAILY    MAXIMUM HOURLY

           MANAGEMENT     SOLAR RADIATION  SOLAR RADIATION

           WOULD BE        INTO SPACE       INTO SPACE

MONTH      EMPLOYED        (BTU/DAY )       (BTU/HR  )

JAN          115.         17124.674         5747.284

FEB          105.         18181.061         5456.071

MAR           83.         16190.938         4649.091

APR           63.         16213.938         3028.610

MAY            0.         12742.038         1964.931

JUN            0.         12404.024         1781.062

JUL            0.         12093.960         1710.625

AUG            0.         11572.551         1892.910

SEP           53.         14603.097         2971.211

OCT          131.         18582.996         4578.264

NOV           75.         13725.439         5209.108

DEC          109.         15969.775         5538.497

             --------      ------------     --------------

ANNUAL       734.         14931.609         5747.284
```

8.28 Systems Reports

8.29   SV-A - System Design Parameters

This report echoes your input to the program as interpreted by the SYSTEMS design routines. The report is divided into two sections: System-Level Design Values and Zone-Level Design Values. Note: the quantities in this report have been adjusted for altitude even through DOE-2 requires that any air flows you enter in SYSTEMS be at sea level.

Systems-Level Design Values

1.   SYSTEM Name is the u-name of the system.

2.   SYSTEM TYPE is the code-word identifying the type of system. See "Applicability of Commands and Keywords to System Types" in the *BDL Summary (2.1E)* for a list of allowed system types.

3.   ALTITUDE MULTIPLIER is the altitude adjustment factor for air flows; it multiplies air flows at sea level to get air flows at actual altitude of the building.

4.   FLOOR AREA is the total floor area for all zones served by the system that have non-zero occupancy. This will generally only include conditioned zones since plenums and unconditioned spaces will generally have no people.

5.   MAX PEOPLE is the maximum number of people in all of the zones served by the system. The maximum number of people is determined by the NUMBER-OF-PEOPLE or AREA/PERSON keywords. PEOPLE-SCHEDULE is ignored in calculating MAX PEOPLE.

6.   SUPPLY FAN (CFM) is the calculated system design air flow rate. It should be equal to the user-input SUPPLY-flow rate times the ALTITUDE MULTIPLIER. If not user-specified, the value will be calculated from the peak loads. For a constant volume system or if SIZING-OPTION = NON-COINCIDENT, the number will be the sum of the design cfms for the zones on the system. If the system is a variable-air-volume system, SIZING-OPTION = COINCIDENT, and this is the only system in the PLANT-ASSIGNMENT, the value is calculated from the building coincident peak load.

7.   ELEC (KW) is the electrical energy consumed by the central system supply fan at design flow. The way that this is calculated depends on how you specified the fan. See the supply fan form, where you have a choice between the power/pressure drop method and the pressure/efficiency method.

8.   DELTA-T (F) is the value of SUPPLY-DELTA-T, the rise in temperature of the air caused by he supply fan.

9.   The next three entries, RETURN FAN (CFM), ELEC (KW), AND DELTA-T (F) are the corresponding values for the return air fan. In the sample report these are all zero because no return fan has been specified.

10.   OUTSIDE AIR RATIO is the ratio of outside air flow to supply air flow at design conditions for central systems. Its value is either the user input value of MIN-OUTSIDE-AIR or is calculated by SYSTEMS from the ventilation or exhaust input at the zone level divided by the supply fan cfm in column 1. This is a design quantity and does not reflect values entered through the MIN-AIR-SCH keyword. For zonal systems, this value will be zero. When OUTSIDE AIR RATIO is determined from zone ventilation rates, it is the sum of the values under OUTSIDE AIR FLOW (in column 6 opposite the zone u-names) divided by the value under SUPPLY FAN. This outside ratio is what the program will use as the minimum outside air ratio. It is assumed that the outside air is brought in at the main system fan and is distributed to the individual zones in proportion to the supply air to each zone. Note: The SYSTEMS design routine does not examine the values entered in schedules. Consequently, if you specify the outside air ratio through MIN-AIR-SCH but want SYSTEMS to size the equipment, you should also specify MIN-OUTSIDE-AIR.

11.   COOLING CAPACITY (KBTU/HR) is either the value you enter for the keyword COOLING-CAPACITY at the system level or is computed by the SYSTEMS from the peak (sensible plus

latent) cooling load. If the cfm chosen for the system is different from the user-specified value of RATED-CFM, COOLING CAPACITY may reflect a correction for off-rated performance.

12. SENSIBLE (SHR) is the sensible heat ratio, i.e., the fraction of the total cooling capacity that is sensible cooling capacity at the peak or design condition, adjusted for RATED-CFM. If you have not entered COOL-SH-CAP at the system level for a central system, this value is calculated from a simulation of the conditions at peak loads, adjusted for RATED-CFM.

13. HEATING CAPACITY (KBTU/HR)is the maximum value for heating; it reflects either the user input or a calculation from peak loads. Like COOLING CAPACITY, this value will be zero for zonal systems, where the capacity is shown at the zone level.

14. COOLING EIR and HEATING EIR (BTU/BTU) are the electric input ratios for cooling heating, respectively. Values are taken from user input or are default values. Values may be modified if the supply cfm differs from the RATED-CFM.

Zone-Level Design Values

The following quantities 15-22 apply to the base zone and are *not* been multiplied by he number of identical zones (as given by the product of MULTIPLIER and FLOOR-MULTIPLIER).

15. SUPPLY FLOW is calculated or user -specified supply cfm for each zone. Only if you have specified a value for the ASSIGNED-CFM Keyword in the ZONE-AIR command will the value here correspond to your input. The ZONE-AIR keywords AIR-CHANGES/HR and CFM/SQFT will be accepted by SYSTEMS only if they are consistent with the user-supplied HEATING-CAPACITY and COOLING-CAPACITY, and are equivalent to a cfm larger than that of the exhaust from or the ventilation to the zone. The ALTITUDE MULTIPLIER will be applied.

16. FAN (KW) is the total of the zone supply and exhaust fan electrical consumption at design conditions. This is zero in the example because there are no zone fans.

17. MINIMUM FLOW RATIO reflects that your input MIN-CFM-RATIO, unless that input is in conflict with exhaust or ventilation requirements. In the absence of user input, SYSTEMS will calculate the minimum cfm ratio for VAV systems from the minimum cfm needed to meet the minimum ventilation requirements and the heating capacity.

18. OUTSIDE AIR-FLOW reflects the user-specified outside air quantity entered at the zone level. If OUTSIDE-AIR-CFM is specified, its value is multiplied by the ALTITUDE MULTIPLIER and reported here. Otherwise the reported value is the maximum of the cfm-equivalent values of OA-CHANGES and OA-CFM/PER, multiplied by ALTITUDE MULTIPLIER. For the actual amount of outside air delivered to the zone for central systems, see OUT-SIDE AIR RATIO above.

19. COOLING CAPACITY (KBTU/HR),at the zone level, will be zero for central systems. For zonal systems it will either be the value you specify for COOLING-CAPACITY or it will be calculated by SYSTEMS to meet the peak loads at the rated conditions for HP, PTAC, TPFC, and FPFC systems or at any conditions for FPIU and TPIU systems. This is done similarly for HEATING CAPACITY for the above- mentioned systems and for UVT and UHT systems.

20. SENSIBLE (SHR) is the sensible part of the cooling capacity for zonal systems.

21. EXTRACTION RATE (KBTU/HR) is the extraction rate (cooling) at design conditions. This is not the value used in the simulation; that value is recalculated hourly and depends upon the loads, the conditions, the thermostat type, and the thermostatic throttling range. ADDITION RATE (heating) is treated similarly.

22. MULTIPLIER is the user-specified number of identical zones (product of MULTIPLIER and FLOOR MULTIPLIER for the zone).

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                              BASECASE                              VisualDOE for Windows

REPORT- SV-A  SYSTEM DESIGN PARAMETERS                SYS0                    WEATHER FILE- CZ01RV2 WYEC2

-----------------------------------------------------------------------------------------------------------------
```

SYSTEM	SYSTEM	ALTITUDE	FLOOR AREA	MAX
NAME	TYPE	MULTIPLIER	(SQFT)	PEOPLE
SYS0	PVAVS	1.000	60000.0	120.

	SUPPLY			RETURN			OUTSIDE	COOLING		HEATING	COOLING	HEATING
	FAN	ELEC	DELTA-T	FAN	ELEC	DELTA-T	AIR	CAPACITY	SENSIBLE	CAPACITY	EIR	EIR
	(CFM)	(KW)	(F)	(CFM)	(KW)	(F)	RATIO	(KBTU/HR)	(SHR)	(KBTU/HR)	(BTU/BTU)	(BTU/BTU)
	25966.	9.088	2.1	0.	0.000	0.0	0.069	635.868	0.827	0.000	0.33	0.37

	SUPPLY	EXHAUST		MINIMUM	OUTSIDE	COOLING		EXTRACTION	HEATING	ADDITION	
ZONE	FLOW	FLOW	FAN	FLOW	AIR FLOW	CAPACITY	SENSIBLE	RATE	CAPACITY	RATE	
NAME	(CFM)	(CFM)	(KW)	RATIO	(CFM)	(KBTU/HR)	(SHR)	(KBTU/HR)	(KBTU/HR)	(KBTU/HR)	MULTIPLIER
SPACE9	1900.	0.	0.000	0.300	294.	0.00	0.00	38.98	-36.93	-21.54	1.0
PLEN9	0.	0.	0.000	0.000	0.	0.00	0.00	0.00	0.00	0.00	1.0
SPACE0	201.	0.	0.000	0.300	8.	0.00	0.00	4.12	-3.90	-2.28	10.0
PLEN0	0.	0.	0.000	0.000	0.	0.00	0.00	0.00	0.00	0.00	1.0
SPACE1	204.	0.	0.000	0.300	8.	0.00	0.00	4.18	-3.96	-2.31	10.0

[ROWS DELETED FOR BREVITY]

8.30 SS-A - System Monthly Loads Summary

This report is always printed by the program for each HVAC system modeled. It shows monthly cooling, heating, and electrical loads. The loads shown are the sum of zone-level loads and central air-handling-unit loads. (Zone-level loads are shown separately in Report SS-G.). This report is for comparison of monthly cooling and heating needs for the HVAC system. DX cooling loads are reported here (for PSZ, PMZS, PVAVS, PTAC, PVVT, RESVVT and RESYS systems) but are not passed to the PLANT program.

1. The title of the report shows the user name of the HVAC system being summarized.

2. COOLING, HEATING, and ELEC are the three sections of this system-level report.

3. COOLING ENERGY(millions of Btu) is the monthly sum of energy (sensible and latent) extracted by the HVAC system during the operation hours of the system and passed as a load to PLANT.

4. MAXIMUM COOLING LOAD(thousands of Btu/hr) includes sensible and latent space cooling loads, ventilation air, and fan heat. The peak cooling load shown here is often the start-up load after the system has been shut down overnight. Notice, however, that when the system size is inadequate to meet the start-up load there is no indication of this problem on he report. You should first inspect the PLANT program BEPS report, which shows the "Percent of Hours Any System Zone Outside of Throttling Range", for a macro view, and Report SS-O or SS-F for a zonal report of where "Loads not met" conditions prevail.

5. HEATING ENERGY(millions of Btu) is the monthly sum of heat delivered by the secondary HVAC system during the operation hours of the system and passed as a load to PLANT.

6. MAXIMUM HEATING LOAD(thousands of Btu/hr) includes space heating loads, ventilation, and humidification. Again, the peak heating load is often due to start-up conditions after the system has been shut down overnight. To the left of this column are the day and hour of the peak heating load along with the outside dry-bulb and wet-bulb temperatures at the time of the peak.

7. ELECTRICAL ENERGY (kWh)is the monthly electrical consumption for lights, convenience outlets, supply and return fans, and energy consumed by package HVAC units. The electrical consumption by the pumps is reported in the PLANT program.

8. MAXIMUM ELEC LOAD (kW) is the monthly peak electrical consumption in one-hour period for lights, convenience outlets, energy consumed by package HVAC units, and fans for the zones served by the HVAC systems.

```
REPORT- SS-A  SYSTEM MONTHLY LOADS SUMMARY FOR           DBE-SYS                    WEATHER FILE- CZ03RV2 WYEC2
------------------------------------------------------------------------------------------------------------------
        - - - - - - - - C O O L I N G - - - - - - - -    - - - - - - - - H E A T I N G - - - - - - - -    - - - E L E C - - -
                                        MAXIMUM                                          MAXIMUM        ELEC-     MAXIMUM
         COOLING    TIME    DRY- WET-   COOLING      HEATING    TIME    DRY- WET-        HEATING        TRICAL      ELEC
         ENERGY    OF MAX   BULB BULB    LOAD        ENERGY    OF MAX   BULB BULB         LOAD          ENERGY      LOAD
MONTH    (MBTU)   DY  HR   TEMP TEMP   (KBTU/HR)     (MBTU)   DY  HR   TEMP TEMP        (KBTU/HR)        (KWH)       (KW)

JAN      0.75737  22  16   67.F 54.F    94.642      -6.847    2   7   40.F 32.F        -239.440         18039.     58.510

FEB      2.90132  28  13   73.F 66.F   170.918      -2.554   17   7   39.F 34.F        -150.842         15817.     62.382

MAR      7.43620  21  16   70.F 64.F   173.836      -1.463   14   7   42.F 39.F         -72.126         17882.     62.098

APR     12.03098  27  17   82.F 72.F   253.043      -1.000    6   7   43.F 42.F         -83.689         17886.     72.149

MAY     21.72720  13  14   86.F 70.F   241.328      -0.425   26   7   51.F 49.F         -51.736         18648.     72.256

JUN     34.58101   9  17   87.F 73.F   285.802      -0.085   22   7   54.F 51.F         -31.148         19742.     76.632

JUL     42.92860  18  14   89.F 69.F   253.245      -0.013   18   7   56.F 51.F          -5.026         20721.     74.400

AUG     40.12727   6  14   88.F 69.F   241.797      -0.023   26   7   55.F 52.F          -5.368         20438.     72.939

SEP     43.53777  26  15   83.F 71.F   278.983      -0.038   30   7   49.F 46.F          -6.059         20603.     74.895
```

```
OCT     32.99314   30  16   85.F  69.F      251.354       -0.054   19   8   46.F  45.F      -26.161      19849.    73.002
NOV      8.61778    5  16   76.F  62.F      177.751       -0.292   30   7   39.F  34.F      -87.746      16555.    63.632
DEC      0.23476   30  15   64.F  49.F       79.603       -3.570   21   7   38.F  35.F     -135.024      17627.    54.807
        ---------                          ----------    ---------                        ----------   --------   -------
TOTAL   247.874                                          -16.365                                        223804.
MAX                                         285.802                                       -239.440                 76.632
```

8.31   SS-B - System Monthly Loads Summary

This is a summary of the heating and cooling required by all zones (combined) served by the HVAC system. The items summarized are zone-level cooling, zone-level heating, zone baseboard heating, and preheat energy. In addition, this report lists the preheat energy required and the peak preheat load. The preheat coils raise the temperature of the mixed air to a specified temperature. When you specify baseboard heating in a zone the heating supplied is reported under the heating BASEBOARD HEATING ENERGY.

1.   The u-name of the HVAC system (SYST-1) is printed on the title line.

2.   COOLING BY ZONE COILS OR NAT VENTIL (millions of Btu)and MAXIMUM COOLING BY ZONE COILS OR NAT VENTIL (thousands of Btu/hr)are, respectively, the monthly total and peak sensible plus latent cooling supplied by coils located in the zone(s) or, for RESYS system only, by natural ventilation. (The cooling of the primary supply air in the system is summarized in Report SS-A.) Loads met by DX units are reported here and an electrical demand is passed to PLANT.

3.   HEATING BY ZONE COILS OR FURNACE (millions of Btu)and MAXIMUM HEATING BY ZONE COIL OR FURNACE (thousand of Btu/hr) are the monthly total heating and peak heating, respectively, supplied by coils or a furnace (oil- or gas-fired) in the zones. The furnace loads, met here in SYSTEMS, are not passed to PLANT but rather a utility demand for oil or gas is passed to PLANT. Baseboard heating is not included. In this example, the zone coils are electric resistance coils and the electrical demand will be passed to PLANT. For RESYS system only, these columns report the heating load on the furnace.

4.   BASEBOARD HEATING ENERGY (millions of Btu) and MAXIMUM BASEBOARD HEATING ENERGY (thousands of Btu/hr) are, respectively, the monthly total heating and peak heating supplied by baseboard heaters in all zones served by the system. These loads are passed to PLANT unless BASEBOARD-SOURCE is set equal to ELECTRIC, GAS-FURNACE, or OIL-FURNACE, in which case the load is met here in SYSTEMS and a utility demand is passed to PLANT.

5.   PREHEAT COIL ENERGY OR ELEC FOR FURN FAN (millions of Btu) and MAXIMUM PREHEAT COIL ENERGY OR ELEC FOR FURN FAN (thousands of Btu/hr) are, respectively, the monthly total heating and peak heating supplied by the preheat coil(s) to raise the temperature of the mixed air (return air plus makeup air) to a specified value, PREHEAT-T or, for RESYS system only, the monthly and peak electricity use by the furnace fan. The preheat loads are passed to PLANT unless PREHEAT-SOURCE is set equal to ELECTRIC, GAS-FURNACE, or OIL-FURNACE, in which case the load is met here in systems and a utility demand is passed to PLANT.

```
REPORT- SS-B  SYSTEM MONTHLY LOADS SUMMARY FOR              DBE-SYS                        WEATHER FILE- CZ03RV2 WYEC2
--------------------------------------------------------------------------------------------------------------------------
      - -Z O N E   C O O L I N G- -  - -Z O N E   H E A T I N G-  - -B A S E B O A R D S - -  --PREHEAT OR FURN FAN ELEC--
                        MAXIMUM                         MAXIMUM                      MAXIMUM                        MAXIMUM
           COOLING BY    COOLING BY   HEATING BY    HEATING BY   BASEBOARD    BASEBOARD   PREHEAT COIL    PREHEAT COIL
          ZONE COILS OR ZONE COILS OR ZONE COILS OR ZONE COILS OR  HEATING    HEATING ENERGY OR ELEC ENERGY OR ELEC
           NAT VENTIL    NAT VENTIL     FURNACE       FURNACE      ENERGY      ENERGY    FOR FURN FAN   FOR FURN FAN
MONTH       (MBTU)       (KBTU/HR)      (MBTU)       (KBTU/HR)     (MBTU)     (KBTU/HR)     (MBTU)        (KBTU/HR)


JAN        0.00000        0.000       0.00000        0.000       0.00000       0.000      0.00000         0.000
FEB        0.00000        0.000       0.00000        0.000       0.00000       0.000      0.00000         0.000
MAR        0.00000        0.000       0.00000        0.000       0.00000       0.000      0.00000         0.000
APR        0.00000        0.000       0.00000        0.000       0.00000       0.000      0.00000         0.000
MAY        0.00000        0.000       0.00000        0.000       0.00000       0.000      0.00000         0.000
```

JUN	0.00000	0.000	0.00000	0.000	0.00000	0.000	0.00000	0.000
JUL	0.00000	0.000	0.00000	0.000	0.00000	0.000	0.00000	0.000
AUG	0.00000	0.000	0.00000	0.000	0.00000	0.000	0.00000	0.000
SEP	0.00000	0.000	0.00000	0.000	0.00000	0.000	0.00000	0.000
OCT	0.00000	0.000	0.00000	0.000	0.00000	0.000	0.00000	0.000
NOV	0.00000	0.000	0.00000	0.000	0.00000	0.000	0.00000	0.000
DEC	0.00000	0.000	0.00000	0.000	0.00000	0.000	0.00000	0.000
	----------	----------	----------	----------	----------	----------	----------	----------
TOTAL	0.000		0.000		0.000		0.000	
MAX		0.000		0.000		0.000		0.000

8.32   SS-C - System Monthly Load Hours

The number of cooling and heating hours and fan operating hours for each month are reported for the system. Included are the hours when both heating and cooling are required. In addition, this report gives the heating and electrical loads at the time of the cooling peak. Notice: the hour counts in this report are incremented by 1.0 when the relevant condition (e.g., "fans on") applies for all or *part* of the hour.

1.   HOURS COOLING LOAD and HOURS HEATING LOAD give the total hours in each month when the HVAC system is operating with cooling load or a heating load, respectively.

2.   HOURS COINCIDENT COOL-HEAT LOAD gives the number of hours in each month when the HVAC system is operating with simultaneous heating and cooling loads. The above numbers do not include hours when the only load was from pilot lights or crankcase heating.

3.   HOURS FLOATING is the total number of hours that no heating or cooling was provided (with the fans on or off).

4.   HOURS HEATING AVAIL is the number of hours that heating equipment is available, as determined by HEATING-SCHEDULE.

5.   HOURS COOLING AVAIL is the number of hours that cooling equipment is available, as determined by COOLING-SCHEDULE.

6.   HOURS FANS ON is the number of hours that fans are in operation, including cycling of fans on to maintain night setback or setup temperature setpoint.

7.   HOURS FANS CYCLE ON is the number of hours fans were cycled on to maintain night setback or setup temperature setpoint.

8.   HOURS NIGHT VENTING is the number of hours fans were on to maintain the night venting set point.

9.   HOURS FLOATING WHEN FANS ON is the number of hours that no heating or cooling was provided (with the fans on).

10.   HEATING LOAD AT COOLING Peak is the heating load at the time of maximum cooling. It provides an assessment of oversizing for simultaneous heating/cooling systems (e.g., reheat systems).

11.   ELECTRIC LOAD AT COOLING Peak is the demand of all electric equipment calculated in LOADS and SYSTEMS at the time of maximum cooling.

```
REPORT- SS-C  SYSTEM MONTHLY LOAD HOURS FOR                    DBE-SYS                     WEATHER FILE- CZ03RV2 WYEC2
---------------------------------------------------------------------------------------------------------------------------
       - - - - - - - - - - - - - - - - - - N U M B E R    O F    H O U R S - - - - - - - - - - - - - - - - - -  --COINCIDENT LOADS--
                          HOURS                                                              HOURS     HEATING    ELECTRIC
         HOURS    HOURS    COINCIDENT              HOURS    HOURS             HOURS    HOURS  FLOATING  LOAD AT    LOAD AT
         COOLING  HEATING  COOL-HEAT    HOURS      HEATING  COOLING  HOURS    FANS     NIGHT  WHEN      COOLING    COOLING
MONTH    LOAD     LOAD     LOAD         FLOATING   AVAIL.   AVAIL.   FANS ON  CYCLE ON VENTING FANS ON  PEAK       PEAK
                                                                                                        (KBTU/HR)  (KW)
JAN         9      127       0            608       744      744      440       0        0     304      0.000      55.962
FEB        28       60       0            584       672      672      394       0        0     306      0.000      62.382
MAR        67       51       0            626       744      744      439       0        0     321      0.000      62.098
APR        95       33       0            592       720      720      430       0        0     302      0.000      72.149
MAY       163       27       0            554       744      744      434       0        0     244      0.000      72.256
JUN       230        9       0            481       720      720      430       0        0     191      0.000      76.632
```

JUL	276	4	0	464	744	744	439	0	0	159	0.000	74.400
AUG	260	7	0	477	744	744	440	0	0	173	0.000	72.939
SEP	287	9	0	424	720	720	430	0	0	134	0.000	74.895
OCT	235	7	0	502	744	744	440	0	0	198	0.000	73.002
NOV	75	20	0	625	720	720	412	0	0	317	0.000	63.632
DEC	3	91	0	650	744	744	439	0	0	345	0.000	54.807
	-------	-------	--------	--------	-------	-------	-------	--------	-------	--------		
ANNUAL	1728	445	0	6587	8760	8760	5167	0	0	2994		

8.33 SS-D - Plant Monthly Loads Summary

Multiple central plants that serve the building's HVAC systems can be simulated. The PLANT-ASSIGNMENT command assigns HVAC systems to central plants. The name of the plant is reported in the title line. In this example, no u-name was specified, and so a default name (DEFAULT-PLANT) is printed. The cooling, heating, and electrical energy required by the systems and zones served by the plant are reported monthly along with the peak cooling, heating, and electrical loads for the combined systems, and time of occurrence. Notice that these peak loads may result from startup after building has been shut down overnight. Cooling done in SYSTEMS by DX units is not included here in cooling loads but in electrical loads.

1. COOLING ENERGY(millions of Btu) is the sensible and latent monthly cooling required by the HVAC systems from the central plant specified in the PLANT-ASSIGNMENT command. For water loop heat pump systems the value reported here is the heat rejected to the plant's cooling tower.

2. TIME OF MAX gives the day and hour that the maximum cooling load occurs.

3. DRY-BULB TEMP and WET-BULB TEMP are the outside dry-bulb wet-bulb temperatures during the peak cooling load.

4. MAXIMUM COOLING LOAD(thousands of Btu/hr) gives the peak cooling load for each month and for the year.

5. HEATING ENERGY(millions of Btu) is the total monthly heating required by the HVAC systems from the specified central plant. For water loop heat pump systems the value reported here is the supplementary heat from the plant's hot water boiler.

6. TIME OF MAX shows the day and hour of maximum heating load.

7. DRY-BULB TEMP and WET-BULB TEMP are the outside dry-bulb wet-bulb temperatures during the peak heating load.

8. MAXIMUM HEATING LOAD(thousands of Btu/hr) gives the peak heating load for each month and for the year.

9. ELECTRICAL ENERGY(kWh) is the monthly electrical requirement for lights and convenience outlets for building *zones* served by the plant. In addition, the electrical energy contains the fan energy requirement for the HVAC systems and electric energy for cooling and heating in packaged units. It does *not* include the electrical energy associated with pumps, cooling towers and chillers. These are reported in the PLANT program.

10. MAXIMUM ELEC LOAD(kW) gives the monthly peak electrical consumption in a one-hour period for items 9 (ELECTRICAL ENERGY).

11. Bottom of Report A the bottom of SS-D are shown the integrated cooling loads for the peak day both the design day run (if any) and the annual run. These numbers are used by PLANT to size cold storage systems.

```
                            BASECASE                              VisualDOE for Windows
REPORT- SS-D  PLANT MONTHLY LOADS SUMMARY FOR          PA0                    WEATHER FILE- CZ01RV2 WYEC2
--------------------------------------------------------------------------------------------------------
       - - - - - - - - C O O L I N G - - - - - - - -    - - - - - - - H E A T I N G - - - - - - - -    - - - E L E C - - -
                                      MAXIMUM                                         MAXIMUM     ELEC-     MAXIMUM
          COOLING    TIME    DRY-  WET-    COOLING      HEATING    TIME    DRY-  WET-    HEATING    TRICAL      ELEC
          ENERGY    OF MAX   BULB  BULB     LOAD        ENERGY    OF MAX   BULB  BULB     LOAD      ENERGY      LOAD
MONTH     (MBTU)    DY  HR   TEMP  TEMP   (KBTU/HR)     (MBTU)    DY  HR   TEMP  TEMP   (KBTU/HR)    (KWH)      (KW)
JAN       0.00000                          0.000       -63.094    1   8   41.F  38.F   -431.990     24818.    89.031
```

FEB	0.00000	0.000	-50.609	14	7	43.F	42.F	-418.234	22287.	89.740
MAR	0.00000	0.000	-53.062	21	7	41.F	40.F	-406.556	26441.	93.134
APR	0.00000	0.000	-39.532	25	7	49.F	44.F	-388.414	24848.	94.494
MAY	0.00000	0.000	-28.142	16	7	44.F	43.F	-344.710	24705.	89.869
JUN	0.00000	0.000	-20.424	6	7	53.F	51.F	-281.146	26261.	102.888
JUL	0.00000	0.000	-17.647	25	7	53.F	51.F	-263.854	24758.	105.177
AUG	0.00000	0.000	-21.213	22	7	52.F	52.F	-254.021	27284.	101.450
SEP	0.00000	0.000	-20.015	15	7	50.F	49.F	-277.731	25146.	105.147
OCT	0.00000	0.000	-31.283	24	7	46.F	45.F	-351.406	24156.	95.101
NOV	0.00000	0.000	-53.233	25	7	36.F	32.F	-426.949	23447.	93.173
DEC	0.00000	0.000	-65.091	27	7	43.F	42.F	-427.302	24839.	89.737
	---------	----------	---------					----------	--------	-------
TOTAL	0.000		-463.344						298990.	
MAX		0.000						-431.990		105.177

MAXIMUM DAILY INTEGRATED COOLING LOAD (DES DAY)   0.000 (KBTU)

MAXIMUM DAILY INTEGRATED COOLING LOAD (WTH FILE)   0.000 (KBTU)

8.34   SS-E - Plant Monthly Load Hours

Just as the monthly load hours are reported for an HVAC system in Report SS-C, the combined load hours for all of the HVAC systems served by the central plant are shown in this report. Heating and electrical loads for the plant at the time of the cooling peak are also reported. Note: the hour counts in this report are incremented by 1.0 when the relevant condition (e.g., "fans on") applies for all or *part* of the hour.

1. HOURS COOLING LOAD HOURS and HOURS HEATING LOAD HOURS are the required operation hours of the central plant for supplying cooling or heating, respectively, to the HVAC systems served.

2. HOURS COINCIDENT COOL-HEAT LOAD gives the number of hours in each month when the central plant is operating with simultaneous heating and cooling loads.

3. HOURS FLOATING is the total hours (with fans on or off) that space temperatures are not thermostat setpoints.

4. HOURS HEATING AVAIL is the number of hours that heating equipment is available, as determined by HEATING-SCHEDULE.

5. HOURS COOLING AVAIL is the number of hours that cooling equipment is available, as determined by COOLING-SCHEDULE.

6. HOURS FANS ON is the number of fan operating hours, including cycling of fans on, needed to maintain the night setback or setup temperature setpoint or for night venting.

7. HOURS FANS CYCLE ON is the number of hours fans were cycled on for night setback or setup temperature setpoint.

8. HOURS NIGHT VENTING is the number of hours fans were on to maintain the night venting set point.

9. HOURS FLOATING WHEN FANS ON is the number of hours (with the fans on) that no heating or cooling was provided.

10. HEATING LOAD AT COOLING PEAK is the heating load at the time of maximum cooling. It provides an assessment of oversizing for simultaneous heating/cooling systems (e.g., reheat systems).

11. ELECTRIC LOAD AT COOLING PEAK is the electric demand of all electric equipment calculated in LOADS and SYSTEMS at the time of maximum cooling.

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                              BASECASE                              VisualDOE for Windows

REPORT- SS-E  PLANT MONTHLY LOAD HOURS FOR                PA0                      WEATHER FILE- CZ01RV2 WYEC2
----------------------------------------------------------------------------------------------------------------
        - - - - - - - - - - - - - - - - - N U M B E R   O F   H O U R S - - - - - - - - - - - - - - - - --COINCIDENT LOADS--
                          HOURS                                                       HOURS    HEATING   ELECTRIC
        HOURS    HOURS   COINCIDENT              HOURS    HOURS             HOURS   HOURS  FLOATING  LOAD AT   LOAD AT
        COOLING  HEATING  COOL-HEAT   HOURS    HEATING  COOLING   HOURS    FANS    NIGHT  WHEN      COOLING   COOLING
MONTH   LOAD     LOAD    LOAD      FLOATING   AVAIL.   AVAIL.   FANS ON  CYCLE ON VENTING FANS ON   PEAK      PEAK
                                                                                                   (KBTU/HR) (KW)
JAN      396      396     396       348        744      744      396       0       0       0        0.000    3.787
FEB      352      347     347       320        672      672      352       0       0       0        0.000    3.787
MAR      416      408     408       328        744      744      416       0       0       0        0.000    3.750
APR      396      364     364       324        720      720      396       0       0       0        0.000    3.750
MAY      384      368     368       360        744      744      384       0       0       0        0.000    3.787
JUN      400      324     324       320        720      720      400       0       0       0        0.000    3.750
```

```
JUL      380      296      296      364      744      744      380       0        0        0     0.000    3.750
AUG      416      322      322      328      744      744      416       0        0        0     0.000    3.750
SEP      384      272      272      336      720      720      384       0        0        0     0.000    3.750
OCT      380      356      356      364      744      744      380       0        0        0     0.000    3.787
NOV      368      363      363      352      720      720      368       0        0        0     0.000    3.750
DEC      396      396      396      348      744      744      396       0        0        0     0.000    3.787

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ANNUAL  4668     4212     4212     4092     8760     8760     4668       0        0        0
```

8.35   SS-F - Zone Demand Summary

This report gives monthly values of eight different zone-related quantities. The user-name of the zone is given in the title of the report, along with the name of the HVAC system that serves this zone. This report has the monthly sums for zone heating and cooling demands from the HVAC system, minimum and maximum zone air temperatures, and the number of hours the *loads are not met in the zone*. The report is generated for each zone.

1.   HEAT EXTRACTION ENERGY and HEAT ADDITION ENERGY (millions of Btu)are sensible cooling energy and heating energy requirements, respectively, of this zone during the HVAC system operation hours. For RESYS systems, the heat extraction may include natural ventilation. For plenums, these values are for heat removed from or added to the return air. For unconditioned zones, these values should be zero.

2.   BASEBOARD ENERGY (millions of Btu) and MAXIMUM BASEBOARD LOAD (thousands of Btu/hr)When the keyword BASEBOARD-RATIO is used, the zone heating is supplied by baseboards. Monthly heating energy requirements for these baseboards are reported in addition to the peak heating requirement.

3.   MAXIMUM ZONE TEMPERATURE (°F) and MINIMUM ZONE TEMPERATURE (°F).The monthly maximum and minimum air temperatures in this zone during system operation (when fans are operating) are reported for checking space temperature variations.

4.   HOURS UNDERHEATED and HOURS UNDERCOOLED if the capacity of the HVAC system is less than hourly heat extraction or heat addition load for this zone, a load-not-met condition is recorded as either an underheated or undercooled hour. The number of hours reported as underheated or undercooled may be startups after a night shutdown of the HVAC system. This information is presented in the Simulation|Diagnostics feature of VisualDOE.

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REPORT- SS-F  ZONE DEMAND SUMMARY  IN   PVAVS2       FOR COND2                    WEATHER FILE- CZ01RV2 WYEC2
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       - - - -D E M A N D S- - - - -  - -B A S E B O A R D S- - -   - -T E M P E R A T U R E S- -  - -L O A D S   N O T   M E T- -
            HEAT         HEAT                     MAXIMUM          MAXIMUM      MINIMUM
          EXTRACTION    ADDITION     BASEBOARD    BASEBOARD         ZONE          ZONE        HOURS          HOURS
           ENERGY       ENERGY        ENERGY        LOAD            TEMP          TEMP        UNDER          UNDER
MONTH      (MBTU)       (MBTU)        (MBTU)      (KBTU/HR)          (F)           (F)        HEATED         COOLED


JAN        3.53954      -0.048       0.00000       0.000            64.3          51.6         83             0
FEB        3.77133      -0.008       0.00000       0.000            62.3          52.8         75             0
MAR        4.65387      -0.008       0.00000       0.000            65.0          52.9         97             0
APR        5.07337       0.000       0.00000       0.000            64.3          53.9        143             0
MAY        6.45772       0.000       0.00000       0.000            64.9          54.3        329             0
JUN        7.51918       0.000       0.00000       0.000            66.6          55.5        447             0
JUL        7.87784       0.000       0.00000       0.000            72.5          55.8        476             0
AUG        7.64003       0.000       0.00000       0.000            66.0          56.2        449             0
SEP        7.06629       0.000       0.00000       0.000            72.6          55.4        403             0
OCT        6.05156       0.000       0.00000       0.000            64.4          54.5        257             0
NOV        3.98585      -0.028       0.00000       0.000            63.4          52.0         66             0
DEC        3.44881      -0.034       0.00000       0.000            62.0          52.0         76             0
```

8.36 SS-G - Zone Loads Summary

Zone cooling, heating, and electrical requirements are reported in this monthly summary. The user name of the zone is in the title line with the name of the HVAC system serving the zone. The cooling and heating energy reported is supplied *only at the zone level* (such as for reheat coils). Often heating and cooling are reported as zero in this report when the central HVAC system (e.g., a dual duct system) provides all the heating and cooling.

1. COOLING ENERGY and HEATING ENERGY(millions of Btu). This is the monthly energy delivered by zone coils and baseboards during scheduled operation hours.

2. MAXIMUM COOLING LOAD and MAXIMUM HEATING LOAD (thousands of Btu/hr). The peak energy delivered by zone coils and baseboards for cooling and heating, respectively. Includes sensible and latent space cooling loads, ventilation air, and fan heat. The peak cooling load shown here is often the start-up load after the system has been shut down overnight. Notice, however, that when the system size is inadequate to meet the start-up load there is no indication of this problem on the report. You should first inspect the PLANT program BEPS or BEPU report, which shows the "Percent of Hours Any System Zone Outside of Throttling Range", for a macro view, and at SS-O or SS-F for a zonal report of where "loads not met" conditions prevail. To the left of these columns are the day and hour of the peak cooling load along with the outside dry-bulb and wet-bulb temperatures at the time of the peak.

3. TIME OF MAX (DY, HR) DRY-BULB TEMP and WET-BULB TEMP the day and hour of the peak zone coil loads are reported; these times may be for startup loads. The temperatures reported are the outdoor air temperatures at the time of the peak zone coil plus baseboards loads.

4. ELECTRICAL ENERGY and MAXIMUM ELECTRICAL LOAD (kWh) the monthly total and peaks of electrical energy use in this zone, including lights, fans, and compressors and electric coils in package HVAC units.

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REPORT- SS-G  ZONE LOADS SUMMARY IN     PVAVS2        FOR COND2                     WEATHER FILE- CZ01RV2 WYEC2
--------------------------------------------------------------------------------------------------------------
       - - - - - - - C O O L I N G - - - - - - - -    - - - - - - - H E A T I N G - - - - - - - -    - - - E L E C - - -
                              MAXIMUM                                          MAXIMUM     ELEC-    MAXIMUM
         COOLING    TIME   DRY-  WET-  COOLING     HEATING    TIME  DRY-  WET-  HEATING     TRICAL    ELEC
         ENERGY    OF MAX  BULB  BULB   LOAD       ENERGY    OF MAX BULB  BULB   LOAD       ENERGY    LOAD
MONTH    (MBTU)    DY  HR  TEMP  TEMP  (KBTU/HR)    (MBTU)   DY  HR  TEMP  TEMP  (KBTU/HR)   (KWH)     (KW)


JAN     0.00000                        0.000       0.000                        0.000       1578.    3.802
FEB     0.00000                        0.000       0.000                        0.000       1425.    3.802
MAR     0.00000                        0.000       0.000                        0.000       1615.    3.802
APR     0.00000                        0.000       0.000                        0.000       1519.    3.802
MAY     0.00000                        0.000       0.000                        0.000       1596.    3.802
JUN     0.00000                        0.000       0.000                        0.000       1558.    3.802
JUL     0.00000                        0.000       0.000                        0.000       1558.    3.802
AUG     0.00000                        0.000       0.000                        0.000       1615.    3.802
SEP     0.00000                        0.000       0.000                        0.000       1519.    3.802
OCT     0.00000                        0.000       0.000                        0.000       1578.    3.802
NOV     0.00000                        0.000       0.000                        0.000       1540.    3.802
DEC     0.00000                        0.000       0.000                        0.000       1558.    3.802

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TOTAL    0.000                                     0.000                                   18660.
MAX                                    0.000                                     0.000                3.802
```

8.37   SS-H - System Monthly Loads Summary

This report gives monthly values of electrical energy for fans, gas/oil energy for heating and cooling, and electrical energy for heating and cooling for an HVAC system. The name of the system (SYST-1) is shown in the title.

1.   FAN ELEC shows the total and maximum hourly electrical consumption of the supply, return, exhaust, and zonal fans.

2.   FUEL HEAT shows the total oil and gas consumption by package systems for heating, in Btu equivalents. This will be zero unless you have made at least one of the heat sources FURNACE.

3.   FUEL COOL shows the total oil and gas consumption by packaged systems for cooling, in Btu equivalents.

4.   ELEC HEAT shows the electrical consumption for heating. This will include electric baseboards and reheat coils as well as the electrical load attributable to the heating cycle of a heat pump.

5.   ELEC COOL shows the electrical consumption and hourly maximum for cooling.

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REPORT- SS-H  SYSTEM MONTHLY LOADS SUMMARY FOR            DBE-SYS                    WEATHER FILE- CZ03RV2 WYEC2
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        - -F A N   E L E C- - -   - -F U E L   H E A T- -   - -F U E L   C O O L- -   -E L E C   H E A T- -   -E L E C   C O O L- -
                    MAXIMUM                   MAXIMUM                   MAXIMUM                   MAXIMUM                   MAXIMUM
             FAN       FAN      GAS OIL     GAS OIL      GAS OIL     GAS OIL     ELECTRIC   ELECTRIC    ELECTRIC   ELECTRIC
           ENERGY     LOAD      ENERGY       LOAD       ENERGY       LOAD        ENERGY      LOAD       ENERGY      LOAD
 MONTH     (KWH)      (KW)      (MBTU)     (KBTU/HR)     (MBTU)     (KBTU/HR)     (KWH)       (KW)       (KWH)       (KW)

 JAN        2767.     6.290     0.000       0.000        0.000       0.000       1121.      31.746        79.      8.773
 FEB        2478.     6.290     0.000       0.000        0.000       0.000        461.      23.081       268.     15.193
 MAR        2761.     6.290     0.000       0.000        0.000       0.000        319.      14.477       671.     14.909
 APR        2705.     6.290     0.000       0.000        0.000       0.000        207.      11.516      1083.     24.960
 MAY        2730.     6.290     0.000       0.000        0.000       0.000        130.       8.127      1985.     25.068
 JUN        2705.     6.290     0.000       0.000        0.000       0.000         38.       6.188      3107.     29.443
 JUL        2761.     6.290     0.000       0.000        0.000       0.000         14.       3.774      3815.     27.211
 AUG        2767.     6.290     0.000       0.000        0.000       0.000         25.       3.786      3574.     25.750
 SEP        2705.     6.290     0.000       0.000        0.000       0.000         33.       3.816      3973.     27.706
 OCT        2767.     6.290     0.000       0.000        0.000       0.000         29.       5.739      2981.     25.813
 NOV        2591.     6.290     0.000       0.000        0.000       0.000        101.      16.067       775.     16.443
 DEC        2761.     6.290     0.000       0.000        0.000       0.000        705.      22.555        30.      7.618

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 TOTAL     32498.                  0.000                    0.000                      3183.                   22341.
 MAX                   6.290                  0.000                    0.000                      31.746                   29.443
```

8.38   SS-I - System Monthly Sensible-Latent Summary

This is a summary of the monthly cooling and heating energy provided by each HVAC system. The quantities shown are the sum of zone-level loads and central air-handling-unit loads. Shown are sensible cooling, latent cooling, maximum cooling (sensible plus latent) with the corresponding sensible heat ratio, and the day and hour the maximum cooling occurs. Also shown are sensible heating, latent heating, and maximum heating (sensible plus latent).

1.   SENSIBLE COOLING ENERGY (millions of Btu) is the monthly sum of sensible energy extracted by the HVAC system.

2.   LATENT COOLING ENERGY (millions of Btu) is the monthly sum of latent energy extracted by the HVAC system. The sum of 1 and 2 equal COOLING ENERGY in SS-A.

3.   MAX TOTAL COOLING ENERGY (thousands of Btu/hr) is the hourly peak energy (sensible plus latent) extracted by the system during each month.

4.   SENSIBLE HEAT RATIO AT MAX is the sensible heat ratio (sensible cooling/total cooling) for the hour that the maximum total cooling occurs.

5.   TIME OF MAX DY HR is the day and hour during which the total peak cooling load occurred.

6.   SENSIBLE HEATING ENERGY (millions of Btu) is the monthly sum of sensible energy added by the HVAC system.

7.   LATENT HEATING ENERGY (millions of Btu) is the monthly sum of latent energy extracted by the HVAC system. The sum of 6 and 7 should equal HEATING ENERGY in SS-A.

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REPORT- SS-I  SYSTEM MONTHLY SENSIBLE LATENT SUMMARY FOR    PVAVS2                      WEATHER FILE- CZ01RV2 WYEC2
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MONTH	SENSIBLE COOLING ENERGY (MBTU)	LATENT COOLING ENERGY (MBTU)	MAX TOTAL COOLING ENERGY (KBTU/HR)	SENSIBLE HEAT RATIO AT MAX	TIME OF MAX DY HR	SENSIBLE HEATING ENERGY (MBTU)	LATENT HEATING ENERGY (MBTU)	MAX TOTAL HEATING ENERGY (KBTU/HR)
JAN	17.87543	1.13637	105.462	0.883	6 23	-0.00350	0.00000	-1.390
FEB	15.16837	0.63735	97.578	0.901	21 19	0.00000	0.00000	0.000
MAR	18.71579	0.97616	107.207	0.918	27 16	0.00000	0.00000	0.000
APR	23.96358	0.54298	107.781	0.940	5 20	0.00000	0.00000	0.000
MAY	39.76847	2.04497	111.988	0.915	9 1	0.00000	0.00000	0.000
JUN	53.38173	5.54232	152.781	0.830	22 19	0.00000	0.00000	0.000
JUL	59.07559	5.60173	146.600	0.880	20 18	0.00000	0.00000	0.000
AUG	58.92416	7.30689	147.728	0.776	29 18	0.00000	0.00000	0.000
SEP	51.00264	5.24184	127.514	0.907	19 19	0.00000	0.00000	0.000
OCT	41.53313	4.09247	110.142	0.869	2 5	0.00000	0.00000	0.000
NOV	22.98968	0.64927	99.119	0.950	1 20	0.00000	0.00000	0.000
DEC	16.24163	0.97532	101.110	0.885	1 5	0.00000	0.00000	0.000
	---------	---------	---------	---------		---------	---------	---------
TOTAL	418.640	34.748				-0.004	0.000	
MAX			152.781	0.830				-1.390

8.39   SS-J - System Peak Heating And Cooling Days

For each HVAC system, this report gives an hourly profile of three types of peak day that occur during the RUN-PERIOD:

Under -- COOLING --, the day that contains the hour with maximum (sensible plus latent) cooling energy.

Under -- HEATING --, the day that contains the hour with maximum heating energy.

Under DAY COOLING PEAK, the day whose *integrated* cooling load (i.e., load summed over 24 hours) is maximum. This day can used to size thermal energy storage systems; however, to insure that the peak integrated load shown here is truly represented, you should examine reports SS-O and SS-F, which show the number of hours that cooling loads are not met.

1.   HOUR gives the hour of the day, ranging from hour 1 (midnight to 1 am) to hour 24 (11 pm to midnight). Even if DAYLIGHT-SAVINGS = YES, summer hours will *not* reflect daylight saving time.

2.   HOURLY COOLING LOAD (thousands of Btu)is the total hourly energy, sensible plus latent by the HVAC system. The cooling load is followed by an asterisk when the system is unable to meet the cooling demand for that hour. This means that in at least one zone served by this system there is an unmet cooling load *and* the zone temperature is outside the throttling range.

3.   SENSIBLE HEAT RATIO is the ratio of sensible to total cooling energy for a given hour.

4.   DRY-BULB TEMP and WET-BULB TEMP are the outside dry-bulb and wet-bulb temperatures, respectively, for the given hour.

5.   HOURLY HEATING LOAD (thousands of Btu)is the hourly heating energy delivered by the HVAC system. For SYSTEM-TYPE = RESYS and RESVVT, this includes baseboard heating energy. The heating load is followed by an asterisk when the system is unable to meet the heating demand for that hour. This means that in at least one zone served by the system, there is an unmet heating load *and* the zone temperature is outside the throttling range.

6.   A separate report is provided whenever a DESIGN-DAY is input in the LOADS section.

7.   Bottom of Report some additional information is shown at the bottom of the SS-J report. SYSTEM-TYPE is the DOE-2 code-word for the type of this HVAC system. SQFT/TON is the area served by this system divided by the peak cooling in tons.   COOLING PEAK (Btu/hr-ft²)is the peak cooling divided by the area served by this system. HEATING PEAK (Btu/hr-ft²) is the peak heating divided by the area served by this system. SUPPLY AIR PEAK FLOW (cfm/ft²)is the design supply air flow divided by area served by this system. MIN-OA/PERSON (cfm)is the design minimum outside air flow divided by the maximum number of people in all the zones served by this system. OA FRAC AT HTG peak is the outside air fraction (outside air flow relative to supply flow) at the peak heating hour. OA FRAC AT CLG peak is the outside air fraction at the peak cooling hour.

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REPORT- SS-J  SYSTEM PEAK HEATING AND COOLING DAYS FOR     DBE-SYS                    WEATHER FILE- CZ03RV2 WYEC2
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          - - - - - C O O L I N G - - - - -       - - - H E A T I N G - - -       D A Y   C O O L I N G   P E A K
                    JUN  9                               JAN  2                              SEP 26

          HOURLY                                 HOURLY                           HOURLY
          COOLING    SENSIBLE   DRY-   WET-       HEATING   DRY-   WET-            COOLING    SENSIBLE   DRY-   WET-
          LOAD       HEAT       BULB   BULB       LOAD      BULB   BULB            LOAD       HEAT       BULB   BULB
HOUR      (KBTU)     RATIO      TEMP   TEMP       (KBTU)    TEMP   TEMP            (KBTU)     RATIO      TEMP   TEMP
   1      0.000      0.000      56.F   53.F       0.000     44.F   35.F            0.000      0.000      61.F   58.F

   2      0.000      0.000      54.F   52.F       0.000     44.F   35.F            0.000      0.000      60.F   59.F

   3      0.000      0.000      52.F   50.F       0.000     44.F   34.F            0.000      0.000      60.F   59.F
```

4	0.000	0.000	49.F	48.F	0.000	44.F	34.F	0.000	0.000	57.F	57.F
5	0.000	0.000	52.F	50.F	0.000	43.F	33.F	0.000	0.000	59.F	58.F
6	0.000	0.000	55.F	52.F	0.000	42.F	33.F	0.000	0.000	56.F	55.F
7	0.000	0.000	58.F	54.F	-239.440	40.F	32.F	0.000	0.000	60.F	58.F
8	0.000	0.000	63.F	58.F	-185.969	42.F	33.F	0.000	0.000	65.F	63.F
9	113.174	0.741	68.F	61.F	-140.233	44.F	35.F	137.312	0.649	71.F	65.F
10	152.689	0.742	73.F	64.F	-83.638	46.F	37.F	189.210	0.694	74.F	66.F
11	198.226	0.705	77.F	67.F	-63.490	47.F	38.F	206.381	0.733	76.F	66.F
12	228.031	0.688	80.F	69.F	-42.912	48.F	39.F	248.692	0.722	82.F	69.F
13	253.510	0.690	84.F	71.F	-25.549	50.F	40.F	251.983	0.708	80.F	69.F
14	267.291	0.682	85.F	72.F	-16.856	50.F	41.F	278.983	0.690	83.F	71.F
15	273.516	0.698	86.F	72.F	-6.415	51.F	42.F	270.626	0.710	82.F	70.F
16	285.802	0.687	87.F	73.F	0.000	52.F	42.F	251.674	0.698	76.F	68.F
17	246.541	0.734	83.F	70.F	0.000	50.F	42.F	245.910	0.690	75.F	68.F
18	197.992	0.735	78.F	67.F	0.000	49.F	43.F	180.118	0.719	74.F	66.F
19	154.277	0.797	73.F	63.F	-25.670	48.F	43.F	141.166	0.662	69.F	65.F
20	115.576	0.831	68.F	60.F	-35.011	47.F	42.F	108.354	0.679	65.F	62.F
21	0.000	0.000	63.F	57.F	-51.006	45.F	41.F	0.000	0.000	65.F	62.F
22	0.000	0.000	58.F	54.F	0.000	44.F	40.F	0.000	0.000	64.F	62.F
23	0.000	0.000	56.F	52.F	0.000	44.F	41.F	0.000	0.000	63.F	61.F
24	0.000	0.000	55.F	52.F	0.000	46.F	43.F	0.000	0.000	61.F	60.F

```
         --------                        --------              ---------
SUM                                                            2510.408

MAX      285.802                         -239.440

         SYSTEM-TYPE       PSZ                 SQFT/TON             1387.7

         COOLING PEAK         8.65 (BTU/HR- SQFT)   HEATING PEAK        -7.24 (BTU/HR- SQFT)

         SUPPLY AIR PEAK FLOW   0.30 (CFM/SQFT)   MIN-OA/PERSON       20.00 (CFM )

         OA FRAC AT CLG PEAK   0.333              OA FRAC AT HTG PEAK   0.333

         * ASTERISKS INDICATE HOURS LOADS NOT MET
```

8.40 SS-K - Space Temperature Summary

This report gives a monthly summary of various temperature quantities for the spaces served by the HVAC system shown in the report title. This report is intended to help you to determine the potential for night ventilation as a cooling strategy. Blank entries indicate that no hours existed in a particular category.

1.   AVERAGE SPACE TEMP ALL HOURS gives the temperature averaged over all hours in the run

2.   AVERAGE SPACE TEMP COOLING HOURS gives the temperature only in hours when cooling was required.

3.   AVERAGE SPACE TEMP HEATING HOURS gives the average temperature only in hours when heating was required.

4.   AVERAGE SPACE TEMP FAN ON HOURS gives the average temperature only when the fans are running.

5.   AVERAGE SPACE TEMP FAN OFF HOURS gives the average temperature only when the fans are not running.

6.   AVERAGE TEMPERATURE DIFFERENCE BETWEEN OUTDOOR & ROOM AIR, ALL HOURS takes the sum of (outdoor temperature - room air temperature) over all hours and divides this quantity by the number of hours.

7.   AVERAGE TEMPERATURE DIFFERENCE BETWEEN OUTDOOR & ROOM AIR, FAN ON HOURS takes the sum of (outdoor temperature - room air temperature) over hours when the fans are on a and divides this quantity by the number of hours the fans are on.

8.   AVERAGE TEMPERATURE DIFFERENCE BETWEEN OUTDOOR & ROOM AIR, FAN OFF HOURS takes the sum of (outdoor temperature - room air temperature) over hours when the fans are off and divides this quantity by the number of hours the fans are off.

9.   SUMMED TEMP DIFFERENCE OUTDOOR & ROOM AIR HEATING HOURS takes the sum of the absolute value of (outdoor temperature - room air temperature) over all hours when heating is required and divides by 24.

10. SUMMED TEMP DIFFERENCE BETWEEN OUTDOOR & ROOM AIR, ALL HOURS takes the sum of the absolute value of (outdoor temperature - room air temperature) over all hours in the run and divides by 24.

```
REPORT- SS-K  SPACE TEMPERATURE SUMMARY                    DBE-SYS                    WEATHER FILE- CZ03RV2 WYEC2
-----------------------------------------------------------------------------------------------------------------
          A V E R A G E    S P A C E    T E M P     AVERAGE TEMPERATURE DIFFERENCE   SUMMED TEMP DIFFERENCE
                                                    BETWEEN    BETWEEN    BETWEEN    BETWEEN    BETWEEN      HUMIDITY RATIO
                                                    OUTDOOR&   OUTDOOR&   OUTDOOR&   OUTDOOR&   OUTDOOR&      DIFFERENCE
                                                    ROOM AIR   ROOM AIR   ROOM AIR   ROOM AIR   ROOM AIR      BETWEEN
          ALL      COOLING   HEATING   FAN ON  FAN OFF  ALL      FAN ON    FAN OFF   HEATING    ALL         OUTDOOR AND
          HOURS    HOURS     HOURS     HOURS   HOURS    HOURS    HOURS     HOURS     HOURS      HOURS         ROOM AIR
MONTH     (F)      (F)       (F)       (F)     (F)      (F)(D    (F)(D     (F)(D     (F)(D      (F)(D       (FRAC.OR MULT. )

JAN       71.10    73.42     70.29     71.92   69.92    -20.71   -19.25    -22.82    119.93     641.89        -0.00052
FEB       71.82    73.44     70.63     72.44   70.94    -18.58   -16.69    -21.26    53.98      520.30        -0.00064
MAR       72.34    73.56     70.89     72.73   71.77    -17.74   -16.02    -20.23    46.44      550.29        -0.00043
APR       72.46    73.61     70.82     72.89   71.82    -16.50   -13.44    -21.04    29.33      497.87        -0.00037
MAY       72.65    73.74     71.02     73.05   72.10    -14.32   -10.93    -19.07    19.98      459.43        -0.00031
JUN       73.13    73.88     71.63     73.41   72.72    -11.78   -8.51     -16.62    5.57       368.62         0.00023
```

JUL	73.55	73.96	72.44	73.63	73.45	-11.18	-7.70	-16.18	2.82	359.95	0.00040
AUG	73.55	73.97	72.85	73.62	73.45	-11.01	-7.88	-15.53	4.58	353.64	0.00029
SEP	73.81	74.03	72.94	73.74	73.91	-9.81	-6.48	-14.75	6.31	328.12	0.00039
OCT	73.50	73.93	72.24	73.50	73.49	-12.22	-9.05	-16.80	5.90	401.51	-0.00009
NOV	72.89	73.73	71.31	73.00	72.75	-17.76	-14.73	-21.81	17.34	532.96	-0.00044
DEC	71.90	73.32	70.75	72.32	71.29	-21.83	-19.74	-24.83	91.69	676.58	-0.00059
ANNUAL	72.73	73.88	70.80	73.02	72.30	-15.27	-12.50	-19.25	403.88	5691.16	-0.00017

8.41   SS-L - Fan Electric Energy For <system>

This report gives a breakdown of monthly electric energy for fans (central and zone-level) and fan part load operation for an HVAC system.

The energy quantities on the left-hand side of the report are given for heating hours only, cooling hours only, simultaneous heating and cooling hours, and floating hours.

1. FAN ELECTRIC ENERGY DURING HEATING gives the total electric energy used by the fans in all hours when only heating is required.

2. FAN ELECTRIC ENERGY DURING COOLING gives the total electric energy use by the fans in all hours when only cooling is required.

3. FAN ELECTRIC ENERGY DURING HEATING-COOLING gives the total electric energy used by the fans in all hours when both heating and cooling are required.

4. FAN ELECTRIC ENERGY DURING FLOATING gives the total electric energy used by the fans when neither heating nor cooling is provided.

The right-hand side of the report shows the part-load operation of the fans. The number of operating hours within each percentage part load band (0-10%, 0-20%, etc.) is given as well as the total hours of operation. If the fan operates during an hour, its part load in percent is determined as 100* (total flow) / (design SUPPLY-CFM).

```
REPORT- SS-L   FAN ELECTRIC ENERGY                       PVAVS2                      WEATHER FILE- CZ01RV2 WYEC2
-------------------------------------------------------------------------------------------------------------------


           FAN ELEC    FAN ELEC    FAN ELEC    FAN ELEC    --------  Number of hours within each PART LOAD range  --------  TOTAL
            DURING      DURING      DURING      DURING      00   10   20   30   40   50   60   70   80   90  100   RUN
            HEATING     COOLING   HEAT & COOL   FLOATING    10   20   30   40   50   60   70   80   90  100   +   HOURS
  MONTH     (KWH)       (KWH)       (KWH)       (KWH)
  -----    ----------  ----------  ----------  ----------   ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----


  JAN          9.546   1113.731       0.000   1244.196      0    0    0    0    0    0    0    0    0  741    3  744
  FEB          0.000    817.801       0.000   1320.574      0    0    0    0    0    0    0    0    0  672    0  672
  MAR          0.000    964.179       0.000   1403.311      0    0    0    0    0    0    0    0    0  744    0  744
  APR          0.000   1116.923       0.000   1174.200      0    0    0    0    0    0    0    0    0  720    0  720
  MAY          0.000   1606.972       0.000    760.524      0    0    0    0    0    0    0    0    0  743    1  744
  JUN          0.000   1901.292       0.000    388.218      0    0    0    0    0    0    0    0    3  686   31  720
  JUL          0.000   2091.673       0.000    270.479      0    0    0    0    0    0    0    0    8  713   23  744
  AUG          0.000   2103.385       0.000    264.115      0    0    0    0    0    0    0    0    0  728   16  744
  SEP          0.000   1886.429       0.000    400.946      0    0    0    0    0    0    0    0    6  708    6  720
  OCT          0.000   1727.892       0.000    639.604      0    0    0    0    0    0    0    0    0  743    1  744
  NOV          0.000   1272.783       0.000   1018.273      0    0    0    0    0    0    0    0    0  720    0  720
  DEC          0.000   1018.264       0.000   1349.205      0    0    0    0    0    0    0    0    0  743    1  744

           ----------  ----------  ----------  ----------   ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----


  ANNUAL       9.546  17619.938       0.000  10233.388      0    0    0    0    0    0    0    0   17 8661   82 8760
```

8.42   SS-M - Fan Electric Energy For <plant>

This report gives a breakdown of fan electric energy for each month passed to PLANT. The quantities are given for heating hours only, cooling hours only, simultaneous heating and cooling hours, and floating hours. The quantities are calculated by summing the individual quantities.

1.   FAN ELECTRIC ENERGY DURING HEATING gives the total electric energy used by the fans in all hours when only heating is required.

2.   FAN ELECTRIC ENERGY DURING COOLING gives the total electric energy used by the fans in all hours when only cooling is required.

3.   FAN ELECTRIC DURING HEATING-COOLING gives the total electric energy used by the fan in all hours when both heating and cooling are required.

4.   FAN ELECTRIC ENERGY DURING FLOATING gives the total electric energy used by the fans when neither heating or cooling is provided.

```
                             BASECASE                              VisualDOE for Windows

REPORT- SS-M  FAN ELECTRIC ENERGY FOR PLANT             PA0                      WEATHER FILE- CZ01RV2 WYEC2
-----------------------------------------------------------------------------------------------------------------

          FAN ELECTRIC   FAN ELECTRIC   FAN ELECTRIC   FAN ELECTRIC
          ENERGY DURING  ENERGY DURING  ENERGY DURING  ENERGY DURING
            HEATING        COOLING      HEATING-COOLING   FLOATING
  MONTH     (KWH)          (KWH)           (KWH)          (KWH)
   JAN     1509.053       1509.053        1509.053         0.000
   FEB     1322.112       1342.536        1322.112         0.000
   MAR     1554.527       1587.376        1554.527         0.000
   APR     1390.691       1519.395        1390.691         0.000
   MAY     1414.330       1478.007        1414.330         0.000
   JUN     1247.906       1559.926        1247.906         0.000
   JUL     1136.587       1483.336        1136.587         0.000
   AUG     1232.657       1614.466        1232.657         0.000
   SEP     1037.551       1491.194        1037.551         0.000
   OCT     1361.180       1458.088        1361.180         0.000
   NOV     1382.646       1402.930        1382.646         0.000
   DEC     1509.215       1509.215        1509.215         0.000
           -------------  -------------  --------------  ------------
 ANNUAL  16099.083       17956.182       16099.083         0.000
```

8.43   SS-N - Relative Humidity Scatter Plot

In this scatter plot, the ordinate, appearing in the left column, shows relative humidity bins. The abscissa, shown at the top, gives hours of the day. Entered in each cell of the plot is the number of hours during the RUN-PERIOD for which the relative humidity of the system return air was in the particular relative humidity bin for this particular hour of the day. Only hours for which the fans are on are counted in this plot.

The column at the far right is the sum of the entries in each row. It shows the frequency of relative humidity values for the RUN-PERIOD. (Because the relative humidity counts are made only for hours when the fans are on, summing the totals column will not sum to the number of hours in the run.)

Note: If fans are on due to NIGHT-CYCLE-CTRL, the hours will not be counted in the plot.

```
REPORT- SS-N  RELATIVE HUMIDITY SCATTER PLOT FOR              PVAVS2                         WEATHER FILE- CZ01RV2 WYEC2
----------------------------------------------------------------------------------------------------------------------


                                      TOTAL HOURS AT RELATIVE HUMIDITY LEVEL AND TIME OF DAY
              HOUR    1AM 2   3   4   5   6   7   8   9  10  11  12  1PM 2   3   4   5   6   7   8   9  10  11  12    TOTAL
                      --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---   -----
            90-100      0   0   0   0   0   0   1   0   1   2   2   1   2   2   2   1   1   0   0   0   0   0   0   0     15
            80-89      20  20  19  17  16  18  17  27  34  39  35  34  36  35  32  33  35  25  21  17  14  12  17  16    589
            70-79     141 148 155 147 158 169 169 188 180 187 189 181 181 165 163 184 172 154 149 129 149 154 148 146   3906
            60-69     152 147 132 143 136 124 127 107 112 111 121 137 132 145 153 129 134 153 154 165 148 141 137 145   3285
            50-59      48  46  54  53  50  49  42  36  34  22  15   9  13  16  12  15  20  28  34  45  45  47  54  49    836
            40-49       4   4   5   5   5   5   9   6   3   3   2   3   1   2   3   3   3   5   7   9   9   9   8   9    122
            30-39       0   0   0   0   0   0   0   1   1   1   1   0   0   0   0   0   0   0   0   0   0   2   1   0      7
            20-29       0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0      0
            10-19       0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0      0
             0-09       0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0      0

                      === === === === === === === === === === === === === === === === === === === === === === === ===   =====


                 ****************************************************************
                 *                                                              *
                 *  NOTE  1)THE RELATIVE HUMIDITY COUNTS ARE MADE ONLY FOR       *
                 *           THE HOURS WHEN THE FANS ARE ON                      *
                 *                                                              *
                 ****************************************************************
```

8.44   SS-O - Temperature Scatter Plot

In this scatter plot, the ordinate, appearing in the left column, shows temperature bins. The abscissa, shown at the top, give hours of the day. Entered in each cell of the plot is the number of hours during the RUN-PERIOD for which the zone air temperature was in the particular bin for this hour of the day. Only hours for which the fans are on are counted in this plot.

The column at far right is the sum of the entries in each row. It shows the frequency of temperature values for the RUN-PERIOD. (Because the temperature counts are only made for hours when the fans are on, summing the totals column will not sum to the number of hours in the run.)

Note: If fans are on due to NIGHT-CYCLE-CTRL, the hours will not be counted in the plot.

```
REPORT- SS-O  TEMPERATURE SCATTER PLOT  PVAVS2           FOR COND2                        WEATHER FILE- CZ01RV2 WYEC2
-------------------------------------------------------------------------------------------------------------------------


                                    TOTAL HOURS AT TEMPERATURE LEVEL AND TIME OF DAY
               HOUR     1AM 2   3   4   5   6   7   8   9  10  11  12  1PM 2   3   4   5   6   7   8   9  10  11  12   TOTAL

                        --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- -----

           ABOVE 85       0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0       0

           80-85          0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0       0

           75-80          0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0       0

           70-75          0   0   0   0   0   0   0   0   0   0   0   0   2   3   3   3   1   0   0   0   0   0   0   0      12

           65-70          0   0   0   0   0   0   0   0   0   0   2   5  12  19  13  10   4   2   1   0   0   0   0   0      68

           60-65         66  57  52  52  48  45  52  80 129 170 197 222 235 237 244 235 219 200 184 165 156 133 104  76    3358

           BELOW 60     299 308 313 313 317 320 313 285 236 195 166 138 116 106 105 117 141 163 180 200 209 232 261 289    5322

                        === === === === === === === === === === === === === === === === === === === === === === === === =====



                  *****************************************************************
                  *                                                             *
                  *  NOTE  1)THE TEMPERATURE COUNTS ARE MADE ONLY FOR           *
                  *          THE HOURS WHEN THE FANS ARE ON                     *
                  *                                                             *
                  *****************************************************************
```

8.45 SS-P - Load, Energy And Part Load In <system>

This report has sections for heating and cooling. Report SS-P is produced at both the SYSTEM and PLANT-ASSIGNMENT levels. The following description is for the SYSTEMS-level report. See "REPORT SS-P (for PLANT-ASSIGNMENT) ", following, for a description of the PLANT-ASSIGNMENT level.

Two SS-P reports are produced for each unit system: one for heating operation and one for cooling operation. These reports are provided for: (1) each PSZ, PVAV, RESYS, RESVVT, or PTAC system if SS-H is requested. (2) each zone in a PTAC or HP system if either SS-H or SS-L is requested in the SYSTEM-REPORT

1.   UNIT TYPE is the DOE-2 code-word for this HVAC system.

2.   COOLING CAPACITYCOOLING EIRHEATING-CAPACITYHEATING-EIRSUPPLY-FLOW are as reported on SV-A for this system.

3.   UNIT LOAD is the total and peak heating/cooling load on the unit.

4.   ENERGY USE is the total and peak electric energy used by the unit. This includes the compressor, outdoors fans, pumps, auxiliaries (UNIT-AUX-KW), crankcase heat and evaporative precooler.

5.   COMPRESSOR is the total and electric energy use by the engine/motor, not including the crankcase heat.

6.   FAN ENERGY is the total and peak fan energy during the time the unit is in the heating/cooling mode.

7.   Number of hours within each PART LOAD range shows the number of hours tat the unit (top line) or indoor fan (bottom line) speed in the various part load ranges when in the heating/cooling mode. If the unit is on during the hour, and the operation is within the specified range, the count of hours in incremented by 1.

```
REPORT- SS-P  LOAD, ENERGY AND PART LOAD HEATING IN DBE-SYS                      WEATHER FILE- CZ03RV2 WYEC2

-----------------------------------------------------------------------------------------------------------------
    UNIT TYPE is PSZ           HEATING-CAPACITY = -331.191 (KBTU/HR) HEATING-EIR = 0.370 (BTU/BTU) SUPPLY-FLOW =  9915. (CFM )
            UNIT LOAD  ENERGY USE  COMPRESSOR  FAN ENERGY   -------- Number of hours within each PART LOAD range --------- TOTAL
        SUM  (MBTU)      (KWH)       (KWH)       (KWH)      00   10   20   30   40   50   60   70   80   90  100   RUN
MONTH PEAK (KBTU/HR)     (KW)        (KW)        (KW)       10   20   30   40   50   60   70   80   90  100    +   HOURS
----- ---- ---------- ----------- ----------- -----------   ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----

JAN   SUM     -6.847   1121.265    1080.726    2767.410 CMP  51   35   21    8    5    4    1    1    0    1    0   127
      PEAK  -239.440     31.746      27.784       6.290 FAN   0    0    0    0    0    0    0    0    0    0  127   127
      DAY/HR    2/ 7       2/ 7        2/ 7       31/22

FEB   SUM     -2.554    460.540     443.356    2478.091 CMP  25   22    9    2    0    1    1    0    0    0    0    60
      PEAK  -150.842     23.081      19.118       6.290 FAN   0    0    0    0    0    0    0    0    0    0   60    60
      DAY/HR   17/ 7      17/ 7       17/ 7       28/22

MAR   SUM     -1.463    318.658     305.596    2761.120 CMP  31   17    2    1    0    0    0    0    0    0    0    51
      PEAK   -72.126     14.477      10.514       6.290 FAN   0    0    0    0    0    0    0    0    0    0   51    51
      DAY/HR   14/ 7       4/ 7        4/ 7       31/21

APR   SUM     -1.000    206.501     202.587    2704.514 CMP  22   10    1    0    0    0    0    0    0    0    0    33
      PEAK   -83.689     11.516      11.516       6.290 FAN   0    0    0    0    0    0    0    0    0    0   33    33
      DAY/HR    6/ 7       6/ 7        6/ 7       30/21

MAY   SUM     -0.425    129.659     127.883    2729.673 CMP  25    2    0    0    0    0    0    0    0    0    0    27
      PEAK   -51.736      8.127       8.127       6.290 FAN   0    0    0    0    0    0    0    0    0    0   27    27
      DAY/HR   26/ 7      26/ 7       26/ 7       31/17
```

```
JUN   SUM     -0.085     38.127     37.902    2704.514 CMP   9     0    0    0    0    0    0    0    0    0    0     9
      PEAK   -31.148      6.188      6.188       6.290 FAN   0     0    0    0    0    0    0    0    0    0    9     9
      DAY/HR   22/ 7      22/ 7      22/ 7       30/21
JUL   SUM     -0.013     14.426     14.401    2761.120 CMP   4     0    0    0    0    0    0    0    0    0    0     4
      PEAK    -5.026      3.774      3.774       6.290 FAN   0     0    0    0    0    0    0    0    0    0    4     4
      DAY/HR   18/ 7      18/ 7      18/ 7       31/21
AUG   SUM     -0.023     25.459     25.459    2767.410 CMP   7     0    0    0    0    0    0    0    0    0    0     7
      PEAK    -5.368      3.786      3.786       6.290 FAN   0     0    0    0    0    0    0    0    0    0    7     7
      DAY/HR   26/ 7      26/ 7      26/ 7       31/21
SEP   SUM     -0.038     33.349     33.303    2704.514 CMP   9     0    0    0    0    0    0    0    0    0    0     9
      PEAK    -6.059      3.816      3.816       6.290 FAN   0     0    0    0    0    0    0    0    0    0    9     9
      DAY/HR   30/ 7      22/ 7      22/ 7       30/21
OCT   SUM     -0.054     28.815     27.814    2767.410 CMP   7     0    0    0    0    0    0    0    0    0    0     7
      PEAK   -26.161      5.739      5.705       6.290 FAN   0     0    0    0    0    0    0    0    0    0    7     7
      DAY/HR   19/ 8      19/ 8      19/ 8       31/22
NOV   SUM     -0.292    101.214     92.600    2591.302 CMP  18     1    0    1    0    0    0    0    0    0    0    20
      PEAK   -87.746     16.067     12.105       6.290 FAN   0     0    0    0    0    0    0    0    0    0   20    20
      DAY/HR   30/ 7      30/ 7      30/ 7       30/21
DEC   SUM     -3.570    705.195    652.801    2761.120 CMP  43    29   10    1    2    4    2    0    0    0    0    91
      PEAK  -135.024     22.555     18.593       6.290 FAN   0     0    0    0    0    0    0    0    0    0   91    91
      DAY/HR   21/ 7      28/ 7      28/ 7       31/21
YR    SUM    -16.365   3183.158   3044.429   32497.502 CMP 251   116   43   13    7    9    4    1    0    1    0   445
      PEAK  -239.440     31.746     27.784       6.290 FAN   0     0    0    0    0    0    0    0    0    0  445   445
      MON/DAY   1/ 2       1/ 2       1/ 2       12/31
```

8.46   SS-P - Load, Energy And Part Load Pump Operation For <Plant Assignment>

REPORT SS-P (for PLANT-ASSIGNMENT) - Load, Energy And Part Load Pump Operation For [u-name of PLANT ASSIGNMENT], LOAD, ENERGY AND PART LOAD BOILER OPERATION FOR [u-name of PLANT ASSIGNMENT], LOAD, ENERGY AND PART LOAD COOLING TOWER OPERATION FOR [u-name of PLANT ASSIGNMENT], LOAD, ENERGY AND PART LOAD WATER-SIDE ECONO OPERATION FOR [u-name of PLANT ASSIGNMENT], LOAD, ENERGY AND PART LOAD DHW TANK OPERATION FOR [u-name of PLANT ASSIGNMENT]

A report is produced for:

(1)   each boiler, cooling tower, and loop circulation pumps in a PUMP-ASSIGNMENT that contains one or more water loop heat pump (HP) systems;

(2)   each cooling tower, circulation pump(s), and water-side economizer in a PLANT-ASSIGNMENT that contains one or ore systems with CONDENSER-TYPE = WATER-COOLED (SYSTEM-TYPE = PSZ, PVAV, or PVVT); and

(3)   each domestic hot water heating unit.

These reports are produced automatically if the equipment is present for the simulation unless PLANT-REPORTS = NO for PLANT-ASSIGNMENT.

PUMP REPORT.

•   CIRC PUMP SIZE is the rated total flow of the pump (s)

•   POWER is the power draw at rated flow.

•   HEAT GAIN is the heated added to the loop per hour due to pumping, at rated flow.

•   MIN PLR is the minimum flow fraction.

Monthly and Annual Values. HEAT GAIN is the heat added to the loop by the pump (s).

•   ENERGY USE is the pumping electrical energy.

•   HEAT MODE is the pumping electrical during loop net heating.

•   COOL MODE is the pumping electrical during loop net cooling.

BOILER REPORT

•   BOILER SIZE is the rated capacity.

•   EIR is (rated electric input) /capacity.

•   HIR is (rated fuel input) /capacity.

Monthly and Annual Values

•   UNIT LOAD is the heat supplied by the boiler to the loop.

•   ENERGY USE is the boiler electrical consumption.

•   AUX ENERGY is the boiler auxiliary energy (fans, pumps, etc.)

COOLING TOWER REPORT

•   TOWER SIZE is the rated heat rejection capacity.

•   FAN is the fan electrical consumption.

- PUMP (first instance) spray pump water flow.

Monthly and Annual Values

- UNIT LOAD is the heat rejected by the tower.

- ENERGY USE is the tower electrical use (fans and pumps).

- FAN ENERGY is the tower fan (s) electrical use.

- PUMP ENERGY is the tower spray pump (s) electrical use.

WATER SIDE ECONOMIZER

- WSE TOWER SIZE is not currently used.

- POWER is not currently used.

- PUMP is the maximum water flow through the units.

Monthly and Annual Values

- UNIT LOAD is the total heat rejection cooling done by the water side economizer coils in all units connected to this PLANT-ASSIGNMENT.

- ENERGY USE is not currently used.

DHW REPORT

- TANK SIZE is the tank water volume in gallons or liters.

- HEATER CAP is the rated amount of energy per hour the heater can supply to the tank water.

- FLOW RATE is the rated water flow rate from the tank.

- PUMP is the tank water pump rated electrical power.

Monthly Annual Values

- UNIT LOAD is the energy content of hot water provided by the tank.

- ENERGY USE is the energy consumed by the tank heater.

- RCV EN USE is the recovered energy added to the tank water.

- PUMP ENERGY is the tank water pump electrical consumption.

FOR ALL THE REPORTS

- NUMBER OF HOURS WITHIN EACH PART LOAD RANGE

This set of 12 columns shows the number of hours that the equipment spent in the various part load ranges. If the unit is on during the hour, and the operation is within the specified range, the count of hours is incremented by 1. For the boiler, cooling tower and domestic hot water heater, the value used to calculate the range for the hour is the load divided by the operating capacity. For the pumps the range is calculated using the loop flow divided by the pump (s) rated capacity. For the water side economizer the range is calculated using the total flow through all units WSE coils during the hour divided by the maximum WSE coil flow.

```
REPORT- SS-P  LOAD, ENERGY AND PART LOAD HEATING IN PVAVS2                              WEATHER FILE- CZ01RV2 WYEC2
----------------------------------------------------------------------------------------------------------------------------
    UNIT TYPE is PVAVS          HEATING-CAPACITY =  -239.313 (KBTU/HR) HEATING-EIR = 0.500 (BTU/BTU) SUPPLY-FLOW =   9189. (CFM )
         UNIT LOAD  ENERGY USE  COMPRESSOR  FAN ENERGY    -------- Number of hours within each PART LOAD range  --------- TOTAL
      SUM  (MBTU)     (KWH)       (KWH)       (KWH)        00   10   20   30   40   50   60   70   80   90  100   RUN
MONTH PEAK (KBTU/HR)  (KW)        (KW)        (KW)         10   20   30   40   50   60   70   80   90  100    +  HOURS
----- ---- ---------- ----------- ----------- -----------   ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
```

MONTH		(1)	(2)	(3)	(4)		00-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100+	TOTAL
JAN	SUM	-0.004	22.913	7.765	2367.479	CMP	3	0	0	0	0	0	0	0	0	0	0	3
	PEAK	-1.390	8.089	2.696	3.182	FAN	0	0	0	0	0	0	0	0	0	2	1	3
	DAY/HR	21/ 6	21/ 4	21/ 6	21/ 7													
FEB	SUM	0.000	0.000	0.000	2138.380	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	28/24	28/24	0/ 0	25/23													
MAR	SUM	0.000	0.000	0.000	2367.494	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	31/24	31/24	0/ 0	27/21													
APR	SUM	0.000	0.000	0.000	2291.128	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	30/ 1	30/ 1	0/ 0	21/18													
MAY	SUM	0.000	0.000	0.000	2367.500	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	31/ 1	31/ 1	0/ 0	10/ 3													
JUN	SUM	0.000	0.000	0.000	2289.511	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	30/ 1	30/ 1	0/ 0	24/17													
JUL	SUM	0.000	0.000	0.000	2362.154	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	31/ 1	31/ 1	0/ 0	11/18													
AUG	SUM	0.000	0.000	0.000	2367.501	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	31/ 1	31/ 1	0/ 0	30/18													
SEP	SUM	0.000	0.000	0.000	2287.377	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	30/ 1	30/ 1	0/ 0	19/20													
OCT	SUM	0.000	0.000	0.000	2367.500	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	31/24	31/24	0/ 0	1/23													
NOV	SUM	0.000	0.000	0.000	2291.061	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	30/24	30/24	0/ 0	24/ 5													
DEC	SUM	0.000	0.000	0.000	2367.477	CMP	0	0	0	0	0	0	0	0	0	0	0	0
	PEAK	0.000	0.000	0.000	3.182	FAN	0	0	0	0	0	0	0	0	0	0	0	0
	DAY/HR	31/24	31/24	0/ 0	31/13													
YR	SUM	-0.004	22.913	7.765	27861.625	CMP	3	0	0	0	0	0	0	0	0	0	0	3
	PEAK	-1.390	8.089	2.696	3.182	FAN	0	0	0	0	0	0	0	0	0	2	1	3
	MON/DAY	1/21	1/21	1/21	1/21													

REPORT- SS-P LOAD, ENERGY AND PART LOAD COOLING IN PVAVS2   WEATHER FILE- CZ01RV2 WYEC2

UNIT TYPE is PVAVS   COOLING-CAPACITY = 238.379 (KBTU/HR) COOLING-EIR = 0.418 (BTU/BTU) SUPPLY-FLOW =   9189. (CFM)

| | | UNIT LOAD | ENERGY USE | COMPRESSOR | FAN ENERGY | | -------- | Number of hours within each PART LOAD range | | | | | | | | -------- | | TOTAL |
| | SUM | (MBTU) | (KWH) | (KWH) | (KWH) | | 00 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | RUN |
MONTH	PEAK	(KBTU/HR)	(KW)	(KW)	(KW)		10	20	30	40	50	60	70	80	90	100	+	HOURS
JAN	SUM	19.012	2487.504	2487.504	2367.479	CMP	0	0	290	59	1	0	0	0	0	0	0	350
	PEAK	105.462	10.501	10.501	3.182	FAN	0	0	0	0	0	0	0	0	0	349	1	350
	DAY/HR	6/23	6/23	6/23	21/ 7													
FEB	SUM	15.806	1876.253	1876.253	2138.380	CMP	0	0	187	69	1	0	0	0	0	0	0	257

```
        PEAK    97.578      9.756       9.756      3.182 FAN   0   0     0     0     0    0    0   0   0   257    0   257
        DAY/HR  21/19      21/19       21/19      25/23
MAR     SUM     19.692   2273.717    2273.717   2367.494 CMP   0   0   209    81    13    0    0   0   0     0    0   303
        PEAK   107.207     10.669      10.669      3.182 FAN   0   0     0     0     0    0    0   0   0   303    0   303
        DAY/HR  27/16      27/16       27/16      27/21
APR     SUM     24.507   2677.849    2677.849   2291.128 CMP   0   0   202   143     6    0    0   0   0     0    0   351
        PEAK   107.781     10.724      10.724      3.182 FAN   0   0     0     0     0    0    0   0   0   351    0   351
        DAY/HR   5/20       5/20        5/20      21/18
MAY     SUM     41.813   4316.190    4316.190   2367.500 CMP   0   0   105   313    87    0    0   0   0     0    0   505
        PEAK   111.988     11.550      11.550      3.182 FAN   0   0     0     0     0    0    0   0   0   504    1   505
        DAY/HR   9/ 1       7/16        7/16      10/ 3
JUN     SUM     58.924   5941.962    5941.962   2289.511 CMP   0   0    44   241   245   60    8   0   0     0    0   598
        PEAK   152.781     15.385      15.385      3.182 FAN   0   0     0     0     0    0    0   0   3   572   23   598
        DAY/HR  22/19      23/14       23/14      24/17
JUL     SUM     64.677   6515.083    6515.083   2362.154 CMP   0   0    38   272   295   53    1   0   0     0    0   659
        PEAK   146.600     14.645      14.645      3.182 FAN   0   0     0     0     0    0    0   0   8   630   21   659
        DAY/HR  20/18      20/18       20/18      11/18
AUG     SUM     66.231   6645.806    6645.806   2367.501 CMP   0   0    23   259   332   45    2   0   0     0    0   661
        PEAK   147.728     15.148      15.148      3.182 FAN   0   0     0     0     0    0    0   0   0   645   16   661
        DAY/HR  29/18      29/18       29/18      30/18
SEP     SUM     56.244   5675.432    5675.432   2287.377 CMP   0   0    36   296   250   12    0   0   0     0    0   594
        PEAK   127.514     13.408      13.408      3.182 FAN   0   0     0     0     0    0    0   0   6   582    6   594
        DAY/HR  19/19       8/17        8/17      19/20
OCT     SUM     45.626   4684.504    4684.504   2367.500 CMP   0   0    96   364    83    0    0   0   0     0    0   543
        PEAK   110.142     11.190      11.190      3.182 FAN   0   0     0     0     0    0    0   0   0   542    1   543
        DAY/HR   2/ 5       1/14        1/14       1/23
NOV     SUM     23.639   2889.284    2889.284   2291.061 CMP   0   0   314    84     2    0    0   0   0     0    0   400
        PEAK    99.119      9.899       9.899      3.182 FAN   0   0     0     0     0    0    0   0   0   400    0   400
        DAY/HR   1/20       1/20        1/20      24/ 5
DEC     SUM     17.217   2267.286    2267.286   2367.477 CMP   0   0   265    49     6    0    0   0   0     0    0   320
        PEAK   101.110     10.086      10.086      3.182 FAN   0   0     0     0     0    0    0   0   0   319    1   320
        DAY/HR   1/ 5       1/ 5        1/ 5      31/13
YR      SUM    453.388  48251.410   48251.410  27861.625 CMP   0   0  1809  2230  1321  170   11   0   0     0    0  5541
        PEAK   152.781     15.385      15.385      3.182 FAN   0   0     0     0     0    0    0   0  17  5454   70  5541
        MON/DAY  6/22       6/23        6/23       1/21
```

8.47   SS-Q - Heat Pump Cooling And Heating Summary For < system or plant-assignment>

Two reports, one for heating operation and one for cooling operation, are produced for each PLANT-ASSIGNMENT or SYSTEM that contains an electric or gas heat pump or a furnace. These reports are provided for each PSZ, PVAVS RESYS, RESVVT, and PTAC system if SS-A is requested, or for each PLANT-ASSIGNMENT if SS-D is requested in the SYSTEM-REPORT command. The PLANT-ASSIGNMENT reports contain the sum of the values from all the SYSTEM reports.

1.   UNIT RUN TIME (hours) is the total run time for all gas heat pumps, or the sum of the hourly part load ratios for all the furnaces and electric heat pumps in the SYSTEM or PLANT- ASSIGNMENT. If a system serves several zones, each of which has a separate heat pump, the run time id the total run of all the heat pumps. For example, if, a particular hour, each of the heat pumps in three zones runs for 0.5 hours, then "UNIT RUN TIME" is incremented by 3 x 0.5 = 1.5.

2.   TOTAL LOAD UNIT (MBtu) is the total heating/cooling load on all units (including the defrost load for heat pumps) in the SYSTEM or PLANT-ASSIGNMENT.

3.   ENERGY INTO UNIT (MBtu) is the electric or fuel energy into all of the units to provide heating or cooling; doesn't include auxiliaries for the unit except those included in the base EIR or HIR.

4.   AUXILIARY ENERGY (Mbtu) is the energy for outdoor fans, evaporative precoolers, auxiliary electrical, or pumps for the units.

5.   SUP UNIT LOAD (Mbtu) is the total load on the supplemental heating units. This includes time when the supplemental unit is operating alone or in conjunction with the heat pump.

6.   SUP UNIT ENERGY (Mbtu) is the energy into the supplemental heating units.

7.   WASTE HEAT GENERATED (Mbtu) is the recoverable heat generated by the units.

8.   WASTE HEAT USE (Mbtu) is the amount of waste heat used to meet the domestic hot water loads.

9.   DEFROST LOAD (Mbtu) is the heating load imposed when running in defrost mode.

10.   INDOOR FAN ENERGY (Mbtu) is the electric consumption of the indoor fans during the heating/cooling mode.

11.   CSPF (WITH PARASITICS), CSPF (WITHOUT PARASITICS), HSPF (WITH PARASITICS), HSPF (WITHOUT PARASITICS) are the cooling and heating season performance factors as computed with and without parasitics. The value *without* parasitics is the total load (main and supplemental) divided by the total energy consumed (main plus supplemental). The value *with* parasitics adds all heat from the load (increases heating load and decreases cooling load).

```
                              BASECASE                              VisualDOE for Windows

REPORT- SS-Q HEAT PUMP COOLING SUMMARY FOR  PA0                        WEATHER FILE- CZ01RV2 WYEC2

-----------------------------------------------------------------------------------------------------------

       UNIT RUN  TOTAL LOAD  ENERGY IN  AUXILIARY   SUP UNIT   SUP UNIT  WASTE HEAT  WASTE HEAT            INDOOR FAN
         TIME     ON UNIT    TO UNIT     ENERGY      LOAD       ENERGY   GENERATED    USE                   ENERGY
       (HOURS)    (MBTU)     (MBTU)      (MBTU)      (MBTU)     (MBTU)    (MBTU)      (MBTU)                 (MBTU)

       ----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------
JAN      101.      53.667      19.310      0.052       0.000      0.000      0.000       0.000       0.000       5.150

FEB       90.      47.544      17.278      0.049       0.000      0.000      0.000       0.000       0.000       4.582

MAR      107.      58.275      20.525      0.053       0.000      0.000      0.000       0.000       0.000       5.418

APR      105.      59.880      19.921      0.038       0.000      0.000      0.000       0.000       0.000       5.186

MAY      105.      63.213      19.723      0.018       0.000      0.000      0.000       0.000       0.000       5.044

JUN      122.      77.324      22.770      0.008       0.000      0.000      0.000       0.000       0.000       5.324
```

```
JUL    117.    74.291    21.813    0.004    0.000    0.000    0.000    0.000    0.000    5.063

AUG    125.    79.544    23.433    0.002    0.000    0.000    0.000    0.000    0.000    5.510

SEP    115.    72.184    21.427    0.010    0.000    0.000    0.000    0.000    0.000    5.089

OCT    104.    63.177    19.697    0.015    0.000    0.000    0.000    0.000    0.000    4.976

NOV     94.    50.796    18.040    0.039    0.000    0.000    0.000    0.000    0.000    4.788

DEC    101.    53.334    19.349    0.053    0.000    0.000    0.000    0.000    0.000    5.151

       -------  ----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------

ANNUAL  1288.   753.230   243.285    0.343    0.000    0.000    0.000    0.000    0.000   61.282

CSPF (WITH PARASITICS)    =    2.47 (KBTU/HR)

CSPF (WITHOUT PARASITICS) =    3.10 (BTU/BTU)
```

8.48   Plant Reports

8.49   PS-A - Plant Energy Utilization Summary

PS-A gives site and source energy use in MBtu (10$^{(}$Btu) for thermal quantities and MWh (10$^{(}$Wh) for electrical quantities.

In DOE-2.1E, PS-A was modified so that the electrical consumption is displayed in units of MWh; the second line showing electrical consumption for each month has been eliminated. Numbers shown in this report may be different than shown in earlier program releases. Previously, energy consumed in SYSTEMS for electrical and fuel usage for heating and cooling did not appear under the heating and cooling categories, only in the total categories; this has been corrected. Also, the figures for the total site and source energy were incorrect when a cogeneration plant is a net exporter of electricity; this has been corrected.

1.   MONTH

2.   TOTAL HEAT LOAD. The heating energy = load from SYSTEMS + load from PLANT (absorption chillers + stream turbines + heat dissipated from storage tanks + domestic hot water + heat stored in tanks but not used) = circulation loop losses. The values here are identical to those in the HEATING ENERGY column of the SYSTEMS SS-D report except that the heat energy delivered to an absorption chiller, steam turbine, domestic hot water, and circulation losses is included. Also included is the heat input to a storage tank from a boiler.

3.   TOTAL COOLING. This is the total of the values shown in the SS-D report plant tank and circulation loop losses; it represents the cooling energy needed each month.

4.   TOTAL ELECTR LOAD. This is the total energy consumed by lights, equipment, and system fans plus the additional energy consumed by chiller motors, pumps, cooling towers, and any other electrical site use including energy entered into the program under BUILDING-RESOURCE.

5.   RECVRED ENERGY. These values are recovered heat used to reduced loads. This is waste heat from turbines, diesels, and double-bundle chillers, and solar energy divided to the load via HEAT-RECOVERY.

6.   WASTED RECVRABL ENERGY. The values in this column represent the heat that *could* have been recovered, had there been a need for it.

7.   FUEL INPUT COOLING. The fuel used to drive engine chillers and gas fired absorption chiller/heater, and regeneration fuel for desiccant cooling systems.

8.   ELEC INPUT COOLING. The electric energy used to drive chillers and to supply power for peripheral cooling equipment, such as circulation pumps, cooling towers, and cold storage tanks.

9.   FUEL INPUT HEATING. This column reports the fuel for heating by boilers, furnaces, and hot water heaters.

10.   ELEC INPUT HEATING. The electrical energy used in association with supplying heating, including the electrical consumption by draft fans, circulation pumps, electric boilers, and hot water storage pumps.

11.   FUEL INPUT ELEC. The fuel used by diesel and gas turbine generators.

12.   TOTAL FUEL INPUT. The sum of fossil fuels use.

13.   TOTAL SITE ENERGY. The sum of purchased fossil fuel, electricity, chilled water and steam.

14.   TOTAL SOURCE ENERGY. The energy used at the source. For each RESOURCE, the energy consumption at the site is divided by the corresponding SOURCE-SITE-EFF to arrive at the energy consumed and transmitted by the generating station; the results are summed.

```
            BASECASE                          VisualDOE for Windows
```

```
REPORT- PV-A  EQUIPMENT SIZES                                                    WEATHER FILE- CZ01RV2 WYEC2
---------------------------------------------------------------------------------------------------------------

                  -------------- -------------- -------------- -------------- -------------- --------------

                     NUMBER         NUMBER         NUMBER         NUMBER         NUMBER         NUMBER
  E Q U I P M E N T  SIZE  INSTD    SIZE  INSTD    SIZE  INSTD    SIZE  INSTD    SIZE  INSTD    SIZE  INSTD
                   (MBTU/H) AVAIL (MBTU/H) AVAIL (MBTU/H) AVAIL (MBTU/H) AVAIL (MBTU/H) AVAIL (MBTU/H) AVAIL

  ------------------ ------ -- --  ------ -- --   ------ -- --   ------ -- --   ------ -- --   ------ -- --
  HW-BOILER          0.435  1  1
  DHW-HEATER         0.029  1  1
  OPEN-CENT-CHLR     0.600  1  1
```

8.50 PV-B - Cost Reference Data (Used For Default Costs)

This report is relevant only if DOE-2 is used to calculate life-cycle costs. VisualDOE does not used this feature so this table is not important unless the user runs DOE-2 outside VisualDOE.

```
                              BASECASE                            VisualDOE for Windows

REPORT- PV-B   COST REFERENCE DATA (USED FOR DEFAULT COSTS)                       WEATHER FILE- CZ01RV2 WYEC2

-----------------------------------------------------------------------------------------------------------------

                         SIZE     UNIT   INSTALD  CONSUM-  MAINTA-   EQPMT   HOURS    HRS TO   MINOR   HRS TO   MAJOR
           E Q U I P M E N T               COST     COST    ABLES    NANCE    LIFE   ALREADY   MINOR   OVHAUL   MAJOR   OVHAUL
                        (MBTU )    (K$)   FACTOR   ($/HR)  (HRS/YR)  (HRS)     USED   OVHAUL  COST ($)  OVHAUL  COST ($)

           --------------------  -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- --------

           HW-BOILER        40.000 300.000  1.400    0.000     8.0  220000.      0.   10000.   2000.   50000.   25000.

           DHW-HEATER        0.000   0.000  0.000    0.000     0.0      0.      0.      0.      0.      0.      0.

           OPEN-CENT-CHLR   12.000 150.000  1.200    0.000    25.0  100000.      0.   20000.   5000.   50000.   15000.



                              BASECASE                            VisualDOE for Windows
```

8.51   PV-C - Equipment Costs

This report is relevant only if DOE-2 is used to calculate life-cycle costs. VisualDOE does not used this feature so this table is not important unless the user runs DOE-2 outside VisualDOE.

```
REPORT- PV-C  EQUIPMENT COSTS                                           WEATHER FILE- CZ01RV2 WYEC2

----------------------------------------------------------------------------------------------------

                     SIZE    UNIT   INSTALD CONSUM- MAINTA-  EQPMT  HOURS   HRS TO  MINOR   HRS TO  MAJOR
     E Q U I P M E N T        COST   COST    ABLES   NANCE   LIFE  ALREADY  MINOR   OVHAUL  MAJOR   OVHAUL
                     (MBTU ) (K$)   FACTOR  ($/HR)  (HRS/YR) (HRS)  USED    OVHAUL  COST ($) OVHAUL COST ($)

     -------------------- -------- -------- -------- -------- -------- -------- -------- -------- -------- -------- --------

     HW-BOILER       0.435  14.514  1.400   0.000    3.2   139992.    0.    4049.     97.  20246.   1209.

     DHW-HEATER      0.029   0.000  0.000   0.000    0.0       0.    0.       0.      0.      0.      0.

     OPEN-CENT-CHLR  0.600  20.156  1.200   0.000   13.7   74113.    0.   10986.    672.  27464.   2016.




                     BASECASE                        VisualDOE for Windows
```

8.52   PV-E - Equipment Load Ratios

```
REPORT- PV-E  EQUIPMENT LOAD RATIOS                                        WEATHER FILE- CZ01RV2 WYEC2
--------------------------------------------------------------------------------------------------------

                           P A R T   L O A D   R A T I O S      ELECTRIC INPUT
                                                                 TO NOMINAL
          E Q U I P M E N T   MINIMUM   MAXIMUM   OPTIMUM     CAPACITY RATIO
                                                                 (BTU/BTU)

          -----------------   -------   -------   -------     ----------------
          HW-BOILER           0.2500    1.2000    1.0000          0.0220
          DHW-HEATER          0.0000    0.0000    0.0000          0.0000
          OPEN-CENT-CHLR      0.1000    1.0000    0.8000          0.1999




                     BASECASE                          VisualDOE for Windows
```

8.53 PV-G - Equipment Quadratics

This report displays the coefficients used for part load curves.

```
REPORT- PV-G  EQUIPMENT QUADRATICS                                    WEATHER FILE- CZ01RV2 WYEC2
-------------------------------------------------------------------------------------------------------

        N A M E              COEFF 1      COEFF 2      COEFF 3      COEFF 4      COEFF 5      COEFF 6

        ------------------   ----------   ----------   ----------   ----------   ----------   ----------

        STM-BOILER-HIR-F      0.082597     0.996764    -0.079361     0.000000     0.000000     0.000000

        HW-BOILER-HIR-FP      0.082597     0.996764    -0.079361     0.000000     0.000000     0.000000

        FURNACE-HIR-FPLR      0.018610     1.094209    -0.112819     0.000000     0.000000     0.000000

        DHW-HIR-FPLR          0.021826     0.977630     0.000543     0.000000     0.000000     0.000000

        OPEN-CENT-CAP-FT     -1.742040     0.029292    -0.000067     0.048054    -0.000291    -0.000106

        OPEN-REC-CAP-FT      -4.161461     0.207050    -0.001931     0.004723    -0.000040    -0.000087

        HERM-CENT-CAP-FT     -1.742040     0.029292    -0.000067     0.048054    -0.000291    -0.000106

        HERM-REC-CAP-FT      -4.161461     0.207050    -0.001931     0.004723    -0.000040    -0.000087


[ROWS DELETED FOR BREVITY]
```

8.54   PS-B - Monthly Peak And Total Energy Use

This report shows the monthly total consumption and peak hourly consumption (demand) of up to five of the following purchased fuels: ELECTRICITY, CHILLED-WATER, STEAM, NATURAL-GAS, LPG, FUEL-OIL, DIESEL-OIL, COAL, METHANOL, and OTHER-FUEL. Usage is displayed in the actual units of consumption (kWh, therms, etc.). The final section of the report gives, for each "fuel", the total energy use for the run period (ONE YEAR USE) , and, below this, the peak hourly energy use (PEAK) for the run period.

```
REPORT- PS-B  MONTHLY UTILITY AND FUEL USE SUMMARY                                  WEATHER FILE- CZ01RV2 WYEC2
-----------------------------------------------------------------------------------------------------------------

                                   ELECTRICITY        NATURAL-GAS
                                   METER-1            METER-1
MONTH              BTU/UNIT:       3413./KWH          100000./THERM
-------                            ---------------    ---------------
  JAN
    ENERGY CONSUMPTION (UNITS/MO)      25856.4             972.8
    PEAK DEMAND (UNITS/HR OR DAY)         89.6               5.7
                    PEAK DAY/HR          27/16              1/ 8
  FEB
    ENERGY CONSUMPTION (UNITS/MO)      23176.5             793.8
    PEAK DEMAND (UNITS/HR OR DAY)         90.1               5.5
                    PEAK DAY/HR           3/17             14/ 7
  MAR
    ENERGY CONSUMPTION (UNITS/MO)      27420.6             841.9
    PEAK DEMAND (UNITS/HR OR DAY)         93.1               5.4
                    PEAK DAY/HR          17/17             21/ 7
  APR
    ENERGY CONSUMPTION (UNITS/MO)      25633.2             642.1
    PEAK DEMAND (UNITS/HR OR DAY)         94.5               5.2
                    PEAK DAY/HR          13/17             25/ 7
  MAY
    ENERGY CONSUMPTION (UNITS/MO)      25354.8             479.9
    PEAK DEMAND (UNITS/HR OR DAY)         90.1               4.7
                    PEAK DAY/HR          24/17             16/ 7
  JUN
    ENERGY CONSUMPTION (UNITS/MO)      26778.9             361.3
    PEAK DEMAND (UNITS/HR OR DAY)        102.9               4.0
                    PEAK DAY/HR          24/17              6/ 7
  JUL
    ENERGY CONSUMPTION (UNITS/MO)      25219.9             318.8
    PEAK DEMAND (UNITS/HR OR DAY)        105.2               3.8
                    PEAK DAY/HR          21/17             25/ 7
  AUG
    ENERGY CONSUMPTION (UNITS/MO)      27814.0             373.5
    PEAK DEMAND (UNITS/HR OR DAY)        101.4               3.7
                    PEAK DAY/HR           1/17             22/ 7
  SEP
    ENERGY CONSUMPTION (UNITS/MO)      25627.3             350.2
    PEAK DEMAND (UNITS/HR OR DAY)        105.1               3.9
                    PEAK DAY/HR           8/17             15/ 7
```

```
OCT
  ENERGY CONSUMPTION (UNITS/MO)        24840.7              524.5
  PEAK DEMAND (UNITS/HR OR DAY)           95.1                4.8
                   PEAK DAY/HR          14/17              24/ 7
NOV
  ENERGY CONSUMPTION (UNITS/MO)        24366.9              832.1
  PEAK DEMAND (UNITS/HR OR DAY)           93.2                5.6
                   PEAK DAY/HR           1/16              25/ 7
DEC
  ENERGY CONSUMPTION (UNITS/MO)        25901.6             1001.8
  PEAK DEMAND (UNITS/HR OR DAY)           90.2                5.6
                   PEAK DAY/HR           8/15              27/ 7
-------                          ----------------   ----------------
TOTAL
  ENERGY CONSUMPTION (UNITS/YR)       307990.8             7492.7
  PEAK DEMAND (UNITS/HR OR DAY)          105.2                5.7
```

8.55   PS-C - Equipment Part Load Operation

For each plant equipment type, this report shows the hours spent in each part load ratio range in increments of 10%. If equipment is oversized, the equipment will never indicate any hours in the 100 to 110+ range.

The TOTAL HOURS entry differs from the total hours in other reports. Here, TOTAL HOURS refers to the hours during which one or more units of a given equipment type are operating. This sum is independent of the *number* of units operating. For example, if three boilers are operating during a given hour, TOTAL HOURS is increased by one rather than three.

1.   ANNUAL LOAD is the useful load handled by the equipment.

2.   FALSE LOAD is reported when a piece of equipment is forced to operate at its minimum unload ratio when the demand is less that this.

3.   ELEC USED is the total electrical energy used by the indicated equipment type.

4.   THERMAL USED refers either to the fuel consumed or the heat required for operation, from whenever it arises.

When there is more than one piece of equipment of the same type, staged for availability, the first line of HOURS AT PERCENT PART LOAD RATIO (for each type) is the hours spent in the partial load ratio range for the capacity of the equipment of that type which is *operating*. The second line is hours spent (for each type) in the partial load ratio range for the *total installed* capacity. Obviously, when only one piece of equipment is installed, the operating capacity and the total installed capacity are identical. (For example, if there are two 4-Mbtuh hot water boilers and only one is operating, then the "operating capacity" is 4 Mbtuh and the "installed capacity" is 8 Mbtuh.)

```
                              BASECASE                          VisualDOE for Windows

REPORT- PS-C  EQUIPMENT PART LOAD OPERATION                      WEATHER FILE- CZ01RV2 WYEC2
-----------------------------------------------------------------------------------------------------------

                                                           TOTAL   ANNUAL   FALSE    ELEC    THERMAL

                          HOURS AT PERCENT PART LOAD RATIO       HOURS    LOAD     LOAD    USED     USED

  EQUIPMENT                                                              (MBTU)   (MBTU)  (KWH)    (MBTU)

           0 -- 10 -- 20 -- 30 -- 40 -- 50 -- 60 -- 70 -- 80 -- 90 -- 100 - 110+ -----   ------   ------  ------   ------

HW-BOILER     1341   813   569   429   408   253   144   120    84    50     1    4212    477.6     0.0   7731.    723.3

              1341   813   569   429   408   253   144   120    84    50     1

DHW-HEATER    8169    60    26    27   113   252     0     0     0   105     8    8760     13.5     0.0      0.     26.0

              8169    60    26    27   113   252     0     0     0   105     8

OPEN-CENT-CHLR   0     0     0     0     0     0     0     0     0     0     0       0      0.0     0.0      0.      0.0

                 0     0     0     0     0     0     0     0     0     0     0


        HOT  LOOP CIRCULATION PUMP ELECTRICAL USE =    1269. KWH

        COLD LOOP CIRCULATION PUMP ELECTRICAL USE =       0. KWH

        CONDENSER    WATER   PUMP ELECTRICAL USE =       0. KWH

        TOWER  OR  CONDENSER  FAN  ELECTRICAL USE =       0. KWH


        NOTES TO TABLE

         1) THE FIRST PART LOAD ENTRY FOR EACH PIECE OF EQUIPMENT IS

            THE HOURLY LOAD DIVIDED BY THE HOURLY OPERATING CAPACITY

         2) THE SECOND PART LOAD ENTRY FOR EACH PIECE OF EQUIPMENT IS

            THE HOURLY LOAD DIVIDED BY THE TOTAL INSTALLED CAPACITY
```

8.56   PS-D - Plant Loads Satisfied

This report flags those situations where the plant is not able to meet the loads imposed by both systems and other plant equipment. This is of special importance when equipment is intentionally undersized to improve part load performance or to reduce costs.

MBTU is the output energy from piece of equipment.

PCT OF TOTAL LOAD is the following ration (in percent) : MBTU SUPPLIED divided by TOTAL LOAD ON PLANT. This will be 100% only if all of the load is satisfied.

When hot or cold storage tank is included, additional entries are given at the bottom of the first page which describe the contribution to the heating and cooling demands made by the storage tank (s).

TOTAL LOAD ON PLANT for heating (cooling) is the sum of the demand from SYSTEMS, the consumption by PLANT, the loss from the storage tank and the heat (cold) remaining in the storage tank at the end of the run. The last, of course, is still recoverable and is reported as RESIDUAL (not shown in this example; see the PS-D report for the 31-story Office Building, Run 2 in the *Sample Run Book (2.1E)).*

In the second part of this report, "SUMMARY OF LOADS MET", TOTAL OVERLOAD is that portion of a load that requires equipment to operate above its nominal rated capacity. PEAK OVERLOAD is the largest hourly overload.

```
                        BASECASE                         VisualDOE for Windows

REPORT- PS-D   PLANT LOADS SATISFIED                                WEATHER FILE- CZ01RV2 WYEC2
-----------------------------------------------------------------------------------------------------------

                      HEATING LOADS           MBTU SUPPLIED     PCT OF TOTAL LOAD

                    ------------------------  -------------     -----------------

                       HW-BOILER                   477.6             97.3

                       DHW-HEATER                    13.5              2.7
                                                =============     =================

                            LOAD SATISFIED          491.1            100.0

                       TOTAL LOAD ON PLANT          491.1

                    ELECTRICAL LOADS          KWH SUPPLIED      PCT OF TOTAL LOAD

                    ------------------------  -------------     -----------------

                       ELECTRICITY              307990.8            100.0
                                                =============     =================

                            LOAD SATISFIED      307990.8            100.0

                       TOTAL LOAD ON PLANT      307993.9
```

8.57   PS-E - Monthly Energy End Use Summary

This report summarizes the monthly energy usage by end use. The breakdown is in terms of ELECTRICITY and FUEL. The end uses are defined in "Metering and Reporting of Energy End Uses", p.3.4. For each month, the report lists the total electrical and fuel usage, the peak usage, and the day/hour during which the peak occurred. For readability, only end uses tat have non-zero yearly consumptions are itemized. This report does not distinguish between the various fuel types that may be present, or different electrical meters. In addition, this report does not attempt to allocate fuel consumed by cogeneration equipment to electrical end uses.

```
BASECASE                        VisualDOE for Windows

REPORT- PS-D  PLANT LOADS SATISFIED                                      WEATHER FILE- CZ01RV2 WYEC2
-----------------------------------------------------------------------------------------------(CONTINUED)--------
                                SUMMARY OF LOADS MET

                        TOTAL        LOAD       TOTAL       PEAK       HOURS

         TYPE OF LOAD   LOAD       SATISFIED   OVERLOAD   OVERLOAD   OVERLOADED

                        (MBTU)      (MBTU)      (MBTU)     (MBTU)

         -------------------- ---------- ---------- ---------- ---------- ----------

         HEATING LOADS      491.1        491.1      0.000      0.000        0
         ELECTRICAL LOADS  1051.2       1051.2      0.000      0.000        0




                        BASECASE                        VisualDOE for Windows

REPORT- PS-G  ELECTRICAL LOAD SCATTER PLOT                               WEATHER FILE- CZ01RV2 WYEC2
-----------------------------------------------------------------------------------------------------------------
                        TOTAL HOURS AT HOURLY DEMAND AND TIME OF DAY

          HOUR   1AM 2   3   4   5   6   7   8   9  10  11  12  1PM 2   3   4   5   6   7   8   9  10  11  12   TOTAL

                 --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---   -----

           143   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0     0
           132   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0     0
           121   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0     0
           110   0   0   0   0   0   0   0   0   0   0   0   0   1   1   9   9   0   0   0   0   0   0   0   0    20
   D        99   0   0   0   0   0   0   0   0   3  10  16  24   1  62  89  97 112   0   0   0   0   0   0   0   414
   E        88   0   0   0   0   0   0   0   0 249 242 236 228 251 189 162 146 131   0   0   0   0   0   0   0  1834
   M K      77   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   5   0   0   0   0   0   0     5
   A W      66   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0 247   0   0   0   0   0   0   0   247
   N        55   0   0   0   0   0   0   0   0   0   0   1   0   0   0   0   0   0   0  31  10   0   0   0   0    42
   D        44   0   0   0   0   0   0   0 252  53  53  52  53   0   2   1   2   0   0 221 242 251 252   0   0  1434
           33   0   0   0   0   0   0 305  53   0   0   0   0  53  51  52  51  53  53   0   0   1   0   0   0   672
           22   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0     0
           11 365 365 365 365 365 365  60  60  60  60  60  60  60  60  60  60  60  60 113 113 113 113 365 365  4092

                === === === === === === === === === === === === === === === === === === === === === === === ===   =====
        PERCENT
         TOTAL   0.4 0.4 0.4 0.4 0.4 0.8 2.9 4.1 8.0 7.9 7.9 7.9 7.1 7.8 7.8 7.9 7.9 5.3 3.7 3.6 3.0 3.1 0.8 0.4
        DEMAND
                                PEAK ELECTRICAL LOAD BREAKDOWN
                        SOURCE                KW      PCT

                        -------------------- --------- -----

                        SYSTEMS LOAD         105.177  100.0

                                             =========
                TOTAL   105.177
```

8.58   PS-F - Energy Resource Peak Breakdown By End Use

This report is an extension of the PLANT program BEPS report. For each of the end uses and fuels in BEPS, this report lists the monthly peak consumption of each resource, the time the peak occurred, and the contribution toward the peak each of the end uses. The end uses are defined in "Metering and Reporting of Energy End Uses", p.3.4. The resources are those specified in the ENERGY-RESOURCE command in PLANT. The end use contribution is listed in terms of both the total amount and the percentage. Only end uses with non-zero yearly consumption are listed. The report repeats for each of the resources.

For cogeneration systems, this report will apportion the fuel consumed to each of the electrical end uses. If the system is a net power producer, an additional line will indicate the portion of the power that is exported and the fuel consumed.

The energy flow associated with charging and discharging a hot water tank is ignored in this report. The reasons for this are somewhat complex. Briefly, when charging the hot water tank, it is not possible to apportion the energy to the end uses, as the end uses are not yet known (a hot water tank can be used for space heating, absorption cooling, or domestic hot water.) End uses could be apportioned at the time of discharged (as they are in BEPS) , but this would then create artificial peaks at the time of use.

```
REPORT- PS-F  ENERGY-RESOURCE PEAK BREAKDOWN BY END-USE                                    WEATHER FILE- CZ03RV2 WYEC2
-------------------------------------------------------------------------------------------------------------------------


ENERGY-RESOURCE:  ELECTRICITY

         UNITS:  KWH

                 JAN     FEB     MAR     APR     MAY     JUN     JUL     AUG     SEP     OCT     NOV     DEC

                -------  -------  -------  -------  -------  -------  -------  -------  -------  -------  -------  -------

PEAK DEMAND:    1136.0  1098.3  1137.5  1224.1  1291.7  1350.6  1280.3  1300.0  1355.0  1344.9  1212.9  1106.8

      DAY/HR:    5/ 9   23/15   27/15   27/15   13/15    9/15   17/15    6/15   28/15   30/15    5/15   28/ 9

BREAKDOWN

-------------

AREA LIGHTS:    381.22  352.33  351.45  351.46  351.47  351.48  351.48  351.48  351.47  351.46  351.90  344.81

        (%):    33.56   32.08   30.90   28.71   27.21   26.02   27.45   27.04   25.94   26.13   29.01   31.15

MISC EQUIPMT:   318.41  315.72  315.72  315.72  315.72  315.72  315.72  315.72  315.72  315.72  315.72  318.41

        (%):    28.03   28.75   27.76   25.79   24.44   23.38   24.66   24.29   23.30   23.48   26.03   28.77

 SPACE HEAT:     52.22    0.54    0.08    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.15   50.13

        (%):     4.60    0.05    0.01    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.01    4.53

 SPACE COOL:      0.00   96.44  131.37  216.26  270.90  316.01  256.52  271.58  296.39  301.76  177.49    0.00

        (%):     0.00    8.78   11.55   17.67   20.97   23.40   20.04   20.89   21.87   22.44   14.63    0.00

HEAT REJECT:      0.00   15.09   16.54   28.75   30.07   33.37   29.07   29.39   29.55   31.13   34.52    0.00

        (%):     0.00    1.37    1.45    2.35    2.33    2.47    2.27    2.26    2.18    2.31    2.85    0.00

PUMPS & MISC:     5.89   23.82   23.82   19.55   24.39   28.47   23.43   24.77   28.87   27.88   23.82    5.12

        (%):     0.52    2.17    2.09    1.60    1.89    2.11    1.83    1.91    2.13    2.07    1.96    0.46

  VENT FANS:     83.06   87.15   91.31   85.15   91.96   98.38   96.88   99.81  125.80  109.73  102.12   82.46

        (%):     7.31    7.93    8.03    6.96    7.12    7.28    7.57    7.68    9.28    8.16    8.42    7.45

SUPPLMT HEAT:     0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00   10.61

        (%):     0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.96

DOMHOT WATER:    75.22   75.22   75.22   75.22   75.22   75.22   75.22   75.22   75.22   75.22   75.22   75.22

        (%):     6.62    6.85    6.61    6.15    5.82    5.57    5.88    5.79    5.55    5.59    6.20    6.80
```

```
EXT MISC:    220.00  132.00  132.00  132.00  132.00  132.00  132.00  132.00  132.00  132.00  132.00  220.00
     (%):     19.37   12.02   11.60   10.78   10.22    9.77   10.31   10.15    9.74    9.81   10.88   19.88
```

8.59   PS-G - Electrical Load Scatter Plot

In this scatter plot ordinate, shown in the left-most column, is the electrical demand divided into 13 bins which range from zero to just above the peak electrical demand. The abscissa shown at the top is the hour of the day. Entered in each cell of the plot is the number of days during the year for which the electrical demand was less that the ordinate shown but larger that the next lower ordinate at that hour of the day.

The right-most column is the sum of the entries in each row and shows the frequency of the electrical demand throughout the run period.

The bottom row shows the distribution of electrical demand for each hour average day. The number here is the electrical consumption for the run period for a *particular* hour of the day divided by the total electrical consumption for *all hours of the day* for run period.

The chart at the bottom is a breakdown of the peak electrical demand into the contributing components. The SYSTEMS LOAD includes the lighting and equipment electrical loads from LOADS as well as that from system fans.

```
REPORT- PS-G  ELECTRICAL LOAD SCATTER PLOT                                          WEATHER FILE- CZ03RV2 WYEC2
------------------------------------------------------------------------------------------------------------------


                              TOTAL HOURS AT HOURLY DEMAND AND TIME OF DAY

           HOUR   1AM 2   3   4   5   6   7   8   9  10  11  12  1PM 2   3   4   5   6   7   8   9  10  11  12   TOTAL

                  --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---   -----

           1686    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0      0

           1556    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0      0

           1426    0   0   0   0   0   0   0   0   0   0   0   0   0   4   5   0   0   0   0   0   0   0   0   0      9

           1297    0   0   0   0   0   0   0   0   2   3   8   0   0  52  62   0   0   0   0   0   0   0   0   0    127

     D     1167    0   0   0   0   0   0   0   0 233 180  90  10  28 111 112   1  11   0   0   0   0   0   0   0    776

     E     1037    0   0   0   0   0   0   0 114  18  70 155  93 139  86  74  32  62   0   0   0   0   0   0   0    843

     M K    908    0   0   0   0   0   0   0 139   0   0   0 150  86   0   0  96 128   8   0   0   0   0   0   0    607

     A W    778    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0 124  52  49   0   0   0   0   0   0    225

     N      648    0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0 140   0   0   0   0   0   0    140

     D      518    0   0   0   0   0   0  16   0   0   0   0   0   0   0   0   0   0  56  19   0   0   0   0   0     91

            389    0   0   0   0   0   0 237   0   1  38  51  52  17  19  18   9   7   0 234  99   0   0   0   0    782

            259    0   0   0   0   3 253  43  64 111  74  61  60  95  93  94 103 105  82  59 222 330 306   0   0   2158

            129  365 365 365 365 362 112  69  48   0   0   0   0   0   0   0   0   0   0  30  53  44  35  59 365 365   3002

                  === === === === === === === === === === === === === === === === === === === === === === === ===   =====

       PERCENT

        TOTAL    0.6 0.6 0.6 0.6 0.7 1.6 2.7 7.0 8.4 8.4 8.2 7.2 7.6 8.6 8.7 6.4 6.9 4.8 3.1 2.3 1.9 1.4 1.0 0.7

       DEMAND



                              PEAK ELECTRICAL LOAD BREAKDOWN
                         SOURCE              KW      PCT

                      --------------------  ---------  -----

                      SYSTEMS LOAD          1065.789   78.7

                      CIRCULATION PUMPS       28.867    2.1

                      HERM-CENT-CHLR         230.812   17.0

                      COOLING-TWR             29.546    2.2

                                           =========
                            TOTAL   1355.015
```

8.60   PS-H - Equipment Use Statistics

This report gives you an assessment of the appropriateness of the equipment selected.

1.   AVG OPER RATIO is the point, on the average, at which the equipment on its part load curve.

2.   MAX LOAD gives the maximum demand loading and the time of occurrence. This value should compare favorably with the size of the equipment selected.

3.   SIZE (Mbtu) is the equipment size selected either automatically by the program or as input by the user.

4.   OPER HRS is the total number of equipment-hours the equipment was "on". If more than unit is involved there is space to report four more units by size and operating hours. If there are two pieces of equipment of the same size, the value for OPER HRS is the sum of the number of hours that each operates.

```
                              BASECASE                                    VisualDOE for Windows

REPORT- PS-H  EQUIPMENT USE STATISTICS                                             WEATHER FILE- CZ01RV2 WYEC2
--------------------------------------------------------------------------------------------------------------------
                                   --------
                      AVG   MAX   MON        ------------  ------------  ------------  ------------  ------------
       E Q U I P M E N T   OPER  LOAD    DAY     SIZE  OPER   SIZE  OPER   SIZE  OPER   SIZE  OPER   SIZE  OPER
                      RATIO (MBTU)      HR  (MBTU)  HRS   (MBTU)  HRS   (MBTU)  HRS   (MBTU)  HRS   (MBTU)  HRS
       ------------------ ----- ------ -- -- -- ------ ----- ------ ----- ------ ----- ------ ----- ------ -----
       HW-BOILER          0.260  0.435  1  1  8   0.435  4212
       DHW-HEATER         0.053  0.029  3 27 20   0.029  8760
       OPEN-CENT-CHLR     0.000  0.000  0  0  0   0.600     0
```

8.61 BEPS - Building Energy Performance Summary

This report makes it possible to quickly review annual building energy use according to energy type (ELECTRICITY, NATURAL-GAS, etc.) and category of use (AREA, LIGHTS, SPACE, HEAT, etc.). The energy types shown are those that you have specified with the ENERGY-RESOURCE command in PLANT. *Only categories of use with non-zero consumption are shown.*

TOTAL SITE ENERGY is the overall energy use at *the building site* for all energy types and categories of use.

TOTAL SOURCE ENERGY is the energy use at point of production; it is obtained by dividing site energy use by the user specified SOURCE-SITE-EFF value in the ENERGY-RESOURCE command.

Site and source energy are given per unit of net area (the sum of the floor areas of conditioned zones) and per unit of gross area (the value of GROSS-AREA in the BUILDING-LOCATION command in LOADS, which defaults to net area).

It should be pointed out that this report is not designed to work when there is a stream turbine among the specified plant equipment items. The numbers reported when a stream turbine is present will not be reliable.

When a hot storage tank is present, a note is printed on the BEPS report stating that the hot water storage tank can get energy from many sources. Any time there is residual energy in the storage tanks, the totals in the BEPS report will not agree with those in report PS-B, because the BEPS report includes only the energy used for the above categories, whereas PS-B includes the energy that is left in the tanks as well.

```
                           BASECASE                           VisualDOE for Windows

REPORT- BEPS  BUILDING ENERGY PERFORMANCE SUMMARY                             WEATHER FILE- CZ01RV2 WYEC2
------------------------------------------------------------------------------------------------------------

                    ENERGY TYPE:   ELECTRICITY   NATURAL-GAS

                    UNITS: MBTU

                    CATEGORY OF USE

                    ---------------

                       AREA LIGHTS       424.6          0.0

                       MISC EQUIPMT      290.9          0.0

                       SPACE HEAT         26.4        723.3

                       SPACE COOL        243.3          0.0

                       PUMPS & MISC        4.7          0.0

                         VENT FANS        61.3          0.0

                       DOMHOT WATER        0.0         26.0

                                    ----------    ----------

                          TOTAL        1051.2        749.3


          TOTAL SITE ENERGY      1800.43 MBTU     60.0 KBTU/SQFT-YR GROSS-AREA      60.0 KBTU/SQFT-YR NET-AREA

          TOTAL SOURCE ENERGY    3903.08 MBTU    130.1 KBTU/SQFT-YR GROSS-AREA     130.1 KBTU/SQFT-YR NET-AREA


          PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 19.4

          PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED                =  0.0

          NOTE:  ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.
```

8.62 BEPU - Building Energy Performance Summary (Utility Units)

This report is identical to the BEPS report, except that the end use breakdown for each of the energy types is given in the actual units of consumption, such as kWh or therms. In addition, the total *site energy* consumption (TOTAL ELECTRICITY, etc.) is given for each energy type. As in the BEPS report, only end uses with a non-zero yearly consumption are displayed.

For cogeneration plants, the breakdown of energy usage may be substantially different than shown in versions prior to DOE-2.1E. Previously, the energy consumption of end uses in LOADS and SYSTEMS such as lights and HVAC apportioned on a yearly basis. This is because hourly data was not available. In DOE-2.1E, all energy is apportioned hourly. In addition, the report previously did not handle the case where a cogeneration plant is a net power exporter. In DOE-2.1E, surplus power is shown as an additional line item. This report assumes that generated power will first be used to satisfy on-site demands, and that any surplus power will be sold. Site and source energy are reduced by the amount of power sold, with source energy reduction calculated using the source/site conversion ratio specified for electricity in the ENERGY-RESOURCE command in PLANT.

BEPS and BEPU break down pump consumption differently from PS-A. In BEPS and BEPU, pump consumption is shown as auxiliary power. In PS-A, the hot water pump is grouped with heating electrical, and the chilled water pump is grouped with cooling electrical. In addition, PS-A groups heat rejection energy with cooling.

```
REPORT- BEPU  BUILDING ENERGY PERFORMANCE SUMMARY (UTILITY UNITS)                    WEATHER FILE- CZ03RV2 WYEC2
-------------------------------------------------------------------------------------------------------------------


                   ENERGY TYPE:   ELECTRICITY   NATURAL-GAS

                   SITE UNITS:       KWH           THERM

          CATEGORY OF USE

          ---------------

               AREA LIGHTS       945079.          0.

               MISC EQUIPMT      993375.          0.

                SPACE HEAT        37582.      37282.

                SPACE COOL       198705.          0.

               HEAT REJECT        34384.          0.

               PUMPS & MISC       94161.          0.

                 VENT FANS       428504.          0.

               SUPPLMT HEAT          760.          0.

               DOMHOT WATER       215151.          0.

                  EXT MISC       554004.          0.

                                ----------    ----------

                     TOTAL      3501704.       37282.



    TOTAL ELECTRICITY   3501704. KWH       8.182 KWH   /SQFT-YR GROSS-AREA   8.182 KWH    /SQFT-YR NET-AREA

    TOTAL NATURAL-GAS     37282. THERM     0.087 THERM /SQFT-YR GROSS-AREA   0.087 THERM  /SQFT-YR NET-AREA


          PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE =  0.2

          PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED                 =  0.0

          NOTE:  ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.
```

8.63   Economics Reports

8.64   ES-D - Energy Cost Summary

This report summarizes the yearly energy consumption and cost for all UTILITY-RATEs defined.

1.   UTILITY -RATE lists the u-name of each UTILITY-RATE

2.   RESOURCE lists the RESOURCE

3.   METERS lists the meter numbers to which each UTILITY-RATE applies.

4.   METERED ENERGY is the actual energy from PLANT, not adjusted for any minimum energy requirements.

5.   TOTAL CHARGE is total yearly charge.

6.   VIRTUAL RATE is the total yearly charge divided by the metered energy.

7.   RATE USE ALL YEAR is No, the rate was not used for all 12 billing cycles, either because the rate did not qualify all months, the QUAL-SCH was not active all months, or the run period was less than 12 months.

8.   ENERGY COST / GROSS BLDG AREA, ENERGY COST / NET BLDG AREA give the energy cost per unit area. Here, gross building area is the value of the keyword GROSS-AREA in the BUILDING-LOCATION command in LOADS. GROSS-AREA defaults to the net building area, which is the sum of the floor areas of the conditioned zones.

The program does a check to ensure that all energy passed from PLANT is accounted for in one or more UTILITY -RATEs. If not, or if double counting of energy has occurred, a warning will be printed at the bottom of this report.

```
REPORT- ES-D  ENERGY COST SUMMARY
-----------------------------------------------------------------------------------------------------------------

                                              METERED         TOTAL      VIRTUAL
                                              ENERGY          CHARGE       RATE      RATE USED
UTILITY-RATE       RESOURCE         METERS    UNITS/YR         ($)        ($/UNIT)   ALL YEAR?
---------------    ----------------  ----------  -------------------  ----------  ----------  ---------
E-19-OFF           ELECTRICITY         1         3327206. KWH        431039.      0.1295       YES
E-19-RTL           ELECTRICITY         2          174490. KWH         26698.      0.1530       YES
G-NR1-OFF          NATURAL-GAS         1           37282. THERM       19783.      0.5306       YES
G-NR1-RTL          NATURAL-GAS         2               0. THERM         161.      0.0000       YES
                                                                    ==========
                                                                      477681.


                                  ENERGY COST/GROSS BLDG AREA:     1.12
                                    ENERGY COST/NET BLDG AREA:     1.12
```

8.65   ES-E - Summary Of Utility-Rate for <rate>

This report summarizes the key costs for each UTILITY-RATE. The top of the report contains general information regarding the UTILITY-RATE as input by he user or defaulted. The remainder of the report summarizes costs by month.

1.   MONTH is the billing period ending with the BILLING-DAY.

2.   METERED ENERGY is the energy in the meters as passed by the plant program.

3.   BILLING ENERGY is the energy used for billing purposes. This amount may be greater than the metered energy is a minimum energy qualifier is used. This amount will be 0.0 if the UTILITY-RATE did not qualify for this month.

4.   METERED DEMAND is the maximum demand in the meters in this billing period as passed by the PLANT program. The value will be either the hourly or daily demand as specified by the DEMAND-WINDOW.

5.   BILLING DEMAND is the demand used for billing purposes. This amount may be either greater or less than the metered demand depending on the minimum demand qualifier and/or ratchets. This value will be 0.0 if the UTILITY-RATE did not qualify for this month.

6.   ENERGY CHARGE are all energy charges, including BLOCK-CHARGEs.

7.   DEMAND CHARGE are all demand charges, including BLOCK-CHARGEs.

8.   ENERGY CST ADJ are the enrage cost adjustment.

9.   TAXES are the sum of per unit and percentage taxes.

10.   SURCHARGES are the sum of per unit and percentage surcharges

11.   FIXED CHARGE are the month MONTH-CHUGS defined by the user.

12.   MINIMUM CHARGE is the minimum monthly charge as determined by the MIN-MON-CHG or the MIN-MON-DEM-CHG.

13.   VIRTUAL RATE is the total charge divided by the metered energy. The rate should not exceed the RATE-LIMITATION plus fixed charges.

14.   TOTAL CHARGE is the sum of all charges.

```
REPORT- ES-E  SUMMARY OF UTILITY-RATE:  E-19-OFF


--------------------------------------------------------------------------------------------------------------------

UTILITY-RATE:  E-19-OFF              RESOURCE:  ELECTRICITY        DEMAND-WINDOW:  HOUR                 3413. BTU/KWH

                                    METERS:  1                    BILLING-DAY:  31          RATE-LIMITATION:   0.0000

                                    POWER-FACTOR:  0.80      EXCESS-KVAR-FRAC:  0.30       EXCESS-KVAR-CHG:   0.0000

RATE-QUALIFICATIONS                 BLOCK-CHARGES                          DEMAND-RATCHETS      MIN-MON-RATCHETS

------------------------------      ----------------------------------    ---------------      ---------------

   MIN-ENERGY:        0.0              S-ON-PEAK

   MAX-ENERGY:        0.0              S-MID-PEAK

   MIN-DEMAND:        0.0              S-OFF-PEAK

   MAX-DEMAND:        0.0              W-MID-PEAK

QUALIFY-RATE:    ALL-MONTHS           W-OFF-PEAK

USE-MIN-QUAL:         NO


        METERED    BILLING   METERED   BILLING   ENERGY   DEMAND   ENERGY                      FIXED  MINIMUM  VIRTUAL    TOTAL
```

MONTH	ENERGY KWH	ENERGY KWH	DEMAND KW	DEMAND KW	CHARGE ($)	CHARGE ($)	CST ADJ ($)	TAXES ($)	SURCHRG ($)	CHARGE ($)	CHARGE ($)	RATE ($/UNIT)	CHARGE ($)
JAN	265187	265187	1095.2	1095.2	18084	6790	0	0	0	175	0	0.0945	25050
FEB	240043	240043	1062.0	1062.0	16381	6584	0	0	0	175	0	0.0964	23140
MAR	275969	275969	1088.3	1088.3	18885	6748	0	0	0	175	0	0.0935	25808
APR	278766	278766	1153.6	1153.6	19141	7152	0	0	0	175	0	0.0949	26469
MAY	269154	269154	1209.2	1209.2	20941	23381	0	0	0	175	0	0.1653	44497
JUN	292806	292806	1259.2	1259.2	23001	24462	0	0	0	175	0	0.1627	47638
JUL	298909	298909	1202.3	1202.3	23424	23194	0	0	0	175	0	0.1565	46793
AUG	293219	293219	1218.0	1218.0	22884	23516	0	0	0	175	0	0.1588	46575
SEP	302806	302806	1271.5	1271.5	23744	24622	0	0	0	175	0	0.1603	48541
OCT	287639	287639	1258.3	1258.3	22385	24166	0	0	0	175	0	0.1624	46726
NOV	250583	250583	1157.4	1157.4	17060	7176	0	0	0	175	0	0.0974	24411
DEC	272127	272127	1063.9	1063.9	18619	6596	0	0	0	175	0	0.0933	25391
TOTAL	3327206	3327206	1271.5		244550	184388	0	0	0	2100		0.1295	431039

8.66   ES-F - Block-Charges And Ratchet Summary

For each UTILITY-RATE this report summarizes the costs associated with each BLOCK-CHARGE, and monthly RATCHET values. The summary varies somewhat for energy and demand BLOCK-CHARGES.

1.   BLOCK CHARGES lists the u-name of each BLOCK-CHARGE.

2.   JAN, Feb, etc. Is the billing period ending at the BILLING-DAY of the parent UTILITY-RATE.

3.   METERED ENERGY is the metered energy as passed to the BLOCK-CHARGE from the parent UTILITY-RATE for each billing period, and as modified by any BLOCK-SCH for actual activity. This value will be less than the value shown for the parent UTILITY-RATE in report ES-E if the BLOCK-CHARGE was not active the whole billing period.

4.   BILLING ENERGY is the enrage used for billing calculations. This value may be larger than the metered energy if a minimum energy qualifier is used. In addition, when costs are to be prorated between two blocks sharing the same billing period (i.e, when the season changes), this value is the total energy for the billing period.

5.   PRORATE FACTOR is shown only if a block is not for an entire billing period. It is the multiplier used to split the costs between two BLOCK-CHARGEs sharing the same billing period. For seasonal changes, it is the ratio of the total hours this BLOC-CHARGE was active to the total hours in the billing period. For seasonal changes involving seasonal or time of use charges, it is the ratio of the total hours this BLOCK-CHARGE was active to the sum of these hours plus the active hours of the other BLOCK-CHARGE.

6.   CHARGES ($) are the charges for the billing period. These charges are based on the billing energy, multiplied by any prorate factor shown.

7.   METERED-DEMAND is the metered demand as passed to the BLOCK-CHARGE from the parent UTILITY-RATE for each billing period, and as modified by any BLOCK-SCH for actual activity.

8.   BILLING DEMAND is the demand used for billing calculations. This value includes any minimum demands and also ratchets. For time of use blocks sharing a TOU-SEASON-LINK, the demand will be the maximum demand of either block when both share the same billing period.

9.   TOTAL ENERGY is the total billing energy accounted for in all BLOCK-CHARGEs. If this value does not match the quantity shown in report ES-E for the parent UTILITY-RATE, a warning will be printed indicating whether the BLOCK-CHARGEs are undercounting or double counting energy.

10.   TOTAL CHARGES are the total charges for energy and demand BLOCK-CHARGEs.

11.   RATCHETS is the u-name of each RATCHET.

12.   TYPE is the type of peak load calculation defined; the value is either PEAK or AVERAGE.

13.   JAN, FEB, etc. Is the billing period ending on the BILLING-DAY. For each billing period, the value of the ratchet is listed. The user should review these values carefully to ensure that the ratchet is functioning as intended.

```
REPORT- ES-F  BLOCK-CHARGE AND RATCHET SUMMARY FOR:  E-19-OFF
---------------------------------------------------------------------------------------------------------------------------
 UTILITY-RATE: E-19-OFF

     RESOURCE: ELECTRICITY

 ENERGY-UNITS: KWH

 DEMAND-UNITS: KW

 DEMAND-WINDOW: HOUR


 BLOCK-CHARGES             JAN    FEB    MAR    APR    MAY    JUN    JUL    AUG    SEP    OCT    NOV    DEC    YEAR
```

```
-------------------------  ------- ------- ------- ------- ------- ------- ------- ------- ------- ------- ------- ------- -------
S-ON-PEAK      USE: TIME-OF-USE
        METERED ENERGY:       0       0       0       0  111184  125414  127083  123012  128958  118862       0       0
        BILLING ENERGY:       0       0       0       0  111184  125414  127083  123012  128958  118862       0       0  734513
        METERED DEMAND:     0.0     0.0     0.0     0.0  1209.2  1259.2  1202.3  1218.0  1271.5  1258.3     0.0     0.0
        BILLING DEMAND:     0.0     0.0     0.0     0.0  1209.2  1259.2  1202.3  1218.0  1271.5  1258.3     0.0     0.0
        ENERGY CHGS($):       0       0       0       0   11018   12428   12594   12190   12780   11779       0       0   72790
        DEMAND CHGS($):       0       0       0       0   19226   20021   19117   19366   20218   20008       0       0  117955
         TOTAL CHGS($):       0       0       0       0   30245   32449   31710   31557   32997   31787       0       0  190745
S-MID-PEAK     USE: TIME-OF-USE
        METERED ENERGY:       0       0       0       0  105499  118674  119110  113986  121331  113191       0       0
        BILLING ENERGY:       0       0       0       0  105499  118674  119110  113986  121331  113191       0       0  691791
        METERED DEMAND:     0.0     0.0     0.0     0.0  1122.8  1200.4  1102.1  1121.5  1190.4  1124.0     0.0     0.0
        BILLING DEMAND:     0.0     0.0     0.0     0.0  1122.8  1200.4  1102.1  1121.5  1190.4  1124.0     0.0     0.0
        ENERGY CHGS($):       0       0       0       0    6924    7789    7817    7481    7963    7429       0       0   45402
        DEMAND CHGS($):       0       0       0       0    4154    4441    4078    4150    4405    4159       0       0   25387
         TOTAL CHGS($):       0       0       0       0   11078   12230   11895   11630   12368   11587       0       0   70789
S-OFF-PEAK     USE: TIME-OF-USE
        METERED ENERGY:       0       0       0       0   52470   48718   52716   56221   52516   55586       0       0
        BILLING ENERGY:       0       0       0       0   52470   48718   52716   56221   52516   55586       0       0  318227
        ENERGY CHGS($):       0       0       0       0    2999    2784    3013    3213    3001    3177       0       0   18187
W-MID-PEAK     USE: TIME-OF-USE
        METERED ENERGY:  195712  177903  207946  214319       0       0       0       0       0       0  183100  204879
        BILLING ENERGY:  195712  177903  207946  214319       0       0       0       0       0       0  183100  204879 1183859
        METERED DEMAND:  1095.2  1062.0  1088.3  1153.6     0.0     0.0     0.0     0.0     0.0     0.0  1157.4  1063.9
        BILLING DEMAND:  1095.2  1062.0  1088.3  1153.6     0.0     0.0     0.0     0.0     0.0     0.0  1157.4  1063.9
        ENERGY CHGS($):   14130   12845   15014   15474       0       0       0       0       0       0   13220   14792   85475
        DEMAND CHGS($):    6790    6584    6748    7152       0       0       0       0       0       0    7176    6596   41047
         TOTAL CHGS($):   20921   19429   21761   22626       0       0       0       0       0       0   20396   21389  126522
W-OFF-PEAK     USE: TIME-OF-USE
        METERED ENERGY:   69475   62140   68023   64446       0       0       0       0       0       0   67483   67248
        BILLING ENERGY:   69475   62140   68023   64446       0       0       0       0       0       0   67483   67248  398815
        ENERGY CHGS($):    3954    3536    3871    3668       0       0       0       0       0       0    3840    3827   22697
                         ======= ======= ======= ======= ======= ======= ======= ======= ======= ======= ======= ======= =======
          TOTAL ENERGY:  265187  240043  275969  278766  269154  292806  298909  293219  302806  287639  250583  272127 3327206
     TOTAL CHARGES ($):   24875   22965   25633   26294   44322   47463   46618   46400   48366   46551   24236   25216  428939
```

9   VisualDOE File Formats

As you define your building using VisualDOE and make DOE-2 simulations, a variety of files are created, each containing information about your project. The files all begin with the up to eight character name you used to identify your project, e.g. "MyJob." The file extension tells you the type of information contained in the file. Files types are summarized below and discussed in greater detail in the paragraphs that follow.

	Created with **VisualDOE**	Created with **VisualPlant**
Project Files	MyJob.gph	MyJob.plt
IP Template	MyJob.g**IP**	MyJob.ptt
SI Template	MyJob.g**SI**	MyJob.ptt
INPut Files	MyJob.**I**xx	MyJob.**N**xx
BDL Files	MyJob.**B**xx	MyJob.**D**xx
OUTput Files	MyJob.**O**xx	MyJob.**U**xx
CHW **Se**nsitivity	MyJob.Sxx	MyJob.**U**xx
Hourly **R**eport Files	MyJob.**H**xx	MyJob.**R**xx
Batch File	MyJob.BAT	MyJob.BAT
Project Log file	MyJob.LOG	MyJob.LOG
VisualDOE Error File	Errors.Log	Errors.Log

The **Project Files** have the extensions GPH when created through VisualDOE and PLT when created with the Plant Only Runs program module. These are binary files that contain all the information you entered through VisualDOE. These files also include a summary of the simulation results so that VisualDOE reports can be generated. These files may only be opened by VisualDOE.

Input files (INP) are created for your base case and for each alternative. Input files created through VisualDOE have the extension "I" followed by numeric characters "xx". When created by the Plant Only Runs program module, the extension is "N" followed by numeric characters. The numeric characters indicate the base case or alternative. The base case is "0." The first alternative (as it appears in the alternatives pull down menu or list box) is "1", the second is "2", the twelfth is "12", etc. These files contain the information that is processed by DOE-2 to perform the simulation. The input files are text files that you can open, review, and modify with a text editor. These files are created by VisualDOE. If you are new to DOE-2 or have only used it with VisualDOE, you should not modify these input files.

The **Building Design Language (BDL)** files contain similar information as the input files. However, these files are produced by DOE-2 after the INP files is read and contains some diagnostic information that you should review in evaluating your results. These are text files that can be opened and reviewed by any text processor. When reviewing, it is a good idea to search through the file for the text "WARNING" and/or "CAUTION". Review these messages if they exist to determine if there is a possible problem. If your simulation fails, the BDL file will also contain "ERROR" messages that you should review to determine the nature and cause of the failure.

When your simulation is successful, one or more **Output (OUT) Files** will be created. These contain the results of your simulations. The output files are text files created by DOE-2. You can look at them and print them out using any text processor. For best results choose an 8 point non-proportional font such as

Courier and print in landscape mode. The DOE-2 reports that are included in the output files depend on what you selected in Simulation|Setup. These files can become quite large, especially if you call for a great number of reports, so you will need to watch disk space.

MyJob.BAT is a batch file which runs DOE-2 with the weather file you selected. This file is created by VisualDOE each time you choose Simulation|Setup. If you need to repeat the simulation, you can run this batch file. If you make a run outside of VisualDOE, however, the VisualDOE project file will not be updated with the results.

MyJob.LOG is a log of all the simulations you have made or attempted to make for the project. This file gives the time required for each part of the simulation and will report other problems.

The **Errors.Log** file is created when program errors occur. This file is not project specific, it includes errors that occurred with any project run with the installation of the program.

10 Calibrating to Billing History

There are many reasons why the energy predicted in your base case model may not match the billing history. This help topic presents some common patterns of deviation between monthly data and simulation results. For each pattern, some suggestions are offered on how to better calibrate the base case model.

Pattern A

With this pattern, both peak electricity (kW) and gas use (therms) predicted by the simulation tool agree reasonably well with the billing history. However, electricity use predicted by the simulation tool is high relative to the billing history.

Possible Remedy

Adjust the simulation schedules to increase lighting and equipment hours at nights and weekends. This is a common problem with using the ASHRAE schedules, since they frequently under-predict off-hours lighting and equipment use.
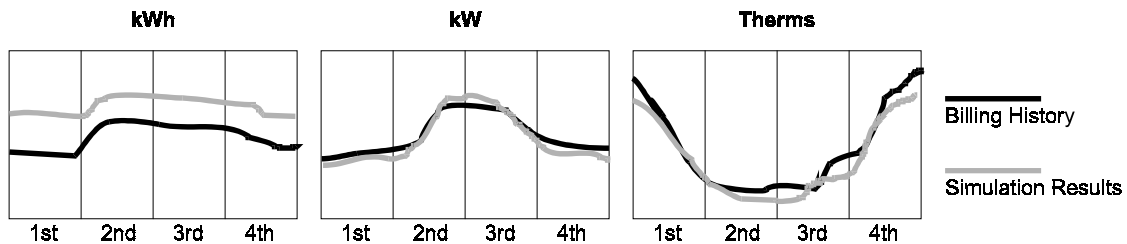
Pattern B

This is the opposite of Pattern A. Both peak electricity (kW) and gas use (therms) predicted by the simulation tool agree reasonably well with the billing history. However, electricity use predicted by the simulation tool is low relative to the billing history.

Possible Remedy

Adjust the simulation schedules to reduce lighting and equipment hours at nights and weekends.
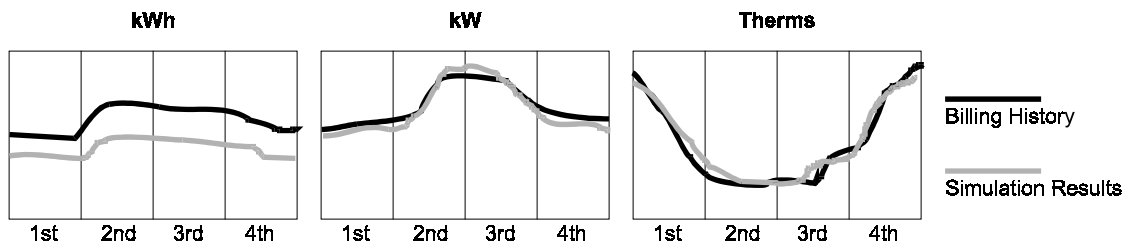
Pattern C

Both electric energy and demand predicted by the simulation tool are higher than the billing history, but predicted gas use is lower than the billing history.

Possible Remedy

Reduce lighting and/or equipment power in the simulation model. This will reduce electric energy and demand, reduce cooling loads and increase heating loads (as internal gains are reduced).

Pattern D

This is the opposite of Pattern C above. Both electric energy and demand predicted by the simulation tool are lower than the billing history, but predicted gas use is higher than the billing history.

Possible Remedy

Increase lighting and/or equipment power in the simulation model. This will increase electric energy and demand, increase cooling loads and reduce heating loads (as internal gains are increased).
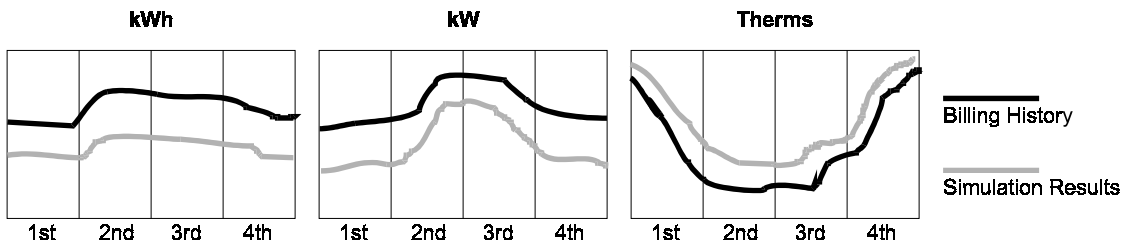
Pattern E

With this pattern, gas use predicted by the simulation tool agrees reasonably well with the billing history, but both kW and kWh are high during the summer months. In the winter, kW and kWh agree with the billing history.

Possible Remedy

Increase the efficiency of the cooling equipment in the simulation model. Check the performance data for the equipment in the model.
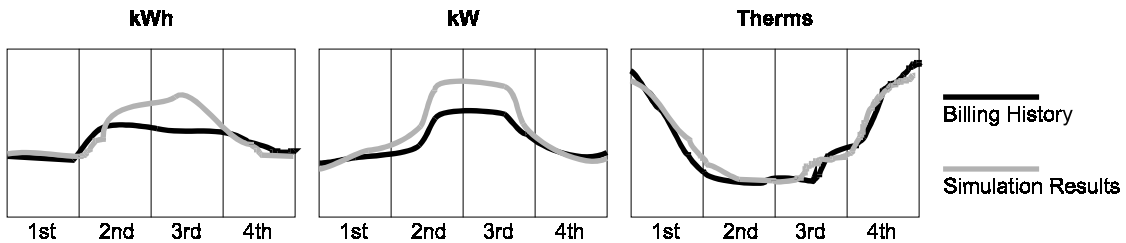
Pattern F

Both electric energy and demand predicted by the simulation model are high in the winter, but in reasonable agreement in the summer. Predicted gas use is relative constant throughout the year while the billing history is higher in the winter.

Possible Remedy

The simulation model has electric space heat while the actual building has gas heat. Check building survey information.

kWh | **kW** | **Therms**

1st 2nd 3rd 4th | 1st 2nd 3rd 4th | 1st 2nd 3rd 4th

Billing History

Simulation Results
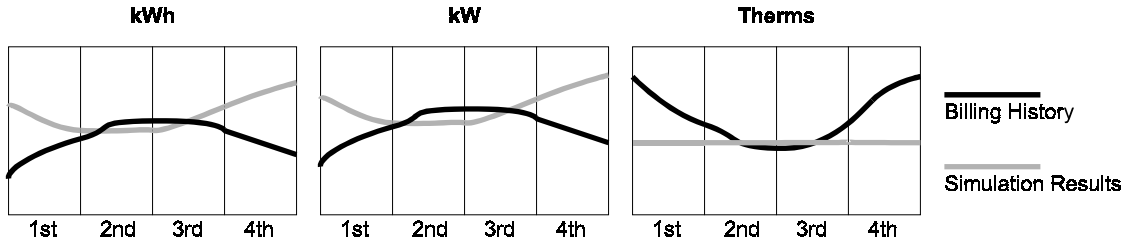
Pattern G

The billing history shows flat kWh and kW throughout the year while the simulation tool predicts significantly lower kW and kWh in the winter. The simulation tool predicts less gas use in reasonable agreement with the billing history.

Possible Remedy

An air economizer is operating in the simulation model, but it either does not exist or is malfunctioning in the actual building.

kWh | **kW** | **Therms**

1st 2nd 3rd 4th | 1st 2nd 3rd 4th | 1st 2nd 3rd 4th

Billing History

Simulation Results
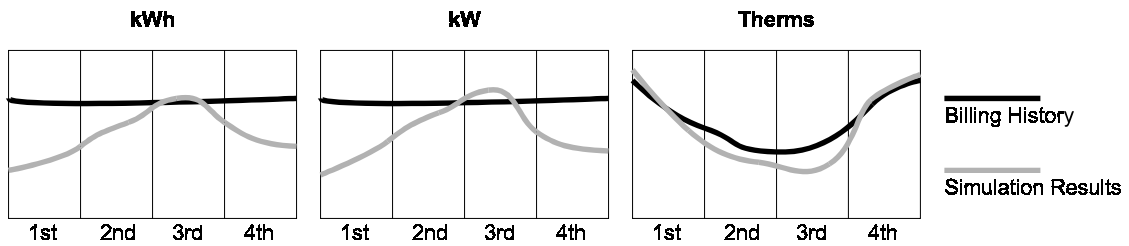
Pattern H

The simulation tool under predicts both electric energy and demand, but gas use is in reasonable agreement.

Possible Remedy

Check to see that all electric energy uses are included in the model. In particular look at elevators, exterior lights, etc.

kWh | **kW** | **Therms**

1st 2nd 3rd 4th | 1st 2nd 3rd 4th | 1st 2nd 3rd 4th

Billing History

Simulation Results
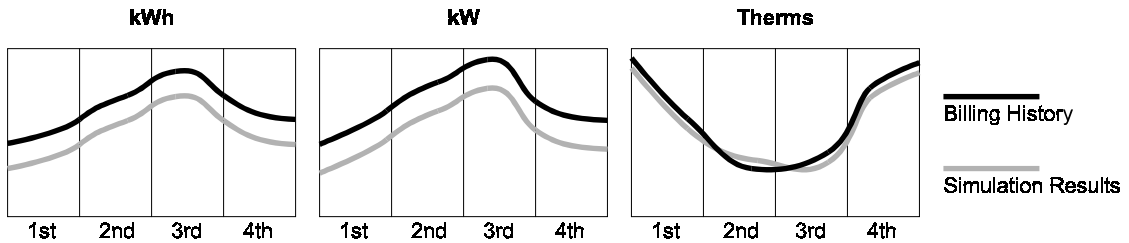
Pattern I

Electric energy and demand are in good agreement, but the simulation tool predicts less gas use than indicated by the billing history. The difference is fairly uniform throughout the year.

Possible Remedy

Water heating energy or other "constant" gas uses are being under-predicted. Adjust the efficiency of the water heating equipment, adjust the peak water heating use or adjust the schedule for water heating consumption.
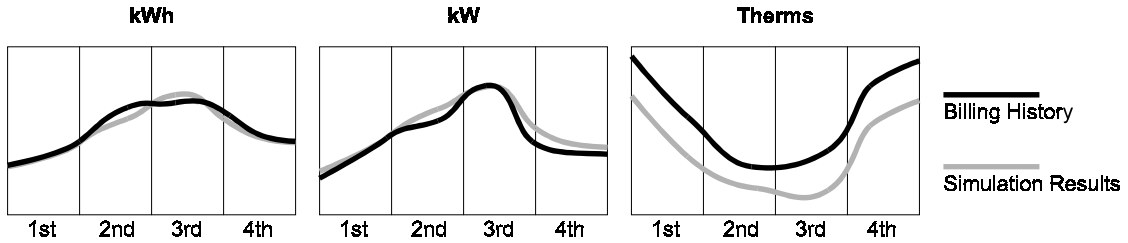
Pattern J

Gas use predicted by the simulation tool agrees with the billing history, but the tool under-predicts both electric energy and demand. The differential is greater in the summer.

Possible Remedy

The cooling capacity in the simulation model may be undersized. Check to see that loads are being satisfied for all periods of time.
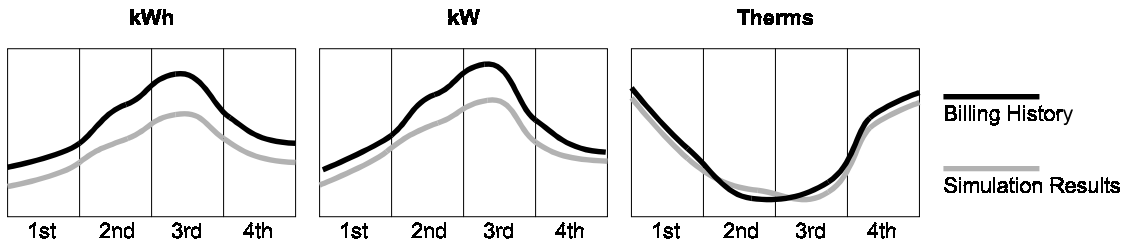
Pattern K

The simulation model under-predicts gas use, more in the winter than in the summer. The model also under-predicts both kW and kWh. The kWh differential is greater in the winter.

Possible Remedy

Check to see if the heating equipment in the model is adequately sized. Undersized equipment would explain this pattern.
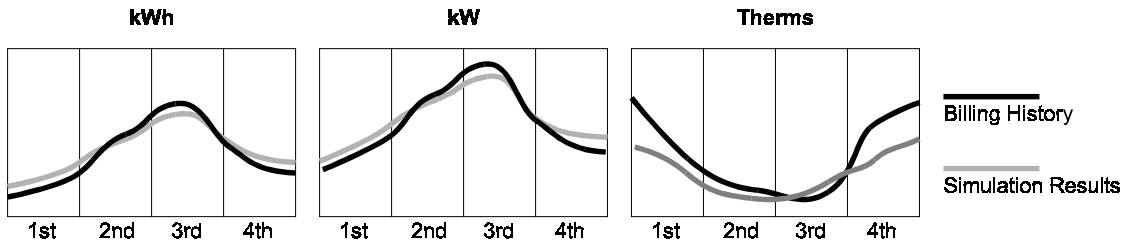
Pattern L

The simulation model predicts electric energy and demand fairly well in the summer months, but under-predicts in the winter. The model over-predicts gas use throughout the year, with the differential increasing in the winter month.

Possible Remedy

Check the heating system in the model. It appears that the building might be all electric, while the model has a gas heating system.

kWh

kW

Therms

1st 2nd 3rd 4th

1st 2nd 3rd 4th

1st 2nd 3rd 4th

Billing History

Simulation Results
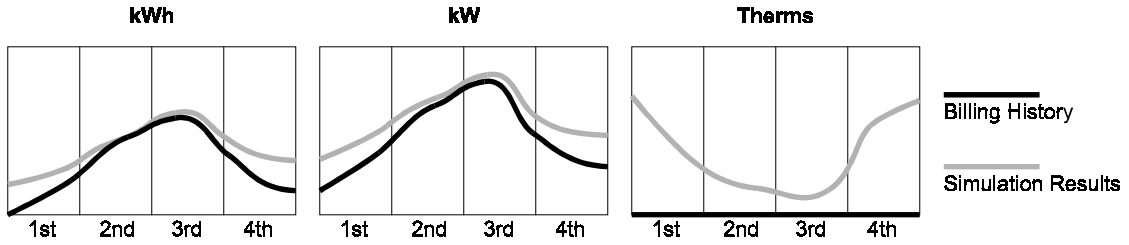
Pattern M

kWh, kW and Gas are too low in summer, but these agree with the billing history in the winter .

Possible Remedy

The reheat energy may be too low. The correct this, either lower the cooling supply air temperature, increase the minimum on the VAV boxes or change the supply air temperature reset schedule.

kWh

kW

Therms

1st 2nd 3rd 4th

1st 2nd 3rd 4th

1st 2nd 3rd 4th

Billing History

Simulation Results
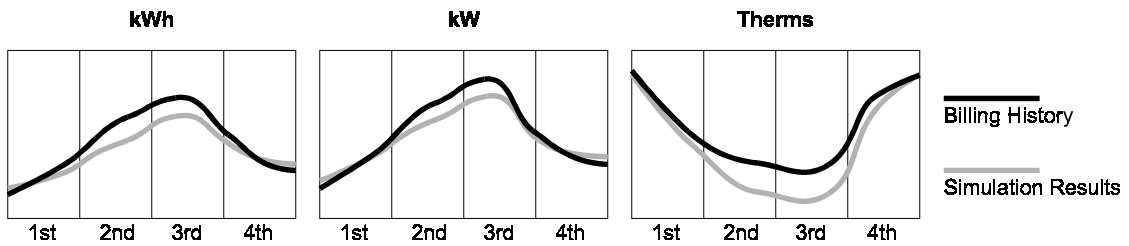
11 VisualDOE FAQ

11.1   Installation

Do I have to install all the programs?

No, you can install individual programs as and when needed. You can also uninstall individual programs without affecting other installed programs.

How do I install the programs to a different directory?

The main setup program installs all the files in the 'C:\Program Files\GDT\' directory. To change the location of these programs you'll have to run the setup programs individually from their respective folders on the CD. This will give you the option to select a different installation path for each program.

How do I uninstall the programs?

The programs can be uninstalled using the 'Add/Remove Program' option on your computer. You can access it by going through 'Start|Settings|Control Panel' on your 'Task Bar' and clicking on 'Add/Remove Program'. All the programs installed by Green Design Tools will be listed in the 'Install/Uninstall' list. Select the program to uninstall and click on 'Add/Remove' button to uninstall it. This will remove all the files related to the program except for the project/data files that you have created. To remove those files you'll have to delete the 'Projects' folder from the installed directory.

The installation seems to run all right, but some of the programs don't get installed.

The main installation program (InstallAll.exe) is not able to run the individual setup programs. Exit the main installation and run the individual installations (Setup.exe) from their directories on the CD.

I get an error message "Cant copy iKernel…" when I run the main installation program.

The main installation program (InstallAll.exe) is not able to run the individual setup programs. Exit the main installation and run the individual installations (Setup.exe) from their directories on the CD.

Do I have to uninstall previous versions of VisualDOE 2.5?

No, the previous version of VisualDOE does not need to be uninstalled. It is recommended that you retain the old version of the program to continue working on projects that were created using VisualDOE 2.5.

I get an error when I install/run/reboot on a computer running 'Windows 2000'?

You have to log in as the 'Administrator' on a 'Windows 2000' or a 'Windows NT' system to be able to install and use the programs. 'Green Design Tools' programs update the Windows registry every time you run them. The user needs to have the right to write to the registry in order to run the program.

Can I install the programs on a 'Windows NT' system?

Although the 'Green Design Tools' programs have been tested successfully on a barebones 'Windows NT' system, it is recommended that you upgrade to 'Windows 2000'. Some software installed on your computer may interfere, or not run correctly after installing 'Green Design Tools' programs. If you do want to test the program on a 'Windows NT' system, run the GDT installation from the individual folders on the 'Green Design Tools' CD. After installation finishes and before you reboot the machine, reinstall the latest service pack for 'Windows NT'.

My Windows NT system crashes after installing Green Design Tools.

Refer to the previous FAQ about NT system installation. Follow these steps to restore your Windows NT system:

1.   Use the Windows NT Setup Disks to reboot your machine.

2.   When prompted to select the installation mode, select Repair NT and follow the instructions, answer "YES to ALL" when prompted to replace files

3.   After repairing Windows NT, re-apply the current service pack

4.   Register all files in 'C:\Program Files\GDT\Shared' directory.

Why are all the component sizes listed as '0' in the setup program?

The main installation program (InstallAll.exe) has a reference to all the other installations. Due to limitations of the installation software the correct sizes of the referenced setup programs can't be displayed. The program description on the form does give you an approximate installed size for each program.

11.2   Project

What is TMY2 weather data?

The TMY2s are data sets of hourly values of solar radiation and meteorological elements for a 1-year period. They represent a typical meteorological year (TMY) and are derived from the 1961-1990 National Solar Radiation Data Base (NSRDB). They are based on more recent and accurate data and will make possible more accurate performance and economic analyses of energy systems, these data sets are recommended for use in place of earlier TMY data sets derived from the 1952-1975 SOLMET/ERSATZ data base.

I can't see the weather file for my location in the climate list.

The weather files are on the 'Green Design Tools' CD under the 'Weather' subdirectory. Copy the files that you want to the 'Green Design Tools' weather directory (the default path is 'C:\Program Files\GDT\Weather'). When launched, VisualDOE reads and displays all the weather files in the 'Weather' directory. You can rename weather files for ease of recognition.

How can I view the weather data?

Weather statistics can be viewed using the 'Climate Editor' from the 'Tools' menu in VisualDOE 3.0.

Where can I get other weather files?

Weather data sources http://gundog.lbl.gov/dirsoft/d2weather.html

Can I modify the weather data?

UNPACKED WEATHER FILE (*.FT) FORMAT

The data required by the DOE2 weather processor is listed below. The first three lines of the file contain different information from the rest of the file. Note that the file is in fixed width format, which means that each variable must be located at the correct position in the row. See the end of this document for a portion of an example California file.

RECORD 1	IWDID,IWYR,WLAT,WLONG,IWTZN,IWSOL	FORMAT (5A4,I5, 2F8.2, 2I5)
RECORD 2	(CLN (I), I=1,12)	FORMAT (12F6.2)
RECORD 3	(GT (I), I=1,12)	FORMAT (12F6.1)
IWDID	LOCATION I.D.	Any name -- may be up to 20 characters.
IWYR	YEAR	For identification only.
WLAT	LATITUDE	In degrees and fractions to two decimal places. Positive for northern latitudes and negative for southern.
WLONG	LONGITUDE	In degrees and fractions to two decimal places, i.e. ###. ## Positive for locations west of Greenwich, and negative for locations east of Greenwich.
IWTZN	TIME ZONE NUMBER	(# Of hrs from prime meridian. 5 for Eastern, 8 for Pacific, negative for locations E of meridian)
IWSOL	SOLAR FLAG	IWSOL = IWSZ + (IFTYP-1)*2 - 1
IWSZ	WORD SIZE	1 = 60-BIT, 2 = 30-BIT (use IWSZ = 2)
IFTYP	FILE TYPE	1 = OLD (no longer used), 2 = no solar (need to

		include CLDAMT and ICLDTY), 3 = data includes total horizontal and direct normal solar data. (Either include CLDAMT and ICLDTY or include SOLRAD and DIRSOL. If solar data is included, then CLDAMT and ICLDTY may be set to zero for all hours. Conversely, if solar data is not available, then SOLRAD and DIRSOL must be set to zero.)
CLN	CLEARNESS NO.	Ratio of clear day radiation to average clear day radiation. Should be close to 1.00, may be as high as 1.15.Only used if solar data is not included in weather file. If information is not available, then use 1.00 for each month.
GT	GROUND TEMP.	In degrees Rankine, which is temperature in degrees Fahrenheit above absolute zero (= °F + 459.7). Use format ###.#. Used to calculate heat loss from underground surfaces in DOE2.Typically equal to the average daily air temperature with a time lag of one to two months.

The data following the first threes lines are listed below. This information is required for each hour of the year.

Records 4,8763

KMON, KDAY, KH, WBT, DBT, PATM, CLDAMT, ISNOW, IRAIN, IWNDDR, HUMRAT, DENSTY, ENTHAL, SOLRAD, DIRSOL, ICLDTY, WNDSPD

FORMAT (3I2, 2F5.0,F6.1, F5.0, 2I3,I4, F7.4, F6.3, F6.1, 2F7.1,I3, F5.0)

Field	Column Width
KMON	2
KDAY	2
KH	2
WBT	5
DBT	5
PATM	6
CLDAMT	5
ISNOW	3
IRAIN	3
IWNDDR	4
HUMRAT	7
DENSTY	6
ENTHAL	6
SOLRAD	7
DIRSOL	7
ICLDTY	3
WNDSPD	5

KMON	Month (1-12)
KDAY	Day (1-31)
KH	Hour (1-24), solar time
WBT	Wetbulb temp (°F)
DBT	Drybulb temp (°F)
PATM	Air pressure (in. Hg)
CLDAMT	Cloud amount (0-10) 0 = no clouds, 10 = heavy clouds. Only used if SOLRAD and DIRSOL are not available. Otherwise set to 0.

ISNOW   Snow flag (1=snowfall, 0=no snowfall). This value is not used by DOE2, set to 0 for all hours.

IRAIN   Rain flag (1=rain, 0=no rain). This value is not used by DOE2, set to 0 for all hours.

IWNDDR   Wind direction (0-15, 0=N, 1=NNE,...)

HUMRAT   Humidity ratio (lb/lb of dry air)

DENSTY   Density (lb/ft3)

ENTHAL   Specific enthalpy (btu/lb of dry air)

SOLRAD   Total horizontal solar (btu/hr-ft2). Set to 0 if solar data is not available, then CLDAMT and ICLDTY must be entered.

DIRSOL   Direct normal solar (btu/hr-ft2). Set to 0 if solar data is not available. Then CLDAMT and ICLDTY must be entered.

ICLDTY   Cloud type (0-2). 0 = Cirrus, 1 = Stratus, 2 = average of Cirrus and Stratus (use 2 if type is unknown). Only necessary if SOLRAD and DIRSOL are not available.

WNDSPD   Wind speed (knots)

Below is an example of the beginning of an *.ft file as described above. The actual file must have 8760 hourly records following the 3 initial lines.

```
    CZ12RV2 WYEC274 38.50121.5085
 1.061.051.031.010.990.970.960.981.001.021.041.05
 514.3 512.2 512.0 513.0 517.0 521.0 524.5 526.7 526.9 525.1 521.7 517.8
 1 1 138.39.30.210.01 9 0.0045 0.08014.00.00.02 4.
 1 1 239.40.30.110.00 8 0.0047 0.07914.50.00.02 4.
 1 1 340.40.30.110.00 6 0.0052 0.07915.00.00.02 4.
 1 1 440.40.30.110.01 5 0.0052 0.07915.00.00.02 4.
 1 1 540.40.30.110.00 5 0.0052 0.07915.00.00.02 4.
 1 1 640.40.30.110.00 5 0.0052 0.07915.00.00.02 3.
 1 1 742.42.30.110.01 6 0.0056 0.07916.00.00.02 3.
 1 1 843.43.30.110.00 6 0.0058 0.07916.50.00.02 3.
 1 1 944.44.30.110.00 7 0.0060 0.07917.0 16.01.02 4.
 1 11045.45.30.110.01 8 0.0063 0.07817.5 35.01.02 4.
 1 11145.46.30.110.00 7 0.0060 0.07817.5 50.03.02 4.
 1 11246.46.30.010.00 6 0.0065 0.07818.0 59.03.02 3.
 1 11346.46.30.010.01 5 0.0065 0.07818.0 60.03.02 3.
 1 11447.47.30.010.00 7 0.0068 0.07818.5 53.02.02 3.
 1 11547.47.29.910.00 8 0.0068 0.07818.5 40.02.02 4.
 1 11647.48.29.910.01 9 0.0066 0.07718.5 22.05.02 4.
 1 11747.47.29.910.0011 0.0068 0.07718.52.00.02 4.
 1 11846.47.29.910.0013 0.0063 0.07718.00.00.02 4.
 1 11945.46.29.810.0015 0.0061 0.07817.50.00.02 4.
 1 12044.45.29.810.0015 0.0059 0.07817.00.00.02 6.
 1 12143.44.29.810.0015 0.0056 0.07816.50.00.02 8.
 1 12242.42.29.810.0015 0.0056 0.07816.00.00.0210.
 1 12341.42.29.8 8.0015 0.0052 0.07815.50.00.0210.
 1 12441.42.29.8 7.0015 0.0052 0.07815.50.00.0210.
 1 2 141.42.29.8 6.0015 0.0052 0.07815.50.00.0210.
 1 2 240.43.29.8 7.0015 0.0045 0.07815.00.00.0213.
```

How can I get rid of the message asking me to select a library every time I start VisualDOE?

The library (vdoe3.lib) is referenced by every project (*.gph) and template (*.gSI, *.gIP) in VisualDOE, and if the library path in the file is different from the current location of the library, the dialog box to find it is displayed.

To get rid of the message when you start VisualDOE, follow these steps:

1. Start the program and click on "No" when the prompted to find the library.

2. Select 'File|Save As Template' from the menu.

3. Overwrite the template file standard.gIP.

4. Exit and restart the program.

Why do I get message asking me to select a library VDOELPCD.lib every time I start VisualPlant?

The standard load profile library (vdoeLPCD.lib) is located on the 'Green Design Tools' CD under the 'Library' folder. VisualPlant needs to access this library when launched. To avoid the message at startup, follow these steps:

1. Copy the library (vdoeLPCD.lib) from the CD and paste it in your installation path's (default is C:\Program Files\GDT\)'Shared' folder.

2. Start VisualPlant and select the copied library when "Open vdoeLPCD library" message appears on startup.

3. Exit and restart VisualPlant.

What is a template?

The template contains all the default values for a project. It allows you to save a set of project schedules like constructions, openings and schedules as a template to serve as defaults for new projects. Any project file can be saved as a template. The template saves the defaults and values from the base case, all other cases are ignored. To create a template follow these steps:

1. Set all the defaults for the base case using the 'Edit Defaults' or 'Set as Default' buttons.

2. Copy all the schedule items to the project schedules and remove the ones you don't need.

3. Save the file and then click on 'File|Save As Template' and select a new template file name.

4. Exit the program.

5. The new template is now ready to be used. You can open it by clicking on 'File|New' and select the new template. If you want this template to start up by default when the program is launched, rename it as standard.gIP, replacing the old standard template.

Can I use SI units? Can I switch units for my project?

You can model a building in either SI or IP units. The selection has to be made before you start the project, and can't be changed after that. By default the program is launched in IP mode. To select SI units select an SI template (*.gSI) from the 'File|New' menu.

I am using SI units but the weather data is still in IP units.

DOE-2 does all the calculations in IP units internally even when you select SI units. For this reason, the weather data is always in IP units.

How do I create new alternatives?

1. Select 'Alternative|Define Alternatives' from the program menu

2. Select one of the alternatives from the list. This will be used as the base case for the new alternative.

3. Click on 'Add Alternative …' to create a copy of the selected case.

4. Rename the new alternative and add a brief description.

5. Exit the form.

6. The newly created alternative will become the current case in VisualDOE 3.0. You can switch between alternatives by selecting them from the 'Alternatives' menu.

When I create new alternatives, the case numbers aren't consecutive?

If an alternative is deleted then the ID's of other cases are not reset.

Can I use VisualDOE 2.5 project files with VisualDOE 3.0?

No, VisualDOE 2.5 project files can't be used with VisualDOE 3.0. You should keep the old program installed for working on VisualDOE 2.5 projects.

11.3 Blocks

How do I create a DXF file for importing blocks into VisualDOE?

You can use any CADD program as long as it has the capability to save data as a DXF (ASCII Drawing Exchange Format) file. When using AutoCAD you'll have to save the file as an AutoCAD version 13 DXF file.

1. Create a layer in your CADD drawing file for each block/level you want to import to VisualDOE. Give these layers names that will make sense to you later. An example layer name is 1stFlrZns.

2. On each layer, draw a group of contiguous closed polygons. Each polygon represents a room in your energy model. When you create the closed polygons, make sure that you honor the custom block rules and restrictions.

3. Save your CADD file using an ASCII DXF format. Depending on the units you used to create your CADD drawing, you may want to set a scale factor as you save your DXF file. It is best that the units in your DXF file match the units you are using in VisualDOE, either feet or meters.

I get an error when importing blocks from a DXF file?

The most common errors when importing DXF files are:

- The DXF file format is not compatible with the AutoCAD version 13's DXF format.
- The DXF file does not have any polygons. Make sure the zones were created using the polygon command.
- The scale factor is not set correctly. The maximum size of the block allowed is 30000 ft/m.
- The 'Add All' command may fail when the order in which the polygons are added, creates surfaces that are not contiguous. In this case you'll have to add the polygons individually.

I am running into an 'Assertion failed:(area*tot_angle>0)[] (abs(abs(tot_angle>-M_PI*2.0)>0.0001),file poly.cpp line 229) ' error when I run the simulation.

This error occurs if the vertices in the custom block(s) are not correctly snapped. This creates vertices that are not perfectly aligned. To fix this error create a backup of the current project, then edit each of the custom blocks to see if the vertices are perfectly aligned and snapped.

If you can't find it visually, try deleting blocks/zones one at a time and running the model. If it runs after a particular block/zone is deleted then you can fix the problem or redraw the block.

How do I copy and paste blocks?

VisualDOE's 'Edit' menu has 'Copy Block' and 'Paste Block' items, which get enabled when you are on the 'Blocks' folder and a block is selected. Select a block from the list and click on the relevant menu items to copy and paste.

How can I put several blocks on the same level?

When adding a new block, VisualDOE prompts you to select a level for it. If you want to add the new block on the same level as an existing block, make sure you the new block doesn't overlap any other existing blocks on the same level.

You can reposition a block by changing the X and Y coordinates on the block folder. The block can also be moved in the custom block editor by selecting the 'Move Block' tool. If several blocks are to be added to the same level then you should reposition the existing blocks before adding a new one.

I have input a floor multiplier but I don't see the extra blocks in the blocks list?

When a floor multiplier is entered at the block level, the DOE-2 multiplies the energy use of that block. VisualDOE ensures that the surface areas for roofs, floors and walls are written correctly in the DOE-2 input file. If for example you have a single block with a floor multiplier of 3, VisualDOE will create a roof with 1/3 the area of the current roof and a multiplier of 3 for the space it belongs to. This ensures that when the simulation is run, the roof area is modeled correctly.

What is the difference between a floor and an interior floor?

Floor: Lowermost floor of the building

Int. Floor: Interior floor between floors in the building.

Roof: Roof on the topmost floor.

Ceiling: Internal ceiling in the building.

All of these properties may not be required, but they are assigned for each block.

How do I create a roof?

The program figures out which blocks have exposed roofs and floors when the simulation is run. For example if there is another room above a room, then the surface between them is created as an "interior floor", if not, a roof is created.

If block is on the lower floor why do I still have to select a roof construction?

The program figures out which blocks have exposed roofs when the simulation is run. If there is another block above, then the surface between them is the "interior floor" input for the block above. If a block has no exposed roof then the roof construction input is not used.

Can I create sloping roofs?

VisualDOE is not capable of creating sloping roofs right now. You will have to make that change to the input file using DOE-2 keywords.

What is a plenum?

The space between the ceiling of one floor and the surface of the floor above. HVAC ducts, VAV boxes, pipes, lighting fixtures and other building equipment is generally located in the plenum space. HVAC systems with air distribution can use the plenum for returning air to the fan system.

How do I move a block to another location?

You can reposition a block by changing the X and Y coordinates on the block folder. The block can also be moved in the custom block editor by selecting the 'Move Block' tool. If several blocks are to be added to the same level then you should reposition the existing blocks before adding a new one.

When I combine several blocks to make a building, does the program know when two sides are adjacent to each other to model it as an internal zone or do I need to indicate that somewhere?

When two blocks are adjacent to each other the common surface is still modeled as an exterior wall in VisualDOE. You'll have to specify an adiabatic construction to these surfaces in order to model them accurately. Create a new construction with a very high R- value (R 1000 will do) and assign it to the common walls of both the blocks. You should also make sure that there are no openings on these surfaces.

No blocks are created when I drop a standard block.

The default zoning is set to "Custom Block". This allows only custom blocks to be added to the model. Change the default zoning to Interior/Perimeter by editing the default block.

11.4   Facades

How do I model window shading?

Shading can be specified for each opening in the project schedule. The editing form for the opening has the options for specifying both interior and exterior shades. The shading only applies to the selected opening and does not shade any walls or other surfaces.

You can also model building shading due to adjacent buildings, trees or louvers by selecting 'Exterior Shading' form the 'Edit' menu in VisualDOE.

The program seems to respond very slowly when I change façade selection or switch tabs in the program.

The 'Plan View' in VisualDOE regenerates every time a new selection is made, this might be a slow process for complicated models, or when running the program on slow computers. You can turn off the automatic regeneration of the 'Plan View' by changing the option from the 'Tools|Options|Plan View Options' menu.

I can't select an opening from the 'Openings Schedule' displayed in the 'Custom Façade Editor'.

The openings are selected by double-clicking on the image in the 'Openings Schedule'. If you are having difficulty selecting an opening, click on the slider bar under to center the opening in the display.

11.5 HVAC Systems

Where do I specify reheat?

Reheat is specified at the zone level. Select a zone on the zones folder and specify the reheat temperature and source. Make sure the control zone for the system has reheat specified.

Can I model Heat Recovery for Exhaust air (exhaust fan)?

Heat recovery can be modeled only for return air.

How do I model Heat Recovery?

You may add heat recovery to a system by checking Heat Recovery in the 'Systems Features' frame of the 'HVAC System Editor'. Heat recovery coils are shown on the system diagram connecting the exhaust air stream with the outside air supply stream. To bring up this form, click on the heat recovery coils. Only one input is needed for heat recovery, the heat exchanger effectiveness. This is the ratio of energy exchanged to that, which would occur if the return air were cooled to the outside air conditions.

I have a number of packaged VAV air-handling units I am attempting to model. Each unit has a water-cooled condenser section. Visual DOE asks to define the closed cooling tower for each VAV unit. Is this creating x number of cooling towers or does the program know that they are all tied into one?

VisualDOE allows the condenser pump inputs to default in this case. The flow (gpm) is based on 10F delta T. The efficiency of pumps and motors are also defaulted. You can check the SS-P output report for sizing information about the condenser pump.

How does Visual DOE model the condenser water pumps serving the towers? Chilled water pump information is entered for the tower/chiller configuration - but the condenser pumps are not defined.

For condenser pumps serving central plants (chillers), the information is entered on the chiller form on the "Condenser" tab.

I am modeling an AHU that serves say 10 zones. Six zones are 24-hr spaces and require a fan operating constantly .Four zones are on a regular office schedule, requiring fan operation 7 AM to 6 PM. How does DOE model this if the system is a VAV with reheat boxes?

The air handler operates on a single fan schedule from the occupancy type selected in the 'HVAC System' form. The thermostat schedule for each zone comes from the occupancy selected on the 'Rooms' folder. Therefore, you can have zones on different thermostat schedules served by the same air handler. In the 7 AM to 6 PM zones, you can set the cooling temperature up to 99 at night, but you would have to set the minimum flow fraction to 0 if you wanted to complete shut off those zones. Otherwise it will operate at minimum flow at night.

Sometimes it is necessary to break up the air handler into two systems so that different fan schedules can be used for each set of zones.

How does the minimum flow ratio in the Zone folder affect the outside air quantities?

The outside airflow input will take precedence. If you choose a minimum flow lower than the outside air input (either based on cfm/person or other means), then DOE-2 overrides the minimum zone flow so that it does not drop below the ventilation rate.

DOE-2 is not the best tool to use for autosizing. It gives a good approximate figure (depending on the system type), but you must go back and look at the zone temperatures to check for yourself how successfully it autosized the equipment. Also the sizing is based on cooling loads.

System-level heating and cooling equipment sizes are listed in the Systems Summary Report in kBtuh for most system types. Unlike zone loads, system sizes do consider outside air load and both heating and cooling indoor design temperatures, but they are based on the non-coincident peak load, i.e. the sum of the zone peaks and not on the building peak load (coincident peak load). These sizes also account for fan heat. System sizes are adjusted to ARI conditions (ARI conditions are different for air-cooled DX equipment than for other types of equipment.) System sizes also include any oversizing ratios you may have specified.

If you have only one system in your building and the fan is VAV (minimum flow ratio < 1) then you can override the default and set SIZING-OPTION = COINCIDENT in the DOE-2 input file (see Editing DOE2.1E files outside of VisualDOE). This will give the coincident system size, including fan heat.

Why do you use a negative number for the heating capacity?

DOE2 uses negative inputs for heating, that's why it also appears so in the VisualDOE. For input, you can enter either negative or positive, and VisualDOE will convert it to negative for the BDL file.

I have the VAV unit heating coils set up with a 65 degree leaving air temp and the terminal units are supposed to take care of the heating requirements beyond that. I tried increasing this in 10-degree increments and this took care of the heating requirements, but the supply airflows were much too high.

There are a number of potential causes for underheated zones. These are a few of them:

1. In a VAV system, the minimum flow ratio (ZONE|AIR) may be too low. If the thermostat type is "proportional" then the flow will be at its minimum point in heating mode. This minimum flow may not be high enough to meet the heating loads of the zone. The solution is to increase the minimum ratio (leading to higher energy usage as well) or to specify a "reverse action" thermostat. The reverse action thermostat increases the zone airflow as the heating load increases (just like it does in cooling mode).

2. Another problem, especially in cold climates and heating dominated buildings, is that the total supply air flow is too low.DOE2 sizes the total supply air based on peak cooling loads. The solution is to enter the supply airflow in the HVAC system editor rather than allowing DOE2 to autosize the flow.

3. Zone reheat may be missing. In a multiple-zone system some form of reheat is generally necessary to control space temperature in zones that do not need much heating. Make sure that reheat (or baseboard heating) is specified on the ZONE tab.

11.6   Central Plant

How is a TES system modeled?

These periods are used only for cogeneration. For Chillers/TES you require only two time periods.

The time period schedules are only used to schedule the events for switching over between charging and discharging. The actual period of the day is defined in the TES setup form in the central plant editor.

Is there a way to model a two separate chilled water system in one building?

No, DOE-2.1E does not support multiple chilled water loops.

11.7   Organizers and Editors

What is the organizer?

VisualDOE 3.0 uses organizers to manipulate the items in the project and the library. The Organizer allows you to store items in the VisualDOE library for later use. You can copy items from the library for your project when needed. VisualDOE uses organizers for openings, glazings, constructions, materials, occupancies, schedules and utility rates.

The Organizer has two list boxes located at the top of the form. The list box on the left contains items from your library, while the one on the right contains items in your project. To copy an item from the library to your project, first select it and then click the Copy button. Alternatively, you can simply double click on an item in the library to copy it to your project and double click on an item in your project to copy it to the library.

You can delete an item from either the library or your project by selecting it and then clicking the Delete button. You can rename an item by selecting it and then clicking the Rename button. To edit an item, first select it in either the library or project list and then click the Edit button.

To add a new item to your project, you must first select an existing item and then click the Add New button. The new item will be a clone of the item you had previously selected. You can then edit the newly created item by selecting it and clicking the Edit button.

The lower portion of the form has a table that displays information about the object that is selected. You can select an object on only one side at a time. When you select an object for the project file, nothing is selected from the other source and *vice versa*.

What is the project schedule?

Project schedules contain all the items that are available to be used in the project. It is analogous to schedules on architectural drawings. Before creating a

How do I create a new Item to the project schedule?

To add a new item to your project, you must first select an existing item and then click the Add New button. The new item will be a clone of the item you had previously selected. You can then edit the newly created item by selecting it and clicking the Edit button.

How can I use constructions or schedules that I created in other projects?

You can save any project item to the library. This makes the item available to any project that uses the same library. On the organizer form the list box on the left contains items from your library, while the one on the right contains items in your project. To copy an item from the project to the library, first select it and then click the Copy button.

11.8   3D Viewer

How do I move or zoom the 3D view?

Use the 'Ctrl' key along with the left or right mouse buttons to manipulate the view in the 3D viewer form. This will let you zoom, rotate and move the objects in the 3D view.

Why can't I see any roofs, floors or other horizontal surfaces in the 3D viewer?

VisualDOE creates horizontal surfaces are only when a simulation is run. You'll have to run a simulation and then refresh the 3D view to see all the horizontal surfaces in the model,

11.9　Running Simulations

How can I view/print hourly reports?

You can view graphs of the hourly data in the Simulation|View Results|Graphs by selecting hourly data.

You cannot print hourly reports directly from the VisualDOE interface, but the data is available in the *.h0 file in text format. You can import the data into a spreadsheet or other programs.

11.10 General

What are the limits for the number of rooms and surfaces in VisualDOE?

Maximum Number of Rooms/Zones = 128

Maximum Number of External Surfaces = 2048

Maximum Number of Interior Surfaces f= 2048

Maximum Number of Openings = 2048

Maximum Number of Systems = 50

How do I model exterior shade?

Use Edit|Exterior Shading to define exterior shades. Hit the 'Add New' tab and go ahead and define the profile angle by choosing 'Other' under 'Orientation'. This lets you define a non-standard angle.

This is 100% (opaque) shading by default. There's a somewhat indirect method of specifying a perforated shade- make an estimate of its transmittance and create a schedule that defines say 60% transmittance for each hour. Then use the 'Transmittance' pull-down menu to attach the schedule to this particular ext shade.

The Design temperature is used byDOE2 at two stages, once at the LOADS level to calculate the space heating and cooling loads and then again at the SYSTEMS level for sizing the equipment.

I want to use outside air to pre-cool the thermal mass during off hours with outside air, in order to reduce cooling energy usage when building is occupied. Can we account for the mass of the space being at a lower temperature, and absorb some of the heat gain when space is occupied.

You can model this by specifying an infiltration schedule to bring in outside air at night. The thermal mass in the space is calculated based on the constructions assigned to the blocks.

12 Glossary of Terms

Air-Side Economizer. A control on the outside air damper that can increase the volume of outside air when increasing outside air can save energy. The control can be based on drybulb temperature, enthalpy, or both temperature and enthalpy.

ARI Conditions. The outdoor and/or indoor temperature and humidity conditions that are used to calculate EER and other energy efficiency ratings based on ARI (American Refrigeration Institute) standards.

Azimuth. Building azimuth is specified by giving the azimuth of the front of the building. The azimuth is the angle between a line that projects perpendicular to the building facade and true north as measured in a clockwise orientation. If you use a compass to determine north, be sure to correct for the magnetic deviation. The following figures are examples to illustrate the azimuth of the front of the building.

The front of the building faces due north and the azimuth is zero.

The front of the building faces south and the azimuth is 180 degrees.

The front of the building faces northeast and the azimuth is 45 degrees.

The front of the building faces south west and the azimuth is 225 degrees.
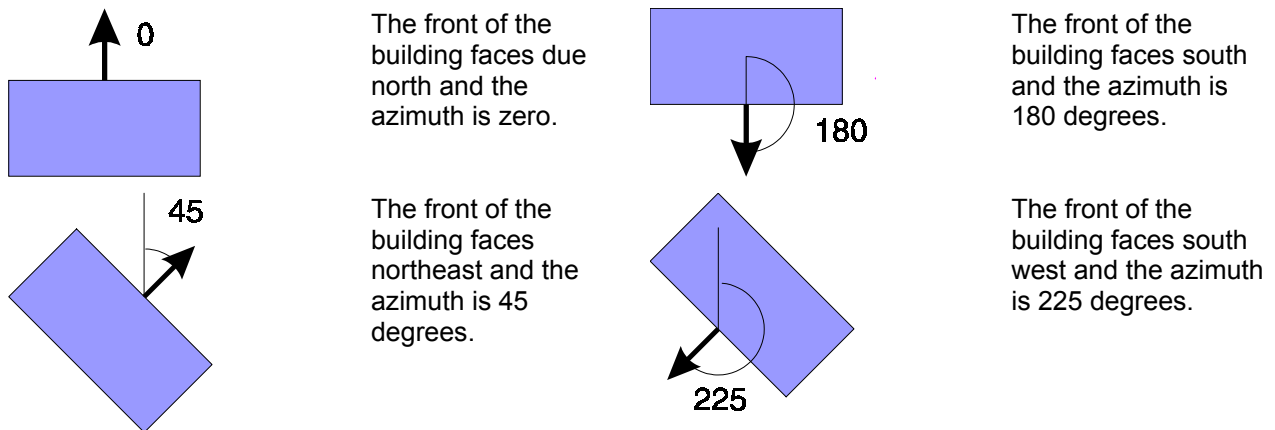
Block, as used by Graphic Editor. A group of thermal zones used by VisualDOE. Standard blocks are rectangular, L-shaped, U-shaped, T-shaped, H-shaped, etc. A block can consist of one or more floors. Up to twenty blocks can be stacked one-on-top-of-the-other to make up a building. Standard blocks can have one of three different zoning patterns. If floors have the same shape, but different zoning arrangements, you can create additional blocks and assign a different type of zoning to each block. When a block overlaps a block beneath it, VisualDOE creates a floor. When a block sets back from the one beneath it, a roof surface is created for the lower block. You do not need to worry about these details, VisualDOE takes care of them. You can think of a block as an object that can be rotated, stretched, pushed and otherwise manipulated. You can also create custom blocks.

Ceiling Bypass VAV System. A multi-zone system with a constant volume fan at the air handler. The air handler receives chilled water from a central plant. This system reduces the supply of air to the zone by diverting air into the plenum space, where it is returned to the fan. A plenum return is assumed for this system.

Ceiling Induction System. A multi-zone system served by a central plant. The system is similar to the variable air volume system with the addition of induction mixing boxes to provide individual temperature control for one or more zones. Induction flow is limited to a maximum of 50% of the supply air so reheat coils are often installed to provide additional temperature control.

Constant Volume Fan. A type of on-hours control of the supply fan. The fan operates at a constant speed and delivers a constant volume of air.

Constant Volume Reheat Fan System. A multi-zone, constant volume system served by chilled water from a central plant. Control to each of the zones served by the system is maintained by reheating the air

at the zone as necessary. Supply air is typically delivered at a temperature cold enough to satisfy the cooling requirement of the warmest zone. Supply air in all the other zones is reheated.

Cycle on Any. A type of off-hours control of the supply fan. If the temperature in *any* zone falls below the throttling range specified for that zone, the system supply fan will come on to satisfy the load. Typically, the temperature setpoints during off-hours will be higher for cooling and lower for heating.

Control Zone. The zone used for primary control of an HVAC system. This zone is selected for each system by holding down the control key and clicking on the zone you want to be the control zone. You may only select one control zone. If you assign more than one zone to single-zone systems, the system will attempt to meet the needs of the control zone only.

Cycle on First. A type of off-hours control of the supply fan. If the temperature of the control zone falls below the throttling range, the system supply fan will come on to satisfy the load. Typically the temperature setpoints during off-hours will be higher for cooling and lower for heating.

Cycle Only Zone Fans. A type of off-hours control of the supply fan. This off-hours fan control method is only available for zones that are served by power induction units. Only the fan in the power induction unit would come on and not the main system supply fan. This method will typically only be capable of satisfying off-hours heating loads, since power induction units typically have heating coils but not cooling coils.

Cycle with Loads. A type of on-hours control of the supply fan. This type of control is typical of water source heat pump systems and residential systems, but the control type is available for other systems as well. When there is no heating or cooling load, the fans are off. If this option is chosen, you should recognize that no outside air will be provided to the space while there are no heating or cooling loads. Outside air ventilation should be provided by natural ventilation or other methods.

Daylighting . Daylighting may be specified for any of the perimeter zones. When daylighting is modeled, the ceiling is assumed to have a reflectance of 80%, walls 60% and floors 20%. If interior shade is specified, windows are assumed to have a medium colored venetian blind that is closed when solar gain exceeds 30 Btu/h-ft². When the blind is closed, the visible light transmission of the glazing is assumed to be reduced to 60% of the light transmission of the window with the blind open. The reference point for daylighting calculations is assumed to be located in the center of the daylighted zone.

Design Illuminance. The illumination level in footcandles that the electric lighting system tries to maintain. A photocell in the zone measures the illumination level at a reference position 7.5 ft from the window. When it drops below the design illumination, the electric lights are turned on or brightened. When the illumination level is greater than the design illumination, the electric lights are dimmed or turned off.

Desuperheater. A mechanism that recovers heat from the superheated gas of a direct expansion air conditioner. The heat may be used for space heating or space heating in combination with water heating.

Discharge Dampers. A type of on-hours control of the supply fan. The fan operates at a constant speed, and air flow is controlled by opening and/or closing dampers located at the fan discharge. This is equivalent to "riding the fan curve". This type of control is appropriate only for variable air volume systems.

Diversity. With heating degree day and bin methods of calculating annual energy use, internal loads such as lighting, occupants, equipment, etc. are multiplied times a diversity factor to consider the fact that the peak condition does not exist for all hours. Diversity factors are not used however with hourly simulation programs such as DOE-2. Diversity is included in the schedule of operation.

[@] **Dry bulb Temperature**. The temperature one reads on a "normal thermometer" in degrees Fahrenheit (°F)- usually referred to as DBT.**Dual Duct Fan System**. A multi-zone system with two coils at the fan, commonly referred to as a hot deck and a cold deck. Both hot and cold air is delivered to a mixing box located in each zone. The mixing box then mixes the hot air and the cold air supply to deliver a constant volume, but variable temperature flow of air to the zone. Thermodynamically, this system is similar to the multi-zone system; the difference is that the mixing takes place at the zone rather than at the air handler.

Equipment Power Density. The power in walls of all equipment (other than lighting) in a zone divided by the floor area of the zone. Do not consider <u>diversity</u> of load since the value you enter is modified for each hour by the equipment schedule.

Evaporative Cooling System. A single-zone system with indirect and/or indirect evaporative cooling. Several heating sources are available including hot water from a central plant, a gas furnace, an electric heat pump (reverse cycle) or electric resistance.

Facade. An architectural term for the side of a building. VisualDOE uses this term to refer to a particular floor *and* a side.

Fixed Records In Library. The VisualDOE library includes constructions, climates, fenestrations, utility rates and other data when it is distributed. Most of these records are fixed. This means that you can add additional records, but you may not delete or modify fixed records.

Floor Panel Heating System. A system that provides heating to one or more zones by circulation of water through pipes embedded in the floor or the ceiling. This system has no fan and provides no outside air.

Four-Pipe Fan Coil System. A single-zone system that is served by chilled water or hot water from a central plant. Because of the four-pipe configuration, some systems can be in a heating mode, while others are in a cooling mode. Typical applications are hotel rooms or residential buildings.

Four-Pipe Induction Unit System. A multi-zone system that is a mixed hydronic and air system. The system is capable of providing simultaneous heating or cooling to a number of individually controlled zones. A central fan provides a constant flow of primary air to the zones. This air is generally supplied at a high velocity to induce additional air from the zone. A coil in the induction unit can operate in either a heating or cooling mode (four-pipe).

Fraction of Lights Controlled. The decimal fraction of lights in the zone that are under the influence of the daylighting controller. For instance, a space might have some decorative lighting included in the specified lighting power density that is not turned off or dimmed in response to available daylight. If such lighting represented 1/3 of the lighting power in the zone, a value of 0.67 would be entered for the fraction of lights controlled. The fraction of lights controlled needs to be specified only when a zone is modeled with daylighting.

Heating and Ventilation System. A constant volume, single-zone system without cooling capability or humidity control. In its most basic configuration, the system provides forced air heating from an air handling unit that contains a heating coil, filters and a supply fan. Several heating sources are available including hot water from a central plant, a gas furnace, an electric heat pump (reverse cycle) or electric resistance.

Inlet Vanes. A type of on-hours control of a centrifugal supply fan. The fan operates at a constant speed. Air flow is controlled by vanes located at the inlet to the drum of the fan. This type of control is appropriate only for variable air volume systems.

Lighting Power Density. The peak lighting power in a space in watts divided by the floor area of the space. The lighting power should include the ballast and any other parasitic loads. Do not consider <u>diversity</u> of use when specifying the lighting power density. Diversity is handled on an hourly basis by the lighting schedule.

Minimum cfm Ratio. The ratio of the minimum volume of supply air to the maximum possible volume of supply air. This is specified for zones that are served by <u>variable air volume systems,</u> <u>packaged VAV</u> systems or <u>power induction units</u>.

Multi-Zone Fan System. A multi-zone system with both a heating coil and a cooling coil at the central air handler. The air handler receives chilled water or hot water from a central plant. A separate duct leaves the air handler to serve each thermal zone. Air from the hot deck and the cold deck is mixed at the central air handler to provide the necessary temperature to satisfy the need of each zone. Thermodynamically, this system is similar to the dual duct system; the difference is that the mixing takes place at the air handler rather than at the zone.

Occupant Density. The maximum number of people in a space, specified as ft² per person. The value you enter will be modified for each hour by the people schedule.

Packaged Gas Solid Desiccant System. A small packaged unit that uses a desiccant while in conjunction with direct and indirect evaporative cooling, instead of the usual DX coils. The unit uses a gas fired hydronic heater to regenerate the desiccant and to provide space heating. The result is a unit that primarily consumes gas to provide heating and cooling. [Not implemented in VisualDOE]

Packaged Multi-Zone Fan System. A multi-zone system with both a heating coil and a cooling coil at the central air handler. Cooling is provided by a direct expansion air conditioner that is part of the packaged equipment. A separate duct leaves the air handler to serve each thermal zone. Air from the hot deck and the cold deck is mixed at the central air handler to provide the necessary temperature to satisfy the need of each zone. Several heating sources are available including hot water from a central plant, a gas furnace, an electric heat pump (reverse cycle) or electric resistance.

Packaged Single-Zone System. A single-zone packaged air conditioner. Several heating sources can be used including a heat pump, which means that the air conditioner works in reverse to provide heating to the zone. Other heating sources are electric resistance, hot water from a central plant or a gas furnace. This is the most common of all equipment for commercial buildings.

Packaged Terminal Air Conditioner System. A single-zone system capable of providing either heating or cooling to a room or space. Units are typically installed in a window or in an opening in the wall (through-the-wall). Cooling is provided by a direct expansion air conditioner with an air cooled condenser. A variety of heating sources are available. Typical applications are hotel/motel guest rooms, hospitals, nursing homes, and office buildings. All PTAC units discharge air directly into the room with no duct work.

Packaged Vari.-Volume, Vari.-Temp. System. A multi-zone variable volume, variable temperature system. It behaves like a packaged single-zone system when no heating or cooling is required by the control zone so mixed air is delivered to the zone for ventilation. In this mode, the heating and cooling capacity is cycled off. It also behaves like a VAV system in that it adjusts the air flow to the zones to match the heating and/or cooling requirements of the control zone.

Packaged Variable Air Volume System. A multi-zone system where the primary means of controlling zone temperatures is to vary the volume of air delivered to a zone. Cooling is provided by a direct expansion air conditioner that is part of the packaged equipment. Each thermal zone has a variable air volume box that is capable of modulating the volume of air between 100% and some minimum amount, usually about 30% of the maximum. VAV boxes can also have reheat capability, especially for perimeter zones. If the zone is still cold after the supply of air has been reduced to the minimum, then the air is reheated as necessary to maintain the setpoint temperature.   Several heating sources are available including hot water from a central plant, a gas furnace, an electric heat pump (reverse cycle) or electric resistance.

Plenum. The space between the ceiling of one floor and the surface of the floor above. HVAC ducts, VAV boxes, pipes, lighting fixtures and other building equipment is generally located in the plenum space. HVAC systems with air distribution can use the plenum for returning air to the fan system.

Powered Induction Unit System. A multi-zone system similar to a variable air volume system. Chilled water is provided to the air handler from a central plant. The main difference between a PIU system and a standard VAV system is that each VAV box has a small fan that can draw air from the plenum space in order to maintain a more constant flow of air into the zone. VisualDOE can model two common zone fan arrangements: a series terminal unit and a parallel terminal unit. These are specified by selecting Systems|Zones.

Preheat Coil. If the system has a preheat coil, you enter the heating source by making a selection from a drop down list box and enter the preheat temperature. Possible heating sources include hot water from a central plant, furnace, or electric resistance.

Residential System. A constant volume, single-zone system typical of those used in single family homes. Unlike most of the other systems, the residential system is not capable of providing outside air. Cooling is

provided by a direct expansion air conditioner. Several heating sources are available including hot water from a central plant, a gas furnace, an electric heat pump (reverse cycle) or electric resistance.

Residential Variable-Volume, Variable-Temperature System. A multi-zone residential style system featuring multiple, individually ducted and thermostatically controlled zones. Central heating and cooling are available from a high efficiency variable speed heat pump. Each thermostat controls a motor driven air damper in the zone duct. These dampers can close completely, giving zero air flow to the zone. Thus, some zones can be conditioned, while others are permitted to float. The system can also do simultaneous heating and cooling in that it can switch between cooling one group of zones and heating another group of zones within the one-hour time step of DOE-2 simulations.

Stay Off. A type of off-hours control of the supply fan. If this option is selected the fans will not come on during off hours even if there are heating and/or cooling loads.

Thermal Zone. A thermal zone is a space within a building that has its own temperature control. For buildings served by variable air volume (VAV) systems, a thermal zone is equal to the area served by each VAV box. In general, a separate thermostat means a separate thermal zone. In modeling buildings, it is common practice to group thermal zones that have the same solar exposure or similar loads.

Two-Pipe Fan Coil System. A single-zone system that is served by chilled water or hot water from a central plant. Because of the two-pipe configuration, all systems must be in either a heating or cooling mode. Typical applications are hotel rooms or residential buildings.

Two-Pipe Induction Unit System. A multi-zone system that is a mixed hydronic and air system. The system is capable of providing heating or cooling to a number of individually controlled zones. Since the hydronic component of the system is in either a heating or cooling mode (two-pipe), all induction units must be in either a heating or cooling mode. A central fan provides a constant flow of primary air to the zones.

Two Speed. A type of on-hours control of the supply fan. Two-speed fan control is typical for packaged terminal air conditioners but is available for other systems as well. If this option is selected, then additional information must be entered on the air volume, efficiency, heating capacity, and cooling capacity at the low speed.

Unit Heater System. A single-zone heater, usually suspended in the space. Several heating sources are available including hot water from a central plant, a gas furnace, or electric resistance.

Unit Ventilator System. A single-zone heater, usually suspended in the space. The system is similar to the unit heater, except that it can provide a supply of outside air. Several heating sources are available including hot water from a central plant, a gas furnace, or electric resistance.

Variable Air Volume System. A multi-zone system where the primary means of controlling zone temperatures is to vary the volume of air delivered to the zone. Chilled water is provided to the air handler from a central plant. Each thermal zone has a variable air volume box that is capable of modulating the volume of air between 100% and some minimum amount, usually about 30% of the maximum. VAV boxes can also have reheat capability, especially for perimeter zones. If the zone is still cold after the supply of air has been reduced to the minimum, then the reheated air is necessary to maintain the setpoint temperature.

Single Zone Variable Temperature System. This system has both a heating coil and a cooling coil at the main air handler that delivers air at a temperature necessary to satisfy the central zone. This system typically serves just one zone. If other zones are served by the system, heating and cooling coils are used at the zone level to heat or cool the air as necessary to serve the needs of the additional zone.

Variable Volume. A type of on-hours control of the supply fan. The speed of the fan is controlled with a variable frequency drive or other means to maintain the required air volume. This type of control is appropriate for variable air volume systems.

Water Loop Heat Pump System. A single-zone system (also known as a California heat pump or a hydronic heat pump). A condenser water loop provides a source for heat rejection or absorption.

Wet bulb Temperature. A temperature reading, in °F, which takes into account the amount of moisture in the air. Its value can be obtained by spinning a thermometer with a wet wick encasing the bulb through the

air (known as sling psychrometer). If the air is dry it will absorb moisture from the wick and indicate a low wet bulb temperature. Conversely, if the air is humid little moisture will evaporate from the wick and a high wet bulb temperature will be indicated.

13 VisualDOE Tutorial

This tutorial will introduce you to the Graphic Editor and demonstrate its main features. The following set of lessons will help you create a basic Visual DOE model for simulation.

13.1   Lesson 1 – Selecting a Template

1. The first step is to choose a template. When you choose File | New, you are asked to select a template. Navigate to C:\Program Files\GDT\VisualDOE\Templates and choose the stanadard IP unit template 'standard.gIP'.

2. More often than not the default template will not contain all the fenestrations, construction, occupancy, utility rates etc. that are applicable to the building you wish to model. However, the Visual DOE library contains a large number of materials, construction, windows etc. which could be added to your project library. The following steps describe how to expand the project library to include the items required for your project from the items present in the Visual DOE library.

3. *Opening organizer*: The opening organizer allows you to add more window types from the Visual DOE library to the Project library. The project library contains a list of items you can choose from for the current project. If your project has openings that are not available in the Visual DOE openings library, the openings organizer will allow you to define new windows, and add it to your project library. This has been addressed in a more advanced lesson. Click on the 'Openings Organizer' button in the menu bar and choose 'Openings'. This launches 'Openings Organizer' window. From the 'Type' drop down list pick 'window'. You will see a frame on the right titled 'Project Items'. This displays the list of openings that you can choose from for the current project. On the left you will see a frame for 'Library Items'. This frame displays all the window types that are available in the Visual DOE windows database. From the 'library items' frame pick '6040 double clear' by clicking on it. Click on the 'copy' button to add it to the 'Project List' frame. You select only one item to copy at a time (i.e. you cannot make multiple selections for copying).The 'Selected Item Description' displays the window dimensions for the highlighted window. You can add as many windows as you wish to by repeating this process.

Similarly, you can add different skylight types to your project library as well. This time from the 'Type' drop down menu choose 'Skylights'. Highlight '4040 double clear' on the 'Library Items' side and click on the 'Copy' button to add it to the project library. Click on the 'Exit' button to close this window.
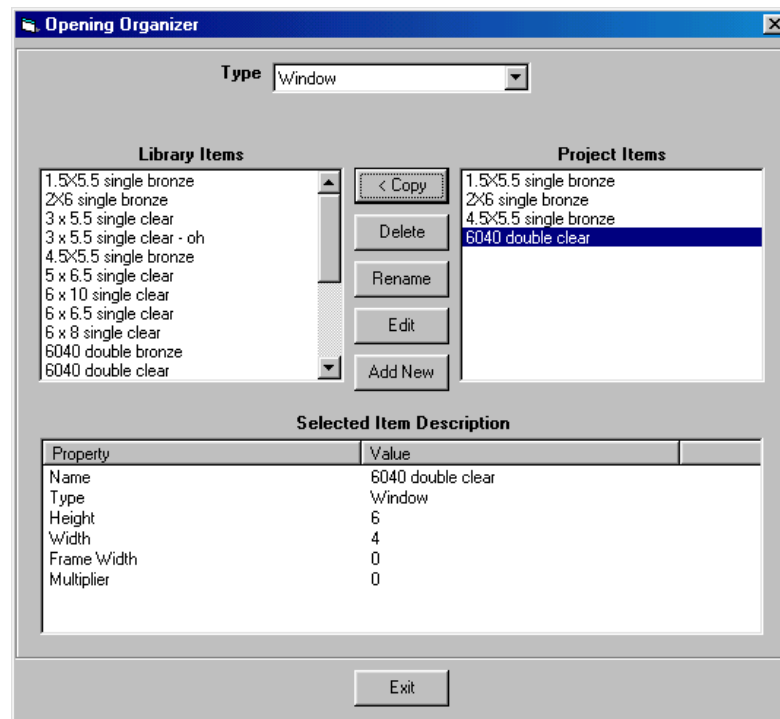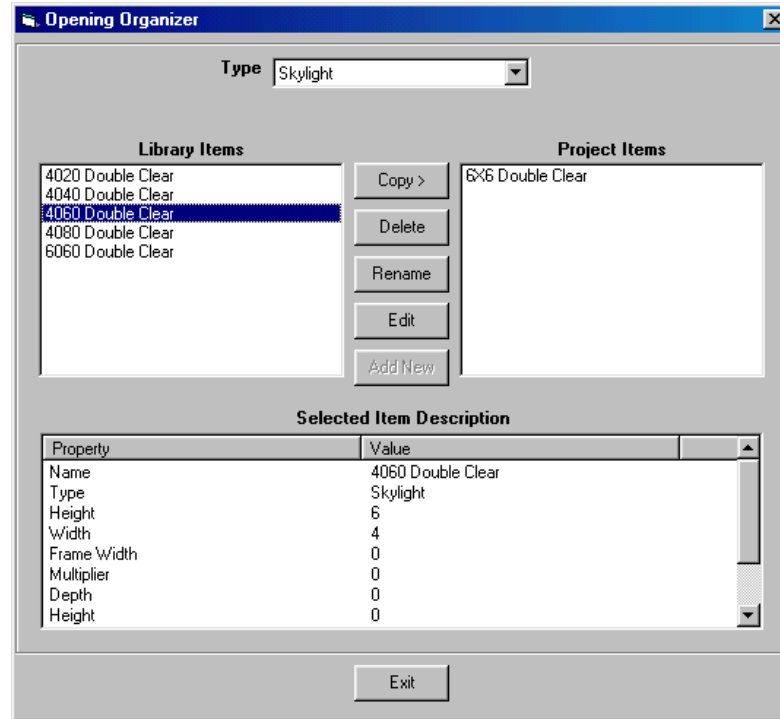
4. *Construction Organizer*: This works in a manner similar to the 'Opening Organizer', and helps you add construction types to your project library. Choose Organizer|Construction. It opens up a window similar to the 'Openings Organizer' with the project library items displayed on the right and the Visual DOE library items on the left. Pick 'Window' for 'Type', and 'Mass' for the 'Category' field. Highlight '6" Conc., EIFS 0.5", Mtl frm R-19, 70%' and copy this selection onto your 'Project Items' list. As in the case of windows, you can add as many wall construction types as you wish to. The 'Construction Organizer' lets you add construction types for walls, roofs, floors, slabs, below grade walls, partitions and ceilings. Walls, roofs and floors are divided into light or mass construction type.

Let us add a 'Floor Construction' type to the Project Library using the same procedure. This time choose 'Floor' for type and 'Mass' for category. Highlight 'R-19 Mass' from the Library Items list by clicking on it and add it to the Project Items list by clicking on the 'Copy' button. The 'Selected Items Description' lists the properties of the highlighted construction type.

Including a construction or opening type that is not listed in the Visual DOE Library, in your project library has been described in an advanced tutorial lesson.
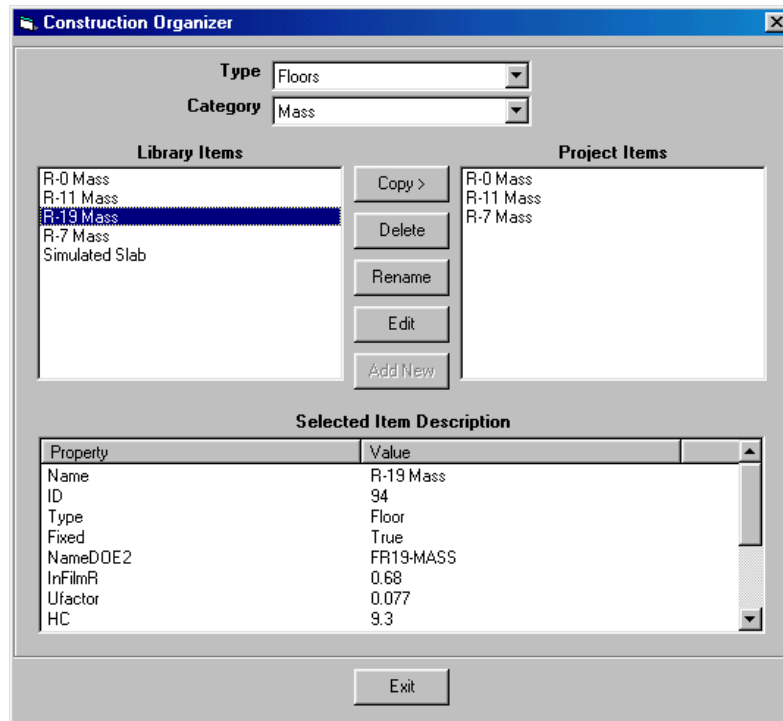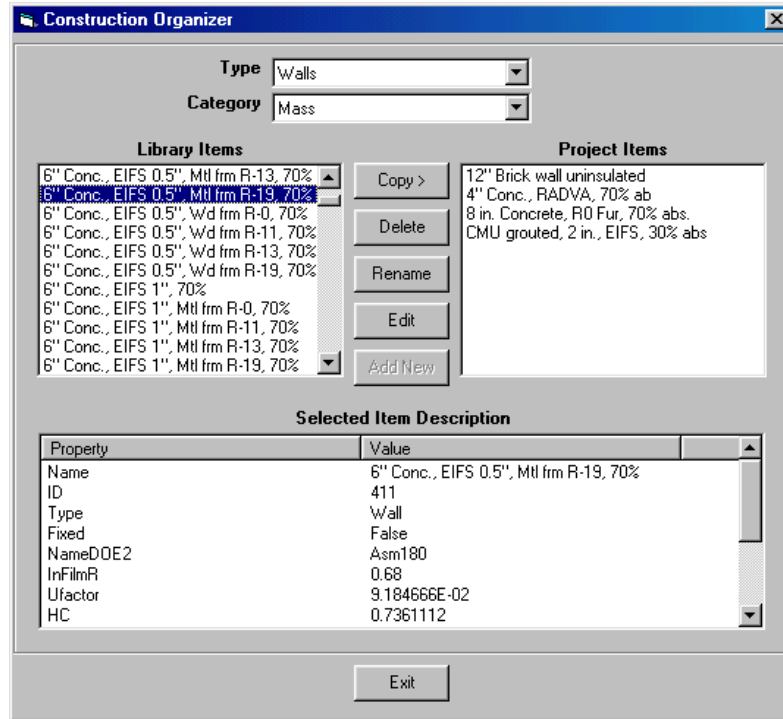
5. *Occupancy Organizer:* The occupancy organizer lets you create a new occupancy type or edit the schedules associated with an existing occupancy type. This feature is very useful when the building has specialized areas which operate differently from the rest of the building.

Click on 'Organizer' in the menu bar, and choose 'Occupancies'. The Occupancy Data Organizer window opens up and you will see two list boxes located at the top of the form. The list box on the

left contains items from your library, while the one on the right contains items in your project. Select 'Retail' from the library and copy it to your project by clicking on the Copy button. You will see the properties associated with this Occupancy type in the Selected Item Description frame. Click on the Exit button to return to the previous window.
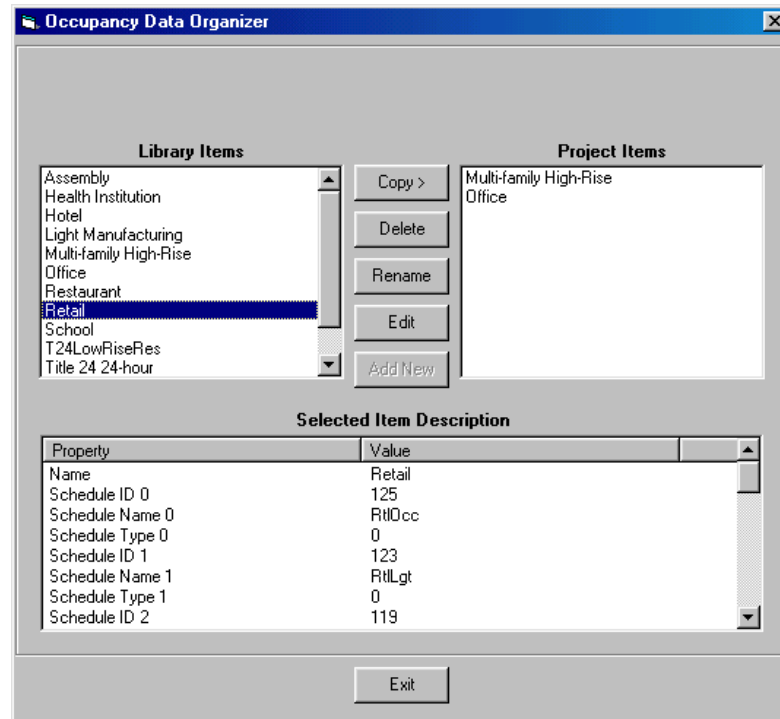
6. *Utility Organizer:* The utility organizer allows you to add appropriate utility rates to your project. This works in a manner similar to any of the other organizers we have discussed earlier. Click on 'Organizer' in the menu bar, and choose 'Utility Rates'. Alternately you can click on the 'Utility Rate Organizer' button in the bottom of the 'Project' folder window. The Utility Rate Organizer window opens up and you will see two list boxes located at the top of the form. The list box on the left contains items from your library, while the one on the right contains items in your project. You will also see a 'Type' field, which has a drop down list of fuel types. Select 'Electricity' from the drop down menu. The' Category' field lists the billing options – 'Time of Use' or 'Flat rate' charges. Choose the 'Time of Use' option. Select 'PG&E A-10' from the library clicking on it and copy it to your project by clicking on the Copy button. You will see the properties associated with this Utility rate type in the Selected Item Description frame. Repeat the same process for gas rates. Choose 'Natural Gas' for the 'Type' field and 'Time of Use' for 'the 'Category' field. Choose 'PG&E GNR-1' and click on the 'Copy' button to add this to your project library. Click on the Exit button to return to the previous window.

In a more advanced lesson we will discuss how to add/create utility rates applicable to your project but not available in the VisualDOE library.
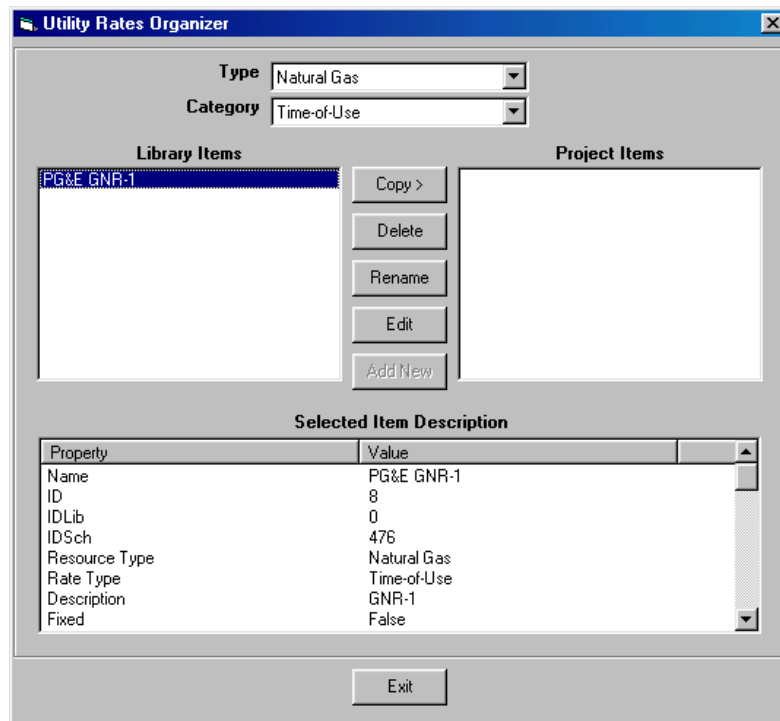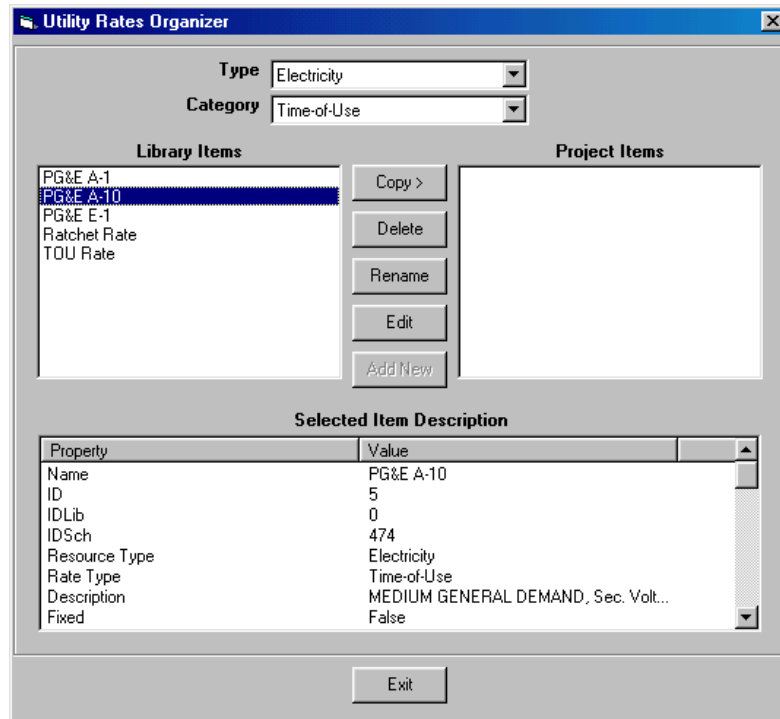
13.2   Lesson 2 – Project Information

The first step in creating a project is to enter general information including names and descriptions, utility rates, and climate data.

1. Enter 'Tutorial' in the 'Name' field and 'Test Project' in both the 'Address' and 'Description' fields. Enter your name in the Energy Analyst field. These data are printed on reports and graphs and help in identifying the project, but do not affect the calculations.

2. Select '1989-Present' for the era built. This is used to set default information about your project, which you can later override if you wish.

3. Enter '90' degrees for Front Azimuth. This implies that front of the building faces east. The azimuth is measured in a clockwise direction with 0 degree azimuth implying that the front of the building faces north, 90 is east, 180 south, 270 west, etc. The azimuth you enter must be between 0 and 360 degrees. As surfaces are created, the words 'front', 'left', etc. will be used in the names, where 'front' would be the direction of the azimuth, 'left correspond to the left of the user in plan view, etc.

4. Enter '50' ft. for 'Site Elevation'.

5. Choose 'cz12rv2' in the Climate Zone drop down list box. This list box displays the list of weather files that exist in your GDT\Weather directory. The installation CD has weather data for locations all across the United States. To add more weather files to the list box, you could use Windows Explorer or other tools to copy the respective file(s) to the GDT\Weather Directory.

6. Choose 'Official US' for the holiday set. During the simulation process, the program will assume that the building is not in operating mode during these days. Choosing 'none' implies that no holidays are observed, and 'Custom Holidays' lets you define your own holidays for the project.

7. Enter 5 percent for the discount rate and 20 years for the project life cycle. These data will be used to calculate the life-cycle cost of design alternatives. Setting up discount factors and project life have been described in greater detail in a more advanced lesson.

8. In the Energy Resources frame, choose one electric meter and one fuel meter. For the electric rate choose 'Elec Rate 66' and for the fuel rate choose 'Gas Rate 67'. . The 'utility rate editor' allows you to add various utility rates to the project and edit them This has been explained in greater detail in an advanced set of lessons. This completes the data input required to describe the general attributes of the project.
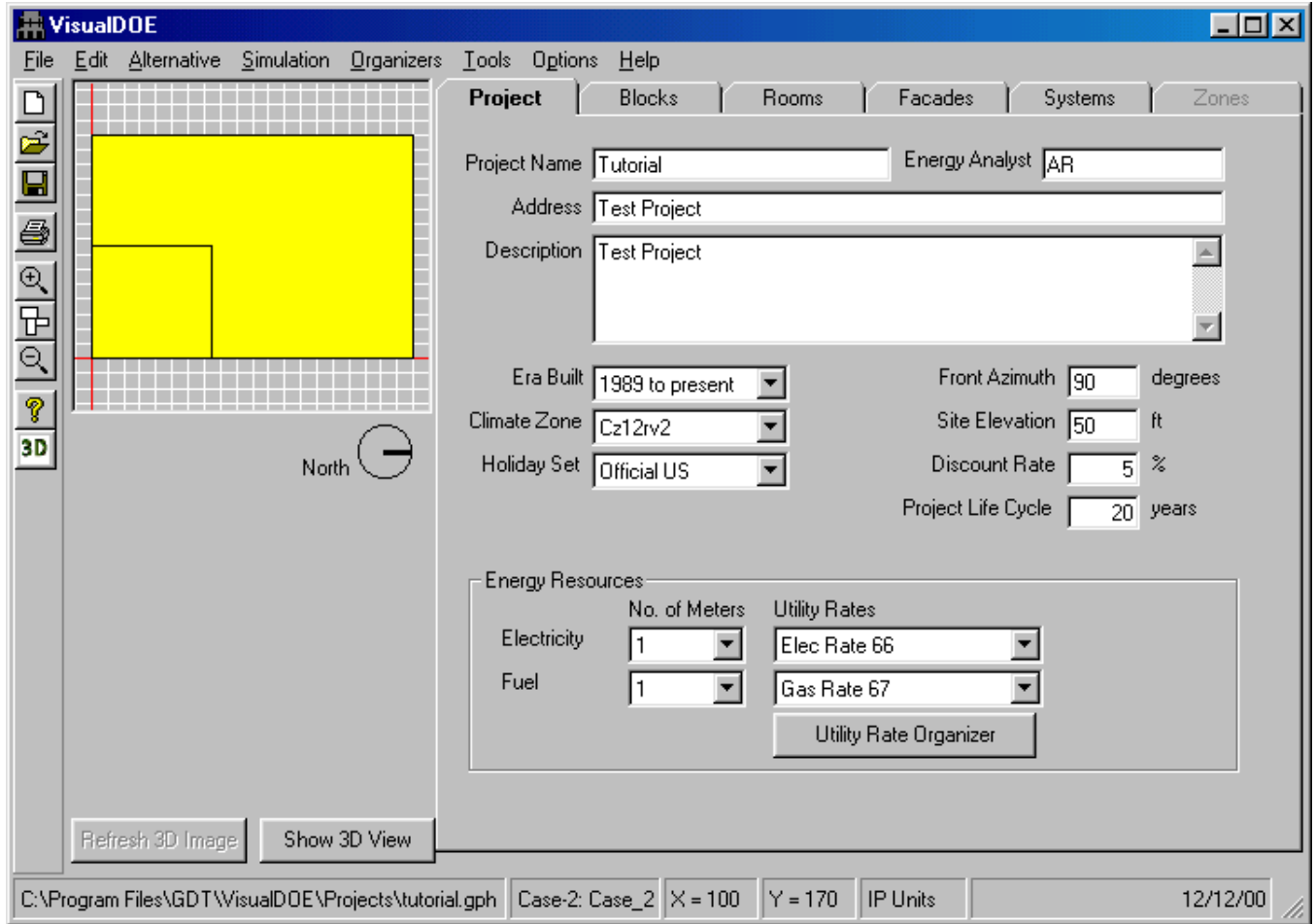
13.3   Lesson 3 – Standard Blocks

This lesson illustrates how to define the physical attributes (shape and volume) of your project using standard blocks. Standard blocks are predefined block shapes (rectangular, donut, L-shaped etc.) that you can modify, stretch, stack and combine to correctly represent the physical mass of your building.

1. Add a rectangle to your model by clicking on the rectangle icon at the top of the blocks folder, dragging it to the plan view (the grid area in the upper left corner of the form), and releasing the mouse. A rectangle will be added to your model with five zones: an interior zone and a perimeter zone for each façade. Also, the 'List of blocks' will now include one item labeled 'Block_1'.

2. Click on the 'Name field' and change the name of the block to 'First Floor'. Notice that the contents in the 'List of Blocks' also changes. Renaming the block is not essential but recommended for easy identification purposes. You can rename blocks based on the floor they are located in or the primary function they serve etc.

3. Select the 'First Floor' block and change the 'Width' to 200 and the 'Depth' to 150. This defines the dimensions of the 'First Floor'. Note that as you click on 'Width', a segment of the X-axis equivalent to the width of the block is highlighted. Similarly, the a segment of the Y-axis equivalent to the depth of the block gets highlighted when you click on 'Depth'.

4. You will see a list describing the various construction types for roof, ceiling, floor, interior floor and partitions. This list is used to describe the construction type for your building. Let the program use the default construction types for our purposes. We will learn how to create your own construction details in a more advanced lesson.

5. You will also see entries for 'Zoning' and 'Level'. Let the program use the default value for these two inputs ('Interior perimeter' for Zoning). 'Zoning' allows you to divide the block into zones with individual thermostats. One zone would imply that the entire block has only one thermostat. The 'Level' command allows you to locate the block in the vertical plane by making a choice from the drop-down list box. In this case, this block is located in 'Level 1- Bottom'.

6. Let 'Number Floors' default to 1. This represents the number of floors with the same properties as this block, not the total number of floors in your building.

7. Let the 'Floor to Floor Ht.' default to 13 ft. and the 'Plenum Height' to 4 ft. after checking the box for plenum.

8. Let 'Perimeter Depth' default to 10 ft. This assigns the depth of the perimeter zones.

9. Next double click on the 'L' shaped icon. 4 different orientations for the L-shaped will appear as drop down list. Select (by clicking on) the one that that has the cutout on the lower left corner. Most of the standard block shapes can have more than one orientation. When you double click on a standard block icon, all the possible orientations are displayed as a drop down list.

10. Drag the rotated 'L' shape to the plan view and release the mouse. You will be asked if you want the new block to be placed on the level above or on the same level. Choose the level above. This places the block on the floor above the first one that you created.

11. As in the case of the earlier block, click on the name field and change the name of the block to 'Second Floor'. Renaming the block name only helps in identifying the blocks. You could leave the default name if you wish.

12. For 'Width' enter 200 and 'Depth' enter 150. For 'Width 2' and 'Depth 2', enter 100 and 50 respectively. 'Width 2' and 'Depth 2' lets you define the length of the two arms of the L-shaped block.

13. Let the program apply defaults to the various construction types, and the other zone related parameters, as in the case of the 'First Floor'.
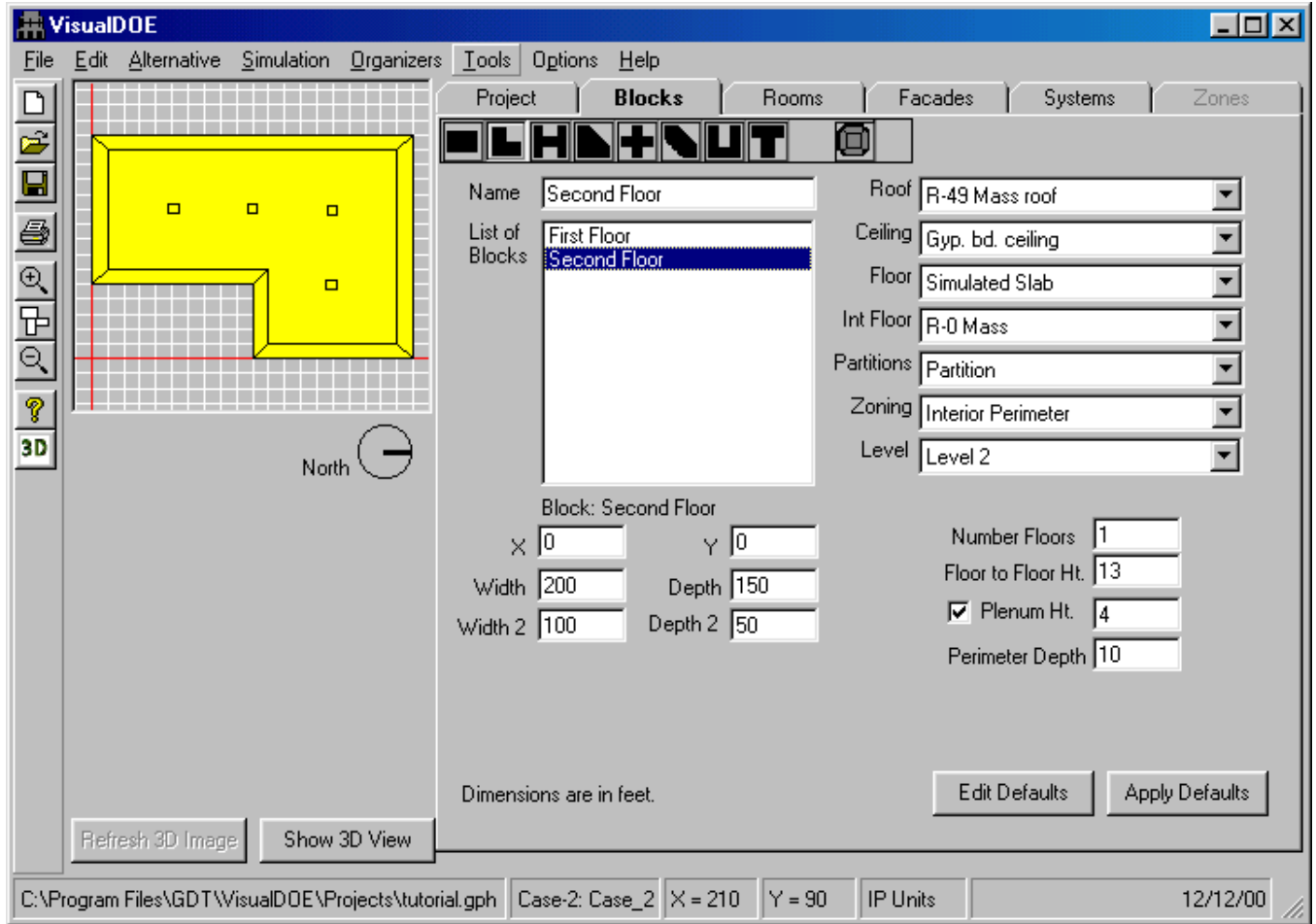
13.4   Lesson 4 – Room Data

After you have created the blocks in your model, you can use the 'Rooms' folder to edit the properties associated with each of the rooms in the blocks. The rooms folder contains parameters that determine some of the internal loads and operating schedules associated with the specific use for that space.

1. Rename the rooms by clicking on each of the names displayed in the list box associated with Name. Renaming the rooms is optional. The rooms have been renamed here for reference in following lessons. As you highlight one of the rooms, the name appears in the box next to 'Name'. You will also see that the associated room gets highlighted in the plan view (the grid area in the upper left corner of the form). Clicking on a particular zone in the plan view also allows you to edit the name of that zone. Edit the name of the first room on the list to 'Lvl1_Room1'. Rename all the 5 rooms in Level 1 moving in a clockwise direction in the plan view, using the same convention ('Lvl1_Room1' through 'Lvl1_Room5'). Follow the same procedure for renaming rooms on level 2 starting with 'Lvl2_Room1'.

2. As you click on 'Lvl1_Room1', you will see a list of associated properties, like LPD (lighting power density), EPD (equipment power density), Occ. Density (occupant density), zone type, occupancy, infiltration and skylight. Let the program use the default values. The default values are dependant on the occupancy type (which is 'office' in this case). The default value for skylight is no skylight and daylight control is 'none'. These defaults are automatically applied to all the rooms in this case. These set of variables help in determining the internal loads. The 'Occupancy' field determines operation schedules for the building.

3. We will assign a new occupancy type to one of the rooms in the Base Case model. Choose 'Lvl1_room1' and choose 'Retail' from the drop down menu for Occupancy (this is the occupancy type that you had Choose 'Yes' when asked 'Do you want the LPD, EPD and Occupant Density to be reset to this occupancy?' This resets the LPD, EPD and Occupant Density for this room to the default values associated with 'Retail' type occupancy.

4. We will learn to assign customized operation schedules for lights, plugs, occupants etc. in a more advanced lesson. For now the program will use the typical schedules associated with the 'Office' and 'Retail' type occupancy.
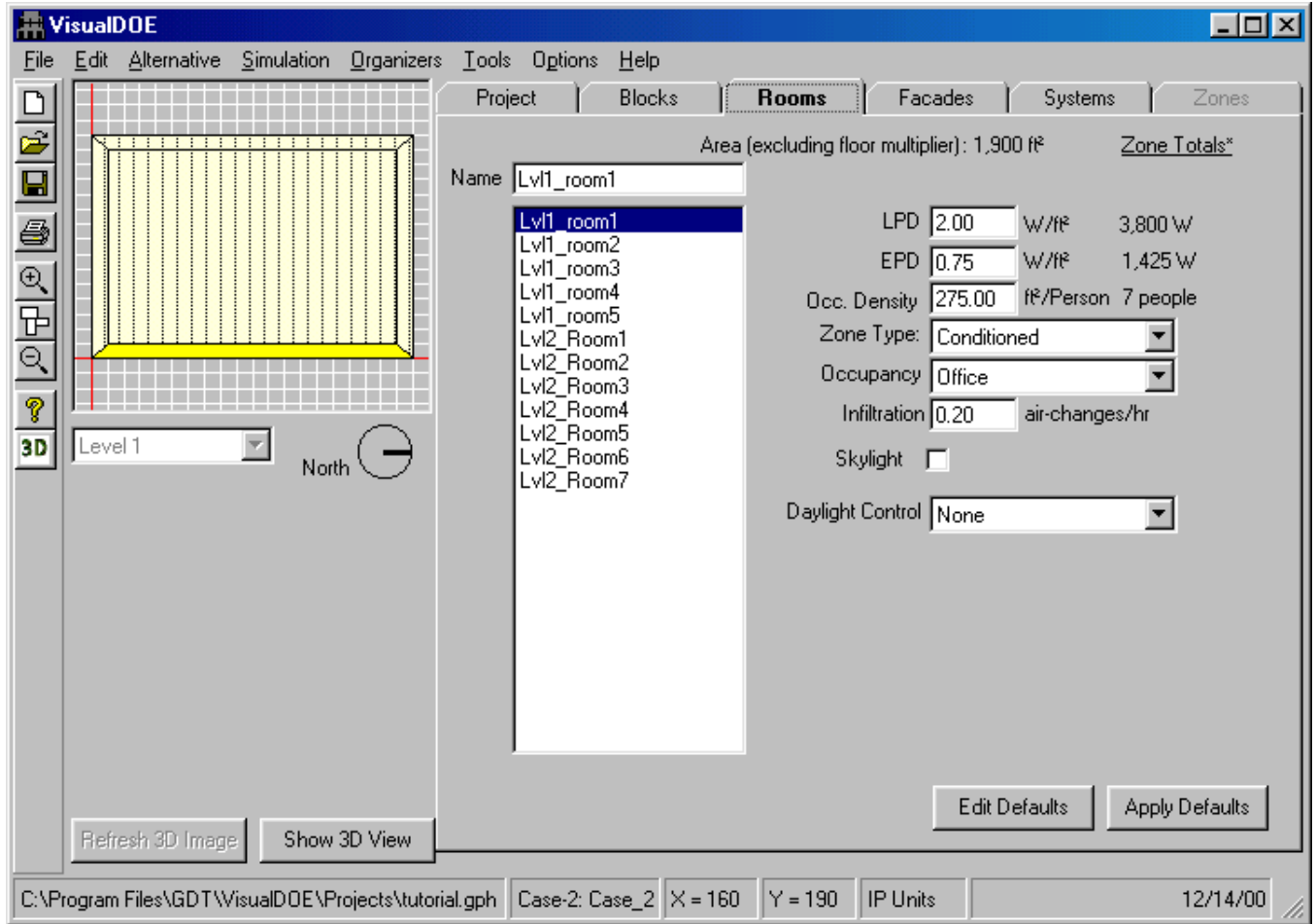
13.5   Lesson 5 – Skylights

1. Highlight 'Lvl2_Room7' in the list box. Check the box to model skylights in the selected room. When the box is checked, a button for defining skylights becomes visible.

2. Click on the 'Define Skylights' button. This launches another window titled 'Edit Skylight'.

3. You will see a small square object (representing the skylight) in the plan view window on the upper left of the form. Click on the window and drag and drop it in the plan view on the right of the form. Release the mouse.

4. Click on the skylight to your extreme left in the plan view of the building. This action highlights the skylight and activates the 'Custom Opening' frame for editing the skylight properties. Rename the opening as 'Skylight_1'. For distance 'From Bottom' enter 100, and distance 'From Left' enter 50. This defines the position of the skylight in feet relative to the X,Y origin. Let glazing construction default to Double Low Iron 3/12/3 mm. The program allows you to customize skylights. We will learn how to do this in an advanced lesson.

5. Add 3 more skylights and edit them using this procedure. Place 'Skylight_2' at a distance of 100 feet from bottom and left. Place 'Skylight_3' at a distance of 100 feet from the bottom, 150 feet from the left. Place 'Skylight_4' at a distance of 50 feet from the bottom and 150 feet from the left.

6. Click 'OK' to exit out of this window.
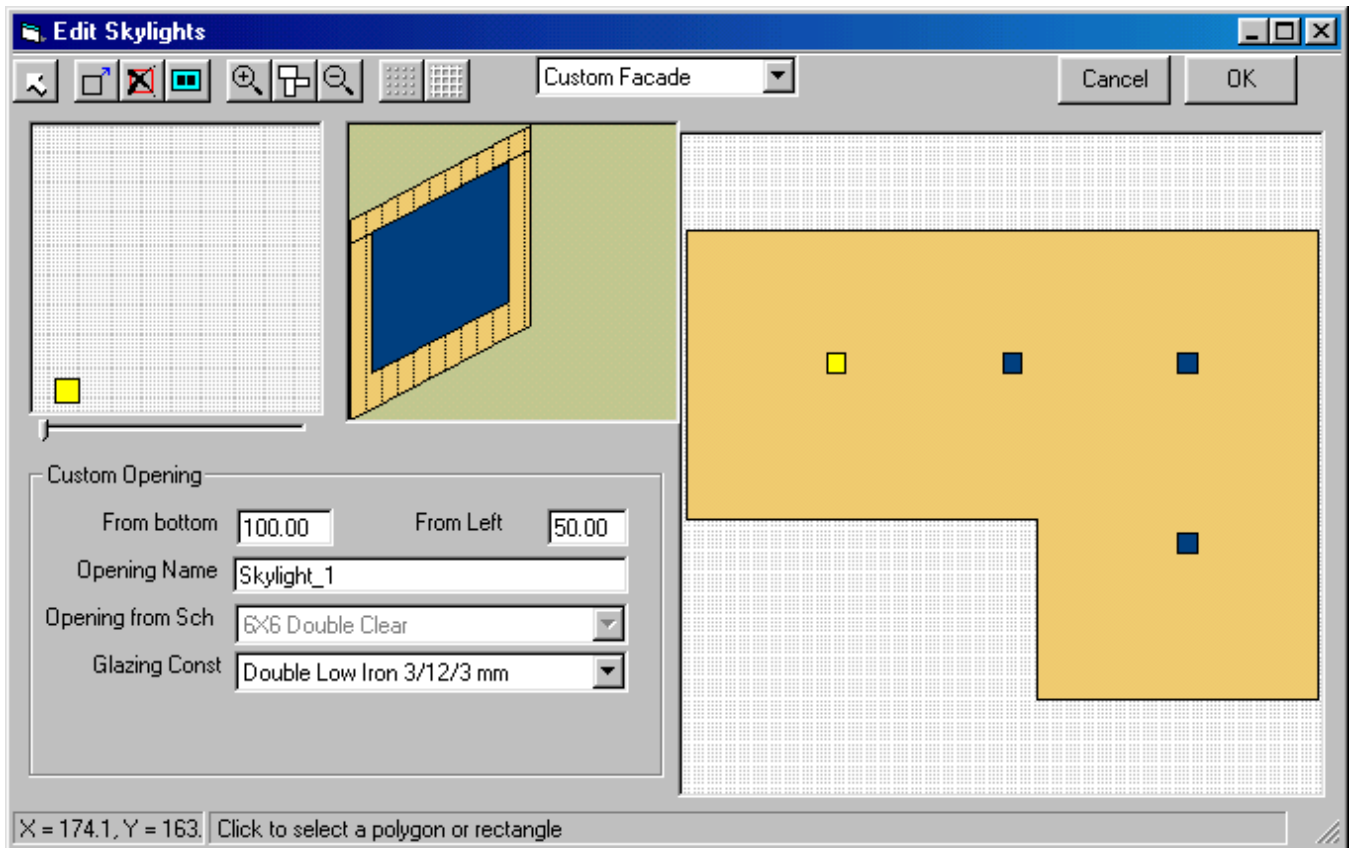
13.6   Lesson 6 – Facades and Windows

After creating blocks in your model, you can use the Facades Folder to assign properties to exterior walls in the project. Clicking on the facades tab in the form takes you to the façade window.

1. Highlight the first surface name in the list box by clicking on it and rename it 'Surface_lvl1_1'. As you click on the surface name in the list box, the associated surface is also highlighted in the plan view. This helps in understanding where this surface is located. Rename all the surfaces using the same convention (Surface_lvl1_1 through Surface_lvl1_2, and Surface_lvl2_1 through Surface_lvl2_6).

2. Highlight 'Surface_lvl1_1'. Press the shift key and click on the surface (Surface_lvl2_6) at the end of the list box. All the surfaces get selected. This saves time in assigning properties to one surface at a time – if all the surfaces have the same properties. Select 'Typical Bay' from the 'Spec. Method' list-box. Leave the partial window box unchecked. Partial window allows the façade to have a fraction of the assigned window size if the number of bays is not a whole number.

3. Pick '12" Brick wall uninsulated' for wall construction and 'Single Bronze 6mm' for glazing construction. (You can choose any of the construction types listed.)

4. Pick '4.5 x 5.5 single bronze' for the 'Window Choice'. The window choice has a list of associated properties with it – like opening size, exterior shades, glass type, frame type and frame fraction. We will learn how to edit these in a later lesson.

5. Type in '25' ft. for Bay Width. This determines the width of the module that will be repeated along each of the facades in the building.

6. Type in '2.25' for 'Sill Height'.

7. For 'Bays with windows' fill in 1.0. This means that each bay will have one window. 0.5 would imply that each bay would have two windows.

8. We can assign as different properties to each surface. To demonstrate this, we assign a different window type to one of the surfaces in the Base Case. Click on 'Surface_lvl1_4'. You will see that '6040 double clear' which you had added to the project library in the beginning of the lesson been added to the list of 'Window Choice'. Choose this window type for this surface. You can change the other parameters as well if you wish to.

9. We have now defined the external skin of the building.
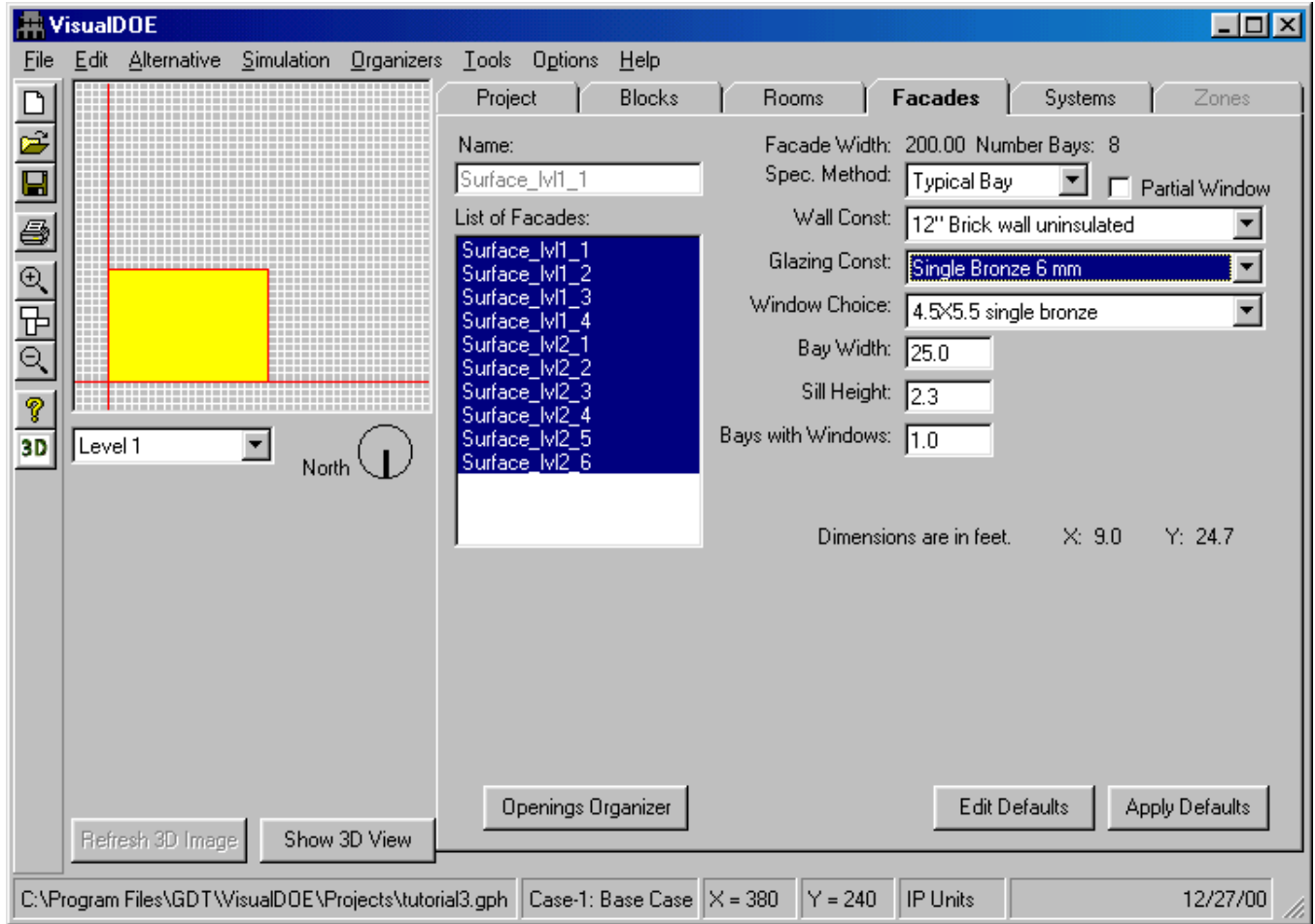
13.7   Lesson 7 – Thermal Zones

The Zone Folder is used to specify zone-level HVAC information such as the type of thermostat, supply air volume, outside air volume, exhaust fans and zone level heating systems such as baseboards and reheat coils in variable air volume boxes.

1. Before you can activate the 'Zones' folder, you will have to assign a HVAC system to the building. Choose the 'Systems' folder. Choose 'One system for Each Block'. Two systems (one for each block) appear on the 'List of Systems' frame. Highlight the one on top of the list by clicking on it. You will see that 'First Floor' block is displayed in the plan view window on the left. Rename the system to 'System_first_floor' in the 'Name' window. You will notice that the name is updated in the 'List of Systems' Frame. Click on the second system on the list. You will see that the plan view changes to the 'Second Floor' block. Rename this system to 'System_Second _Floor'.

2. Click on the 'Zones' folder. You will see a list of zones in the 'List of Conditioned Zones' frame. Click on the first zone name in the list. You will see that 'First Floor' block appears in plan view with the zone corresponding to this name highlighted. Click on the 'Name' tab and rename the zone to 'Zone_1_1'. Repeat this for all the zones in First floor. Rename the other 4 zones in the First Floor 'Zone_1_2' through 'Zone_1_5'. Rename all the zones in the second floor 'Zone_2_1' through 'Zone_2_7'.

3. The zones folder lets you assign HVAC related variables for the zone – like the outside air supply per person etc. Let the program use defaults for the all the zone related parameters. Select all the zones by clicking on the first zone name in the list of conditioned zones and holding down the Shift key and clicking on the last zone name. Make sure that the 'Flow/person' option is checked in the 'Outside Air' frame and that it is set equal to 15. Also check zone reheat.
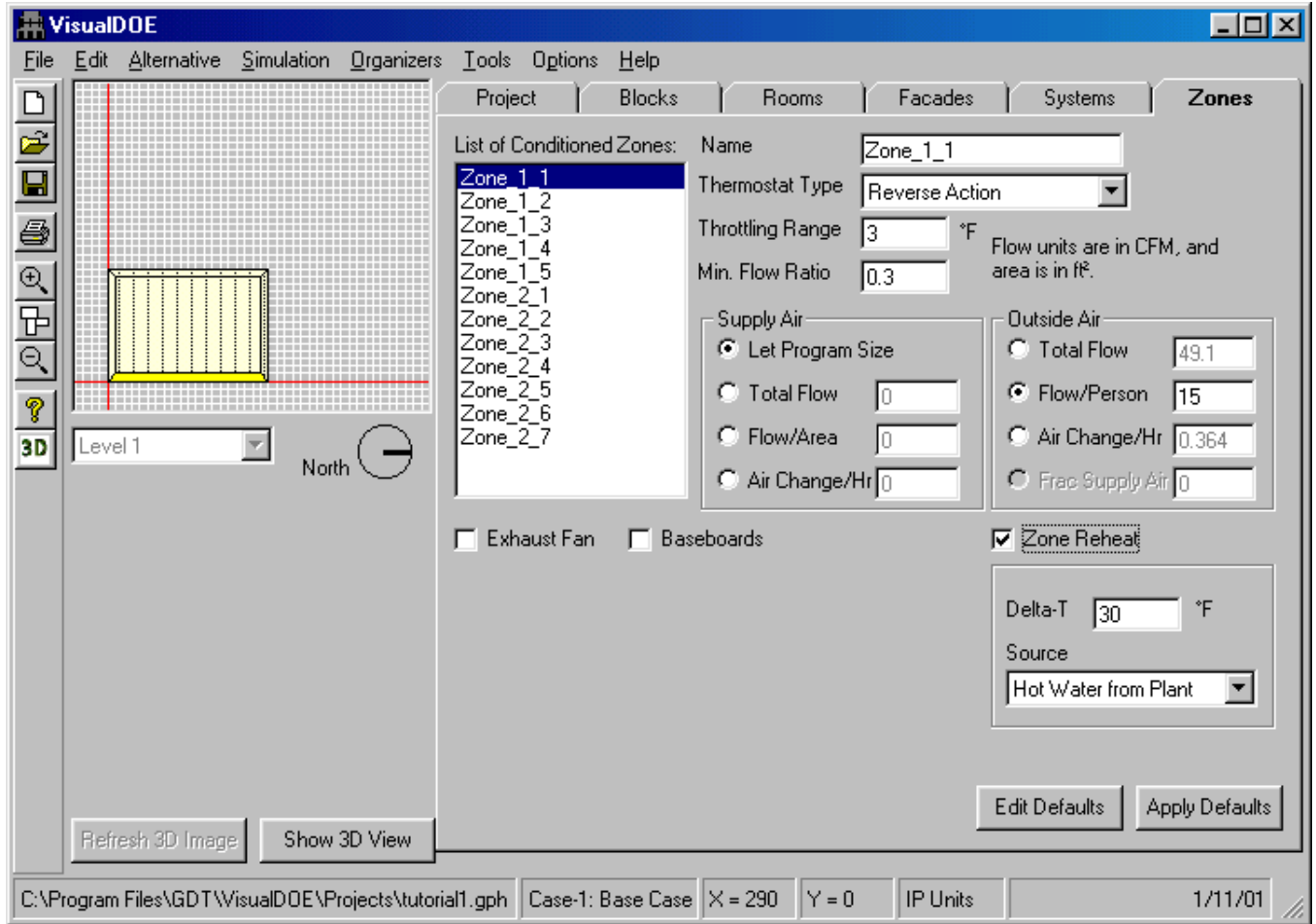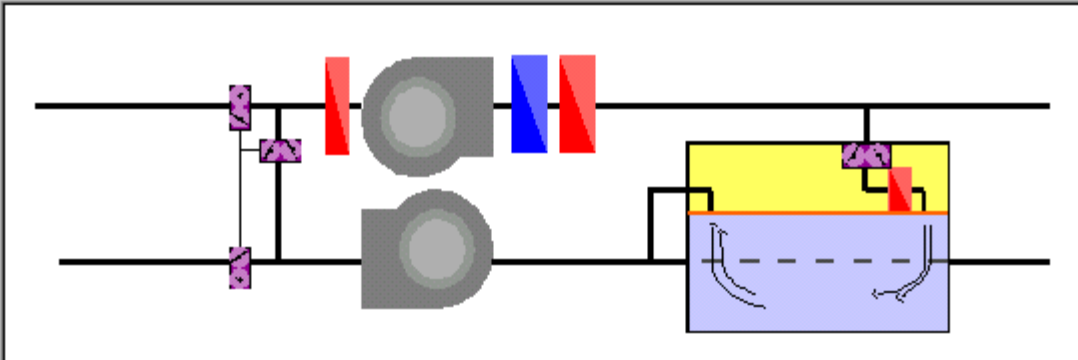
13.8   Lesson 8 – HVAC Systems

The Systems folder to define the HVAC system. We had already assigned one system per block.

1. Click on 'System_First_Floor' and then click on the 'HVAC Systems Editor' tab. Another window with the systems parameters pops up. Let the program use defaults for all the system parameters. You will see that the system assigned to this floor is VAV system. Change the 'Return Air Path' to 'Plenum' by picking it from the drop-down list.

2. Pick 'System_Second_Floor' from the drop down list for 'System'. Change the 'Return Air Path' to 'Plenum' for this system as well.

3. Click 'OK' to exit out of this window.

4. With this we have completed the basic description of the model. Before simulating the model, save the file by clicking on the 'Save File' icon in the left edge of the window.
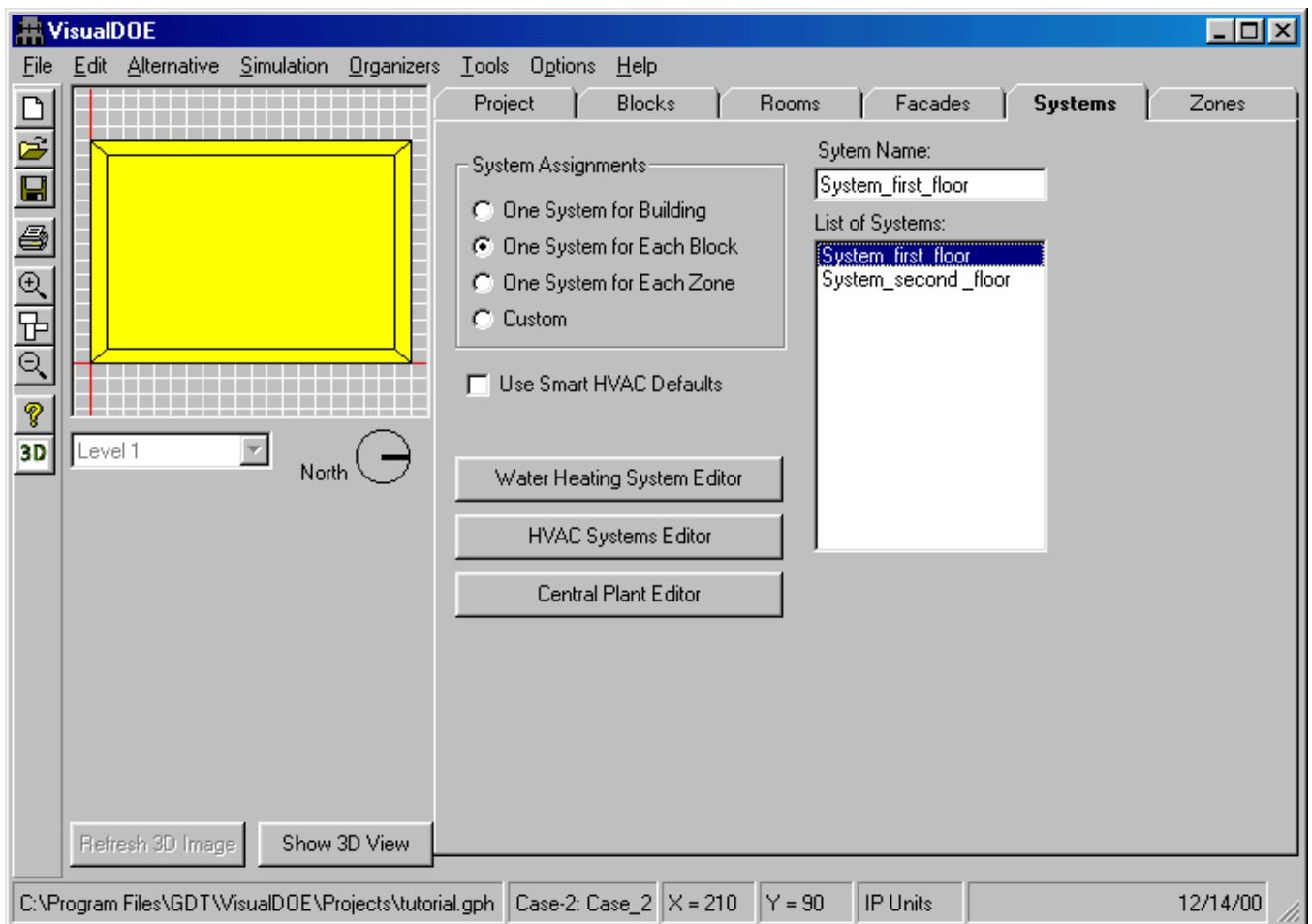
13.9   Lesson 9 – Running a Simulation

The VisualDOE interface produces some summary reports as described below. You can generate these reports for viewing on the screen or for printing while you are developing your model. The results report will of course, be incomplete until you have performed a simulation

1. *Architectural Summary*. This report is a summary of the surface areas and window areas in the building broken down by construction type.

2. *Architectural Detail*. This report summarizes the information that you entered about the construction materials size and shape of the building along with details about the windows on each façade.

3. *Zones Summary.* This report summarizes information about the zones in the building, including internal loads, supply air volumes and outside air volumes.

4. *Systems Summary.* This report summarizes information about each of the systems.

5. *Plant Summary.* This report summarizes information about the central plant components.

6. *Results.* Once the simulations are complete, VisualDOE will extract a summary of end-use energy, monthly electricity use, monthly gas use, and peak demand by month, annual gas cost, annual electricity cost and the source energy use in kBtu/y-ft². These data will be displayed and then placed in the project data base for either the base case or the proposed design, depending on the type of simulation you performed.

We can assign additional DOE-2 reports if we wish to.

1. Click on 'Simulation' in the menu bar for VisualDOE. Choose 'Set up and Run' from the drop down list of commands. A 'Run Setup' Window pops up.

    1. Click on the 'Standard DOE-2 Reports' folder. Choose the following reports one at a time from the 'Standard DOE-2 Reports' frame (by clicking on the appropriate name) and clicking on the 'single arrow' button to add it to the 'Assigned Reports' frame -

    LV-A, LS-A, LS-B, LS-C, LS-D, SS-A, SS-B, SS-D, SS-F, PS-B, PS-E, PS-F.
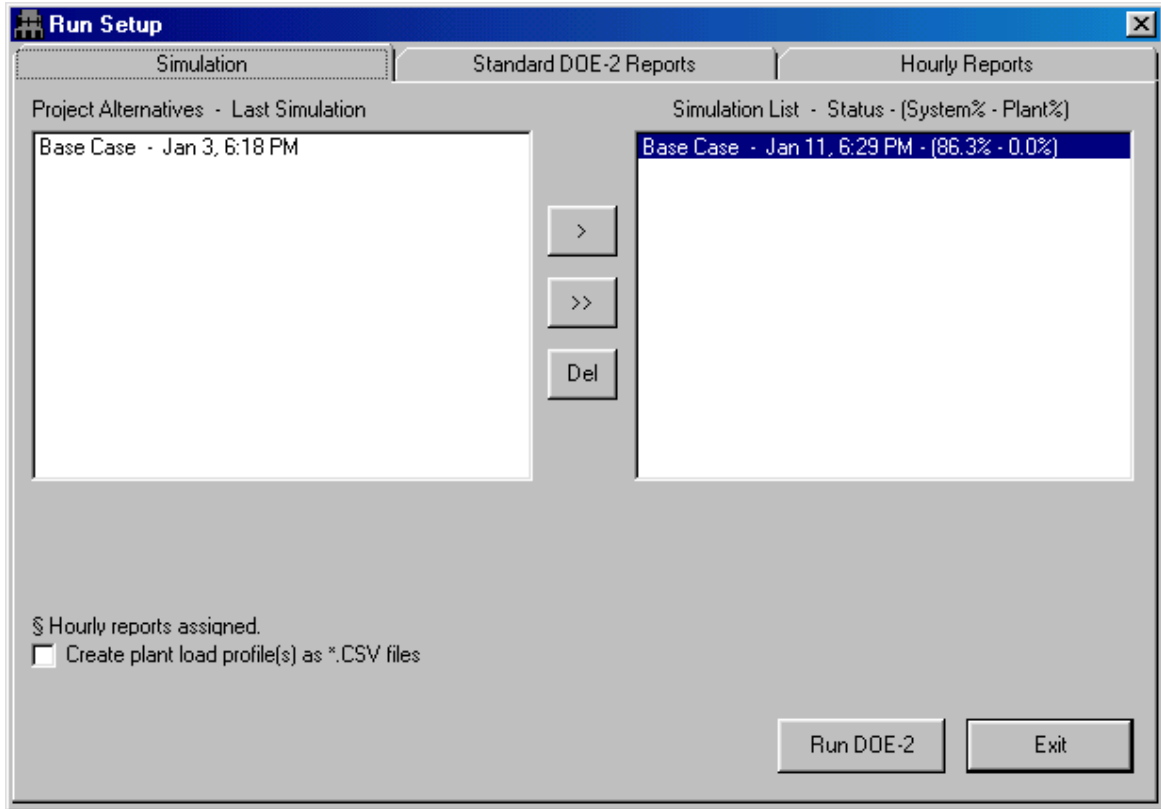
2. Click on the 'Simulation' folder. Choose 'Base Case – Unrun' from the 'Simulation Status List' frame.

3. Click on the 'Run DOE-2' button.
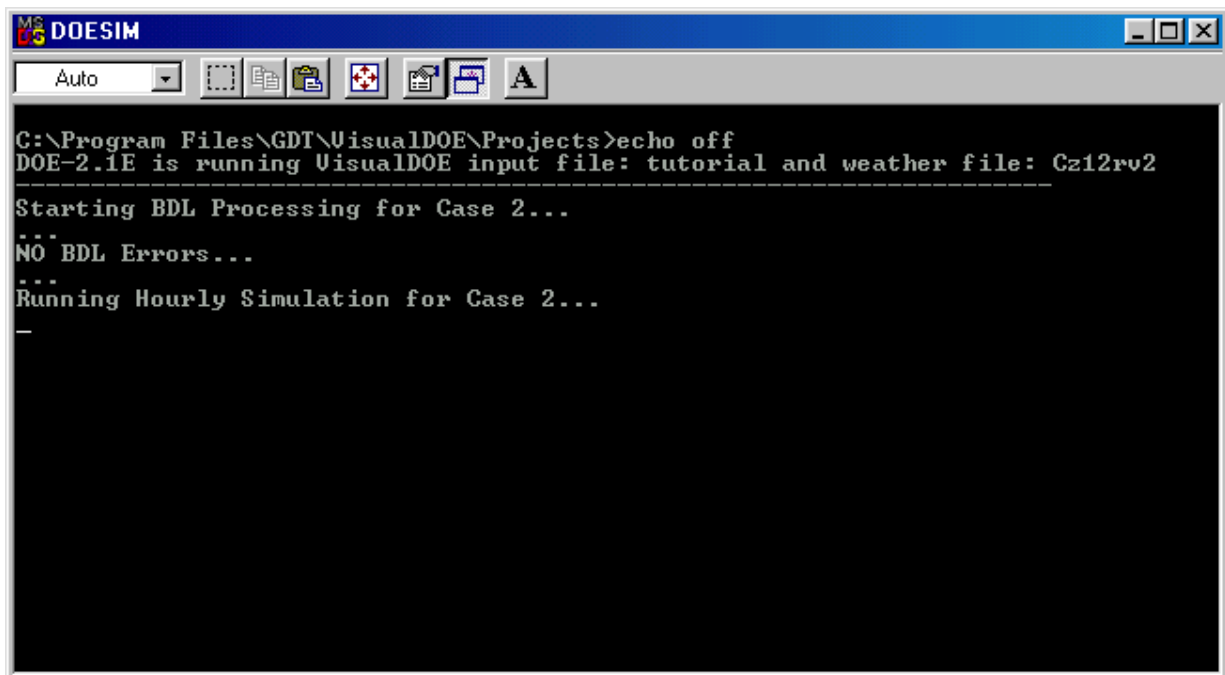
4. A MS-DOS window titled 'DOESIM' pops up and displays the status of the simulation. After this window disappears – you can view the status on the 'Simulation List – Status' frame in the 'Run Setup' window. You will be able to see the percentage of loads not met by the system and the plant – once the simulation is complete, you can exit out of this window by clicking on the 'Exit' button.

5. To view the results, click on 'Simulation' in the VisualDOE menu bar, and choose 'View Results' from the drop down list. Choose 'Reports'. This will cause a 'VisualDOE Reports' form to appear with two list boxes. One list box shows the reports that are available and the other shows the base case that you have created. You can make multiple selections from both lists. Click on 'Plant Reports Summary' from the list of reports in the 'Reports' frame. Click on the 'Print Preview' button to view the report. The report is displayed in the 'Print Preview' Window. You can use the 'zoom' icon and choose 'Page Width' from the drop down menu. This report contains details on the plant parameters, like size of equipment, chilled water temperature etc. Click on the 'Print' icon if you wish to print this report. This action displays the 'Print' window. Ensure that you have the correct settings for your computer for printing. Click on the 'OK' button after you have checked the print settings to print the report. Click on the 'Close' button to finish viewing this report. This action takes you back to the 'VisualDOE Reports' window. Click on the 'Exit' button to close this window.
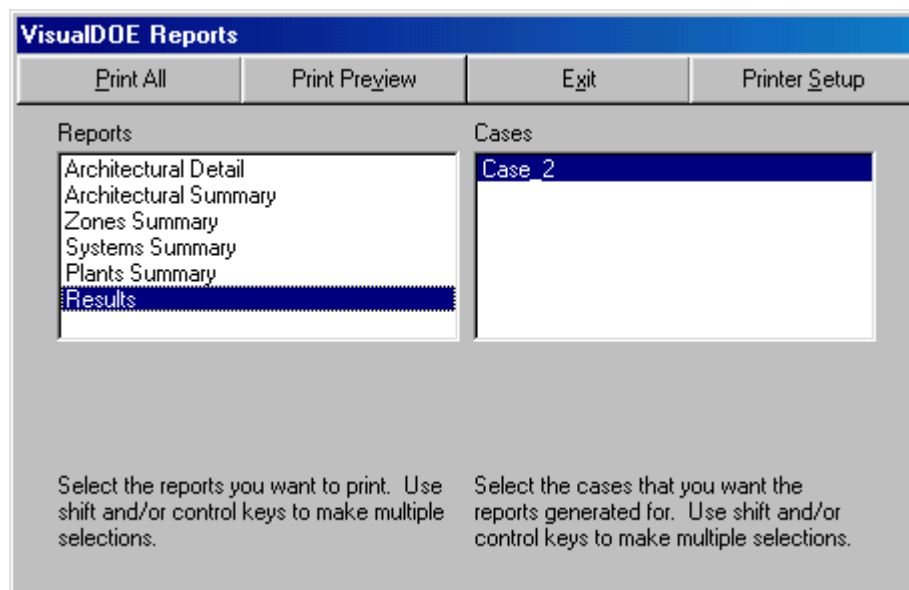
6. You can also view the DOE – 2 input, BDL and output files. Click on 'Simulation' in the VisualDOE menu bar and choose 'View DOE-2' reports from the drop down menu. A window displaying the DOE-2 BDL file pops up. Click on the 'Output files' tab to view the output reports. A list of available DOE-2 reports is displayed as a drop down list in the 'DOE-2 Reports' field. Choose 'BEPU Building Energy Performance Summary (Utility Units) to view the summary of total gas and electrical energy consumption by various components in the building from the dropdown list of reports in associated with 'DOE-2 Reports'. Click on the 'Exit' button to close this window.

Print Preview

Close

1/1

VisualDOE Plants Summary   **December 19, 2000**

Name: Tutorial
Address: Test Project
Analysis done by: Eley Associates
Project File: c:\program files\gdt\visualdoe\projects\tutorial.gph
Library File: c:\program files\gdt\visualdoe\projects\tutorial.gph
Alternative Name: Case_2

Chilled Water Pump   **Cooling Tower (Central Plant)**
Type   Fixed-Speed   Efficiency (bhp/tons)   0.0127
Head (ft)   30   Approach Temperature   8 °F
Motor Efficiency   0.9   Design Wetbulb Temperature78 °F
Impeller Efficiency 0.8   Capacity (tons)   1.0
                                             Water Economizer   No
Chilled Water Temperature 44 °F   Number of Cells   1
                                             Cell Control   Minimum Needed
Hot Water Pumps   Temperature Control Type   Fixed
Type   Fixed-Speed   Setpoint Temperature   85 °F
Head (ft)   30   Throttling Temperature   10 °F
Motor Efficiency   0.85   Minimum Water Temperature66 °F
Impeller Efficiency 0.7   Design Range   10 °F
                                             Capacity Control   One-Speed Fan

Chiller Type #1: Using Template - Med Eff WC with Water-cooled Condensor
Automatic Sizing   Yes   Evap. Flow   3 (gpm/ton)   Number Installed   1
Hot Gas ByPass   No   Evap. Pressure Drop   5 (ft)   AutoSize #1   128.6 (tons)
Min. Operating Point   0.1   Evap. Imp. Eff.   0.77
100% APLV Efficiency   0.8 (kW/ton) Evap. Motor Eff.   0.9
CHWS Rating Condition 44 °F   Cond. Flow   3 (gpm/ton)
CWS Rating Condition   85 °F   Cond. Pressure Drop   5 (ft)
                                  Cond. Imp. Eff.   0.77
                                  Cond. Motor Eff.   0.9

Print

Printer

Name: HP LaserJet 5/5M PostScript   Properties

Status: Ready
Type: HP LaserJet 5/5M PostScript
Where: \\NT_SERVER\HP5
Comment: ☐ Print to file

Print range   **Copies**

◉ All   Number of copies: 1

○ Pages from: 1   to: 1

○ Selection   1 2 3

                                                OK   Cancel

```
tutorial.02                                                                                    _ |B| X

Search String    PS-E          Search    Print        Save     Exit
DOE-2 Reports    BEPU BUILDING ENERGY PERFORMANCE SUMMARY (UTILITY UNITS)   ▼

         Input File                         BDL File                      Output File

REPORT- BEPU  BUILDING ENERGY PERFORMANCE SUMMARY (UTILITY UNITS)              WEATHER FILE- CZ12RV2 WYEC2
---------------------------------------------------------------------------------------------------------


                          ENERGY TYPE:   ELECTRICITY   NATURAL-GAS
                          SITE UNITS:       KWH           THERM

                   CATEGORY OF USE
                   ---------------

                       AREA LIGHTS       311344.          0.

                       MISC EQUIPMT      116754.          0.

                        SPACE COOL       163444.          0.

                       HEAT REJECT         5523.          0.

                       PUMPS & MISC        3824.          0.

                         VENT FANS       306189.          0.

                       DOMHOT WATER        9558.          0.
                                       ----------    ----------

                              TOTAL      916635.          0.


          TOTAL ELECTRICITY    916635. KWH      16.666 KWH    /SQFT-YR GROSS-AREA   16.666 KWH    /SQFT-YR NET-AREA
          TOTAL NATURAL-GAS         0. THERM     0.000 THERM   /SQFT-YR GROSS-AREA    0.000 THERM   /SQFT-YR NET-AREA

                  PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 86.6
                  PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED               =  0.0

                  NOTE:  ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.


1VisualDOE                                                  DOE-2.1E-110  Tue Dec 19 10:49:25 2000EDL RUN  1
 Case_2                              \Program Files\GDT\VisualDOE\Projects\tuVisualDOE 3.0
REPORT- ES-D  ENERGY COST SUMMARY
```

Congratulations! You have successfully completed creating and simulating a VisualDOE model. We can now move on and learn how to use the more advanced features of this program.