FEDS USER'S GUIDE: FACILITY
ENERGY DECISION SCREENING

RELEASE 2.10

J. A. Dirks

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Pacific Northwest Laboratory
Richland, Washington 99352

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1.0 INTRODUCTION TO FEDS

The Facility Energy Decision Screening (FEDS) Model is under development at Pacific Northwest Laboratory (PNL)^(a) for the Department of Energy Federal Energy Management Program (DOE-FEMP) and the U.S. Army Construction Engineering Research Laboratory (USA-CERL). FEDS is a multi-level energy analysis software system designed to provide a comprehensive approach to fuel-neutral, technology-independent, integrated (energy) resource planning and acquisition.⁽¹⁾ The FEDS system includes Level-1, which is a top-down, first-pass energy systems analysis and energy resource acquisition decision software model for buildings and facilities, and the Level-2 software model, which allows specific engineering inputs and provides detailed output.

FEDS Level-1 is a user-friendly, DOS-based, menu-driven software program for assessing the energy efficiency resource at a large federal installation. It uses high-level installation information (number, age, size, and types of buildings and energy systems), an internal data base of typical energy-system configurations and performance data, and sophisticated energy simulation and optimization models to estimate the net present value of potential energy retrofits in federal installations.

The FEDS Level-1 analysis will typically be followed by a FEDS Level-2 analysis, which allows FEDS Level-1 information to be augmented with detailed energy-system information and returns detailed *project-by-project technology selection* and economic information. FEDS Level-2 is accessed through a Windows-based user interface. This release, which includes both levels, will cover only building systems. Future releases will cover other energy systems, including central heating and cooling plants and thermal distribution loops.

This development effort is being managed by Mr. K. Dean DeVine, Senior Engineer, Federal Energy Management Program, U.S. Department of Energy. Please refer any programmatic recommendations, comments, and/or questions to Mr. DeVine at 202-586-6784.

The software is being developed at Pacific Northwest Laboratory, DOE's lead laboratory for the Federal Energy Management Program. Please report any software bugs, and refer any recommendations, comments, and/or questions of a technical nature to Mr. Jim Dirks at 509-372-4272.

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1.1 GENERAL DESCRIPTION OF FEDS

1.1.1 The FEDS Software System

The FEDS software system consists of six main modules. The first is the Level-1 user interface (L1UI). This module will allow the user to access all of the other Level-1 modules from a DOS-based graphical, menu-driven environment. Two versions of the L1UI are supplied:

- FEDS - the fully functional L1UI, used for developing the Level-1 input file, generating Level-2 files, and running the FEDS model.
- FEDSVIEW - a version of the L1UI that can be used to view the input screens and a Level-1 input file without entering and saving data. The second version is necessary because error-trapping routines in FEDS preclude any movement from screen to screen without proper data entry.

The second module, called FEDSL1PP, is the pre-processor for Level-1. When this module is called, it converts the Level-1 user input to the FEDS binary data structures used by the rest of the system. Additionally, FEDSL1PP uses the inference generator and the HVAC system sizing model to completely fill those structures with inferred parameters.

The Level-2 user interface (L2UI) is the third module. This module provides the user access to the inferred parameters from a Windows-based graphical, menu-driven environment. This module also allows the user to access all of the other Level-2 modules.

The fourth module, the Level-2 pre-processor consists of three executables. L2TOBIN parses the ASCII Level-2 input file produced by the L1UI and modified by the user, checking the file for syntax errors and invalid values. The parser converts the Level-2 input to the same FEDS binary data structures as produced by FEDSL1PP. L2DEFLT is the inference generator for those parameters that have not been locked by the user (see Section 3.2.3, for a discussion of locking input values); this is called by either the L1UI when generating a new ASCII Level-2 input file or by the L2UI before execution of the optimizer or upon user request. The contents of the data structures are then checked to ensure that there are no user inputs (or combinations of user inputs and inferred defaults) that may cause the model to abort. Finally, a new ASCII Level-2 input file containing the new inferences is created by L2GEN.

The fifth module is FEDSOPT, the optimizer which is called by either the L1UI or the L2UI. The optimizer contains the building energy model, the retrofit modeling, and the life-cycle cost analysis.

Finally, the sixth module is FEDSRPT, the report writer. It generates text output reports for both Level-1 and Level-2, and an ASCII file suitable for importation into a spreadsheet.

1.1.2 Functional Description of FEDS

FEDS provides a comprehensive fuel-neutral, technology-independent, integrated (energy) resource planning approach from the top down. The basic intent of the model is to provide an installation with the information necessary to determine the minimum life-cycle cost (LCC) configuration of the installation's energy generation and consumption infrastructure. The model has no fuel or technology bias; it simply selects the technologies that will provide an equivalent or superior level of service (e.g., heating, cooling, illumination) at the minimum LCC.

When determining the minimum LCC configuration of generation and end-use technologies, all interactive effects between energy systems are explicitly modeled. For example, when considering a lighting retrofit, the model evaluates the change in energy consumption in all building energy systems rather than just the change in the lighting energy. The value or cost of these interactive effects varies by building type (level of internal gain), building size (portion of heating, ventilation, and air conditioning loads attributable to internal gains versus envelope gains/losses), climate (whether a particular building is cooling or heating dominated), occupancy schedule and a number of other factors. Thus, there is no simple solution, and detailed modeling, as is done in FEDS, is the best way to provide a credible estimate of the impact.

In determining the optimal retrofit for each technology, the interactions at the installation level are considered by determining the impact on the installation's electric energy and demand cost, as well as the interactive effects among end-uses. This is important because the peak electric demand in any individual building may not occur at the same time as the installation's peak demand. Since the buildings on large federal installations are not individually metered, the installation is billed based on the combined demand of all buildings. Thus, proper valuation of the changes in an individual building's electric demand must be done in the context of the impact on the installation's demand profile--including time-of-day pricing and demand ratchets.

1.2 FEDS INSTALLATION

This section describes the minimum computer requirements and the installation of the software.

1.2.1 Minimum Computer Requirements

The FEDS software requires the following minimum computer platform:

- A DOS-based personal computer. The Level-1 user interface is memory-intensive and the program is computationally intensive. The time required to run the program is highly dependent upon computer platform. A fast computer (at least 80486DX/25MHz) is recommended to prevent the program from tying up the user's machine for long periods of time. Using the minimum computer identified above, running the program (after data input) should take from 5 minutes to 4 hours, depending upon the size (number of building categories) and complexity (number of HVAC types and energy sources, etc.) in the input file.

For all intents and purposes, a coprocessor is a requirement for the computational portion of the model. A comparable machine, without a coprocessor, will take more than 30 times longer to run the model. Computers with 32-bit architecture (80486) will also have quicker run times than 16-bit machines.

[For instance, running the four-building sample case that accompanies the software {Sample-2.il} requires approximately 100 minutes on a 486DX2/66 machine, and substantially longer time on a standard 286 or 386 machine.]

- Windows 3.0 or greater is required for the FEDS Level-2 User Interface (Windows 3.1 is highly recommended).
- Available hard disk space of at least 40 MB. Disk space is required for loading the FEDS program files, and for storing FEDS input and output files. Level-1 input files are small and the output files are generally between 30 KB and 150 KB per set. ASCII Level-2 input files require about 55 KB per building set for both input and output. Finally, during execution of the model, large temporary files are created; these are about 500 KB per building set.
- 3.5-in., 1.44-MB floppy drive (for loading the FEDS software).
- VGA graphics adaptor and monitor
- 580 KB of available RAM. In DOS, if you use the command "mem", it will display the largest executable program size. This number must be greater than 593,920 ($580 * 1024$) for FEDS to run successfully.

- DOS 3.3 or higher.
- Microsoft-compatible mouse. Note: a mouse is not required to run FEDS Level-1--it can be run using only the keyboard--but using a mouse is highly recommended.
- "Config.sys" must have at least 50 files and 40 buffers defined.

NOTE: The computer needs to be devoid of any memory-resident programs (e.g., windows, local area network software, etc.), which might interfere with proper running of the code or which might consume too much memory.

1.2.2. FEDS Installation

FEDS must be run from a hard disk on a DOS-based machine. The following steps must be completed to install the FEDS Level-2 User Interface software on your hard disk.

To perform the installation you need five disks:

- FEDS Disk #1 of 3 Release 2.10
 - FEDS Disk #2 of 3 Release 2.10
 - FEDS Disk #3 of 3 Release 2.10
 - FEDS Level-2 User Interface Disk #1 of 2 Release 2.10
 - FEDS Level-2 User Interface Disk #2 of 2 Release 2.10.
1. Start in your base directory (e.g., c: prompt). Make sure that you are in DOS.
 2. To install the software, insert Disk #1 into your drive and use the following format to install the software:

```
<source>:\INSTALL <source> <dest>
```

where <source> = disk drive containing install.bat
<dest> = destination disk drive\directory.

Example: A:\INSTALL A C
(install from A: drive into C:\FEDS directory)

3. The installation program will create a FEDS directory and a MODEL sub-directory. If you currently have a FEDS directory, the INSTALL program will overwrite any existing FEDS program files in this directory and

within your FEDS\MODEL subdirectory. While the installation program should not harm any input or output files, it is recommended that you back up and delete all files in your FEDS and FEDS\MODEL directories, and remove these subdirectories before you install FEDS. You will be warned if you have a FEDS directory and will have a chance to abort installation.

4. The INSTALL program will prompt you to put in Disk #2.
5. The INSTALL program will prompt you to put in Disk #3.
6. The INSTALL program will let you know that installation has been successful.
7. Insert "FEDS Level-2 User Interface Disk #1 of 2 Release 2.10" into your drive. From the Windows Program Manager, select File and then Run. Then, type in:

<source>:\SETUP

Where <source> = disk drive containing install.bat.

This will create a Windows program group and a Windows program item accessible by an icon.

8. The SETUP program will prompt you to put in Disk #2 ("FEDS Level-2 User Interface Disk #2 of 2 Release 2.10").

You now are ready to run FEDS!

2.0 FEDS LEVEL-1

The objective of FEDS Level-1 is to provide a top-level screen as a preliminary indication of what actions should be initiated; further analysis is required before a project is designed and implemented. FEDS Level-1 depends upon numerous assumptions about the "typical" federal installation, with only minimal energy price and installation configuration information needed as input. FEDS Level-1 *never* requires the input of engineering parameters.

The purpose of the FEDS Level-1 tool is to provide utility, institution, agency, energy, or installation managers with a simple 3-4 hour method to:

- estimate resource efficiency potential at a single multi-building installation with limited metered energy-use data
- characterize and prioritize the most promising building and end-use retrofit project opportunities
- estimate capital investment requirements and potential energy and cost savings based upon federal life-cycle cost economics.

The tool can also be used at the headquarters or agency level to characterize opportunities at all sites, thereby providing a way to prioritize among these sites.

Specific FEDS Level-1 capabilities include:

- accepting input data of a generic and/or aggregated nature - For example, the percentage of a building type that uses a particular heating fuel is entered, but the individual heating technologies are not specified.
- estimating current and post-retrofit energy consumption for all energy systems under consideration
- determining the optimal retrofits to the current system (considering interactive effects) and estimating the post-retrofit energy consumption, initial installed cost of the retrofits, recurring costs of the retrofits, value of the change in energy consumption and operation and maintenance (O&M) requirements, and the net present value of the retrofit - The net present value is the difference between the LCC of the existing technology and the LCC of the retrofit technology.

FEDS Level-1 requires the minimum possible information for making a reasonable first-cut estimate at the energy resource efficiency potential. Following are the required FEDS Level-1 inputs and purposes:

- **Installation Location:** This information is used to determine the appropriate climate zone, weather data, and DOE region.
- **Installation Energy Consumption Data:** These data determine current fuel mix used by buildings and central plants.
- **Installation Energy Price Data:** These data include detailed electric rate structure information for time-of-day rates and demand ratchets. These data also include fuel price information for all other fuels used or available at the installation, including oil, natural gas, coal, purchased steam, site-generated steam, purchased hot water, site-generated hot water, and other fuels.
- **Building Types:** These include 17 civilian (commercial and residential) and 31 military building types, which are listed in Table 2.1. Buildings with common purposes and/or functions are grouped together into building sets defined by the available building types.
- **Building Physical Data:** These data include vintage (construction year), size, and number of buildings of each type in the building set.
- **Types of Energy and Technologies Used in Each Different Building Set:** These include the percentage of building set end-use service provided by each heating fuel type, cooling technology, service hot water fuel type, and lighting technology.
- **Building Operating/Occupancy Hours:** This includes occupancy starting and ending hours for weekdays, Saturdays, and Sundays.
- **Financial Parameters:** These include the real discount rate, the appropriate real escalation rates for all fuels, and the level of gas and electric utility rebates or cost-sharing for energy-efficient retrofit technologies.

FEDS Level-1 uses the information provided by the user to internally generate descriptions of prototypes of each building type selected by the user. The default values of the parameters used to describe the prototypes are inferred from the input data; for instance, the climate zone is used in conjunction with the building type, vintage, and size to infer parameters relating to the building construction characteristics. This information is

Table 2.1. FEDS Building Types

FEDS Civilian Building Types

Assembly	Public Order/Safety
Education	Warehouse & Storage
Food Sales	Other
Food Service	Single Family Detached
Health Care	Single Family Attached
Lodging	2 to 4 Unit Buildings
Mercantile & Service	5 or More Unit Buildings
Office	Mobile Homes
Post Office	
Administration	Laundry
Administration/Storage	Morale, Welfare, & Recreation
Barracks	Military Other
Barracks/Administration	Production and/or Process
Barracks/Dining Hall	Recreation
Chapel	Schools and/or Training
Clinic	Security
Clubs	Shops
Commissaries	Storage
Dining Halls	Warehouse
Electronics	Single Family Detached House
Exchange Facilities	Single Family Attached House
Guest Houses	Duplex
Hangar	Multi-family 3 or More Unit
Hospital	Military Mobile Homes
Labs	

also used to infer the most likely heating equipment types for each user-supplied heating fuel type. The resulting building prototype parameter values are statistically the most likely values for a given building type, climate zone, average vintage, size, and fuel/technology mix. The FEDS building model (described below) uses these parameters to estimate the energy consumption of each building prototype.

The user-supplied energy price data are used in conjunction with the estimates of full building set energy consumption (to account for the interactive effects) and the user-specified or selected real energy cost escalation rates to determine the energy costs of the existing and the potential retrofit technologies. The FEDS model then uses the federally mandated life-cycle cost methodology, as specified in 10 CFR Part 436⁽²⁾, to combine the retrofit

capital cost, operation and maintenance cost changes, and changes in the energy costs to determine the cost-effectiveness of potential retrofits (i.e., the minimum LCC technology is selected).

Applicability. The most-likely parameter-value approach to the development of the building prototypes allows FEDS Level-1 to perform detailed modeling of a installation while requiring only very limited information from the user. The results from FEDS Level-1 are intended to be used as a gross indication of the required investment, and the energy and cost savings potential at an installation. The results can indicate which building types and end uses have the greatest savings potential. However, the most-likely parameter-value approach also means that FEDS Level-1 is most appropriately applied to installations with large numbers of buildings. This approach makes the application of FEDS Level-1 to single buildings less accurate than when it is used to model multi-building installations.

2.1 LEVEL-1 USER INTERFACE (L1UI)

The following is a brief description of the FEDS Level-1 user interface (L1UI). It is not intended to describe the use or function of all screens; instead, it is intended to provide an overview. Detailed screen help is available via context-sensitive help within the program. A summary of help messages is included as Appendix E.

There are two FEDS interface alternatives. From the directory FEDS, type either FEDSVIEW or FEDS.

FEDSVIEW

Use FEDSVIEW to become familiar with FEDS and to practice using it. You do not need to enter data to run FEDSVIEW. It allows you to move from screen to screen and back and forth, so that you can become familiar with the kinds of information you will need to provide and the order in which you will need to provide it. FEDSVIEW is also useful for quickly looking at a particular case, when you don't want to change the case.

You can enter data in FEDSVIEW if you want to but, since there is no error checking, that data cannot be saved. Again, FEDSVIEW is to be used to become familiar with FEDS, not for developing input files.

FEDS

The command FEDS will start the L1UI with full validation. FEDS is used for creating an input file for use in the FEDS model. The model will not allow the user to leave any screen until appropriate data inputs are entered into the data fields and the inputs all fall within specified ranges.

2.1.1 Screen Navigation

FEDS can operate with or without a mouse. However, using a mouse makes operation much easier. Using a combination of the two methods provides the easiest operation.

Non-Mouse Operation: You may elect to navigate through the input screens using the keyboard instead of the mouse. This can be accomplished by using combinations of the up, down, right, and left arrows; tab key (next box); shift-tab key (previous box); and alt-key. The use of these keyboard combinations will be explained for each type of screen object.

Mouse Operation: You can quickly move to the desired location on the screen using the mouse. Simply position the mouse pointer on the desired object and click the left mouse button.

On the Level-1 screens, there are four object types: push buttons, check boxes, data fields, and pop-up menus. Objects are screen features that allow the user to enter information into the model. The operation of each object is described below.

Push Button: At the bottom of each screen are three buttons. Typically, these buttons are labeled *continue*, *previous screen*, *save/quit*. On the opening screens and the last screen, the labels are somewhat different but the purpose is clearly defined.

Non-Mouse Operation: On each push button, one of the letters in the label accompanying each box is underlined. If you hold down the alt-key while typing that letter, that action will be taken immediately. *OR* Move the mouse pointer to the push button using the arrow keys until the push button is highlighted (changes color from gray-blue to red), and then press the enter-key while holding down the shift-key.

Mouse Operation: Move the mouse pointer to the desired push button; the button will be highlighted (change color from gray-blue to red) when the mouse pointer is on the push button. Click the left mouse button and that action will be taken immediately.

Check Boxes: On many screens, check boxes are used. To the side of the check box is a label describing the function of the box. Some sets of boxes are exclusive (the model will allow you to select only one) and others will let you check as many as apply.

Non-Mouse Operation: Move the mouse pointer to the check box using the arrow keys, which highlights the check box (changes its color from mustard to dark blue), and then press the enter-key to check the box.

Mouse Operation: Move the mouse pointer to the desired check box; the button will be highlighted (changed from mustard to dark blue) when the mouse pointer is on the push button. Click the left mouse button to check the box.

Data Fields: On many screens, data fields are used to enter information. A label describing the function of the box is located near the data field, which describes the information requested.

Non-Mouse Operation: Move the mouse pointer to the data field using the arrow keys, which also move the cursor to that data field. Then, enter the requested information.

OR Move the cursor to the desired data field using the tab-key and shift-tab key (press the tab-key while holding down the shift-key). The tab-key moves the cursor to the next data field and the shift-tab key moves the cursor to the previous data field. When the cursor is in the last data field, pressing the tab-key will take you to the first data field; conversely, when the cursor is in the first data field, pressing the tab-key will take you to the last data field. When the cursor is in the desired data field, enter the requested information.

OR Move the cursor to the desired data field using the enter-key. The enter-key moves the cursor to the next data field. When the cursor is in the last data field, pressing the enter-key will take you to the first data field. When the cursor is in the desired data field, enter the requested information.

Mouse Operation: Move the mouse pointer to the desired data field, which highlights the center of the field (changes color from light-blue to deep-red); click the left mouse button and the cursor will appear in the data field. When the cursor is in the desired data field, enter the requested information.

Pop-up Menus: For several data screens, you need to access a pop-up menu to select from a list of alternative choices. There are two different

methods in which the pop-ups are accessed, depending on their use. The pop-ups for the selection of the installation location, weather station, and file name are accessed by pressing the F2-key when the cursor is in the appropriate data field. (See "Data Field" above for an explanation of how to move the cursor to the data field.) Enter the building types selection pop-up in the same manner you operate any other push button.

Non-Mouse Operation: Once the list has appeared, move to the appropriate item using the arrow keys. Select that item by hitting shift-enter; in the building type pop-up, multiple items can be selected. Once you have made your selection, use the alt-key in conjunction with the underlined letter to initiate the desired action.

Mouse Operation: Once the list has appeared, you can maneuver within the list using the mouse as in any other window-type environment. Click on the appropriate box when the selection has been made from the pop-up list.

2.1.2 Input Files

After the first "Welcome" screen, four screens briefly describe the FEDS software. These can be avoided by clicking on "Jump to Inputs" on the first screen.

The Input Files screen is used to select one of the major functions of the L1UI. Note that, depending on the function selected, the FEDS L1UI will act differently. In all cases, check that the directory specified is where you want to save and retrieve files. If the model has been run before, it will remember the name and directory of the last file developed. If you are starting a new case, you will want to erase or change this old file name (the last screen, Saving Input and Output Files, will allow you to enter a file name).

All FEDS Level-1 input files have the extension ".il" and all output files have the extension ".ol". When naming your file, it is only necessary to enter the filename, and the program will automatically enter the extension.

For instance, if you name a file "fort," the input file can later be located as "fort.il." After the model is run, the output can be located as "fort.ol."

The following are the choices available on the Input Files screen:

Start New Case: All input screens are visited in sequence, and you may exit from any screen. This selection is made when you want to start a

case from scratch. The information required under this choice is the same as required under "Edit Existing Case," which is described in Section 2.1.3.

Finish Existing Case: When this selection is made, the program will jump to the beginning of the edit group (see Section 2.1.3), which contains the last completed input screen for the unfinished case. Continue forward from here until you reach the last screen on which you entered data. Proceed on from here as if this were a new case. This selection should be made when you need to complete a case that you started but didn't finish using the "Start New Case."

Edit Existing Case: This selection will bring you directly to the Input File Edit Menu, which provides the ability to visit one or more of the input subsets. When one of the input subsets is selected, you will visit each of the screens within that subset and be returned to the File Edit Menu screen. See Section 2.1.3.

Create Level-2 File: Selecting this option will generate ASCII and binary Level-2 input files, based on the file name that appears at the bottom of the screen. The name that you select from the pop-up at the bottom of the screen can be either a Level-1 file or an ASCII Level-2 input file in which you have made changes. The ASCII Level-2 input files will be stored in the specified directory and have the extension ".i2?". See Section 3.1.4.

Run Case: Executes the case specified. After completion, the LIUI will notify you that the FEDS model is complete. The output file will have the same name as the input file, with the extension ".o1" for a Level-1 run and ".o2?" for a Level-2 run. For example, "fort.i1" would result in "fort.o1".

Create ASEAM Files: *This option is currently unavailable.* When it is completed, it will allow you to generate ASEAM quick-input files based on your FEDS input.

2.1.3 File Editing

The file editing screen is used for jumping to an input group. It is only available if you have selected "Edit Existing Case" on the Input Files screen.

From the File Editing screen, select one of the following:

Location & Run Date: Provides the name and location of the site being modeled in this edit group, and also select the weather station that most closely matches the weather at the site. Additionally, the run year for the analysis is included in this edit group. The run year adjusts cost and escalation rates to the same year.

Installation Energy Usage: Provides information on the energy consumption at the site for a typical year. This information currently has limited use in the model (determining the fuels and technologies available for selection in buildings and the predominant fuel for central chilled water generation). This is because the model currently only simulates buildings and has no way to reconcile energy use lost in transmission and distribution systems or that used in central plants or for industrial processes. In future versions of FEDS, when the entire site is modeled, the program will more fully use this input information.

Energy Price Data: Provides, in a series of input screens, the program information on energy sources available to the site (even if they are not currently used) and the prices for each energy type. Note that if a price is entered for any energy type, then the program will assume that energy source is available to all buildings being modeled and will optimize the life-cycle economics for all buildings using technologies that employ that energy source. Conversely, if a price is not entered for a particular fuel, then no technologies that use that fuel will be evaluated. The input screens provide the capability to model almost any electric rate structure with up to five different rate periods (energy and demand charges) per day and also includes demand ratchets. Fuel prices should be given for the run year specified above.

Building Level Information: Provides the model information on the types of buildings at the installation. Information includes building type (e.g., office), number of buildings of each type, total square feet, and average year of construction for each building type.

Building Energy Use: Provides the model information on the energy systems contained within each building type. The systems for which information needs to be provided include heating fuel type, cooling technology, hot water fuel type, and lighting technology. This information is provided on an "average basis" for all buildings of each type. Office buildings, for instance, might be modeled as having 80% fluorescent and 20% incandescent lighting across all office buildings.

Building Operating Hours: This edit group provides the model information on the hours each of the building types is operated/occupied. Provision is made for different operating schedules for weekdays, Saturdays, and Sundays, if operating hours are different.

Financial Parameters: This edit group provides the model information on financial parameters necessary for life-cycle cost analysis and system optimization. These parameters include discount rate, energy escalation rates, utility cost-sharing (on a fuel-type and technology-type basis), and screening on simple payback and savings-to-investment ratio.

NOTE #1: If while editing the Installation Energy Usage edit group, you eliminate any energy source (and thus eliminate that energy source as a currently used fuel at the installation), then you must also visit the Building Energy Use edit group to ensure that none of the building energy systems described in these screens use the energy type that has been eliminated. *Failing to follow this guideline may result in an invalid file that will cause the FEDS model to crash.*

NOTE #2: If while editing Building Level Information you identify additional building categories, then you must visit the Building Energy Use and Building Operating Hours edit groups to characterize the energy systems and operating hours in those building types. *Failing to follow this guideline may result in an invalid file that will cause the FEDS model to crash.*

2.1.4 Saving Files

FEDS inputs can be saved at any time by clicking the Quit button and then clicking on the Save button. The program is provided with a backup function that will automatically save inputs every 1 minute so that regular manual saving is not required.

2.1.5 Running Level 1

The model is run directly from the input files screen, which is the first data screen encountered in the LIUI. Click the "Run FEDS Model" box, select the input file to be run, and click on "Continue."

2.1.6 Timed Backup and Recovering Input Data

As stated above, the LIUI will automatically save inputs every 1 minute. If for some reason your computer locks up, you have a power failure, or for

some other reason you are unable to exit the program in an orderly manner, the data you have entered are not lost--only the last screen or up to 1 minute's worth of entry is lost.

To recover the data, do the following from the DOS prompt (outside of the FEDS model) *before you reenter the model*:

```
C:\FEDS> copy c:\feds\case.bak c:\feds\model\<case>.il
```

where *<case>* is the name of a file that you select.

At this point, you reenter the FEDS L1UI and at the Input Files screen, select "Finish Existing Case" and then move to the "File Name" data entry input section. Strike the F2-key and a list of Level-1 input files will appear. Select the file name that you just copied from "case.bak" and then hit "Continue." The program will move you to the beginning of the last section in which you were working. Proceed from here as if this were a new case.

2.2 DESCRIPTION OF SAMPLE CASES

When you install FEDS onto your hard disk, the software will automatically create two sample input files for your use, called "sample-1.il" and "sample-2.il." These files can be used for several purposes, including the following:

- recalled using "Edit Old Case" to review on a screen-by-screen basis how data files are constructed.
- run by the FEDS model to check whether your computer platform is adequate for running the FEDS software - This can be especially useful if files that you have developed do not run, and you get error messages that lead you to believe that your platform may be inadequate.
- recalled using "Edit Old Case" and edited to create your own case.

2.2.1 Sample-1.il

This case file contains a single 40,000 ft² office building in San Francisco, California. The office was built in 1978. It is heated by electric resistance and cooled by electric packaged single zone units. Service hot water is heated with electric resistance. The building has 30% incandescent lighting, 50% conventional fluorescent lighting, and 20% high-efficiency

fluorescent lighting. On weekdays, the building is occupied from 7 am to 6 pm; on Saturdays, from 10 am to 4 pm; on Sundays, the building is unoccupied.

2.2.2 Sample-2.11

This case file contains two 50,000-ft² office buildings, six 50,000-ft² warehouses, ten 2,000-ft² single-family (detached) residences, and three multi-family (five or more units) buildings with an average floor area of 26,667 ft². These buildings are located in Seattle, Washington.

The two office buildings were constructed in 1977. One office is heated and cooled with an electric air-source heat pump; it has an electric water heater. The other office is heated with natural gas and cooled with packaged single zone units; it has natural gas water-heating. For both offices, the lighting is 20% incandescent and 80% conventional fluorescent. On weekdays, the building is occupied from 7 am to 6 pm; on Saturdays, from 10 am to 4 pm; on Sundays, the building is unoccupied.

The warehouses were all built in 1979. Three of the warehouses are heated with oil; three are not heated at all. None of the warehouses have cooling. All six warehouses have oil service water-heaters. All of the warehouses have 100% high-pressure sodium lighting. The warehouses are occupied from 6 am to 8 pm on weekdays, 8 am to 6 pm on Saturdays, and 10 am to 4 pm on Sundays.

The single-family residences were built in 1981. Five of the homes are heated and cooled by electric air-source heat pumps; the other five are heated by gas and not cooled at all. All the homes have electric water heaters and 100% incandescent lighting. They are occupied from 5 pm to 7 am on the weekdays and continuously occupied during the weekends.

The multi-family buildings were constructed in 1984. One of the buildings (24,000 ft²) is all electric, with electric resistance heating and electric water heaters. The other two buildings (28,000 ft² each) are heated with natural gas and have gas water-heaters. All three buildings cool with window air-conditioners. Ten percent of the lighting is fluorescent and 90% is incandescent. The buildings are occupied from 5 pm to 7 am on the weekdays and continuously occupied during the weekends.

3.0 FEDS LEVEL-2

The objective of FEDS Level-2 is to allow a knowledgeable user to override the default building and energy-using/generating equipment parameters that were set in FEDS Level-1. You may generate ASCII and binary FEDS Level-2 input files from FEDS Level-1 input data. The Level-2 input can be modified using the Level-2 User Interface, or a text editor (e.g., MSDOS Edit®, PE®, Brief®) may then be used to edit the FEDS ASCII Level-2 input file in order to change the various default parameter values generated by FEDS Level-1.^(a) Unlike other models which require detailed inputs, this approach allows but does not require you to enter any site-specific information that is readily available.

Additional FEDS Level-2 capabilities include:

- **Modeling a user-defined building that has two distinct uses (termed "use-areas"):** Two types of these dual-use buildings are supported-- those with use-areas that share a common HVAC system (termed "dual-use, common HVAC buildings") and those with use-areas served by different HVAC systems (termed "dual-use, separate HVAC buildings").
- **Access to nearly 500 existing lighting technology configurations:** A list of the codes used to identify each of the lighting technology configurations for the FEDS model along with descriptions of the technology configurations are contained in Appendix A.
- **Specification of an unlimited number of building groupings, including multiple groups of the same building type:** These groupings are termed "building sets." At a minimum, building sets should consist of a number of buildings of the same type, of about the same age and size, with the same kind of fuels available.
- **Ability to model buildings that are used only part of the year:** At Level-2, you may specify which months a building is in use. You may also indicate the heating thermostat set-point to be used during the unoccupied months.

^(a)A word processor (such as WordPerfect® of Microsoft Word®) may also be used to edit the file, but care must be exercised in so doing. Margins should be set wide enough that there is no "wrapping" of the lines in the Level-2 file, and the file must be saved as a standard ASCII file, not as a WordPerfect or Word file.

- **Ability to specify which fuels to consider for potential fuel-switching retrofits for individual building sets:** When considering fuel-switching retrofits at Level-1, it is assumed that the fuels available to the installation are available to each building in the installation. Level-2 allows the user to change this assumption to better reflect the actual fuel availability on different parts of an installation.

Through Level-2, the user has access to almost all the inferred parameter values used to describe the Level-1 building prototypes. These inferences include the following:

- **Building envelope characteristics:** You may change the Level-1 inferences for the construction materials used for the walls, roof, floor, and windows. You may also specify different insulation R-values and thicknesses than those assumed in Level-1 or simply specify the desired overall U-value for the windows, walls, roof, and floor. Appendix K provides a detailed description of the FEDS wall and roof types.
- **Lighting systems:** You may change the Level-1 inferences for the lighting technology configuration(s), the lighting fixture density, utilization levels for occupied and unoccupied periods, and lighting heat to space.
- **Heating and cooling equipment:** The Level-1 assumptions for equipment type, number of units, nominal output capacity, and efficiency (or coefficient of performance) for heating and cooling equipment may be changed by the Level-2 user.
- **Ventilation system:** Fan and fan-motor capacities and efficiencies, as well as the ventilation system control mode, may be changed.
- **Service water heating system:** Level-1 assumptions regarding the hot water consumption levels, system type, equipment efficiency, equipment capacity, and size may all be changed.
- **Miscellaneous equipment:** You may change the Level-1 inferences for miscellaneous equipment densities, utilization levels, and heat to space.

Additional information that you provide in FEDS Level-2 is used to re-calculate (where appropriate) any dependant inferred values. You may then examine these resulting inferences and, if desired, make further changes to them before running the FEDS model.

3.1 THE LEVEL-2 PROCESS

Briefly, the FEDS Level-2 analysis process will usually consist of the following steps:

- 1) Complete an initial Level-1 screening.
- 2) Gather additional data about the installation.
- 3) Determine building set breakdown.
- 4) Generate binary and ASCII Level-2 input files from the Level-1 input file.
- 5) Modify inferences, generate new inferences, examine new inferences, make appropriate changes, update inferences again, and repeat process until satisfied with inputs.
- 6) Run model on final Level-2 input.

Each of these steps is described below.

3.1.1 Step 1: Level-1 Screening

A Level-2 analysis will typically begin with a Level-1 screening of the installation. The screening step serves several purposes:

- Completion of the Level-1 input requires the user to organize and examine the data that are available for the installation.
- Results from the Level-1 screening can be used to direct resources for additional data-gathering. The building types, end uses and fuels with the largest potential savings (according to the screening) are the building types, end uses and fuels that should be given the most time and money for additional data-gathering (see step 2, Section 3.1.2, for a lengthier discussion on the gathering of additional data).
- The Level-1 screening results can also be used to indicate which building types should have the highest resolution in terms of number of individual building sets (see step 3, Section 3.1.3, for a description of breaking down building types into building sets).
- The Level-1 input file serves as the starting point for the Level-2 input files.

Complete information about how to perform a Level-1 screening can be found in Section 2.

3.1.2 Step 2: Gathering Additional Data

Level-2 allows a user to examine the inferences used in the Level-1 analysis and to change those inferences for which the user has more accurate information. The results of the Level-1 analysis can be used to direct the data-gathering efforts; building types, end uses, and fuels with the greatest potential savings are the ones that should get the most effort. This effort may be as minimal as confirming the heating and cooling equipment types and the construction types with a quick walk-through or drive-by or it may involve determining actual lighting densities by counting light fixtures.

For most large installations, there will be a limit to how much additional data it is reasonable to gather. The user must make the trade-off between the cost of gathering additional data and the quality of the output. The Level-1 screening results can be used to help prioritize the data-gathering effort, and the effort must also be coordinated with breaking the building types into building sets (step 3).

3.1.3 Step 3: Breaking Building Types into Building Sets

An example can illustrate how and why building types are broken into building sets. An installation contains two groups of administration buildings: a group of approximately 1943 vintage buildings and a group of buildings constructed in the early 1980s. At FEDS Level-1, the average vintage of the administration buildings would be about 1963, a value that is not very representative of either group. At FEDS Level-2, the building type may be broken up into two sets, one for each vintage category. Making this one change will greatly improve the applicability of the inferred values to the two building sets. It may also be appropriate to use other determinants as well, such as common construction characteristics, common HVAC system types or characteristics, similar penetration rates of particular lighting technology configurations, or similar miscellaneous equipment densities.

Section 5.2 contains a brief description of the FEDS inference generation. After building type, the major determinants of inference selection are the building vintage, location, and size. A first step for determining building sets could be to break each type into the vintage and size ranges used by FEDS, which are given below:

Size Categories (ft²)

0 - 4999
 5000 - 9999
 10000 - 24999
 25000 - 49999
 50000 - 99999
 100000 and greater

Vintage Categories

before 1946
 1946 - 1960
 1961 - 1973
 1974 - 1979
 1980+

With six size categories and five vintage categories, there are potentially 30 building sets for each building type. Moreover, this does not even account for differences in fuel availability among similar building sets. Obviously, a Level-2 file could grow very large, very quickly. A more reasonable approach may be to break up a particular building type into sets by grouping along common construction characteristics (e.g., wall type, presence or absence of insulation, percent of wall area that is glazed, etc.), common lighting and/or equipment densities, and common fuel availability. Again, Level-1 screening results can be used to guide the decisions in this task.

3.1.4 Step 4: Generating Initial Level-2 File from Level-1 Input File

The initial Level-2 input files can be generated from the Level-1 input file through the L1UI. At the input screen, select "Generate Level-2 File." You may then select the Level-1 input file name from the pick list, or type it in directly. Note that the L1UI requires that you enter a file extension if you choose to type the name in. Level-1 input filenames have the form "<case>.i1"; the Level-1 output report is in a file named "<case>.o1." Two types of Level-2 input files are generated in this manner ASCII Level-2 input files that can be edited with a text editor (see Section 3.5), and binary Level-2 input files used by the Level-2 user interface. The name of the ASCII Level-2 input file generated from the Level-1 input file will have the form of "<case>.i2." There are several binary files generated for the Level-2 user interface; the form displayed in the Level-2 user interface is "<case>.fac."

3.1.5 Steps 5 and 6: Level-2 Input, Inference Generation, and Running the Model

All user-modifiable FEDS inferences are in the Level-2 input files. These inferences can be modified using the Level-2 user interface, as described in Sections 3.2 through 3.4, or they can be modified using the ASCII Level-2 input file, as described in Section 3.5.

3.2 THE LEVEL-2 USER INTERFACE (L2UI)

The following is a brief description of the FEDS Level-2 user interface (L2UI). It is not intended to describe the use or function of all screens, but instead to provide an overview. Additional information is provided in Appendix M.

3.2.1 Screen Navigation and Operation

The FEDS L2UI is a menu-driven Windows application. It should be intuitive to Windows users.

Tab and shift-tab: Tab moves the cursor forward from one object to the next. Shift-Tab moves the cursor backwards from object to object.

Buttons: Buttons control many operations in the L2UI, for example, selecting individual lighting technology records. A single click of the left mouse button will activate any button.

Check boxes: On many screens, check boxes are used. A left mouse click will select the item. Clicking the item again will turn off the selected indicator. Some check boxes are exclusive, that is, selecting one item will deselect a previously selected item.

Data fields: On many screens, data fields are used to enter information. A label describing the function of the box is located near the data field. When the cursor is in the desired data field, enter the requested information. A tab will move you to the next field.

Drop-down lists: For several data screens, you will need to access a drop-down list to select from a list of choices. The slide bar and arrows will move you to the desired item. A single left mouse click will select the item.

List objects: In the Installation Inputs:General Information screen and the Building Inputs:General Information screen there are list objects. These allow you to access different areas of the program to input site-specific information. A double left mouse click will bring up the selected sub-menu. *NOTE: This is the only place where a double mouse click should be used.*

3.2.2 Special Buttons

"Save," "Cancel," "Save-Done": These three buttons are located on all sub-menus. "Save" will save the information you have entered and leave

the cursor in that screen. "Cancel" will erase any information that has not been previously saved and take you to the previous screen. "Save-Done" saves the information you have entered and takes you to the previous screen.

"Add," "Delete": For each technology in a building set, there is a separate screen (record). "Add" creates a blank record. "Delete" removes an existing record.

"First," "Previous," "Next," "Last," "Locate": These buttons allow you to quickly move between technology and building set records. "First" moves to the first record. "Previous" moves back one record. "Next" moves forward one record. "Last" moves to the last record in the set. "Locate" pops up a pick list of all records; a double left mouse click on the desired record or single left mouse click on the desired record followed by "Continue" moves you to that record.

"Current Position": This button is located on all screens. Its function is to display errors, position in the program, and positions within a building set or multiple record input screen (e.g., lighting technologies).

3.2.3 Special Indicators and Locking

All user-entry areas except list menus are gray. Data-entry areas are located to the right of the current values.

White current values: If the background of a current value area is white, it is not part of the minimum set. A double left mouse click on a value in the white area will lock the value (i.e., FEDS will not change this value). Any user-entered value is automatically locked. Locked values are indicated by always being present in the user-entry area. To unlock a value, double click on the value in the gray area and strike Delete. This value will then be inferred when inferences are updated.

Blue current values: If the background of a current value area is blue, it is in the minimum set. For a new building set or technology record, all minimum set items must be provided in order to determine the inferences and run the model. All minimum set items are not inferred by FEDS and, thus, do not have the locking feature associated with them.

3.2.4 Screen Layout

Figure 3.1 shows the screen layout for the L2UI. The figure shows the path to get to each input screen and sub-screen. There is no specified order required, but sub-screens can only be reached through their parent.

After you select a case, the first screen you see is the Installation Input:General Information screen. From this screen you may select any of the installation level inputs or move to the building set inputs. Additional functionality at the Installation Input:General Information screen includes updating installation level inferences, updating all inferences (installation and building level), and running the model.

3.2.5 Technology Records

There are limits on the number of technology records for a particular end use, within a particular building (or a particular use-area for dual-use, separate HVAC building sets).

Table 3.1 contains the maximum number of technology records allowed for each end use. The first column gives the maximum number of records allowed in a single-use building, or within both use-areas of a dual-use building with a common HVAC system, or within use-area 1 of a dual-use building with separate HVAC systems. The second column gives the maximum number of records allowed in use-area 2 of a dual-use building with separate HVAC systems.

Note that there are no technology records for the ventilation end use. FEDS requests only the control and operational information for the ventilation system.

3.2.6 Saving and Backing Up Files

This is the first release of the L2UI. While all known bugs have been eliminated, there may still be some problems. To prevent loss of work, SAVE AND BACK UP YOUR FILES to a temporary directory you have created (e.g., "c:\feds\backup").

Copying the files to your backup directory can be done in Windows File Manager or from DOS. To do this from DOS, toggle to DOS and copy all files associated with the case as follows:

```
C:\FEDS\MODEL> copy c:\feds\model\<case>.* c:\feds\backup\<case>.*
```

where <case> is the name of a file that you selected.

Installation Input: General Information

- ├─ Energy Consumption Inputs
- ├─ Non-Electric energy price inputs
- ├─ Marginal electricity price inputs
 - └─ Time of day rate schedules
- ├─ Central plant inputs
- ├─ Financial Parameters and screening inputs
- └─ Utility cost sharing inputs

Building Inputs: General Information

- ├─ Fuel type inputs
- ├─ Use-Area inputs
 - ├─ Geometry (*includes use-area types*)
 - ├─ Occupancy: General
 - └─ Occupancy: Seasonal
- ├─ Building envelop inputs
 - ├─ Roof
 - ├─ Floor
 - ├─ Walls
 - └─ Windows
- ├─ Lighting configuration inputs
 - ├─ Lighting Technology Inputs Use-Area 1
 - └─ Lighting Technology Inputs Use-Area 2
- ├─ Heating system inputs
 - ├─ Heating end use inputs
 - └─ Heating equipment
- ├─ Cooling system inputs
 - ├─ Cooling end use inputs
 - └─ Cooling equipment
- ├─ Ventilation inputs
- ├─ Hot water inputs
 - ├─ Service hot water end use inputs Use-Area 1
 - ├─ Service hot water equipment Use-Area 1
 - └─ Distributed
 - └─ Loop
 - ├─ Service hot water end use inputs Use-Area 2
 - ├─ Service hot water equipment Use-Area 2
 - └─ Distributed
- └─ Miscellaneous equipment inputs
 - ├─ Use-Area 1 inputs
 - └─ Use-Area 2 inputs

Figure 3.1. Level-2 User Interface Screen Layout

Table 3.1. Maximum Technology Records by End Use

End Use	Maximum Per Building, or For Use-area 1 of Dual-use Separate HVAC Buildings	Maximum for Use-area 2 of Dual-use Separate HVAC Buildings
Lighting	18	18
Heating	8	8
Cooling	9	9
Ventilation	N/A	N/A
Service Hot Water	17	17
Miscellaneous Equipment	6	6

Under some system configurations, you may get a "Sharing Violation" while attempting to copy. If this occurs, exit the L2UI, copy the files, and then reenter the L2UI.

3.3 CONVERTING EXISTING FILES

In order to run the L2UI using existing files, the files must be converted into the appropriate format. Sections 3.3.1 and 3.3.2 contain instructions on how to convert Level-1 and existing Level-2 input files for use in the L2UI.

3.3.1 Converting Level-1 Files

Convert Level-1 files to Level-2 files and run from Level-2 as follows:

- Enter Level-1 (Menuet Version).
- Generate a Level-2 file from the L1UI (see Sections 2.1.2 and 3.1.4).
- Modify input in L2UI.
- Update inferences from within L2UI.

- Examine new inferences, make appropriate changes, update inferences again, and repeat process until satisfied with inputs.
- Run model from within L2UI.

3.3.2 Converting Level-2 Files

Process an existing Level-2 file as follows:

- Generate new ASCII and binary Level-2 input files from the L1UI (see Sections 2.1.2 and 3.1.4).
- Modify input in L2UI.
- Update inferences from within L2UI.
- Examine new inferences, make appropriate changes, update inferences again, and repeat process until satisfied with inputs.
- Run model from within L2UI.

3.4 DUAL-USE SEPARATE HVAC BUILDING SETS

Release 2.1 of the L2UI does not support dual-use separate HVAC building sets. If you want to run a case containing a dual-use separate HVAC building set, follow the instruction in Sections 3.4.1 and 3.4.2 for new and existing Level-2 files.

3.4.1 Adding Dual-Use Separate HVAC Building Sets to New Level-2 Files

To add dual-use separate HVAC building sets to new Level-2 files, do the following:

- Follow the steps described in Section 3.3.1 up to run the model from within in L2UI.
- Run l2gen on L2UI binary files to produce an ASCII Level-2 input file as follows:

```
C:\FEDS\MODEL> l2gen <case> <case>.i2?
```

where <case> is the name of a file that you selected and <case>.i2? is the name of the file you wish to create. The ? should be replaced with a letter.

- Modify ASCII file to accommodate dual-use separate HVAC according to the instructions in Section ???
- Run FEDS using the ASCII Level-2 input file from the L1UI.

3.4.2 Dual-Use Separate HVAC Building Sets in Existing Level-2 Files

To use existing Level-2 files that contain separate HVAC building sets, do the following:

- Generate new ASCII and binary Level-2 input files from the L1UI (See Sections 2.1.2 and 3.1.4).
- Modify input in L2UI for all building sets that are not dual-use separate HVAC. *Note: When a dual-use separate HVAC building is brought into the L2UI, it is automatically separated into two different building sets.*
- Update inferences from within L2UI.
- Examine new inferences, make appropriate changes, update inferences again, and repeat process until satisfied with inputs.
- Run l2gen on L2UI binary files to produce ASCII Level-2 input file as follows:

```
C:\FEDS\MODEL> l2gen <case> <case>.i2?
```

where <case> is the name of a file that you selected and <case>.i2? is the name of the file you wish to create. The ? should be replaced with a letter different than the one just produced by the L1UI.

- Remove the two building sets from the ASCII file that were created from the dual-use separate HVAC building set and replace them with the dual-use separate HVAC building set from the original ASCII file.
- Run FEDS using the ASCII Level-2 input file from the L1UI.

3.5 THE ASCII LEVEL-2 INPUT FILE

This release of FEDS is the first to offer a user interface for Level-2; prior to this release, Level-2 input had to be made through an ASCII file. Additionally, as explained in Section 3.4, the ASCII file method must still be used for dual-use separate HVAC building sets. *Note: If you are using the*

L2UI and do not need to perform analyses of dual-use separate HVAC building sets, you can skip this section.

The first ASCII Level-2 input file that you generate will contain the information entered at Level-1 as well as the inferences generated from the Level-1 input. The ASCII file will have one building set for each building type modeled at Level-1. Text within the ASCII file contains guidance regarding individual entries, which should be needed while editing the file.

Section 3.5.1 gives a general description of the ASCII Level-2 input file structure and how the information is organized for the installation, for building sets within the installation, and for end uses within the building sets. Section 3.5.2 describes some of the features of the input lines within the files. Section 3.5.3 gives some hints that may make the file editing process a little easier. Section 3.5.4 explains the process of generating a new ASCII Level-2 file from an existing one. Section 3.5.5 guides you as you examine the new building inferences. Section 3.5.6 explains the running of the model using the ASCII Level-2 input files.

3.5.1 ASCII Level-2 Input File Structure

The ASCII Level-2 input file is divided into several sections. The sections are delimited with special double characters (for instance, "!!" is used to signal the beginning and end of a building set section) to allow the user to move around in the file easily, using the search function in a text editor.

The first part of the ASCII Level-2 input file is the installation information section. This section contains the information that applies to the entire installation, such as fuel prices and electric rate structures, location, and weather station. A formfeed (<FF>) sequence (which is seen as a hard page return by WordPerfect and PE) is placed at the end of the installation information section.

The building information sections are also delimited by the <FF> sequence. As can be seen from the structure diagram, they are also set off by double exclamation points (!!). The building set section is subdivided into sections for general building information (e.g., building geometry and fuel availability), the building envelope description, and then sections for the six end uses that FEDS models. In general, the end-use sections will contain information regarding the control and operation of equipment in the end use (for instance, the heating end use requests the heating thermostat setting) as well as at least one technology record.

As stated in Section 3.0, FEDS models two kinds of dual-use buildings. The ASCII Level-2 input file is structured to take input for both kinds of dual-use buildings. Dual-use buildings with a common HVAC system can have:

- use-area-specific operating schedules and occupant densities
- use-area-specific lighting technology configurations
- use-area-specific miscellaneous equipment types
- use-area-specific distributed service hot water systems.

Additionally, dual-use buildings with separate HVAC systems can have:

- use-area-specific heating systems,
- use-area-specific cooling systems,
- use-area-specific loop service hot water systems.

When editing the ASCII Level-2 input file, the building set section (delimited by "!!") can be replicated or deleted. It is important that the entire section be replicated (or deleted), or syntax errors will be generated when the file is parsed. Within a building set section, individual technology records can also be replicated. These sections are delimited by the double pound signs (##). Again, it is important that the sections be completely replicated or deleted.

Technology records contain information about individual technologies within an end use. For example, each unique combination of heating fuel and equipment type should have its own technology record.

Table 3.2 contains an abbreviated structure of the ASCII Level-2 input file. A complete listing of the ASCII Level-2 input file structure and format is contained in Appendix H.

3.5.2 ASCII Level-2 Input File Line Format

A sample from the installation section of an ASCII Level-2 input file has been reproduced below:

Non-Electric Energy Price Data: (Note: A zero value [BEGNEP] indicates that a fuel is not available on the site, and that fuel will not be considered for fuel-switching retrofits--these values should be

valid for the run year entered above.)

Oil (\$/gallon).....	[EPOIL]	0.780000	
Natural Gas (\$/therm).....	[EPNGAS]	0.400000	
Coal (\$/ton).....	[EPCOAL]	92.00000	
Purchased Steam (\$/MBtu).....	[EPPSTM]	0.000000	
Self-Generated Steam (\$/MBtu).....	[EPGSTM]	5.000000	
Purchased Hot Water (\$/MBtu).....	[EPPHW]	0.000000	
Self-Generated Hot Water (\$/MBtu).....	[EPGHW]	0.000000	
Other Fuels (\$/MBtu).....	[EPFUEL]	4.050000	
	[ENDNEP]		

This sample illustrates a number of features of the input file lines. First, a text header in column one describes what is being requested on the input lines. The input lines themselves have a series of dots leading up to the keyword in column two, which is contained in square brackets (e.g., [EPOIL]). The keyword is a code that allows the data from the text file to be parsed. The column after the keyword is the output column, where the values resulting from the inferences or previous input are displayed. Following the output column is a column between the two vertical lines; this is the locking column. If you decide that a particular inference is correct and should not be changed during subsequent runs, place an "X" in the locking column. The last column, the input column, is where an alternative value can be entered by the user.

In the sample above, the units for the input (e.g., \$/therm) were given on the input line. Other input data may offer a choice of units. In this case, there are two input lines associated with a single data item. The first line is for the numeric quantity, and the second is used to indicate the units. An example, for a cooling equipment capacity input, is given below:

Equipment output capacity (total per building).....	[C1EOC]	3.940532	
Capacity units (K=kW; M=MBtu/hr; T=tons).....	[C1EOCU]		T

Note that units are entered using a single letter code. There are numerous places in the file where either alpha or numeric codes are used to make an entry. Except for the following three codes, these codes are given on the input line:

- Lighting technology configuration codes are in Appendix B.
- Weather station file names are in Appendix C.
- Building and use-area type codes are in Appendix D.

```

Installation Information
<FF>
!!Begin Building:
    Building set description
        Use-area 1 description
        Use-area 2 description
    @@Begin Building Envelope Section:
        Use-area 1 envelope
            roof, walls, windows, floors
        Use-area 2 envelope
            roof, walls, windows, floors
    &&End Building Envelope Section
    @@Begin Lighting End Use Section:
        ##Begin Lighting Technology Configuration Record
        ##End Lighting Technology Configuration Record
    &&End Lighting End Use Section
    @@Begin Heating End Use Section:
        Use-area 1 control and operational information
            ##Begin Use-Area 1 Heating Type Record
            ##End Use-Area 1 Heating Type Record
        Use-area 2 control and operational information
            ##Begin Use-Area 2 Heating Type Record
            ##End Use-Area 2 Heating Type Record
    &&End Heating End Use Section
    @@Begin Cooling End Use Section:
        Use-area 1 control and operational information
            ##Begin Use-Area 1 Cooling Type Record
            ##End Use-Area 1 Cooling Type Record
        Use-area 2 control and operational information
            ##Begin Use-Area 2 Cooling Type Record
            ##End Use-Area 2 Cooling Type Record
    &&End Cooling End Use Section
    @@Begin Ventilation End Use Section
        Use-area 1 ventilation system information
        Use-area 2 ventilation system information
    &&End Ventilation End Use Section
    @@Begin Service Hot Water End Use Section
        Use-area 1 consumption information
        Use-area 2 consumption information
        ##Begin Service Hot Water System Record
        ##End Service Hot Water System Record
    &&End Service Hot Water End Use Section
    @@Begin Miscellaneous Equipment End Use Section
        ##Begin Miscellaneous Equipment Type Record
        ##End Miscellaneous Equipment Type Record
    &&End Miscellaneous Equipment End Use Section
!!End Building
<FF>
!!Begin Building
    .
    .
    .
    .
!!End Building
<FF>

```

Figure 3.2. Abbreviated Structure of ASCII Level-2 Input File

3.5.3 Editing Hints

ASCII Level-2 input files can become very large very quickly. The installation-wide information section (this is completed once per installation) requires about 50 KB. Each building set requires on the order of 25 KB of disk space. A file with 93 building sets is larger than 5 MB. It is probably most convenient to edit several smaller separate files, perhaps one for each building type. When you are ready to process the file, it can be merged using the DOS copy command in the following form:

```
C:\> copy file1+file2+file3+file4 bigfile
```

If this approach is taken, it is important to be sure that the installation section is only in the first file and not repeated in each of the other building set files.

In editing the input file for the first time, it may be easiest to set up the number of building sets (as determined in step 3), entering only the building type, building vintage, number of buildings, total floor area, use-area types, schedules, lighting technologies and percent of illumination, and heating, cooling, and service hot water fuels. Then, allowing the rest of the inputs to default based on inferences made from that minimum set of information. Finally, you can go in and examine the inferences and make the appropriate changes.

3.5.4 Generating a New ASCII Level-2 File from an Existing ASCII Level-2 File

Once the ASCII Level-2 input file has been edited, a new ASCII Level-2 input file can be generated. This new ASCII Level-2 input file will contain new inferences made in response to your edits. The new Level-2 file can be generated from the LIUI in the same way as the first Level-2 file was generated, except that the first Level-2 file is selected as the input file. The new Level-2 filename will be of the form "<case>.i2a."

It is possible (if not probable) that errors will be introduced during the editing process. All errors must be corrected before the model can be run on the Level-2 file. There are two kinds of errors that are possible: parser errors and validation errors.

Errors in the parser result from lines with keywords missing or out of order, invalid inputs, or incomplete inputs (e.g., selecting a built-up roof but not specifying the roof deck type). Parser errors will be written to a file with the name "<case>.err." There will be an approximate line number and a keyword that can be used to help locate the error in the input file.

Often, an initial parser error will start a "chain reaction" of errors. Correcting the first error and then re-parsing the file may correct many other errors. If an error is found in one building set, it is worthwhile to confirm that the error has not occurred in other building sets, especially if you were editing multiple copies of the same initial building set. It may take several passes to find and correct all of the parser errors.

Validation errors occur after the file has been parsed and the inferences have been regenerated. These can take two forms: 1) Warnings will be given if a quantity seems to be out of range (e.g., the zone depth being more than half the length of the shortest side of a building). 2) Fatal errors occur when a combination of user inputs causes the building model to abort. Text of the validation errors are written to a file called "<case>.val." The line will give the building set number, the keyword associated with the error, and the values that cause the error.

3.5.5 Examining New Building Inferences

After the errors have been corrected, you will have a new ASCII Level-2 input file to examine. Note that inputs made in the last column now appear in the output column, and an X appears next to them in the locking column. An X also appears wherever you locked a value while editing the file. If you decide to change one of these values, you may just enter the new value in the last column, and it will be automatically updated and locked; the inference generator will not overwrite your locked value.

It may take a few iterations before you are satisfied with your ASCII Level-2 input file. Each time you make changes, you should generate a new ASCII Level-2 input file. Each new file will increment the extension to the next available letter. For instance, if you generate a new input file from "<case>.i2a," the new file will be named "<case>.i2b." If you then generate yet another file from "<case>.i2a", the new file will be named "<case>.i2c." The only exception to this incrementing of the extension is if you use your original Level-1 file again as input. It always generates a Level-2 file with the ".i2" extension.

3.5.6 Running the Model Using ASCII Level-2 Input Files

After you are satisfied with the Level-2 input, you can run the FEDS model on the file. In the L1UI at the input screen, select "Run FEDS Model" and enter your Level-2 input file name. A final Level-2 input file will first be generated to document all of the changes made to the file. Then, the FEDS optimization model will be run. You may want to let the model run overnight.

After the model has been run, the report writer will produce an output report and the ASCII "<case>.prn" file. The form of the extension on the output report name will match the form of the extension on the Level-2 input file name that was generated just before the model was run. For example, if you selected "<case>.i2c" as your input file on the input screen, then the model would first generate "<case>.i2d". When the output report is written, it would have the name "<case>.o2d," to correspond to the final version of the input file.

3.6 ADDITIONAL LEVEL-2 FUNCTIONALITY

As mentioned above, there are several new features that have been added to the FEDS system in conjunction with Level-2. The ones that will be discussed here include the modeling of dual-use buildings and the FEDS approach to modeling HVAC loads.

3.6.1 Dual-Use Buildings

FEDS models two types of dual-use buildings: dual-use buildings with an HVAC system common to both use-areas and dual-use buildings with use-areas served by separate HVAC systems. An example of a common HVAC system is a barracks renovated with administrative offices in the first floor. An example of a separate HVAC system is a warehouse with a small office built on to one side.

For dual-use buildings with a common HVAC system, Level-2 allows the following parameters to be specified for each use-area:

- use-area type
- occupancy characteristics, including schedules and occupant density
- lighting technology configurations, fixture densities, utilization factors, and heat to space
- distributed (as opposed to central loop) service hot water systems
- miscellaneous equipment capacity densities, utilization factors, and heat to space.

For dual-use buildings with separate HVAC systems, Level-2 allows these additional parameters to be specified for each use-area:

- geometric characteristics, such as number of floors, number of HVAC zones, percent of wall area that is window
- all building envelope characteristics
- heating and cooling control and operational information, such as thermostat settings and supply temperatures
- central loop service hot water systems.

3.6.2 HVAC System Modeling

FEDS has three different algorithms for the calculation of heating, cooling, and ventilation loads. One algorithm models heating and cooling systems that use forced air for distribution. These are referred to as linked systems (the cooling or heating coil is directly linked with a fan). Linked systems are furnaces, fan coil units, air handling units, rooftop packaged units, window air conditioners, and heat pumps. A second algorithm models heating systems that do not use forced air for distribution (e.g., radiators). These systems are called unlinked systems, and there may or may not be a separate ventilation system in the building. Unlinked heating systems are electric baseboards and radiators. A third algorithm models the special case of evaporative coolers (which are linked systems), which cool air by adding moisture to it. Evaporative coolers are assumed to only use ventilation energy, i.e., the cooling is "free."

Additionally, for linked systems, FEDS makes a distinction between ducted and unducted systems. Unducted cooling types are fan coil units, window air conditioners, and evaporative coolers. Unducted heating types are fan coil units and all unlinked heating types. Ducted systems are all other types of linked heating and cooling. Due to the calculation of ventilation system parameters, FEDS will only model ducted linked heating and cooling systems together in a building set (for instance, rooftop package units and furnaces) or unducted systems (fan coil units served by district steam with fan coil units served by central chilled water) together in a single building set. Mixing of ducted and unducted systems will generate validation errors. Validation errors written out to "<case>.val."

Because all unlinked heating is also unducted it can only be combined with unducted cooling. This means that a particular building set can have a combination of unlinked, unducted heating system types (e.g., radiators served by single building boilers, radiators served by district steam, and electric

baseboard heaters) with a combination of linked, unducted cooling types (e.g., fan coil units served by single building chillers and window air conditioners). Unlinked, unducted heating may also be combined with evaporative coolers.

Appendix L provides a tabular description of the allowable HVAC combinations including unlinked, unducted heating types; linked, unducted heating and cooling types; linked, ducted heating and cooling types; and evaporative coolers.

4.0 FEDS LEVEL-1 AND LEVEL-2 OUTPUT

Following is a description of Level-1 and Level-2 output. The output file from Level-1 will be named "[casename].ol" and the output files from Level-2 will be named "[casename].o2?" and "[casename].prn."

4.1 DESCRIPTION OF [CASENAME].01 AND [CASENAME].02 OUTPUT

Two sample output files are included as Appendix F. "Sample-1.out" is provided on pages F-1 through F-12. "Sample-2.out" is provided on pages F-13 through F-33.

The standard FEDS Level-1 output file is structured as follows:

Page 1: An echo of the site energy-use characterization that you have provided in the input file.

Page 2: An echo of the electricity price and schedule information that you have provided in the input file.

Page 3: An echo of the site building characteristics that you have provided in the input file. The echo includes number of buildings, floor area, construction date, space heating technology space cooling technology, and service water heating technology.

Page 4: An echo of additional site building characteristics that you have provided in the input file. The echo includes indoor lighting technology and building operating hours.

Page 5: An echo of the site economic data that you have provided in the input file. The echo includes financial analysis parameters (discount rate, energy cost escalation rates, etc.) and utility cost-sharing.

Page 6: Following is an example of the page 6 output; each line of the output is explained below.

First year energy and demand dollar savings due to retrofits .	xxx,xxx
Present value of life-cycle energy, demand, and O&M savings ..	xxx,xxx
Total estimated investment required for retrofits	xxx,xxx
Present value of capital investments	xxx,xxx
Net present value of retrofits	xxx,xxx
Estimated current installation energy use (MBtu)	xxx,xxx
Estimated post-retrofit installation energy use (MBtu)	xxx,xxx
Estimated installation annual energy savings (MBtu)	xxx,xxx

First year energy and demand dollar savings due to retrofits - is the sum of the energy savings for each fuel across the entire installation plus the electric demand savings. The value of savings is the product of the energy savings and user entered price. Electric energy savings are based on hourly changes when time of day rates are used. Electric demand savings reflect changes in hourly demand and demand ratchets.

Present value of life-cycle energy, demand, and O&M savings - the sum of the present values of all energy and O&M savings over the investment lifetime. The investment lifetime for equipment is the short of 25 years or the remaining life of the existing equipment; for other improvements (e.g., envelope measures) the investment lifetime is 25 years. The "present value of life-cycle energy and O&M savings" is also the sum of the "net present value of retrofits" and the "present value of capital investments."

Present value of capital investments - the sum of all the present values of annualized installed costs. Note: the "present value of capital investments" is less than or equal to the "total estimated investment required for retrofits." This is because only those equipment capital costs that are amortized during the remaining life of the existing equipment are included in the calculation of the present value of capital investments.

Total estimated investment required for retrofits - the sum of all the retrofit installed costs.

Net present value of retrofits - the present value of life-cycle energy, demand, and O&M savings less the present value of capital investments (also called the net savings).

Estimated current installation energy use (MBtu) - the estimated total annual site energy use for buildings in MBtu prior to retrofit. This does not include process energy, electric distribution system losses, outdoor lighting, central plant energy consumption, thermal loop losses, etc. This value will not equal the annual energy consumption that the user entered. The difference is due to excluded uses described above and the difference between the actual weather for the site during the time period for which consumption data were provided and the 30-year average data used by the model.

Estimated post-retrofit installation energy use (MBtu) - the estimated total annual site energy use for buildings in MBtu.

Estimated installation annual energy savings (MBtu) - the difference between *Estimated current installation energy use (MBtu)* and *Estimated post-retrofit installation energy use (MBtu)*.

Page 7: Annual installation energy use and cost by fuel type (before and after retrofit), the difference, and the percentage change.

Page 8: Annual installation electric peak demand and cost (before and after retrofit), the difference, and the percentage change. The time of the installation peak demand (month, day type, and hour) is also provided.

Page 9: Annual installation energy use by fuel type and end use (heating, cooling, ventilation, lights, miscellaneous loads, and hot water). Values are provided for existing, post-retrofit, the difference, and the percentage change.

Page 10+: Annual energy use and cost by building set similar to that provided on page 7 for the installation. Electric costs on this page are based on the installation average cost and, thus, will not necessarily match the value on page 13 of the output. *[One page per building type]*

Page 11+: Annual electric peak demand by building set (before and after retrofit), the difference, and the percentage change. The time of the building set peak electric demand (month, day type, and hour). The contribution to the installation peak demand (coincident demand) and cost (before and after retrofit), the difference, and the percentage change. *[One page per building type]*

Page 12+: Annual building set energy use, by fuel type and end use, similar to that provided on page 9 for the installation. *[One page per building type]*

Page 13+ (Level-2 only): Summary building set information, including building type, number of buildings in set, total floor area in set. Existing, post-retrofit, and the change in the building set energy and demand cost are also provided. Lastly, summary life-cycle cost savings and installed capital costs for building set retrofits are included.

Page 14+ (Level-2 only): Detailed information on each optimal retrofit selected. Page 4.5 shows an example.

Section 4 FEDS Level-1 and Level-2 Output

Installation Name (A)
Technology Retrofit Information for Building Set #2: (B) MWR-05 (C)
End Use: Lights (D)
Use Area: MORALE-WELFARE-RECREATION (E)
Existing Lighting Configuration: 4
Existing Technology: FL4: FL 1X4 2F40T12 STD2 (F)
Percent of Building Set Served by this Technology: 16.54%
Retrofit Technology: FL52: FL 1X4 2F32T8 ELC2 (G)

Retrofit Technology	Existing	Retrofit	Difference
Watts/fixture	98 (K)	62 (L)	36
Operating hours/Year	2,234 (M)	2,234 (N)	0
Fixtures in this Bldg. Set	9 (I)	9 (J)	0
Vintage	1967 (H)	New	
Remaining Life (years)	25	25	

Technology Energy Use/Demand (this technology)	Existing	Retrofit	Difference
Energy (user units)	2,059 (O) (kWh) (P)	1,303 (Q) (kWh) (R)	-756
Energy (MBtu)	7	4	-3 (S)
Electric Peak Demand (kW)	1	0	0 (T)
Coincident Pk Demand (kW)	1	0	0

Building Set Energy Use/Demand (All technologies at minimum LCC sans technology being retrofit)	Existing	Retrofit	Difference
Heating (MBtu)	122	123	1
Cooling (MBtu)	288	288	-1
Ventilation (MBtu)	91	91	0
Lighting (MBtu)	108	105	-3
Misc. Equip. (MBtu)	116	116	0
Service Water Heating (MBtu)	134	134	0
Total	858	856	-2 (U)
Peak Electric Demand (kW)	93	92	0 (V)

Building Set Energy/Demand Cost--First Year (All technologies at minimum LCC sans technology being retrofit)	Existing	Retrofit	Difference
This technology			
Energy	\$ 144	\$ 91	\$ -53 (W)
Annual Electric Demand	\$ 58	\$ 37	\$ -21 (X)
Balance of Building Set (All technologies other than the one being retrofit--includes systems and retrofit interactions)			
Energy	\$ 14,713	\$ 14,702	\$ -12 (Y)
Annual Electric Demand	\$ 8,763	\$ 8,759	\$ -4 (Z)

Life-Cycle Costs Savings	Present Values	Annual Values
Installed Cost	\$ -458 (AA)	\$ -27 (AB)
Annual Maintenance	\$ 0 (AC)	\$ 0 (AD)
Non-Annual Maintenance	\$ 368 (AE)	\$ 21 (AF)
Annualized Energy/Demand	\$ 1,624 (AG)	\$ 94 (AH)
Total LCC Savings (NPV)	\$ 1,534 (AI)	\$ 89 (AJ)
Simple Payback (years)	4.1 (AK)	
AIRR(percent/year)	9.3 (AL)	
SIR	4.4 (AM)	
Installed Capital Cost:	\$ 458 (AN)	

4.2 DESCRIPTION OF [CASENAME].PRN OUTPUT

In addition to the "[casename].o2" output report, an ASCII file formatted for easy importation into almost any spreadsheet will also be produced. This file will be named "[casename].prn." Selected quantities from the "[casename].o2" output report are included in this file. The shaded characters in parentheses (e.g., (Q)) represent the spreadsheet column indicator where the data will reside after they are imported into a spreadsheet.

Note: While each Level-2 run will produce a unique "[casename].o2?" output, the "[casename].prn" will be overwritten if the name is not changed.

4.3 PRINTING OUTPUT FILES

FEDS will output its results into an ASCII file located in "C:\FEDS\MODEL." The output file from Level-1 will be named [casename].ol and the output files from Level-2 will be named "[casename].o2?" and "[casename].prn." The "[casename].o*" output files can be imported into any word processor for review, editing, and printing. The output is formatted so that using a non-proportional font (e.g., letter gothic, courier) at 16.7 characters per inch and 0.5-inch margins will align the output tables appropriately. The output will be separated into its various elements across separate pages. If desired, these hard page breaks can be eliminated in the word processor program in order to conserve paper.

5.0 FEDS TECHNICAL APPROACH

FEDS contains complex energy and economic modeling capabilities, which are utilized by a sophisticated optimization algorithm in the determination of the most life-cycle cost-effective energy resource/utilization configuration for an installation. The FEDS approach allows estimation of the installation-wide energy and peak demand, which is used in conjunction with complex electric rate schedules to determine installation electric costs.

5.1 DESIGN GOALS

The tool was designed with two major purposes in mind:

- estimating current energy consumption for all energy systems under consideration - Currently, FEDS only models building systems; it is intended that future FEDS releases will capture all energy consuming systems.
- determining the minimum life-cycle-cost retrofits to systems within a facility and on an installation (considering all interactive effects) - This includes estimating the pre- and post-retrofit consumption, first cost of the retrofits, recurring O&M costs for the retrofits, the value of the change in annual energy consumption and annual O&M requirements, and the net present value of the retrofits.

5.1.1 Level-1 Specific Design Goals

FEDS Level-1 provides the user with a user-friendly tool for analyzing energy use and the potential for energy-efficiency retrofit projects at large federal installations. A major feature of its design is that only a minimal amount of energy-system information is required to perform a first-level screen of an entire installation. FEDS uses information that you supply to infer the appropriate values needed to determine the amount of installation energy consumption and the potential cost-effectiveness of energy retrofits.

5.1.2 Level-2 Specific Design Goals

Level-2 is intended to allow the user to identify specific projects that are cost-effective and appropriate to the installation. This is done by allowing the user to change Level-1 inferences, generate multiple building sets for a building type, and describe dual-use buildings.

5.2 INFERENCE GENERATION

FEDS Level-1 uses the information provided to internally generate descriptions of prototypes of each building type selected. The default values of the parameters used to describe the prototypes are inferred from the input data; for instance, the climate zone is used in conjunction with the building type, vintage, and size to infer parameters relating to the building construction characteristics. This information is also used to infer the most likely heating equipment types for each user-supplied heating fuel type. The resulting building prototype parameter values are statistically the most likely values for a given building type, climate zone, average vintage, size, and fuel/technology mix. The FEDS building model (described below) uses these parameters to estimate the energy consumption of each building prototype.

The most-likely parameter-value approach to the development of the building prototypes allows FEDS Level-1 to perform detailed modeling of an installation while requiring only very limited information from the user. The results from FEDS Level-1 are intended to be used as a gross indication of the required investment, and the energy and cost savings potential at an installation. The results can indicate which building types and end uses have the greatest savings potential. However, the most-likely parameter-value approach also means that FEDS Level-1 is most appropriately applied to installations with large numbers of buildings. This approach makes the application of FEDS Level-1 to single buildings less accurate than when it is used to model multi-building installations.

Sources for the inferences about the building characteristics are mostly from the following sources:

- NBECS^(3,4) and RECS^(5,6) building characteristics data
- ELCAP^(7,8,9) commercial and residential end-use load and building characteristics data
- ASHRAE^(10,11) standard design and construction practices.

5.3 ENERGY MODELING

The FEDS building model estimates energy consumption for the following end uses:

- lighting
- miscellaneous equipment
- service hot water

- heating
- cooling
- ventilation.

Lighting and miscellaneous equipment consumptions are calculated for the user-supplied occupancy schedule. Heating, cooling, and service hot water consumption estimates are calculated using estimated loads and system efficiencies. Ventilation energy consumption is also modeled using a number of possible operating scenarios.

5.4 RETROFIT MODELING

After modeling the current energy consumption using the existing equipment, the replacement or modification of the equipment is considered. These modifications include complete replacement with similar, but more efficient equipment (e.g., replacing existing fluorescent fixtures with new high-efficiency fluorescent fixtures); changes to different types of equipment which provide equivalent service more efficiently (e.g., replacing a forced air electric furnace with a heat pump); and changes to more efficient equipment using a different fuel (fuel-switching).

When considering any equipment changes, the total effect on the building's energy consumption is considered. For example, the model determines the full impact of a lighting system retrofit by determining not only the change in lighting electrical consumption but also the change in the heating, cooling, and ventilation systems consumption due to the change in the internal gains.

The impact of any difference in electric consumption is assessed by determining the change in the installation electric energy consumption and demand profiles. These profiles are used in conjunction with the detailed electric rate structures and demand ratchets to calculate the cost or benefit of the change.

5.5 OPTIMIZATION

Optimization of the building energy system is accomplished by an iterative process, as illustrated in Figures 5.1 and 5.2. The first end use is evaluated (e.g., lights) and the minimum life-cycle cost configuration for that end use is determined. When the second end use is evaluated, the model assumes that the first end use has already been changed. Once all end uses

Figure 5.1. The FEDS Model Baseline Process

Figure 5.2. The FEDS Model Optimization Process

have been evaluated, the model reconsiders the first end use to see if the minimum life-cycle cost configuration for that end use has changed due to changes in other end uses; this is driven by interactive effects. This process continues until the model has converged to the minimum life-cycle cost configuration for each end use in the entire building set. The model then considers the next building set.

6.0 REFERENCES

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Fixture Name Abbreviations

Exit Signs

EX1	EXIT - INC (2x20)	Two 20-watt incandescent lamps
	EX2 EXIT - INC (2x15)	Two 15-watt incandescent lamps
	EX3 EXIT - FL 1-PL9	One 9-watt compact fluorescent lamp
	EX4 EXIT - FL 2-PL9	Two 9-watt compact fluorescent lamps
	EX5 EXIT - FL RET 1-PL9	One 9-watt compact fluorescent retrofit kit
	EX6 EXIT - LED	Light emitting diode
	EX7 EXIT - SELF LUMINOUS	Tritium gas self-luminous
	EX8 EXIT - INC (2x25)	Two 25-watt incandescent lamps
	EX9 EXIT - FLEX TUBE 8	Flexible tube, 8-watt fixture

Fluorescent Lamps

Fluorescent fixtures are based on a standard notation comprising codes that describe the different fixture parts. Fluorescent fixtures are further subdivided into fluorescent and compact fluorescent (CFL) fixtures. Compact fluorescent fixtures are discussed in the next subsection. The naming convention for fluorescent fixtures can be divided into five parts: dimension of the fixture, number of lamps, lamp type, ballast type, and reflector. As each part is described, an example will be given to illustrate how that part fits into the whole description based on a standard 4-40-watt lamp fixture.

Table 1 lists the possible fixture dimensions (2X4 4F40T12 STD2 REF). The fixture dimension is the size of the "box" that contains the lamps, ballasts, and reflectors, in feet.

Table 1. Fixture Dimensions

Dimensions	Common Fixture Types
1x4	One or two four-foot fluorescent lamps
2x4	One to four foot four fluorescent lamps, most commonly three or four lamps
2x2	One or two U-shaped fluorescent lamps
1x8	One or two eight-foot fluorescent lamps

The second part of the naming convention refers to the number of lamps contained within the fixture (2x4 4F40T12 STD2 REF). The number of lamps can vary from one to four lamps per fixture.

The third part of the naming convention refers to the type of lamp in the fixture (2x4 4F40T12 STD2 REF). The "T" number (T12 or T8) describes the diameter of the lamp tube, in eighths of an inch; e.g., a T12 lamp has a diameter of 12/8 or 1.5 inches. Table 2 lists the possible lamp types and their descriptions.

Table 2. Lamp Types

Lamp Type	Description
F40T12	40-watt T12 lamp, 48-in. length
F40T12U	40-watt T12 U-shaped lamp, 22-in. length
F40T12ES	Energy saving 40-watt T12 lamp (approx. 34 watts), 48-in. length
F40T12UES	Energy-saving, 40-watt T12 U-shaped lamp (approx. 34 watts), 22-in. length
F40T12HO	High-output 40-watt T12 lamp (approx. 60 watts), 48-in. length
F32T8	32-watt T8 lamp, 48-in. length
F32T8U	32-watt T8 U-shaped lamp, 22-in. length
F96T12	75-watt T12 lamp, 96-in. length
F96T12ES	Energy saving 75-watt T12 lamp (approx. 60 watts), 96-in. length
F96T12HO	High-output 75-watt T12 lamp (approx. 110 watts), 96-in. length
F96T8	T8 lamp, 96-in. length

The fourth part of the naming convention refers to the type of ballast within the fixture (2X4 4F40T12 STD2 REF). Table 3 lists the possible ballast types and their descriptions.

Table 3. Ballast Type

Ballast Type	Description
STD1	Standard magnetic ballast designed for one lamp
STD2	Standard magnetic ballast designed for two lamps; for four-lamp fixtures, two STD2s are used
STD1,2	Combination of one lamp and two lamp standard magnetic ballasts, for use with three-lamp fixtures
EEF1	Energy-efficient magnetic ballast designed for one lamp
EEF2	Energy-efficient magnetic ballast designed for two lamps; for four-lamp fixtures, two EEF2s are used
EEF1,2	Combination of one- and two-lamp energy-efficient magnetic ballasts, for use with three-lamp fixtures
ELC1	Electronic ballast designed for one lamp
ELC2	Electronic ballast designed for two lamps; for four-lamp fixtures, two ELC2s or one ELC4 can be used
ELC1,2	Combination of one- and two-lamp electronic ballasts, for use with three-lamp fixtures
ELC3	Electronic ballast designed for three lamps
ELC4	Electronic ballast designed for four lamps.

The final part of the naming convention indicates whether a reflector is added to the fixture (2X4 4F40T12 STD2 REF). If the fixture is followed with "REF," a reflector is part of the fixture. If the fixture is not followed with the reflector indicator, then the fixture does not contain a reflector.

Compact Fluorescent Lamps

FL173 CFL 15 GLOBE UNIT	15-watt compact fluorescent globe lamp
FL174 CFL 18 GLOBE UNIT	18-watt compact fluorescent globe lamp

FL175 CFL 27 INTEGRAL UNIT	27-watt compact fluorescent cylinder lamp
FL176 CFL 5 + BLST UNIT	5-watt comp. fl. lamp and adapter assembly
FL177 CFL 7 + BLST UNIT	7-watt comp. fl. lamp and adapter assembly
FL178 CFL 9 + BLST UNIT	9-watt comp. fl. lamp and adapter assembly
FL179 CFL 2-9 + BLST UNIT	Two 9-watt comp. fl. lamps and adapter assemblies
FL180 CFL 11 + BLST UNIT	11-watt comp. fl. lamp and adapter assembly
FL181 CFL 13 + BLST UNIT	13-watt comp. fl. lamp and adapter assembly
FL182 CFL 2-13 + BLST UNIT	Two 13-watt comp. fl. lamps and adapter assemblies
FL183 CFL 15 + BLST UNIT	15-watt comp. fl. lamp and adapter assembly
FL184 CFL 20 + BLST UNIT	20-watt comp. fl. lamp and adapter assembly
FL185 CFL 7 CEIL FIXT	7-watt comp. fl. hardwired ceiling fixture
FL186 CFL 11 CEIL FIXT	11-watt comp. fl. hardwired ceiling fixture
FL187 CFL 15 CEIL FIXT	15-watt comp. fl. hardwired ceiling fixture
FL188 CFL 2-11 CEIL FIXT	Hardwired ceiling fixture w/ two 11-watt comp. fl. lamps
FL189 CFL 2-15 CEIL FIXT	Hardwired ceiling fixture w/ two 15-watt comp. fl. lamps
FL190 CFL 7 WALL FIXT	7-watt comp. fl. hardwired wall fixture
FL191 CFL 11 WALL FIXT	11-watt comp. fl. hardwired wall fixture
FL192 CFL 15 WALL FIXT	15-watt comp. fl. hardwired wall fixture
FL193 CFL 2-11 WALL FIXT	Hardwired wall fixture w/ two 11-watt comp. fl. lamps
FL194 CFL 2-15 WALL FIXT	Hardwired wall fixture w/ two 15-watt comp. fl. lamps
FL195 CFL 7 CAN	7-watt comp. fl. hardwired recessed can fixture

FL196 CFL 11 CAN

11-watt comp. fl. hardwired
recessed can fixture

FL197 CFL 15 CAN

15-watt comp. fl. hardwired
recessed can fixture.

High-Efficiency Incandescent Lamps

HI1

HI 250 FLD

250-watt high-efficiency incandescent floodlight.

HI2

HI 500 FLD

500-watt high-efficiency incandescent floodlight.

High-Pressure Sodium Lamps

HS1

HPS 35 POLE

35-watt high-pressure sodium pole
fixture

HS2

HPS 50 POLE

50-watt high-pressure sodium pole
fixture

HS3

HPS 70 POLE

70-watt high-pressure sodium pole
fixture

HS4

HPS 100 POLE

100-watt high-pressure sodium pole
fixture

HS5

HPS 150 POLE

150-watt high-pressure sodium pole
fixture

HS6

HPS 200 POLE

200-watt high-pressure sodium pole
fixture

HS7

HPS 250 POLE

250-watt high-pressure sodium pole
fixture

HS8

HPS 310 POLE

310-watt high-pressure sodium pole
fixture

HS9

HPS 400 POLE

400-watt high-pressure sodium pole
fixture

HS10

HPS 1000 POLE

1000-watt high-pressure sodium pole
fixture

HS11

HPS 35 PEND

35-watt high-pressure sodium pendant
fixture

HS12

HPS 50 PEND

50-watt high-pressure sodium pendant
fixture

HS13

HPS 70 PEND

70-watt high-pressure sodium pendant
fixture

HS14

HPS 100 PEND

100-watt high-pressure sodium
pendant fixture

HS15

HPS 150 PEND

150-watt high-pressure sodium
pendant fixture

HS16

HPS 200 PEND

200-watt high-pressure sodium
pendant fixture

HS17	HPS 250 PEND	250-watt high-pressure sodium pendant fixture
HS18	HPS 310 PEND	310-watt high-pressure sodium pendant fixture
HS19	HPS 400 PEND	400-watt high-pressure sodium pendant fixture
HS20	HPS 1000 PEND	1000-watt high-pressure sodium pendant fixture
HS21	HPS 35 WALL	35-watt high-pressure sodium wall fixture
HS22	HPS 50 WALL	50-watt high-pressure sodium wall fixture
HS23	HPS 70 WALL	70-watt high-pressure sodium wall fixture
HS24	HPS 100 WALL	100-watt high-pressure sodium wall fixture
HS25	HPS 150 WALL	150-watt high-pressure sodium wall fixture
HS26	HPS 200 WALL	200-watt high-pressure sodium wall fixture
HS27	HPS 250 WALL	250-watt high-pressure sodium wall fixture
HS28	HPS 310 WALL	310-watt high-pressure sodium wall fixture
HS29	HPS 400 WALL	400-watt high-pressure sodium wall fixture
HS30	HPS 35 FLD	35-watt high-pressure sodium floodlight
HS31	HPS 70 FLD	70-watt high-pressure sodium floodlight
HS32	HPS 50 CAN	50-watt high-pressure sodium can fixture
HS33	HPS 70 CAN	70-watt high-pressure sodium can fixture
HS34	HPS 100 CAN	100-watt high-pressure sodium can fixture
HS35	HPS 150 REP FOR MV PEND	150-watt high-pressure sodium lamp for merc. vapor pendent fixture
HS36	HPS 215 REP FOR MV PEND	215-watt high-pressure sodium lamp for merc. vapor pendant fixture
HS37	HPS 220 REP FOR MV PEND	220-watt high-pressure sodium lamp for merc. vapor pendant fixture

HS38	HPS 360 REP FOR MV PEND	360-watt high-pressure sodium lamp for merc. vapor pendant fixture
HS39	HPS 880 REP FOR MV PEND	880-watt high-pressure sodium lamp for merc. vapor pendant fixture
HS40	HPS 940 REP FOR MV PEND	940-watt high-pressure sodium lamp for merc. vapor pendant fixture
HS41	HPS 150 REP FOR MV WALL	150-watt high-pressure sodium lamp for merc. vapor wall fixture
HS42	HPS 215 REP FOR MV WALL	215-watt high-pressure sodium lamp for wall fixture
HS43	HPS 220 REP FOR MV WALL	220-watt high-pressure sodium lamp for merc. vapor wall fixture
HS44	HPS 360 REP FOR MV WALL	360-watt high-pressure sodium lamp for merc. vapor wall fixture
HS45	HPS 880 REP FOR MV WALL	880-watt high-pressure sodium lamp for merc. vapor wall fixture
HS46	HPS 940 REP FOR MV WALL	940-watt high-pressure sodium lamp for merc. vapor wall fixture
HS47	HPS 150 REP FOR MV POLE	150-watt high-pressure sodium lamp for merc. vapor pole fixture
HS48	HPS 215 REP FOR MV POLE	215-watt high-pressure sodium lamp for merc. vapor pole fixture
HS49	HPS 220 REP FOR MV POLE	220-watt high-pressure sodium lamp for merc. vapor pole fixture
HS50	HPS 360 REP FOR MV POLE	360-watt high-pressure sodium lamp for merc. vapor pole fixture
HS51	HPS 880 REP FOR MV POLE	880-watt high-pressure sodium lamp for merc. vapor pole fixture
HS52	HPS 940 REP FOR MV POLE	940-watt high-pressure sodium lamp for merc. vapor pole fixture
HS53	HPS 70 IS PEND	70-watt high-pressure sodium instant start pendant fixture
HS54	HPS 100 IS PEND	100-watt high-pressure sodium instant start pendant fixture
HS55	HPS 150 IS PEND	150-watt high-pressure sodium instant start pendant fixture
HS56	HPS 250 IS PEND	250-watt high-pressure sodium instant start pendant fixture
HS57	HPS 400 IS PEND	400-watt high-pressure sodium instant start pendant fixture
HS58	HPS 70 IS WALL	70-watt high-pressure sodium instant start wall fixture
HS59	HPS 100 IS WALL	100-watt high-pressure sodium instant start wall fixture

HS60	HPS 150 IS WALL	150-watt high-pressure sodium instant start wall fixture
HS61	HPS 250 IS WALL	250-watt high-pressure sodium instant start wall fixture
HS62	HPS 400 IS WALL	400-watt high-pressure sodium instant start wall fixture
HS63	HPS 70 IS POLE	70-watt high-pressure sodium instant start pole fixture
HS64	HPS 100 IS POLE	100-watt high-pressure sodium instant start pole fixture
HS65	HPS 150 IS POLE	150-watt high-pressure sodium instant start pole fixture
HS66	HPS 250 IS POLE	250-watt high-pressure sodium instant start pole fixture
HS67	HPS 400 IS POLE	400-watt high-pressure sodium instant start pole fixture
HS68	HPS 35 WL PEND	35-watt high-pressure sodium "white light" pendant fixture
HS69	HPS 50 WL PEND	50-watt high-pressure sodium "white light" pendant fixture
HS70	HPS 100 WL PEND	100-watt high-pressure sodium "white light" pendant fixture
HS71	HPS 35 WL WALL	35-watt high-pressure sodium "white light" wall fixture
HS72	HPS 50 WL WALL	50-watt high-pressure sodium "white light" wall fixture
HS73	HPS 100 WL WALL	100-watt high-pressure sodium "white light" wall fixture
HS74	HPS 35 WL POLE	35-watt high-pressure sodium "white light" pole fixture
HS75	HPS 50 WL POLE	50-watt high-pressure sodium "white light" pole fixture
HS76	HPS 100 WL POLE	100-watt high-pressure sodium "white light" pole fixture
HS77	HPS 150 REP FOR MH PEND	150-watt high-pressure sodium lamp for metal halide pendant fixture
HS78	HPS 215 REP FOR MH PEND	215-watt high-pressure sodium lamp for metal halide pendant fixture
HS79	HPS 220 REP FOR MH PEND	220-watt high-pressure sodium lamp for metal halide pendant fixture
HS80	HPS 360 REP FOR MH PEND	360-watt high-pressure sodium lamp for metal halide pendant fixture
HS81	HPS 880 REP FOR MH PEND	880-watt high-pressure sodium lamp for metal halide pendant fixture

HS82	HPS 940 REP FOR MH PEND	940-watt high-pressure sodium lamp for metal halide pendant fixture
HS83	HPS 150 REP FOR MH WALL	150-watt high-pressure sodium lamp for metal halide wall fixture
HS84	HPS 215 REP FOR MH WALL	215-watt high-pressure sodium lamp for metal halide wall fixture
HS85	HPS 220 REP FOR MH WALL	220-watt high-pressure sodium lamp for metal halide wall fixture
HS86	HPS 360 REP FOR MH WALL	360-watt high-pressure sodium lamp for metal halide wall fixture
HS87	HPS 880 REP FOR MH WALL	880-watt high-pressure sodium lamp for metal halide wall fixture
HS88	HPS 940 REP FOR MH WALL	940-watt high-pressure sodium lamp for metal halide wall fixture
HS89	HPS 150 REP FOR MH POLE	150-watt high-pressure sodium lamp for metal halide pole fixture
HS90	HPS 215 REP FOR MH POLE	215-watt high-pressure sodium lamp for metal halide pole fixture
HS91	HPS 220 REP FOR MH POLE	220-watt high-pressure sodium lamp for metal halide pole fixture
HS92	HPS 360 REP FOR MH POLE	360-watt high-pressure sodium lamp for metal halide pole fixture
HS93	HPS 880 REP FOR MH POLE	880-watt high-pressure sodium lamp for metal halide pole fixture
HS94	HPS 940 REP FOR MH POLE	940-watt high-pressure sodium lamp for metal halide pole fixture

Incandescent Lamps

IN1	INC 40 CEIL	40-watt incandescent ceiling fixture
IN2	INC 2-40 CEIL	Incandescent ceiling fixture w/ two 40-watt lamps
IN3	INC 3-40 CEIL	Incandescent ceiling fixture w/ three 40-watt lamps
IN4	INC 4-40 CEIL	Incandescent ceiling fixture w/ four 40-watt lamps
IN5	INC 60 CEIL	60-watt incandescent ceiling fixture
IN6	INC 2-60 CEIL	Incandescent ceiling fixture w/ two 60-watt lamps
IN7	INC 3-60 CEIL	Incandescent ceiling fixture w/ three 60-watt lamps
IN8	INC 75 CEIL	75-watt incandescent ceiling fixture
IN9	INC 2-75 CEIL	Incandescent ceiling fixture w/ two 75-watt lamps

IN10	INC 3-75 CEIL	Incandescent ceiling fixture w/ three 75-watt lamps
IN11	INC 100 CEIL	100-watt incandescent ceiling fixture
IN12	INC 2-100 CEIL	Incandescent ceiling fixture w/ two 100-watt lamps
IN13	INC 25 TABLE LAMP	25-watt incandescent table lamp
IN14	INC 40 TABLE LAMP	40-watt incandescent table lamp
IN15	INC 60 TABLE LAMP	60-watt incandescent table lamp
IN16	INC 75 TABLE LAMP	75-watt incandescent table lamp
IN17	INC 100 TABLE LAMP	100-watt incandescent table lamp
IN18	INC 25 WALL	25-watt incandescent ceiling fixture
IN19	INC 40 WALL	40-watt incandescent wall fixture
IN20	INC 2-40 WALL	Incandescent wall fixture w/ two 40-watt lamps
IN21	INC 3-40 WALL	Incandescent wall fixture w/ three 40-watt lamps
IN22	INC 4-40 WALL	Incandescent wall fixture w/ four 40-watt lamps
IN23	INC 60 WALL	60-watt incandescent wall fixture
IN24	INC 2-60 WALL	Incandescent wall fixture w/ two 60-watt lamps
IN25	INC 75 WALL	75-watt incandescent wall fixture
IN26	INC 2-75 WALL	Incandescent wall fixture w/ two 75-watt lamps
IN27	INC 100 WALL	100-watt incandescent wall fixture
IN28	INC 150 PEND	150-watt incandescent pendant fixture
IN29	INC 200 PEND	200-watt incandescent pendant fixture
IN30	INC 300 PEND	300-watt incandescent pendant fixture
IN31	INC 40 CAN	40-watt incandescent can fixture
IN32	INC 60 CAN	60-watt incandescent can fixture
IN33	INC 75 CAN	75-watt incandescent can fixture
IN34	INC 100 CAN	100-watt incandescent can fixture
IN35	INC 40 FLD	40-watt incandescent flood light
IN36	INC 60 FLD	60-watt incandescent flood light
IN37	INC 75 FLD	75-watt incandescent flood light
IN38	INC 100 FLD	100-watt incandescent flood light
IN39	INC 150 FLD	150-watt incandescent flood light
IN40	INC 200 FLD	200-watt incandescent flood light

Low-pressure Sodium Lamps

LS1	LPS 18 PEND	18-watt low-pressure sodium pendant fixture
LS2	LPS 35 PEND	35-watt low-pressure sodium pendant

		fixture
LS3	LPS 55 PEND	55-watt low-pressure sodium pendant fixture
LS4	LPS 90 PEND	90-watt low-pressure sodium pendant fixture
LS5	LPS 135 PEND	135-watt low-pressure sodium pendant fixture
LS6	LPS 180 PEND	180-watt low-pressure sodium pendant fixture
LS7	LPS 18 POLE	18-watt low-pressure sodium pole fixture
LS8	LPS 35 POLE	35-watt low-pressure sodium pole fixture
LS9	LPS 55 POLE	55-watt low-pressure sodium pole fixture
LS10	LPS 90 POLE	90-watt low-pressure sodium pole fixture
LS11	LPS 135 POLE	135-watt low-pressure sodium pole fixture
LS12	LPS 180 POLE	180-watt low-pressure sodium pole fixture
LS13	LPS 18 WALL	18-watt low-pressure sodium wall fixture
LS14	LPS 35 WALL	35-watt low-pressure sodium wall fixture
LS15	LPS 55 WALL	55-watt low-pressure sodium wall fixture
LS16	LPS 90 WALL	90-watt low-pressure sodium wall fixture
LS17	LPS 135 WALL	135-watt low-pressure sodium wall fixture
LS18	LPS 180 WALL	180-watt low-pressure sodium wall fixture

Metal Halide Lamps

MH1	MH 50 PEND	50-watt metal halide pendant fixture
MH2	MH 70 PEND	70-watt metal halide pendant fixture
MH3	MH 100 PEND	100-watt metal halide pendant fixture
MH4	MH 175 PEND	175-watt metal halide pendant fixture
MH5	MH 250 PEND	250-watt metal halide pendant fixture
MH6	MH 400 PEND	400-watt metal halide pendant fixture
MH7	MH 1000 PEND	1000-watt metal halide pendant fixture

MH8	MH 1500 PEND	1500-watt metal halide pendant fixture
MH9	MH 50 WALL	50-watt metal halide wall fixture
MH10	MH 70 WALL	70-watt metal halide wall fixture
MH11	MH 100 WALL	100-watt metal halide wall fixture
MH12	MH 175 WALL	175-watt metal halide wall fixture
MH13	MH 250 WALL	250-watt metal halide wall fixture
MH14	MH 400 WALL	400-watt metal halide wall fixture
MH15	MH 1000 WALL	1000-watt metal halide wall fixture
MH16	MH 1500 WALL	1500-watt metal halide wall fixture
MH17	MH 50 POLE	50-watt metal halide pole fixture
MH18	MH 70 POLE	70-watt metal halide pole fixture
MH19	MH 100 POLE	100-watt metal halide pole fixture
MH20	MH 175 POLE	175-watt metal halide pole fixture
MH21	MH 250 POLE	250-watt metal halide pole fixture
MH22	MH 400 POLE	400-watt metal halide pole fixture
MH23	MH 1000 POLE	1000-watt metal halide pole fixture
MH24	MH 1500 POLE	1500-watt metal halide pole fixture
MH25	MH 50 CAN	50-watt metal halide can fixture
MH26	MH 70 CAN	70-watt metal halide can fixture
MH27	MH 750 WALL	750-watt metal halide wall fixture
MH28	MH 32 WALL	32-watt metal halide wall fixture
MH29	MH 32 PEND	32-watt metal halide pendant fixture
MH30	MH 750 POLE	750-watt metal halide pole fixture
MH31	MH 750 PEND	750-watt metal halide pendant fixture
MH32	MH 32 POLE	32-watt metal halide pole fixture
MH33	MH 70 HE PEND	70-watt metal halide high-efficiency pendant fixture
MH34	MH 150 HE PEND	150-watt metal halide high-efficiency pendant fixture
MH35	MH 175 HE PEND	175-watt metal halide high-efficiency pendant fixture
MH36	MH 250 HE PEND	250-watt metal halide high-efficiency pendant fixture
MH37	MH 400 HE PEND	400-watt metal halide high-efficiency pendant fixture
MH38	MH 1000 HE PEND	1000-watt metal halide high-efficiency pendant fixture
MH39	MH 70 HE WALL	70-watt metal halide high-efficiency wall fixture
MH40	MH 150 HE WALL	150-watt metal halide high-efficiency wall fixture
MH41	MH 175 HE WALL	175-watt metal halide high-efficiency wall fixture

MH42	MH 250 HE WALL	250-watt metal halide high-efficiency wall fixture
MH43	MH 400 HE WALL	400-watt metal halide high-efficiency wall fixture
MH44	MH 1000 HE WALL	1000-watt metal halide high-efficiency wall fixture
MH45	MH 70 HE POLE	70-watt metal halide high-efficiency pole fixture
MH4	6MH 150 HE POLE	150-watt metal halide high-efficiency pole fixture
MH47	MH 175 HE POLE	175-watt metal halide high-efficiency pole fixture
MH48	MH 250 HE POLE	250-watt metal halide high-efficiency pole fixture
MH49	MH 400 HE POLE	400-watt metal halide high-efficiency pole fixture
MH50	MH 1000 HE POLE	1000-watt metal halide high-efficiency pole fixture

Mercury Vapor Lamps

MV1	MERC 50 PEND	50-watt mercury vapor pendant fixture
MV2	MERC 75 PEND	75-watt mercury vapor pendant fixture
MV3	MERC 100 PEND	100-watt mercury vapor pendant fixture
MV4	MERC 175 PEND	175-watt mercury vapor pendant fixture
MV5	MERC 250 PEND	250-watt mercury vapor pendant fixture
MV6	MERC 400 PEND	400-watt mercury vapor pendant fixture
MV7	MERC 700 PEND	700-watt mercury vapor pendant fixture
MV8	MERC 1000 PEND	1000-watt mercury vapor pendant fixture
MV9	MERC 50 POLE	50-watt mercury vapor pole fixture
MV10	MERC 75 POLE	75-watt mercury vapor pole fixture
MV11	MERC 100 POLE	100-watt mercury vapor pole fixture
MV12	MERC 175 POLE	175-watt mercury vapor pole fixture
MV13	MERC 250 POLE	250-watt mercury vapor pole fixture
MV14	MERC 400 POLE	400-watt mercury vapor pole fixture
MV15	MERC 700 POLE	700-watt mercury vapor pole fixture
MV16	MERC 1000 POLE	1000-watt mercury vapor pole fixture
MV17	MERC 50 WALL	50-watt mercury vapor wall fixture

Appendix A Fixture Name Abbreviations

MV18	MERC 75 WALL	75-watt mercury vapor wall fixture
MV19	MERC 100 WALL	100-watt mercury vapor wall fixture
MV20	MERC 175 WALL	175-watt mercury vapor wall fixture
MV21	MERC 250 WALL	250-watt mercury vapor wall fixture
MV22	MERC 400 WALL	400-watt mercury vapor wall fixture
MV23	MERC 700 WALL	700-watt mercury vapor wall fixture
MV24	MERC 1000 WALL	1000-watt mercury vapor wall fixture.

Fixture Codes

The following is a list of fixtures that are contained in the FEDS lighting database and the corresponding fixture code.

<u>Fixture Code</u>	<u>Fixture Name</u>
EX1	EXIT - INC (2x20)
EX2	EXIT - INC (2x15)
EX3	EXIT - FL 1-PL9
EX4	EXIT - FL 2-PL9
EX5	EXIT - FL RET 1-PL9
EX6	EXIT - LED
EX7	EXIT - SELF LUMINOUS
EX8	EXIT - INC (2x25)
EX9	EXIT - FLEX TUBE 8
FL1	FL 2X4 4F40T12 STD2
FL2	FL 2X4 3F40T12 STD1,2
FL3	FL 2X4 2F40T12 STD2
FL4	FL 1X4 2F40T12 STD2
FL5	FL 1X4 1F40T12 STD1
FL6	FL 2X2 2F40T12U STD2
FL7	FL 2X4 4F40T12 STD2 REF
FL8	FL 2X4 3F40T12 STD1,2 REF
FL9	FL 2X4 2F40T12 STD2 REF
FL10	FL 1X4 2F40T12 STD2 REF
FL11	FL 1X4 1F40T12 STD1 REF
FL12	FL 2X2 2F40T12U STD2 REF
FL13	FL 2X4 4F40T12 EEF2
FL14	FL 2X4 3F40T12 EEF1,2
FL15	FL 2X4 2F40T12 EEF2
FL16	FL 1X4 2F40T12 EEF2
FL17	FL 1X4 1F40T12 EEF1
FL18	FL 2X2 2F40T12U EEF2
FL19	FL 2X4 4F40T12 EEF2 REF
FL20	FL 2X4 3F40T12 EEF1,2 REF
FL21	FL 2X4 2F40T12 EEF2 REF
FL22	FL 1X4 2F40T12 EEF2 REF
FL23	FL 1X4 1F40T12 EEF1 REF
FL24	FL 2X2 2F40T12U EEF2 REF
FL25	FL 2X4 4F40T12 ELC2

<u>Fixture Code</u>	<u>Fixture Name</u>
FL26	FL 2X4 3F40T12 ELC1,2
FL27	FL 2X4 2F40T12 ELC2
FL28	FL 1X4 2F40T12 ELC2
FL29	FL 1X4 1F40T12 ELC1
FL30	FL 2X2 2F40T12U ELC2
FL31	FL 2X4 4F40T12 ELC2 REF
FL32	FL 2X4 3F40T12 ELC1,2 REF
FL33	FL 2X4 2F40T12 ELC2 REF
FL34	FL 1X4 2F40T12 ELC2 REF
FL35	FL 1X4 1F40T12 ELC1 REF
FL36	FL 2X2 2F40T12U ELC2 REF
FL37	FL 2X4 4F32T8 EE2
FL38	FL 2X4 3F32T8 EE1,2
FL39	FL 2X4 2F32T8 EE2
FL40	FL 1X4 2F32T8 EE2
FL41	FL 1X4 1F32T8 EE1
FL42	FL 2X2 2F32T8U EE2
FL43	FL 2X4 4F32T8 EE2 REF
FL44	FL 2X4 3F32T8 EE1,2 REF
FL45	FL 2X4 2F32T8 EE2 REF
FL46	FL 1X4 2F32T8 EE2 REF
FL47	FL 1X4 1F32T8 EE1 REF
FL48	FL 2X2 2F32T8U EE2 REF
FL49	FL 2X4 4F32T8 ELC2
FL50	FL 2X4 3F32T8 ELC1,2
FL51	FL 2X4 2F32T8 ELC2
FL52	FL 1X4 2F32T8 ELC2
FL53	FL 1X4 1F32T8 ELC1
FL54	FL 2X2 2F32T8U ELC2
FL55	FL 2X4 4F32T8 ELC2 REF
FL56	FL 2X4 3F32T8 ELC1,2 REF
FL57	FL 2X4 2F32T8 ELC2 REF
FL58	FL 1X4 2F32T8 ELC2 REF
FL59	FL 1X4 1F32T8 ELC1 REF
FL60	FL 2X2 2F32T8U ELC2 REF
FL61	FL 1X8 4F96T12 STD2
FL62	FL 1X8 2F96T12 STD2
FL63	FL 1X8 1F96T12 STD1
FL64	FL 1X8 4F96T12 STD2 REF
FL65	FL 1X8 2F96T12 STD2 REF
FL66	FL 1X8 1F96T12 STD1 REF

<u>Fixture Code</u>	<u>Fixture Name</u>
FL67	FL 1X8 4F96T12 EE2
FL68	FL 1X8 2F96T12 EE2
FL69	FL 1X8 1F96T12 EE1
FL70	FL 1X8 4F96T12 EE2 REF
FL71	FL 1X8 2F96T12 EE2 REF
FL72	FL 1X8 1F96T12 EE1 REF
FL73	FL 1X8 4F96T12 ELC2
FL74	FL 1X8 2F96T12 ELC2
FL75	FL 1X8 1F96T12 ELC1
FL76	FL 1X8 4F96T12 ELC2 REF
FL77	FL 1X8 2F96T12 ELC2 REF
FL78	FL 1X8 1F96T12 ELC1 REF
FL79	FL 2X4 4F40T12ES STD2
FL80	FL 2X4 3F40T12ES STD1,2
FL81	FL 2X4 2F40T12ES STD2
FL82	FL 1X4 2F40T12ES STD2
FL83	FL 1X4 1F40T12ES STD1
FL84	FL 2X2 2F40T12UES STD2
FL85	FL 2X4 4F40T12ES STD2 REF
FL86	FL 2X4 3F40T12ES STD1,2 REF
FL87	FL 2X4 2F40T12ES STD2 REF
FL88	FL 1X4 2F40T12ES STD2 REF
FL89	FL 1X4 1F40T12ES STD1 REF
FL90	FL 2X2 2F40T12UES STD2 REF
FL91	FL 2X4 4F40T12ES EE2
FL92	FL 2X4 3F40T12ES EE1,2
FL93	FL 2X4 2F40T12ES EE2
FL94	FL 1X4 2F40T12ES EE2
FL95	FL 1X4 1F40T12ES EE1
FL96	FL 2X2 2F40T12UES EE2
FL97	FL 2X4 4F40T12ES EE2 REF
FL98	FL 2X4 3F40T12ES EE1,2 REF
FL99	FL 2X4 2F40T12ES EE2 REF
FL100	FL 1X4 2F40T12ES EE2 REF
FL101	FL 1X4 1F40T12ES EE1 REF
FL102	FL 2X2 2F40T12UES EE2 REF
FL103	FL 2X4 4F40T12ES ELC2
FL104	FL 2X4 3F40T12ES ELC1,2
FL105	FL 2X4 2F40T12ES ELC2
FL106	FL 1X4 2F40T12ES ELC2
FL107	FL 1X4 1F40T12ES ELC1

<u>Fixture Code</u>	<u>Fixture Name</u>
FL108	FL 2X2 2F40T12UES ELC2
FL109	FL 2X4 4F40T12ES ELC2 REF
FL110	FL 2X4 3F40T12ES ELC1,2 REF
FL111	FL 2X4 2F40T12ES ELC2 REF
FL112	FL 1X4 2F40T12ES ELC2 REF
FL113	FL 1X4 1F40T12ES ELC1 REF
FL114	FL 2X2 2F40T12UES ELC2 REF
FL115	FL 1X8 4F96T12ES STD2
FL116	FL 1X8 2F96T12ES STD2
FL117	FL 1X8 1F96T12ES STD1
FL118	FL 1X8 4F96T12ES STD2 REF
FL119	FL 1X8 2F96T12ES STD2 REF
FL120	FL 1X8 1F96T12ES STD1 REF
FL121	FL 1X8 4F96T12ES EE2
FL122	FL 1X8 2F96T12ES EE2
FL123	FL 1X8 1F96T12ES EE1
FL124	FL 1X8 4F96T12ES EE2 REF
FL125	FL 1X8 2F96T12ES EE2 REF
FL126	FL 1X8 1F96T12ES EE1 REF
FL127	FL 1X8 4F96T12ES ELC2
FL128	FL 1X8 2F96T12ES ELC2
FL129	FL 1X8 1F96T12ES ELC1
FL130	FL 1X8 4F96T12ES ELC2 REF
FL131	FL 1X8 2F96T12ES ELC2 REF
FL132	FL 1X8 1F96T12ES ELC1 REF
FL133	FL 2X4 4F40T12HO STD2 REF
FL134	FL 2X4 3F40T12HO STD1,2 REF
FL135	FL 2X4 2F40T12HO STD2 REF
FL136	FL 1X4 2F40T12HO STD2 REF
FL137	FL 1X4 1F40T12HO STD1 REF
FL138	FL 2X4 4F40T12HO EE2
FL139	FL 2X4 3F40T12HO EE1,2
FL140	FL 2X4 2F40T12HO EE2
FL141	FL 1X4 2F40T12HO EE2
FL142	FL 1X4 1F40T12HO EE1
FL143	FL 2X4 4F40T12HO EE2 REF
FL144	FL 2X4 3F40T12HO EE1,2 REF
FL145	FL 2X4 2F40T12HO EE2 REF
FL146	FL 1X4 2F40T12HO EE2 REF
FL147	FL 1X4 1F40T12HO EE1 REF
FL148	FL 2X4 4F40T12HO ELC2

<u>Fixture Code</u>	<u>Fixture Name</u>
FL149	FL 2X4 3F40T12HO ELC1,2
FL150	FL 2X4 2F40T12HO ELC2
FL151	FL 1X4 2F40T12HO ELC2
FL152	FL 1X4 1F40T12HO ELC1
FL153	FL 2X4 4F40T12HO ELC2 REF
FL154	FL 2X4 3F40T12HO ELC1,2 REF
FL155	FL 2X4 2F40T12HO ELC2 REF
FL156	FL 1X4 2F40T12HO ELC2 REF
FL157	FL 1X4 1F40T12HO ELC1 REF
FL158	FL 1X8 4F96T12HO STD2 REF
FL159	FL 1X8 2F96T12HO STD2 REF
FL160	FL 1X8 1F96T12HO STD1 REF
FL161	FL 1X8 4F96T12HO EE2
FL162	FL 1X8 2F96T12HO EE2
FL163	FL 1X8 1F96T12HO EE1
FL164	FL 1X8 4F96T12HO EE2 REF
FL165	FL 1X8 2F96T12HO EE2 REF
FL166	FL 1X8 1F96T12HO EE1 REF
FL167	FL 1X8 4F96T12HO ELC2
FL168	FL 1X8 2F96T12HO ELC2
FL169	FL 1X8 1F96T12HO ELC1
FL170	FL 1X8 4F96T12HO ELC2 REF
FL171	FL 1X8 2F96T12HO ELC2 REF
FL172	FL 1X8 1F96T12HO ELC1 REF
FL173	CFL 15 GLOBE UNIT
FL174	CFL 18 GLOBE UNIT
FL175	CFL 27 INTEGRAL UNIT
FL176	CFL 5 + BLST UNIT
FL177	CFL 7 + BLST UNIT
FL178	CFL 9 + BLST UNIT
FL179	CFL 2-9 + BLST UNIT
FL180	CFL 11 + BLST UNIT
FL181	CFL 13 + BLST UNIT
FL182	CFL 2-13 + BLST UNIT
FL183	CFL 15 + BLST UNIT
FL184	CFL 20 + BLST UNIT
FL185	CFL 7 CEIL FIXT
FL186	CFL 11 CEIL FIXT
FL187	CFL 15 CEIL FIXT
FL188	CFL 2-11 CEIL FIXT
FL189	CFL 2-15 CEIL FIXT

<u>Fixture Code</u>	<u>Fixture Name</u>
FL190	CFL 7 WALL FIXT
FL191	CFL 11 WALL FIXT
FL192	CFL 15 WALL FIXT
FL193	CFL 2-11 WALL FIXT
FL194	CFL 2-15 WALL FIXT
FL195	CFL 7 CAN
FL196	CFL 11 CAN
FL197	CFL 15 CAN
FL198	FL 1X8 4F96T8 EEF2
FL199	FL 1X8 2F96T8 EEF2
FL200	FL 1X8 1F96T8 EEF1
FL201	FL 1X8 4F96T8 EEF2 REF
FL202	FL 1X8 2F96T8 EEF2 REF
FL203	FL 1X8 1F96T8 EEF1 REF
FL204	FL 2X4 3F40T12HO STD1,2
FL205	FL 2X4 2F40T12HO STD2
FL206	FL 1X4 2F40T12HO STD2
FL207	FL 1X4 1F40T12HO STD1
FL208	FL 1X8 2F96T12HO STD2
FL209	FL 1X8 1F96T12HO STD1
FL210	FL 1X8 3F96T12 STD1,2 REF
FL211	FL 1X8 3F96T12 EEF1,2 REF
FL212	FL 1X8 3F96T12 ELC1,2 REF
FL213	FL 1X8 3F96T8 EEF1,2 REF
FL214	FL 1X8 3F96T12HO STD1,2
FL215	FL 1X8 3F96T12HO STD1,2 REF
FL216	FL 1X8 3F96T12HO EEF1,2
FL217	FL 1X8 3F96T12HO ELC1,2
FL218	FL 1X8 3F96T12HO EEF1,2 REF
FL219	FL 1X8 3F96T12HO ELC1,2 REF
FL220	FL 1X8 3F96T12ES STD1,2
FL221	FL 1X8 3F96T12ES STD1,2 REF
FL222	FL 1X8 3F96T12ES EEF1,2
FL223	FL 1X8 3F96T12ES EEF1,2 REF
FL224	FL 1X8 3F96T12ES ELC1,2
FL225	FL 1X8 3F96T12ES ELC1,2 REF
FL226	FL 1X8 3F96T12 STD1,2
FL227	FL 1X8 3F96T12 EEF1,2
FL228	FL 1X8 3F96T12 ELC1,2
FL229	FL 1X8 3F96T8 EEF1,2
FL230	FL 2X4 3F40T12ES ELC3

<u>Fixture Code</u>	<u>Fixture Name</u>
FL231	FL 2X4 3F40T12ES ELC3 REF
FL232	FL 2X4 3F40T12 ELC3
FL233	FL 2X4 3F40T12 ELC3 REF
FL234	FL 2X4 3F40T12HO ELC3
FL235	FL 2X4 3F40T12HO ELC3 REF
FL236	FL 2X4 3F32T8 ELC3
FL237	FL 2X4 3F32T8 ELC3 REF
FL238	FL 2X4 4F40T12ES ELC4
FL239	FL 2X4 4F40T12ES ELC4 REF
FL240	FL 2X4 4F40T12 ELC4
FL241	FL 2X4 4F40T12 ELC4 REF
FL242	FL 2X4 4F40T12HO ELC4
FL243	FL 2X4 4F40T12HO ELC4 REF
FL244	FL 2X4 4F32T8 ELC4
FL245	FL 2X4 4F32T8 ELC4 REF
HI1	HI 250 FLD
HI2	HI 500 FLD
HS1	HPS 35 POLE
HS2	HPS 50 POLE
HS3	HPS 70 POLE
HS4	HPS 100 POLE
HS5	HPS 150 POLE
HS6	HPS 200 POLE
HS7	HPS 250 POLE
HS8	HPS 310 POLE
HS9	HPS 400 POLE
HS10	HPS 1000 POLE
HS11	HPS 35 PEND
HS12	HPS 50 PEND
HS13	HPS 70 PEND
HS14	HPS 100 PEND
HS15	HPS 150 PEND
HS16	HPS 200 PEND
HS17	HPS 250 PEND
HS18	HPS 310 PEND
HS19	HPS 400 PEND
HS20	HPS 1000 PEND
HS21	HPS 35 WALL
HS22	HPS 50 WALL
HS23	HPS 70 WALL
HS24	HPS 100 WALL

<u>Fixture Code</u>	<u>Fixture Name</u>
HS25	HPS 150 WALL
HS26	HPS 200 WALL
HS27	HPS 250 WALL
HS28	HPS 310 WALL
HS29	HPS 400 WALL
HS30	HPS 35 FLD
HS31	HPS 70 FLD
HS32	HPS 50 CAN
HS33	HPS 70 CAN
HS34	HPS 100 CAN
HS35	HPS 150 REP FOR MV PEND
HS36	HPS 215 REP FOR MV PEND
HS37	HPS 220 REP FOR MV PEND
HS38	HPS 360 REP FOR MV PEND
HS39	HPS 880 REP FOR MV PEND
HS40	HPS 940 REP FOR MV PEND
HS41	HPS 150 REP FOR MV WALL
HS42	HPS 215 REP FOR MV WALL
HS43	HPS 220 REP FOR MV WALL
HS44	HPS 360 REP FOR MV WALL
HS45	HPS 880 REP FOR MV WALL
HS46	HPS 940 REP FOR MV WALL
HS47	HPS 150 REP FOR MV POLE
HS48	HPS 215 REP FOR MV POLE
HS49	HPS 220 REP FOR MV POLE
HS50	HPS 360 REP FOR MV POLE
HS51	HPS 880 REP FOR MV POLE
HS52	HPS 940 REP FOR MV POLE
HS53	HPS 70 IS PEND
HS54	HPS 100 IS PEND
HS55	HPS 150 IS PEND
HS56	HPS 250 IS PEND
HS57	HPS 400 IS PEND
HS58	HPS 70 IS WALL
HS59	HPS 100 IS WALL
HS60	HPS 150 IS WALL
HS61	HPS 250 IS WALL
HS62	HPS 400 IS WALL
HS63	HPS 70 IS POLE
HS64	HPS 100 IS POLE
HS65	HPS 150 IS POLE

<u>Fixture Code</u>	<u>Fixture Name</u>
HS66	HPS 250 IS POLE
HS67	HPS 400 IS POLE
HS68	HPS 35 WL PEND
HS69	HPS 50 WL PEND
HS70	HPS 100 WL PEND
HS71	HPS 35 WL WALL
HS72	HPS 50 WL WALL
HS73	HPS 100 WL WALL
HS74	HPS 35 WL POLE
HS75	HPS 50 WL POLE
HS76	HPS 100 WL POLE
HS77	HPS 150 REP FOR MH PEND
HS78	HPS 215 REP FOR MH PEND
HS79	HPS 220 REP FOR MH PEND
HS80	HPS 360 REP FOR MH PEND
HS81	HPS 880 REP FOR MH PEND
HS82	HPS 940 REP FOR MH PEND
HS83	HPS 150 REP FOR MH WALL
HS84	HPS 215 REP FOR MH WALL
HS85	HPS 220 REP FOR MH WALL
HS86	HPS 360 REP FOR MH WALL
HS87	HPS 880 REP FOR MH WALL
HS88	HPS 940 REP FOR MH WALL
HS89	HPS 150 REP FOR MH POLE
HS90	HPS 215 REP FOR MH POLE
HS91	HPS 220 REP FOR MH POLE
HS92	HPS 360 REP FOR MH POLE
HS93	HPS 880 REP FOR MH POLE
HS94	HPS 940 REP FOR MH POLE
IN1	INC 40 CEIL
IN2	INC 2-40 CEIL
IN3	INC 3-40 CEIL
IN4	INC 4-40 CEIL
IN5	INC 60 CEIL
IN6	INC 2-60 CEIL
IN7	INC 3-60 CEIL
IN8	INC 75 CEIL
IN9	INC 2-75 CEIL
IN10	INC 3-75 CEIL
IN11	INC 100 CEIL
IN12	INC 2-100 CEIL

<u>Fixture Code</u>	<u>Fixture Name</u>
IN13	INC 25 TABLE LAMP
IN14	INC 40 TABLE LAMP
IN15	INC 60 TABLE LAMP
IN16	INC 75 TABLE LAMP
IN17	INC 100 TABLE LAMP
IN18	INC 25 WALL
IN19	INC 40 WALL
IN20	INC 2-40 WALL
IN21	INC 3-40 WALL
IN22	INC 4-40 WALL
IN23	INC 60 WALL
IN24	INC 2-60 WALL
IN25	INC 75 WALL
IN26	INC 2-75 WALL
IN27	INC 100 WALL
IN28	INC 150 PEND
IN29	INC 200 PEND
IN30	INC 300 PEND
IN31	INC 40 CAN
IN32	INC 60 CAN
IN33	INC 75 CAN
IN34	INC 100 CAN
IN35	INC 40 FLD
IN36	INC 60 FLD
IN37	INC 75 FLD
IN38	INC 100 FLD
IN39	INC 150 FLD
IN40	INC 200 FLD
LS1	LPS 18 PEND
LS2	LPS 35 PEND
LS3	LPS 55 PEND
LS4	LPS 90 PEND
LS5	LPS 135 PEND
LS6	LPS 180 PEND
LS7	LPS 18 POLE
LS8	LPS 35 POLE
LS9	LPS 55 POLE
LS10	LPS 90 POLE
LS11	LPS 135 POLE
LS12	LPS 180 POLE
LS13	LPS 18 WALL

<u>Fixture Code</u>	<u>Fixture Name</u>
LS14	LPS 35 WALL
LS15	LPS 55 WALL
LS16	LPS 90 WALL
LS17	LPS 135 WALL
LS18	LPS 180 WALL
MH1	MH 50 PEND
MH2	MH 70 PEND
MH3	MH 100 PEND
MH4	MH 175 PEND
MH5	MH 250 PEND
MH6	MH 400 PEND
MH7	MH 1000 PEND
MH8	MH 1500 PEND
MH9	MH 50 WALL
MH10	MH 70 WALL
MH11	MH 100 WALL
MH12	MH 175 WALL
MH13	MH 250 WALL
MH14	MH 400 WALL
MH15	MH 1000 WALL
MH16	MH 1500 WALL
MH17	MH 50 POLE
MH18	MH 70 POLE
MH19	MH 100 POLE
MH20	MH 175 POLE
MH21	MH 250 POLE
MH22	MH 400 POLE
MH23	MH 1000 POLE
MH24	MH 1500 POLE
MH25	MH 50 CAN
MH26	MH 70 CAN
MH27	MH 750 WALL
MH28	MH 32 WALL
MH29	MH 32 PEND
MH30	MH 750 POLE
MH31	MH 750 PEND
MH32	MH 32 POLE
MH33	MH 70 HE PEND
MH34	MH 150 HE PEND
MH35	MH 175 HE PEND
MH36	MH 250 HE PEND

<u>Fixture Code</u>	<u>Fixture Name</u>
MH37	MH 400 HE PEND
MH38	MH 1000 HE PEND
MH39	MH 70 HE WALL
MH40	MH 150 HE WALL
MH41	MH 175 HE WALL
MH42	MH 250 HE WALL
MH43	MH 400 HE WALL
MH44	MH 1000 HE WALL
MH45	MH 70 HE POLE
MH46	MH 150 HE POLE
MH47	MH 175 HE POLE
MH48	MH 250 HE POLE
MH49	MH 400 HE POLE
MH50	MH 1000 HE POLE
MV1	MERC 50 PEND
MV2	MERC 75 PEND
MV3	MERC 100 PEND
MV4	MERC 175 PEND
MV5	MERC 250 PEND
MV6	MERC 400 PEND
MV7	MERC 700 PEND
MV8	MERC 1000 PEND
MV9	MERC 50 POLE
MV10	MERC 75 POLE
MV11	MERC 100 POLE
MV12	MERC 175 POLE
MV13	MERC 250 POLE
MV14	MERC 400 POLE
MV15	MERC 700 POLE
MV16	MERC 1000 POLE
MV17	MERC 50 WALL
MV18	MERC 75 WALL
MV19	MERC 100 WALL
MV20	MERC 175 WALL
MV21	MERC 250 WALL
MV22	MERC 400 WALL
MV23	MERC 700 WALL
MV24	MERC 1000 WALL

Appendix C

Weather Station File Names and Locations

<u>State</u>	<u>File Name</u>	<u>Location</u>	
AL	birminal	Birmingham	AL
	mobileal	Mobile	AL
	montgoal	Montgomery	AL
AK	adakak	Adak	AK
	bigdelak	Big Delta	AK
	juneauak	Juneau	AK
	mcgratak	Mcgrath	AK
	annettak	Annette	AK
	gulkanak	Gulkana	AK
	kingsaak	King Salmon	AK
	summitak	Summit	AK
	bethelak	Bethel	AK
	homerak	Homer	AK
	kodiakak	Kodiak	AK
	yakutaak	Yakutat	AK
AR	fortsmar	Fort Smith	AR
	littlear	Little Rock	AR
AZ	phoeniaz	Phoenix	AZ
	prescoaz	Prescott	AZ
	tucsonaz	Tucson	AZ
	winsloaz	Winslow	AZ
	yumaaz	Yuma	AZ
CA	arcataca	Arcata	CA
	fresnoca	Fresno	CA
	oaklanca	Oakland	CA
	sandieca	San Diego	CA
	bakersca	Bakersfield	CA
	longbeca	Long Beach	CA
	pointmca	Point Mugu	CA
	sanfraca	San Francisco	CA
	chinalca	China Lake	CA
	losangca	Los Angeles	CA
	redbluca	Red Bluff	CA
	santamca	Santa Maria	CA
	eltoroca	El Toro	CA
	mountsca	Mount Shasta	CA
	sacramca	Sacramento	CA
	sunnyvca	Sunnyvale	CA
CO	coloraco	Colorado Springs	CO
	denverco	Denver	CO

Appendix C Weather Station File Names and Locations

<u>State</u>	<u>File Name</u>	<u>Location</u>	
	eagleco	Eagle	CO
	grandjco	Grand Junction	CO
	puebloco	Pueblo	CO
CT	hartfoct	Hartford	CT
DE	wilminde	Wilmington	DE
FL	apalacfl	Apalachicola	FL
	jacksofl	Jacksonville	FL
	orlandfl	Orlando	FL
	westpaf1	West Palm Beach	FL
	daytonfl	Daytona	FL
	miamifl	Miami	FL
	tallahfl	Tallahassee	FL
	tampaf1	Tampa	FL
GA	atlantga	Atlanta	GA
	augustga	Augusta	GA
	maconga	Macon	GA
	savannga	Savannah	GA
HI	barberhi	Barbers Point	HI
	honoluhi	Honolulu	HI
	lihuehi	Lihue	HI
IA	desmoia	Des Moines	IA
	masoncia	Mason City	IA
	siouxcia	Sioux City	IA
ID	boiseid	Boise	ID
	lewistid	Lewiston	ID
	pocateid	Pocatello	ID
IL	chicagil	Chicago	IL
	molineil	Moline	IL
	springil	Springfield	IL
IN	indianin	Indianapolis	IN
	southbin	South Bend	IN
KS	dodgecks	Dodge City	KS
	goodlaks	Goodland	KS
	topekaks	Topeka	KS
KY	lexingky	Lexington	KY
	louisvky	Louisville	KY
LA	batonrla	Baton Rouge	LA
	lakechla	Lake Charles	LA
	neworlla	New Orleans	LA
	shreve1a	Shreveport	LA
MA	bostonma	Boston	MA
MD	baltimmd	Baltimore	MD
	patuxemd	Patuxent	MD

State	File Name	Location	
ME	bangorme	Bangor	ME
	caribome	Caribou	ME
	portlame	Portland	ME
MI	alpenami	Alpena	MI
	detroimi	Detroit	MI
	flintmi	Flint	MI
	grandrmi	Grand Rapids	MI
	saultsmi	Sault Sainte Marie	MI
	travermi	Traverse City	MI
MN	duluthmn	Duluth	MN
	internmn	International Falls	MN
	minneamn	Minneapolis	MN
	rochesmn	Rochester	MN
MO	columbmo	Columbia	MO
	saintlmo	Saint Louis	MO
	springmo	Springfield	MO
MS	jacksoms	Jackson	MS
	meridims	Meridian	MS
MT	billinmt	Billings	MT
	dillonmt	Dillon	MT
	greatfmt	Great Falls	MT
	lewistmt	Lewistown	MT
	missoumt	Missoula	MT
	cutbanmt	Cutbank	MT
	glasgomt	Glasgow	MT
	helenamt	Helena	MT
	milesomt	Miles City	MT
NC	ashevinc	Asheville	NC
	charlone	Charlotte	NC
	greensnc	Greensboro	NC
	capehanc	Cape Hatteras	NC
	cherrync	Cherry Point	NC
	raleignc	Raleigh	NC
ND	bismarnd	Bismarck	ND
	fargond	Fargo	ND
	minotnd	Minot	ND
NE	grandine	Grand Island	NE
	northpne	North Platte	NE
	omahane	Omaha	NE
	scottssne	Scottsbluff	NE
NH	NONE		NH
NJ	lakehunj	Lakehurst	NJ
	newarknj	Newark	NJ

Appendix C Weather Station File Names and Locations

<u>State</u>	<u>File Name</u>	<u>Location</u>	
NM	albuqunm	Albuquerque	NM
	claytonm	Clayton	NM
	roswelnm	Roswell	NM
	truthonm	Truth or Conseq.	NM
	tucumcnm	Tucumcari	NM
NV	elkonv	Elko	NV
	lasvegnav	Las Vegas	NV
	renonv	Reno	NV
	winnemnav	Winnemucca	NV
	elynv	Ely	NV
	lovelonv	Lovelock	NV
	tonopanv	Tonopah	NV
	yuccafnv	Yucca Flats	NV
	albanyny	Albany	NY
	buffalny	Buffalo	NY
NY	newyocny	New York City	NY
	rochesny	Rochester	NY
	binghany	Binghamton	NY
	massenny	Massena	NY
	newyolny	LaGuardia Air.	NY
	syracuny	Syracuse	NY
	akronoh	Akron	OH
	columboh	Columbus	OH
OH	cleveloh	Cleveland	OH
	toledooh	Toledo	OH
	cincino	Cincinnati	OH
	daytonoh	Dayton	OH
	youngsoh	Youngstown	OH
	oklahook	Oklahoma	OK
	tulsaok	Tulsa	OK
	astorior	Astoria	OR
OR	northbor	North Bend	OR
	redmonor	Redmond	OR
	medforor	Medford	OR
	portlaor	Portland	OR
	saalemor	Salem	OR
PA	allentpa	Allentown	PA
	eriepa	Erie	PA
	philadpa	Philadelphia	PA
	avocapa	Avoca	PA
	harrispa	Harrisburg	PA
	pittsbpa	Pittsburgh	PA
PI	wakeispi	Wake Island	PI
PR	sanjuapr	San Juan	PR
RI	providri	Providence	RI

Appendix C Weather Station File Names and Locations

State	File Name	Location	
SC	charlesc	Charleston	SC
	columbsc	Columbia	SC
	greenvsc	Greenville	SC
SD	huronsd	Huron	SD
	pierresd	Pierre	SD
	rapidcsd	Rapid City	SD
	siouxfsd	Sioux Falls	SD
TN	chattatn	Chattanooga	TN
	knoxvitn	Knoxville	TN
	memphitn	Memphis	TN
	nashvitn	Nashville	TN
TX	abilentx	Abilene	TX
	corpustx	Corpus Christi	TX
	houstotx	Houston	TX
	lufkintx	Lufkin	TX
	sananttx	San Antonio	TX
	amariltx	Amarillo	TX
	delriotx	Del Rio	TX
	kingsvtx	Kingsville	TX
	midlantx	Midland	TX
	shermatx	Sherman	TX
	austintx	Austin	TX
	elpasotx	El Paso	TX
	laredotx	Laredo	TX
	portartx	Port Arthur	TX
	wacotx	Waco	TX
	brownstx	Brownsville	TX
	fortwotx	Fort Worth	TX
	lubboctx	Lubbock	TX
	sanangtx	San Angelo	TX
	wichittx	Wichita Falls	TX
UT	brycecut	Bryce Canyon	UT
	cedarcut	Cedar City	UT
	saltlaut	Salt Lake City	UT
VA	norfolva	Norfolk	VA
	richmovva	Richmond	VA
	roanokva	Roanoke	VA
VT	burlinvt	Burlington	VT
WA	olympiwa	Olympia	WA
	seattlwa	Seattle	WA
	spokanwa	Spokane	WA
	whidbewa	Whidbey Island	WA
	yakimawa	Yakima	WA

Appendix C Weather Station File Names and Locations

<u>State</u>	<u>File Name</u>	<u>Location</u>	
WI	eauclawi	Eau Claire	WI
	greenbwi	Green Bay	WI
	lacroswi	La Crosse	WI
	madisowi	Madison	WI
	milwauwi	Milwaukee	WI
WV	charlewv	Charleston	WV
WY	casperwy	Casper	WY
	rockspwy	Rock Springs	WY
	cheyenwy	Cheyenne	WY
	sheridwy	Sheridan	WY
BC	vancoubc	Vancouver	BC
AB	edmontab	Edmonton	AB
SW	NONE		SW
MB	winnipmb	Winnipeg	MB
ON	toronton	Toronto	ON
PQ	montrepq	Montreal	PQ
DC	washindc	Washington DC	DC

Appendix D

Building and Use-Area Types

<u>Building and Use-Area Types</u>	<u>Building Class</u>	<u>Building Type Category</u>	<u>Use-Area Type Category</u>
ADMINISTRATION	Military	0	0
BARRACKS	Military	1	1
CHAPEL	Military	2	2
CLINIC	Military	3	3
CLUBS	Military	4	4
COMMISSARIES	Military	5	5
DINING HALLS	Military	6	6
ELECTRONICS	Military	7	7
EXCHANGE FACILITIES	Military	8	8
GUEST HOUSES	Military	9	9
HANGER	Military	10	10
HOSPITAL	Military	11	11
LABS	Military	12	12
LAUNDRY	Military	13	13
MORALE, WELFARE, & RECREATION	Military	14	14
MILITARY OTHER	Military	15	15
PRODUCTION and/or PROCESS	Military	16	16
RECREATION	Military	17	17
SCHOOLS and/or TRAINING	Military	18	18
SECURITY	Military	19	19
SHOPS	Military	20	20
STORAGE	Military	21	21
WAREHOUSE	Military	22	22
SINGLE FAMILY DETACHED HOUSE	Military	23	23
SINGLE FAMILY ATTACHED HOUSE	Military	24	24
DUPLEX	Military	25	25
MULTI-FAMILY 3 OR MORE UNIT	Military	26	26
MILITARY MOBILE HOMES	Military	27	27
Assembly	Civilian	0	0
Education	Civilian	1	1
Food Sales	Civilian	2	2
Food Service	Civilian	3	3
Health Care	Civilian	4	4
Lodging	Civilian	5	5
Mercantile & Service	Civilian	6	6
Office	Civilian	7	7
Public Order/Safety	Civilian	8	8
Warehouse & Storage	Civilian	9	9
Other	Civilian	10	10

Appendix D *Building and Use-Area Types*

<u>Building and Use-Area Types</u>	<u>Building Class</u>	<u>Building Type Category</u>	<u>Use-Area Type Category</u>
Single Family Detached	Civilian	11	11
Single Family Attached	Civilian	12	12
2 to 4 Unit Buildings	Civilian	13	13
5 or More Unit Buildings	Civilian	14	14
Mobile Homes	Civilian	15	15

Level-1 Help Messages

Following is a summary listing of the help messages that will pop up to assist the user in developing a FEDS input file. The messages are accessed by placing the cursor in the box for which the user needs help, and then pressing the "F1" key. The messages are presented below in chronological order -- the order in which they would be accessed during the process of creating a FEDS input file.

Input Files Screen

Start New Case

Select start new case to start a case from scratch. FEDS will sequentially visit all screens before the case is finished. You may save the case at anytime and restart were you left off by selecting "Finish Existing Case".

Finish Existing Case

Select finish existing case to start a case where you left off. If you have this option selected FEDS will go to the last screen group in which you complete a screen. This option is used to complete a case that you created using "Start New Case".

Edit Existing Case

"Edit Existing Case" is used to make minor modification to a completed existing case. If this option is selected FEDS will go to the "Input File Editing" screen which enables you to edit any of the screen groups.

Create Level-2 File

This option will generate a Level-2 input file for you with the file name that appears at the bottom of the screen. This file can be either a Level-1 file or and Level-2 file in which you have made changes. The Level-2 files will be stored in the specified directory and have the extension ".i2?".

Run FEDS Model

Run case will run the case as supplied by the directory path and the case filename. After completing the FEDS model run the user will return to this screen with the status of the run.

Create ASEAM Files

This option is currently unavailable. When it is completed it will allow the user to generate ASEAM quick input files based on your FEDS input.

Directory Path

The directory name to save or retrieve the case file. This directory must exist if "Finish Existing Case", "Edit Existing Case", "Create Level-2 File", "Run FEDS Model", or "Create ASEAM File" is selected.

File Name

The case file name to save or retrieve the case file. This file must exist if "Finish Existing Case", "Edit Existing Case", "Create Level-2 File", "Run FEDS Model", or "Create ASEAM File" is selected. Press the "F2" key while on this field to see a list of available input files in the directory specified above.

Model Run Data

Run Date

Enter the run data which is used in financial calculations.

Installation Location Screen

Installation Location

The state or province where your installation is located. Please press the "F2" key while the cursor is in the installation location edit box. This will allow you to select the state or province where your installation is located.

Weather City

The city of the weather station that you wish to use. Please press the "F2" key while the cursor is in the weather city box. This will allow you to select the city that most closely reflects the weather at your site.

Installation Name

An optional field used on FEDS model reports. Enter the installation name or other information that is appropriate.

Installation Location

An optional field used on FEDS model reports. Enter the installation location or other information that is appropriate.

Installation Energy, Operating, and Physical Characteristics Screen

Start Date--Month

The first month (inclusive) of the one year period for which you will be providing the all energy consumption data.

Start Date--Year

The year associated with the "Start Date--Month" for the one year period for which you will be providing the all energy consumption data.

End Date--Month

The last month (inclusive) of the one year period for which you will be providing the all energy consumption data. This value is computed based on the "Start Date--Month" and "Start Date--Year."

End Date--Year

The year associated with the "End Date--Month" for the one year period for which you will be providing the all energy consumption data. This value is computed based on the "Start Date--Month" and "Start Date--Year."

Installation Non-Transportation Energy Consumption Screen

MWh Consumed

The total electrical consumption for your installation over the time period shown (entered in the previous screen). This consumption includes purchased and self-generated electricity. MWh (megawatt-hours) are equal to 1000 times kWh (kilowatt-hours).

Peak Demand (MW)

The maximum monthly installation demand for electricity including electricity supplied by purchases and self-generation. Determine this by examining your monthly electric bills and adding any on site generation occurring concurrently. MW (megawatts) equals 1000 * KW.

Month in Which Peak Occurred

The month of the year in which the peak demand occurred. This can also be found by examining your monthly electric bills.

Oil--Gallons Consumed

The total non-transportation oil consumption for your installation over the time period shown (entered in the previous screen). This can be determined by subtracting increases (or adding decreases) in the oil inventory level from oil purchases during the time period.

Natural Gas--Therms Consumed

The total non-transportation natural gas consumption for your installation over the time period shown (entered in the previous screen). This can be determined by examining your monthly natural gas bills for the installation.

Installation Non-Transportation Energy Consumption (continued) Screen

Coal--Tons Consumed

The total coal consumption for your installation over the time period shown (entered in the previous screen). This can be determined by subtracting increases (or adding decreases) in the coal inventory level from coal purchases during the time period.

Purchased Steam--MBtu Consumed

The total purchased steam consumption for your installation over the time period shown (entered in the previous screen). This can be determined by examining your monthly bills from the steam supplier(s).

Purchased Hot Water--MBtu Consumed

The total high-temperature hot water purchased (typically used for space heating, etc.) for your installation over the time period shown (entered in the previous screen). This can be determined by examining your monthly bills from the supplier(s).

Other Fuels--MBtu Consumed

Your installation's total consumption over the time period shown (entered in the previous screen) of fuels not previously requested (e.g., LPG, biomass). This can typically be determined by examining your monthly bills from the supplier(s) and adjusting for inventory changes.

Energy Generation/Transformation Screen

District Steam

The total on-site generation of steam from all fuel sources supplied to district loops (steam systems that supply more than one building). Please provide this value in million Btu.

District Hot Water

The total on-site generation of high-temperature hot water from all fuel sources supplied to district loops (high-temperature hot water systems that supply more than one building). Please provide this value in million Btu.

District Chilled Water

The total on-site chilled water generation from central chillers that is supplied to district loops (chilled H₂O systems that supply more than one building) regardless of fuel source. A ton-hour is the amount of chilled water produced by a 1 ton chiller in one hour (12,000 Btu).

Electricity

The total on-site generation of electricity from cogeneration or other electrical generation equipment using all fuel sources. MWh (megawatt-hours) are equal to 1000 times kWh (kilowatt-hours).

Non-Electric Energy Price Information Screen

Oil (\$/gallon)

The current cost you are paying for fuel oil (average of distillate and residual). This value should represent the marginal cost; if your rates vary depending on the amount purchased, provide the price for the last gallon purchased (i.e., the value of a gallon saved).

Natural Gas (\$/therm)

The current cost you are paying for natural gas. This value should represent the marginal cost; if your rates vary depending on the amount purchased, provide the price for the last therm purchased (i.e., the value of a therm saved).

[Individual Fuel] Consumption Breakdown Screens

Industrial Process Loads

A rough percentage estimate of all industrial process consumption of this fuel and all other consumption of this fuel that is not included in the categories below. This also includes any consumption of this fuel that occurs for central services such as water and sewer.

Central Boilers for District Steam Generation

A rough percentage estimate of all consumption of this fuel used in boilers that produce steam for more than one building (e.g., boilers that supply thermal loops).

Central Boilers for District Hot Water Generation

A rough percentage estimate of all consumption of this fuel used in boilers that produce high-temperature hot water for more than one building (e.g., boilers that supply thermal loops).

Central Chiller Plants

A rough percentage estimate of all consumption of this fuel used in absorption chillers or other chillers using this fuel that produce chilled water for more than one building (e.g., chillers that supply chilled water loops).

Cogeneration Equipment

A rough percentage estimate of all consumption of this fuel used in equipment producing steam or high-temperature hot water while also producing electricity. The thermal output is typically used by an industrial process or input to a thermal loop.

Other Electrical Generation Equipment

A rough percentage estimate of all consumption of this fuel used in equipment that produces electricity without any other useful thermal output (e.g., steam or high-temperature hot water).

Building Systems

A rough percentage estimate of all consumption of this fuel by building systems including heating, cooling, water heating, etc.

Coal (\$/ton)

The current cost you are paying for coal. This value should represent the marginal cost; if your rates vary depending on the amount purchased, provide the price for the last ton purchased (i.e., the value of a ton saved).

Purchased Steam (\$/MBtu)

The current cost you are paying for steam (at the site boundary) that you purchase. This value should represent the marginal cost; if your rates vary depending on the amount purchased, provide the price for the last MBtu of steam purchased.

Self-Generated Steam (\$/MBtu)

The current price at which you value steam that you generate on site. This value represents the cost of fuel used and the conversion efficiency of the boilers. Thus, this is the value of the steam at the point of generation.

Purchased Hot Water (\$/MBtu)

The current cost you pay for purchase high-temperature hot water. This value should represent the marginal cost; if your rates vary depending on the amount purchased, provide the price for the last MBtu of hot water purchased (i.e., the value of a MBtu of hot water saved).

Self-Generated Hot Water (\$/MBtu)

The current price at which you value high-temperature hot water that you generate on site. This value represents the cost of fuel used and the conversion efficiency of the boilers. Thus, this is the value of the high-temperature hot water at the point of generation.

Other Fuels (\$/MBtu)

The current cost you are paying for others fuels (a weighted average across all other fuels). This value should represent the marginal cost; if your rates vary depending on the amount purchased, provide the price for the last MBtu purchased (i.e., the value of a MBtu saved).

Marginal Electricity Price and Schedule Information Screen

Winter Season Begins on--Month

The month during which your winter electric rate season begins (e.g., January = 1). If you do not have seasonal rates this value should be 1.

Winter Season Begins on--Day

The day of the month (inclusive) on which your winter electric rate season begins. If you do not have seasonal rates this value should be 1.

Winter Season Ends on--Month

The month during which your winter electric rate season ends (e.g., January = 1). If you do not have seasonal rates this value should be 12.

Winter Season Ends on--Day

The day of the month (inclusive) on which your winter electric rate season ends. If you do not have seasonal rates this value should be 31.

Marginal Electricity Price and Schedule Information Screen

Time-of-day Rates

Electric rates for energy or demand that vary according to the time-of-day that the energy is used or the power demanded. If you do not know your rate schedule check with your local utility.

Flat Rates

Electric rates for energy or demand that not vary according to the season or time-of-day that the energy is used or the power demanded. If you do not know your rate schedule check with your local utility.

Energy (cents/kWh)

The cost that you pay for electric energy when you have flat rates. If you did not select flat rates above you should not, and will not be allowed to, enter a value here.

Demand (\$/kW)

The cost that you pay for electric power demand when you have flat rates. If you did not select flat rates above you should not, and will not be allowed to, enter a value here.

Winter (Summer) Marginal Electricity Prices and Schedule Screens

Winter (Summer) Weekday: Period One to Period Five--Start and End Times

Enter the beginning and end time time-of-day rate periods for Winter (Summer) Weekdays. Rate periods with identical energy and demand costs are assumed to be the same period (e.g., the mid-peak period is in the morning and afternoon). Midnight is 2400, and 0000 is not a valid entry.

Winter (Summer) Weekday: Period One to Period Five--Energy and Demand Costs

Enter the electric energy cost in cents/kWh and demand cost in \$/kW for each time-of-day rate period for Winter (Summer) Weekdays. Rate periods with identical energy and demand costs are assumed to be the same period (e.g., the mid-peak period is in the morning and afternoon).

Winter (Summer) Saturday: Period One to Period Three--Start and End Times

Enter the beginning and end time time-of-day rate periods for Winter (Summer) Saturdays. Rate periods with identical energy and demand costs are assumed to be the same period (e.g., the mid-peak period is in the morning and afternoon). Midnight is 2400, and 0000 is not a valid entry.

Winter (Summer) Saturday: Period One to Period Three--Energy and Demand Costs

Enter the electric energy cost in cents/kWh and demand cost in \$/kW for each time-of-day rate period for Winter (Summer) Saturdays. Rate periods with identical energy and demand costs are assumed to be the same period (e.g., the mid-peak period is in the morning and afternoon).

Winter (Summer) Sunday: Period One to Period Three--Start and End Times

Enter the beginning and end time time-of-day rate periods for Winter (Summer) Sundays. Rate periods with identical energy and demand costs are assumed to be the same period (e.g., the mid-peak period is in the morning and afternoon). Midnight is 2400, and 0000 is not a valid entry.

Winter (Summer) Sunday: Period One to Period Three--Energy and Demand Costs

Enter the electric energy cost in cents/kWh and demand cost in \$/kW for each time-of-day rate period for Winter (Summer) Sundays. Rate periods with identical energy and demand costs are assumed to be the same period (e.g., the mid-peak period is in the morning and afternoon).

Electric Rate Demand Ratchet Screen

Electric Rate Demand Ratchet--Yes

This option should be selected if your demand charges in any month are affected (or potentially affected) by the measured demand in any previous month. If you do not know if you have a demand ratchet schedule check with your local utility.

Electric Rate Demand Ratchet--No

This option should be selected if your demand charges in any month are not affected (or potentially affected) by the measured demand in any previous month. If you do not know if you have a demand ratchet schedule check with your local utility.

Electric Rate Demand Ratchet Information Screen

Summer Months Only

Should be selected if the your demand ratchet rate schedule is only applied to summer months. That is, the peak demand in one summer month can affect the demand charges in another summer month; but, demand in winter months does not affect demand charges in the summer or other winter months.

Winter Months Only

Should be selected if the your demand ratchet rate schedule is only applied to winter months. That is, the peak demand in one winter month can affect the demand charges in another winter month; but, demand in summer months does not affect demand charges in the winter or other summer months.

All Months

Should be selected if the your demand ratchet rate schedule does not have a seasonal component. That is, the peak demand in any month can affect the demand charges another month regardless of the season.

Number of Preceding Months

The number of months back that the demand from that month can affect the demand charge in this month. This value is clearly stated in your rate schedule.

Percentage of the Peak Demand

The percentage of the peak demand in a previous month (within the "Number of preceding months") that is compared to the actual demand in the current month. The demand charge is based on the greater of these two values. This percentage is clearly stated in your rate schedule.

Building Floor Area and Number of Buildings

Civilian

Should be selected if you have civilian buildings at your site. Selecting civilian here will allow you to select civilian building types when you press the button "Select Building Types".

Military

Should be selected if you only have military buildings at your site. Selecting military here will allow you to select military building types when you press the button "Select Building Types".

Building Types

Use select all of the building types at your installation. Consult the user's guide for a description of each building type.

Total Building Floor Area

The total floor area, in square feet, of all buildings at your installation.

Total Number of Buildings

The total number of independent buildings at your installation. An apartment building is considered as only one building even though it represents a number of housing units. However each attached single family housing units (e.g., row houses) is considered as a separate building.

Number of Buildings, Floor Area, and Vintage

Percent of Total -- Buildings

Select if you prefer using percentages to enter the breakdown of the total number of buildings on your installation that you provided on the previous screen. The percentages that you provide below must add up to 100.

Actual Numbers -- Buildings

Select if you prefer to breakdown the total number of building on your installation that you provided on the previous screen by entering the actual number of buildings of each type. The numbers that you provide below must add up to total number of buildings previously entered.

Percent of Total -- Floor Area

Select if you prefer using percentages to enter the breakdown of the total buildings floor area on your installation that you provided on the previous screen. The percentages that you provide below must add up to 100.

Actual Numbers -- Floor Area

Select if you prefer to breakdown the total buildings floor area on your installation that you provided on the previous screen by entering the actual floor area for each building type. The numbers that you provide below must add up to total buildings floor area previously entered.

Number

The number of buildings of this type at your installation (if Actual Numbers was selected) or the percentage this building type represents of the total number of buildings (if Percentage of Total was selected).

Floor Area

The floor area for all building of this type at your installation (if Actual Numbers was selected) or the percentage of the total floor area entered above that this building type represents (if Percentage of Total was selected).

Vintage

The average construction date for this building type at your installation. For example, if 1/3 of your buildings of this type were built in 1946, and the rest were built in 1958, you would enter 1954 $((1/3 * 1946) + (2/3 * 1958))$.

Space Heating Energy Type/Technology Screen

Same Energy Type/Technology

Should be selected if all buildings at your installation use the same space heating energy type. For example, this option should be selected if all buildings are heated and they all use district steam for heating. The next screen will request the specific energy type/technology.

Different Energy Type/Technology

Should be selected if all buildings at your installation do not use the same space heating energy type. For example, if some buildings heat with oil and some heat with gas, this option should be selected. The following screens will request the energy type/technology.

Not Heated

Should be selected only if no buildings at your installation have heating.

Space Heating Energy Type/Technology in All Buildings Screen

Electric Resistance

Should be selected if all heating in all buildings at your installation is from some form of electric resistance heating (e.g., baseboard, electric forced air furnace).

Electric Heat Pump

Should be selected if all heating in all buildings at your installation use from heat pumps.

Steam (District)

Should be selected if all heating in all buildings at your installation is from steam supplied by district loops.

Hot Water (District)

Should be selected if all heating in all buildings at your installation is from high-temperature hot water supplied by district loops.

Oil

Should be selected if all heating in all buildings at your installation is from some form of oil heating (e.g., oil-fired boiler, oil-fired forced air furnace).

Natural Gas

Should be selected if all heating in all buildings at your installation is from some form of natural gas heating (e.g., natural gas-fired boiler, natural gas-fired forced air furnace).

Coal

Should be selected if all heating in all buildings at your installation is from some form of coal heating (e.g., coal-fired boiler).

Other Fuels

Should be selected if all heating in all buildings at your installation is from some form of other fuel heating (e.g., wood-fired boiler, LPG-fired forced air furnace).

Space Heating Energy Type/Technology [for Specific Building Types] Screens

Electric Resistance

Represents the percentage of buildings of this type heated with some form of electric resistance heating (e.g., baseboard, electric forced air furnace). The percentages for all space heating energy types/technologies must add to 100.

Electric Heat Pump

Represents the percentage of buildings of this type heated with heat pumps. The percentages for all space heating energy types/technologies must add to 100. PLEASE enter the same percentage for electric heat pumps for heating as you do for cooling.

Steam (District)

Represents the percentage of buildings of this type heated with steam supplied by district loops. The percentages for all space heating energy types/technologies must add to 100.

Hot Water (District)

Represents the percentage of buildings of this type heated with high-temperature hot water supplied by district loops. The percentages for all space heating energy types/technologies must add to 100.

Oil

Represents the percentage of buildings of this type heated with some form of oil heating (e.g., oil-fired boiler, oil-fired forced air furnace). The percentages for all space heating energy types/technologies must add to 100.

Natural Gas

Represents the percentage of buildings of this type heated with some form of natural gas heating (e.g., natural gas-fired boiler, natural gas-fired forced air furnace). The percentages for all space heating energy types/technologies must add to 100.

Coal

Represents the percentage of buildings of this type heated with some form of coal heating (e.g., coal-fired boiler). The percentages for all space heating energy types/technologies must add to 100.

Other Fuels

Represents the percentage of buildings of this type heated with some form of other fuel heating (e.g., wood-fired boiler, LPG-fired forced air furnace). The percentages for all space heating energy types/technologies must add to 100.

Not Heated

Represents the percentage of buildings of this type that are not heated. The percentages for all space heating energy types/technologies must add to 100.

Building Cooling Technology Screen

Same Cooling Technology

Should be selected if all buildings use the same space cooling technology at your installation. For example, this option should be selected if all buildings are cooled and they all use chilled water supplied by central plants. The next screen will request the specific cooling technology.

Different Cooling Technologies

Should be selected if all buildings at your installation do not use the same space cooling technology. For example, if some buildings cool with heat pumps and some have no cooling, this option should be selected. The following screens will request the cooling technology by building.

Not Cooled

Should be selected only if no buildings at your installation have cooling.

Cooling Technology Used in All Buildings Screen

Evaporative Cooler

Should be selected if all cooling in all buildings at your installation is from evaporative coolers.

Package Units (Window or Roof Top)

Should be selected if all cooling in all buildings at your installation is from package cooling units.

Electric Heat Pump

Should be selected if all cooling in all buildings at your installation is from electric heat pumps. PLEASE select this value if you selected all heating in all buildings to be heat pumps.

Single Building Electric Chiller

Should be selected if all cooling in all buildings at your installation is from single building electric chillers.

Steam Absorption Chiller

Should be selected if all cooling in all buildings at your installation is from high-temperature water source absorption chillers.

High-Temperature Water Source Absorption Chiller

Should be selected if all cooling in all buildings at your installation is from high-temperature water source absorption chillers.

Natural Gas-Fired Absorption Chiller

Should be selected if all cooling in all buildings at your installation is from natural gas-fired absorption chillers.

Other Fuel-Fired Absorption Chiller

Should be selected if all cooling in all buildings at your installation is from other fuel-fired absorption chillers. Other fuels include those not listed above (e.g., oil, LPG).

Chilled Water (District Plant)

Should be selected if all cooling in all buildings at your installation is from chilled water supplied by district plants (i.e., chillers that provide cooling to more than one building).

Not cooled

Should be selected only if no buildings at your installation have cooling.

Cooling Technology [Used in Each Building Type] Screens

Evaporative Cooler

Represents the percentage of buildings of this type cooled with evaporative coolers. The percentages for all cooling technologies must add to 100.

Package Units (Window or Roof Top)

Represents the percentage of buildings of this type cooled with package units. The percentages for all cooling technologies must add to 100.

Electric Heat Pumps

Represents the percentage of buildings of this type cooled with electric heat pumps. The percentages for all cooling technologies must add to 100. PLEASE enter the same percentage for electric heat pumps for cooling as you do for heating.

Single Building Electric Chiller

Represents the percentage of buildings of this type cooled with electric chillers. The percentages for all cooling technologies must add to 100.

Steam Absorption Chiller

Represents the percentage of buildings of this type cooled with steam absorption chillers. The percentages for all cooling technologies must add to 100.

High-Temperature Water Source Absorption Chiller

Represents the percentage of buildings of this type cooled with high-temperature water source absorption chillers. The percentages for all cooling technologies must add to 100.

Natural Gas-Fired Absorption Chiller

Represents the percentage of buildings of this type cooled with natural gas-fired absorption chillers. The percentages for all cooling technologies must add to 100.

Other Fuel-Fired Absorption Chiller

Represents the percentage of buildings of this type cooled with natural gas-fired absorption chillers. The percentages for all cooling technologies must add to 100. Other fuels include those not listed above (e.g., oil, LPG).

Chilled Water (District Plant)

Represents the percentage of buildings of this type cooled with chilled water supplied by district plants (i.e., chillers that provide cooling to more than one building). The percentages for all cooling technologies must add to 100.

Not Cooled

Represents the percentage of buildings of this type that are not cooled. The percentages for all cooling technologies, including not cooled, must add to 100.

Service Water Heating Technology Screen

Same Water Heating Technology

Should be selected if all buildings at your installation use the same service water heating energy type. For example, this option should be selected if all buildings have hot water and they all use oil for water heating. The next screen will request the energy type/technology.

Different Energy Type/Technology

Should be selected if all buildings do not use the same service water heating energy type. For example, if some buildings heat water with district steam and some use gas, this option should be selected. The following screens will request the energy fuel type/technology by building.

Not Heated

Should be selected only if no buildings at your installation service water heating.

Service Water Heating Energy Type/Technology Used in all Buildings Screen

Electric Resistance

Should be selected if all buildings have service water heating and it is all supplied by some form of electric resistance water heating (e.g., electric water heater, electric boiler).

Electric Heat Pump

Should be selected if all buildings have service water heating and it is all produced by heat pumps.

Steam (District)

Should be selected if all buildings have service water heating and it is all produced by steam supplied by district loops.

Hot Water (District)

Should be selected if all buildings have service water heating and it is all produced by high-temperature hot water supplied by district loops.

Oil

Should be selected if all buildings have service water heating and it is all produced by some form of oil water heating (e.g., oil-fired boiler, oil water heater).

Natural Gas

Should be selected if all buildings have service water heating and it is all produced by some form of natural gas water heating (e.g., natural gas-fired boiler, natural gas water heater).

Coal

Should be selected if all buildings have service water heating and it is all produced by some form of coal water heating (e.g., coal-fired boiler).

Other Fuels

Should be selected if all buildings have service water heating and it is all produced by some form of other fuel water heating (e.g., wood-fired boiler, LPG water heater).

Service Water Heating Energy Type/Technology [Used in each Building Type] Screens

Electric Resistance

Represents the percentage of buildings of this type which use some form of electric resistance water heating (e.g., electric water heater, electric boiler). The percentages for all service water heating energy types/technologies must add to 100.

Electric Heat Pump

Represents the percentage of buildings of this type which use heat pumps for service water heating. The percentages for all service water heating energy types/technologies must add to 100.

Steam (District)

Represents the percentage of buildings of this type which use steam supplied by district loops for service water heating. The percentages for all service water heating energy types/technologies must add to 100.

Hot Water (District)

Represents the percentage of buildings of this type which use high-temperature hot water supplied by district loops for service water heating. The percentages for all service water heating energy types/technologies must add to 100.

Oil

Represents the percentage of buildings of this type which use some form of oil water heating (e.g., oil-fired boiler, oil water heater). The percentages for all service water heating energy types/technologies must add to 100.

Natural Gas

Represents the percentage of buildings of this type which use some form of natural gas water heating (e.g., natural gas-fired boiler, natural gas water heater). The percentages for all service water heating energy types/technologies must add to 100.

Coal

Represents the percentage of buildings of this type which use some form of coal water heating (e.g., coal-fired boiler). The percentages for all service water heating energy types/technologies must add to 100.

Other

Represents the percentage of buildings of this type which use some form of other fuel water heating (e.g., wood-fired boiler, LPG water heater). The percentages for all service water heating energy types/technologies must add to 100.

No Water Heating

Represents the percentage of buildings of this type that have no water heating. The percentages for all service water heating energy types/technologies must add to 100.

Indoor Lighting Technologies Screen

Same Indoor Lighting Technology

Should be selected if all buildings at your installation use the same indoor lighting technology. For example, this option should be selected if all buildings use only incandescent lighting. The next screen will request the specific lighting technology.

Different Indoor Lighting Technology

Should be selected if all buildings do not use the same indoor lighting technology. For example, if some buildings use incandescent lights and some use fluorescent lights, this option should be selected. The following screens will request the building lighting technology.

Indoor Lighting Technologies Used in All Buildings Screen

Incandescent

Should be selected if all buildings at the installation have only incandescent lighting.

High Efficiency Incandescent (e.g., Halogen)

Should be selected if all buildings at the installation have only high efficiency incandescent lighting.

Fluorescent

Should be selected if all buildings at the installation have only fluorescent lighting.

High Efficiency Fluorescent

Should be selected if all buildings at the installation have only high efficiency fluorescent lighting. High efficiency fluorescent lighting would include fixtures with electronic ballasts or T-8 technology.

Mercury Vapor

Should be selected if all buildings at the installation have only mercury vapor lighting.

Metal Halide

Should be selected if all buildings at the installation have only metal halide lighting.

High-Pressure Sodium

Should be selected if all buildings at the installation have only high-pressure sodium lighting.

Low-Pressure Sodium

Should be selected if all buildings at the installation have only low-pressure sodium lighting.

Indoor Lighting Technologies [Used in Each Building Type] Screens

Incandescent

Represents the percentage of lighting in all buildings of this type which is supplied by incandescent lighting. The percentages for all lighting technologies must add to 100.

High Efficiency Incandescent (e.g., Halogen)

Represents the percentage of lighting in all buildings of this type which is supplied by high efficiency incandescent lighting. The percentages for all lighting technologies must add to 100.

Fluorescent

Represents the percentage of lighting in all buildings of this type which is supplied by fluorescent lighting. The percentages for all lighting technologies must add to 100.

High Efficiency Fluorescent

Represents the percentage of lighting in buildings of this type which is supplied by high efficiency fluorescent lighting. High efficiency fluorescent lighting includes fixtures with electronic ballasts or T-8 technology. The percentages for all lighting technologies must add to 100.

Mercury Vapor

Represents the percentage of lighting in all buildings of this type which is supplied by mercury vapor lighting. The percentages for all lighting technologies must add to 100.

Metal Halide

Represents the percentage of lighting in all buildings of this type which is supplied by metal halide lighting. The percentages for all lighting technologies must add to 100.

High-Pressure Sodium

Represents the percentage of lighting in all buildings of this type which is supplied by high-pressure sodium lighting. The percentages for all lighting technologies must add to 100.

Low-Pressure Sodium

Represents the percentage of lighting in all buildings of this type which is supplied by low-pressure sodium lighting. The percentages for all lighting technologies must add to 100.

Building Operating Hours Screen

Same Operating/Occupancy Hours

Should be selected if all buildings at your installation have the same operating/occupancy hours. For example, this option should be selected if all buildings are operated/occupied from 0800 to 1700 hours. The next screen will request the specific operating/occupancy hours.

Different Operating/Occupancy Hours

Should be selected if all buildings at your installation do not have the same operating/occupancy hours. For example, this option should be selected if some buildings are operated/occupied from 0800 to 1700 hours and some are operated/occupied continuously.

Building Operating/Occupancy Schedule for All Buildings Screen

Start Time -- Every Day

When all buildings on the installation begin operating/occupancy every day (weekdays, Saturdays, and Sundays). Enter 0 here (and for the end time below) only if the buildings are always unoccupied. Enter all times as military time; for example 1800 represents 6pm.

End Time -- Every Day

When all buildings on the installation end operating/occupancy every day (weekdays, Saturdays, and Sundays). Enter 0 here (and for the start time above) only if the buildings are always unoccupied. Enter all times as military time; for example 1800 represents 6pm.

Start Time -- Weekdays

When all buildings on the installation begin operating/occupancy every weekday. Enter 0 here (and for the end time below) only if the buildings are unoccupied on weekdays. Enter all times as military time; for example 1800 represents 6pm.

End Time -- Weekdays

When all buildings on the installation end operating/occupancy every weekday. Enter 0 here (and for the start time above) only if the buildings are unoccupied on weekdays. Enter all times as military time; for example 1800 represents 6pm.

Start Time -- Saturdays

When all buildings on the installation begin operating/occupancy on Saturdays. Enter 0 here (and for the end time below) only if the buildings are unoccupied on Saturdays. Enter all times as military time; for example 1800 represents 6pm.

End Time -- Saturdays

When all buildings on the installation end operating/occupancy on Saturdays. Enter 0 here (and for the start time above) only if the buildings are unoccupied on Saturdays. Enter all times as military time; for example 1800 represents 6pm.

Start Time -- Sundays

When all buildings on the installation begin operating/occupancy on Sundays. Enter 0 here (and for the end time below) only if the buildings are unoccupied on Sundays. Enter all times as military time; for example 1800 represents 6pm.

End Time -- Sundays

When all buildings on the installation end operating/occupancy Sundays. Enter 0 here (and for the start time above) only if the buildings are unoccupied on Sundays. Enter all times as military time; for example 1800 represents 6pm.

Building Operating/Occupancy Schedule [for Each Building Type] Screens

Start Time -- Every Day

The average time when buildings of this type begin operating/occupancy every day (weekdays, Saturdays, and Sundays). Enter 0 here (and for the end time below) only if the buildings are always unoccupied. Enter all times as military time; for example 1800 represents 6pm.

End Time -- Every Day

The average time when buildings of this type end operating/occupancy every day (weekdays, Saturdays, and Sundays). Enter 0 here (and for the start time above) only if the buildings are always unoccupied. Enter all times as military time; for example 1800 represents 6pm.

Start Time -- Weekdays

The average time when buildings of this type begin operating/occupancy every weekday. Enter 0 here (and for the end time below) only if the buildings are unoccupied on weekdays. Enter all times as military time; for example 1800 represents 6pm.

End Time -- Weekdays

The average time when buildings of this type end operating/occupancy every weekday. Enter 0 here (and for the start time above) only if the buildings are unoccupied on weekdays. Enter all times as military time; for example 1800 represents 6pm.

Start Time -- Saturdays

The average time when buildings of this type begin operating/occupancy on Saturdays. Enter 0 here (and for the end time below) only if the buildings are unoccupied on Saturdays. Enter all times as military time; for example 1800 represents 6pm.

End Time -- Saturdays

The average time when buildings of this type end operating/occupancy on Saturdays. Enter 0 here (and for the start time above) only if the buildings are unoccupied on Saturdays. Enter all times as military time; for example 1800 represents 6pm.

Start Time -- Sundays

The average time when buildings of this type begin operating/occupancy on Sundays. Enter 0 here (and for the end time below) only if the buildings are unoccupied on Sundays. Enter all times as military time; for example 1800 represents 6pm.

End Time -- Sundays

The average time when buildings of this type end operating/occupancy Sundays. Enter 0 here (and for the start time above) only if the buildings are unoccupied on Sundays. Enter all times as military time; for example 1800 represents 6pm.

Financial Parameters Screen

Use Default Values

Should be selected if you wish to use the default financial parameters. If selected, then the you will not be asked to enter Discount rates, and energy cost escalation rates.

Use User Entered Financial Parameters

Should be selected if you wish to enter your own financial parameters. If selected, then the you will be asked to enter Discount rates, and energy cost escalation rates.

Discount Rate Screen

Use Government Specified Discount Rate

Should be selected if government funds are going to be used to undertake energy conservation and generation projects at the installation.

Use User Specified Discount Rate

Should be selected if non-government funds (e.g., private sector financing through Shared Energy Savings or utility financing) are going to be used to undertake energy conservation and generation projects at the installation.

Real Discount Rate

The real (effects of inflation removed) interest rate or rate of return required for non-government projects. For example, energy service companies performing Shared Energy Savings contracts typically require real rates of return of 18 to 20%.

Energy Cost Escalation Rates Screen

Use DOE/EIA Real Energy Escalation Rates

Should be selected if want to use the government specified energy cost escalation rates. If you have better information on the energy escalation rates (e.g., long-term contract with specified escalation rates) select "user specified escalation rates."

Use User Specified Escalation Rates

Should be selected only if you have better information on the energy escalation rates (e.g., long-term contract with specified escalation rates). Select defaults if you want to use the government specified energy cost escalation rates.

Energy Cost Escalation Rates Continued Screen

All Fuels

The expected annual real (effects of inflation removed) escalation rate for all fuels available at your installation. This value should be entered as a percent; for example, enter 2.6 if you expect your cost for all fuel to increase at a rate 2.6% greater than the rate of general inflation.

Electricity

The expected annual real (effects of inflation removed) escalation rate for electricity used at your installation. This value should be entered as a percent; for example, enter 2.6 if you expect your cost for electricity to increase 2.6% more than the rate of general inflation.

Oil

The expected annual real (effects of inflation removed) escalation rate for oil used at your installation. This value should be entered as a percent; for example, enter 2.6 if you expect your cost for oil to increase 2.6% more than the rate of general inflation.

Natural Gas

The expected annual real (effects of inflation removed) escalation rate for natural gas used at your installation. This value should be entered as a percent; for example, enter 2.6 if you expect your cost for natural gas to increase 2.6% more than the rate of general inflation.

Coal

The expected annual real (effects of inflation removed) escalation rate for coal used at your installation. This value should be entered as a percent; for example, enter 2.6 if you expect your cost for coal to increase 2.6% more than the rate of general inflation.

Purchased Steam

The expected annual real (effects of inflation removed) escalation rate for purchased steam used at your installation. This value should be entered as a percent; for example, enter 2.6 if you expect your cost for purchased steam to increase 2.6% more than the rate of general inflation.

Purchase Hot Water

The expected annual real (effects of inflation removed) escalation rate for purchase hot water used at your installation. This value should be entered as a percent; for example, enter 2.6 if you expect your cost for purchase hot water to increase 2.6% more than the rate of general inflation.

Other Fuels

The expected annual real (effects of inflation removed) escalation rate for other fuels (e.g., LPG) used at your installation. This value should be entered as a percent; for example, enter 2.6 if you expect your cost for other fuels to increase 2.6% more than the rate of inflation.

Additional Financial Screening Screen

No Screen on Payback and SIR

Simple payback time is the number of years required for the cumulative value of energy cost savings less future non-fuel costs to equal the investment costs. Savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy efficiency measure.

ECIP Payback and SIR Values

The values shown on the screen are the current ECIP program minimum SIR and maximum payback values as provided by law. Checking this box will eliminate some retrofits with positive net savings and will only provide retrofits that meet the ECIP requirements. THIS WILL NOT YIELD THE MINIMUM LIFE-CYCLE COST.

User-Enter Payback and SIR

Checking this box will eliminate some retrofits with positive net savings and will only provide retrofits that meet the requirements you enter below. THIS WILL NOT YIELD THE MINIMUM LIFE-CYCLE COST FOR YOUR INSTALLATION.

Maximum Simple Payback

Simple payback time is the number of years required for the cumulative value of energy cost savings less future non-fuel costs to equal the investment costs. All projects with a payback greater than this value will be eliminated.

Minimum SIR

Savings-to-investment ratio (SIR) is the ratio of the present value savings to the present value costs of an energy efficiency measure. All projects with an SIR less than this value will be eliminated.

Electric Utility Cost Sharing Screen

Yes

Should be selected if your electric utility will pay for a portion of the cost of energy conservation at your installation through cost sharing, rebates, or other mechanisms. If no cost sharing is available you should select "No" (below).

No

Should be selected if your electric utility will not pay for a portion of the cost of energy conservation at your installation through cost sharing, rebates, or other mechanisms. If cost sharing is available you should select "Yes" (above).

Lights

Represents the average percentage of the total installed cost that your electric utility will pay for lighting retrofits. This value should be entered as a percent; for example, enter 40 if your electric utility will pay 40% of the cost of lighting retrofits.

Heating

Represents the average percentage of the total installed cost that your electric utility will pay for electric heating retrofits. This value should be entered as a percent; for example, enter 40 if your electric utility will pay 40% of the cost of electric heating retrofits.

Cooling

Represents the average percentage of the total installed cost that your electric utility will pay for electric cooling retrofits. This value should be entered as a percent; for example, enter 40 if your electric utility will pay 40% of the cost of electric cooling retrofits.

Ventilation

Represents the average percentage of the total installed cost that your electric utility will pay for ventilation retrofits. This value should be entered as a percent; for example, enter 40 if your electric utility will pay 40% of the cost of ventilation retrofits.

Water Heating

Represents the average percentage of the total installed cost that your electric utility will pay for electric water heating retrofits. This value should be entered as a percent; for example, enter 40 if your electric utility will pay 40% of the cost of electric water heating retrofits.

Building Envelope Improvements

Represents the average percentage of the total installed cost that your electric utility will pay for building envelope improvements electric heated or cooled buildings. This value should be entered as a percent (e.g., enter 40 if your electric utility will pay 40% of the cost).

Gas Utility Cost Sharing Screen

Yes

Should be selected if your gas utility will pay for a portion of the cost of energy conservation at your installation through cost sharing, rebates, or other mechanisms. If no cost sharing is available you should select "No" (below).

No

Should be selected if your gas utility will not pay for a portion of the cost of energy conservation at your installation through cost sharing, rebates, or other mechanisms. If cost sharing is available you should select "Yes" (above).

Heating

Represents the average percentage of the total installed cost that your gas utility will pay for gas heating retrofits. This value should be entered as a percent; for example, enter 40 if your gas utility will pay 40% of the cost of gas heating retrofits.

Cooling

Represents the average percentage of the total installed cost that your gas utility will pay for gas cooling retrofits. This value should be entered as a percent; for example, enter 40 if your gas utility will pay 40% of the cost of gas cooling retrofits.

Ventilation

Represents the average percentage of the total installed cost that your gas utility will pay for ventilation retrofits. This value should be entered as a percent; for example, enter 40 if your gas utility will pay 40% of the cost of ventilation retrofits.

Water Heating

Represents the average percentage of the total installed cost that your gas utility will pay for gas water heating retrofits. This value should be entered as a percent; for example, enter 40 if your gas utility will pay 40% of the cost of gas water heating retrofits.

Building Envelope Improvements

Represents the average percentage of the total installed cost that your gas utility will pay for building envelope improvements in gas heated or cooled buildings. This value should be entered as a percent (e.g., enter 40 if your gas utility will pay 40% of the cost).

Savings Input and Output Files

Save Case

Will save the case you are working on.

Do Not Save Case

Will not save the case you are working on.

Filename

The name of the case that you are saving. The file specified will be saved in the directory specified above; the extension .il will automatically be added for you.

Appendix F

Sample Output

FEDERAL ENERGY DECISION SCREENING MODEL (FEDS) SCREEN INPUT DATA - VERSION 2.10

INSTALLATION NON-TRANSPORTATION ENERGY CONSUMPTION AND GENERATION

Case: C:\FEDS\MODEL\SAMPLE-1 Output File: C:\FEDS\MODEL\SAMPLE-1.01 Start Date: Wed Oct 19 13:55:59 1994

Analysis Run Year: 1994

Weather Station: San Francisco CA

Installation Name: Sample-1: Office Buildings

Installation Location: San Francisco

Energy Data Start Date: 12/90

Energy Data End Date: 11/91

BREAKDOWN BY PERCENTAGE OF END USE

Energy Type	ENERGY CONSUMPTION		BREAKDOWN BY PERCENTAGE OF END USE					Other Elect Gener	Building Systems
	Consumption	Units	Indust Process Loads	Steam Central Boilers	Hot Water Central Boilers	Central Chillers	Cogen		
Electricity	1,000	MWh	1.00	0.00	0.00	10.00	0.00	0.00	89.00
Oil	1,000	gallons	0.00	5.00	5.00	0.00	0.00	0.00	90.00
Natural Gas	1,000	therms	0.00	5.00	5.00	0.00	0.00	0.00	90.00
Coal	1,000	ton	0.00	5.00	5.00	0.00	0.00	0.00	90.00
Steam	1,000*	MBtu	0.00	0.00	0.00	10.00	0.00	0.00	90.00
Hot Water	1,000*	MBtu	0.00	0.00	0.00	10.00	0.00	0.00	90.00
Other Fuels	1,000	MBtu	0.00	5.00	5.00	0.00	0.00	0.00	90.00

* Consumption is for purchased steam and hot water only.

INSTALLATION PEAK ELECTRIC DEMAND

	Amount	Units	Peak Month
Electric Peak Demand ..	10.00	MW	January

ON-SITE ENERGY GENERATION/TRANSFORMATION

Energy Type	Amount	Units
District Steam	1	MBtu
District Hot Water	1	MBtu
District Chilled Water ..	1,000	Ton-Hours
Electricity	0	MWh

ENERGY PRICE DATA
NON-ELECTRIC ENERGY PRICE INFORMATION

Energy Type	Price	Units
Oil	1.03	\$/gallons
Natural Gas	0.55	\$/therms
Coal	22.00	\$/ton
Purchased Steam	5.00	\$/MBtu
Self-Gen Steam	5.00	\$/MBtu
Purchased Hot Water ...	5.00	\$/MBtu
Self-Gen Hot Water	5.00	\$/MBtu
Other Fuels	6.38	\$/MBtu

Sample-1: Office Buildings / San Francisco / San Francisco

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MARGINAL ELECTRICITY PRICE AND SCHEDULE INFORMATION

Start Date: 1/ 1 End Date: 12/31

Schedule: Flat rates

	Price	Units
Energy Rate	5.00	cents/kWh
Demand	5.00	\$/kW

Sample-1: Office Buildings / San Francisco / San Francisco

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BUILDING INFORMATION

Building Type	Number of Buildings	Each Building Floor Area (sf)	Average Date Construction
Office	1.00	40,000	1978

SPACE HEATING ENERGY TYPE/TECHNOLOGY
(Percent of Floor Area Heated by Each Energy Type/Technology)

Building Type	Elect Resist	Elect Heat Pump	Steam	Hot Water	Oil	Nat Gas	Coal	Other	Not Heated
Office	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SPACE COOLING ENERGY TYPE/TECHNOLOGY
(Percent of Floor Area Cooled by Each Technology)

Building Type	Evap Cooler	Pack Units	Elect Heat Pump	Single Building Chiller	Steam Absorp Chiller	Water Absorp Chiller	Nat Gas Absorp Chiller	Other Absorp Chiller	District Chilled Water	Not Cooled
Office	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SERVICE WATER HEATING TECHNOLOGY
(Percent of Floor Area Served by Each Water Heating Energy Type/Technology)

Building Type	Elect Resist	Elect Heat Pump	Steam	Hot Water	Oil	Nat Gas	Coal	Other	Not Heated
Office	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Sample-1: Office Buildings / San Francisco / San Francisco

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INDOOR LIGHTING TECHNOLOGIES
(Percent of Lighting Illumination Provided by Each Technology)

Building Type	Elect Incand	High Eff Incan	Fluor	High Eff Fluor	Mercury Vapor	Metal Halide	High Pres Sodium	Low Pres Sodium	Exit Sign
Office	30.00	0.00	50.00	20.00	0.00	0.00	0.00	0.00	Present

BUILDING OPERATING HOURS

Building Type	Weekdays		Saturdays		Sundays	
	Start	End	Start	End	Start	End
Office	700	1800	1000	1600	0	0

Sample-1: Office Buildings / San Francisco / San Francisco

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FINANCIAL PARAMETERS

Discount rate	3.00%
Maximum simple payback	N/A
Minimum savings-to-investment ratio	N/A

Energy escalation rate fuel Electricity	DOE/EIA
Energy escalation rate fuel Oil	DOE/EIA
Energy escalation rate fuel Natural Gas	DOE/EIA
Energy escalation rate fuel Coal	DOE/EIA
Energy escalation rate fuel Purchased Steam	DOE/EIA
Energy escalation rate fuel Self-Gen Steam	DOE/EIA
Energy escalation rate fuel Purchased Hot Water	DOE/EIA
Energy escalation rate fuel Self-Gen Hot Water	DOE/EIA
Energy escalation rate fuel Other Fuels	DOE/EIA
Energy escalation rate fuel Chilled Water	N/A

UTILITY COST SHARING
(Percent of Installed Cost of Retrofits)

	Electric Utility	Gas Utility
Heating.....	0.00	0.00
Cooling.....	0.00	0.00
Ventilation..	0.00	0.00
Lights.....	0.00	N/A
Water Heating	0.00	0.00
Envelope.....	0.00	0.00

Sample-1: Office Buildings / San Francisco / San Francisco

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FEDS ANALYTICAL RESULTS

Summary of Retrofit Resource Potentials

First year energy and demand dollar savings due to retrofits .	19,066
Present value of life-cycle energy, demand, and O&M savings ..	389,791
Total estimated investment required for retrofits	88,750
Present value of capital investments	79,865
Net present value of retrofits	309,926
Estimated current installation energy use (MBtu)	2,612
Estimated post-retrofit installation energy use (MBtu)	1,946
Estimated installation annual energy savings (MBtu)	667

Sample-1: Office Buildings / San Francisco / San Francisco

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Detailed Results of Retrofits

Fuel	Annual Installation Energy Use by Fuel Type Energy	Dollars (1994)
Electricity (kw-hr)		
existing	765,437	50,608
post-retrofit	430,849	28,942
difference	334,588	21,666
% change	-44	-43
Natural Gas (therms)		
existing	0	0
post-retrofit	4,754	2,600
difference	-4,754	-2,600
% change	n/a	n/a
Total (MBtu)		
existing	2,612	50,608
post-retrofit	1,946	31,542
difference	667	19,066
% change	-26	-38

Sample-1: Office Buildings / San Francisco / San Francisco
Annual Installation Electric Demand

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	Demand (kW)	Dollars (1994)
Installation Peak Demand:		
existing	251	12,336
post-retrofit	181	7,399
difference	70	4,937
% change	-28	-40
Time of Installation	Existing	Post-Retrofit
Peak Demand:		
Month	September	September
Day Type	Weekday	Saturday
Hour	1400	1400

Sample-1: Office Buildings / San Francisco / San Francisco

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Annual Installation Energy Use by Fuel Type and End Use Technology

Fuel	Heating	Cooling	Vent	Lights	Misc Equip	Hot Water
Electricity (kw-hr)						
existing	97,154	46,108	23,450	381,263	210,239	7,224
post-retrofit	0	30,503	18,168	168,640	210,239	3,299
difference	97,154	15,605	5,282	212,622	0	3,925
% change	-100	-34	-23	-56	0	-54
Natural Gas (therms)						
existing	0	0	0	0	0	0
post-retrofit	4,754	0	0	0	0	0
difference	-4,754	0	0	0	0	0
% change	n/a	0	0	0	0	0
Total (MBtu)						
existing	332	157	80	1,301	718	25
post-retrofit	475	104	62	576	718	11
difference	-144	53	18	726	0	13
% change	43	-34	-23	-56	0	-54

Sample-1: Office Buildings / San Francisco / San Francisco

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Annual Energy Use by Building Type and Fuel Type

Building Type ... Office

Fuel	Energy	Dollars (1994)
Electricity (kw-hr)		
existing	765,437	50,608
post-retrofit	430,849	28,942
difference	334,588	21,666
% change	-44	-43
Natural Gas (therms)		
existing	0	0
post-retrofit	4,754	2,600
difference	-4,754	-2,600
% change	n/a	n/a
Total (MBtu)		
existing	2,612	50,608
post-retrofit	1,946	31,542
difference	667	19,066
% change	-26	-38

Sample-1: Office Buildings / San Francisco / San Francisco
Annual Electric Demand by Building Type

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Building Type... Office

	Demand (kW)	
Building Type Peak Demand:		
existing	251	
post-retrofit	181	
difference	70	
% change	-28	
Time of Building Type	Existing	Post-Retrofit
Peak Demand:		
Month	September	September
Day Type	Weekday	Saturday
Hour	1400	1400
Building Type Coincident	Demand (kW)	Dollars (1994)
Peak Demand		
existing	251	12,336
post-retrofit	181	7,399
difference	70	4,937
% change	-28	-40

Sample-1: Office Buildings / San Francisco / San Francisco

CA / Page 12

Annual Energy Use by Building Type, Fuel Type, and End Use Technology

Building Type ... Office

Fuel	Heating	Cooling	Vent	Lights	Misc Equip	Hot Water
Electricity (kw-hr)						
existing	97,154	46,108	23,450	381,263	210,239	7,224
post-retrofit	0	30,503	18,168	168,640	210,239	3,299
difference	97,154	15,605	5,282	212,622	0	3,925
% change	-100	-34	-23	-56	0	-54
Natural Gas (therms)						
existing	0	0	0	0	0	0
post-retrofit	4,754	0	0	0	0	0
difference	-4,754	0	0	0	0	0
% change	n/a	0	0	0	0	0
Total (MBtu)						
existing	332	157	80	1,301	718	25
post-retrofit	475	104	62	576	718	11
difference	-144	53	18	726	0	13
% change	43	-34	-23	-56	0	-54

Appendix F Sample Output

FEDERAL ENERGY DECISION SCREENING MODEL (FEDS) SCREEN INPUT DATA - VERSION 2.10

INSTALLATION NON-TRANSPORTATION ENERGY CONSUMPTION AND GENERATION

Case: C:\FEDS\MODEL\SAMPLE-2 Output File: C:\FEDS\MODEL\SAMPLE-2.01 Start Date: Wed Oct 19 13:31:41 1994

Analysis Run Year: 1994

Weather Station: Seattle WA
Installation Name: Sample 2: Office/Warehouse/Housing
Installation Location: Seattle

Energy Data Start Date: 2/91 Energy Data End Date: 1/92

BREAKDOWN BY PERCENTAGE OF END USE

Energy Type	ENERGY CONSUMPTION		BREAKDOWN BY PERCENTAGE OF END USE					Other	
	Consumption	Units	Indust Process Loads	Steam Central Boilers	Hot Water Central Boilers	Central Chillers	Cogen	Elect Gener	Building Systems
Electricity	10,000	MWh	0.00	0.00	0.00	10.00	0.00	0.00	90.00
Oil	121,212	gallons	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Natural Gas	121,212	therms	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Coal	123	ton	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Other Fuels	123,123	MBtu	100.00	0.00	0.00	0.00	0.00	0.00	0.00

INSTALLATION PEAK ELECTRIC DEMAND

	Amount	Units	Peak Month
Electric Peak Demand ..	10.00	MW	January

ON-SITE ENERGY GENERATION/TRANSFORMATION

Energy Type	Amount	Units
District Steam	0	MBtu
District Hot Water	0	MBtu
District Chilled Water	10	Ton-Hours
Electricity	0	MWh

ENERGY PRICE DATA NON-ELECTRIC ENERGY PRICE INFORMATION

Energy Type	Price	Units
Oil	1.03	\$/gallons
Natural Gas	0.55	\$/therms
Coal	10.00	\$/ton
Purchased Steam	0.00	\$/MBtu
Self-Gen Steam	0.00	\$/MBtu
Purchased Hot Water ...	0.00	\$/MBtu
Self-Gen Hot Water	0.00	\$/MBtu
Other Fuels	10.00	\$/MBtu

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

WA / Page 2

MARGINAL ELECTRICITY PRICE AND SCHEDULE INFORMATION

Start Date: 1/ 1 End Date: 12/31

Schedule: Flat rates

	Price	Units
Energy Rate	8.50	cents/kWh
Demand	2.00	\$/kW

ELECTRIC RATE DEMAND RATCHET

Applicable Months ... winter only Number of preceeding months on ... 12
which the demand ratchet is based

Percentage of peak demand in the preceeding months ... 100.00
used to compute the minimum demand charge

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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BUILDING INFORMATION

Building Type	Number of Buildings	Each Building Floor Area (sf)	Average Date Construction
Single Family Detached	10.00	2,000	1981
5 or More Unit Building	3.00	26,667	1984
Office	2.00	50,000	1977
Warehouse & Storage ...	6.00	50,000	1979

SPACE HEATING ENERGY TYPE/TECHNOLOGY
(Percent of Floor Area Heated by Each Energy Type/Technology)

Building Type	Elect Resist	Elect Heat Pump	Steam	Hot Water	Oil	Nat Gas	Coal	Other	Not Heated
Single Family Detached	50.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 or More Unit Building	30.00	0.00	0.00	0.00	0.00	70.00	0.00	0.00	0.00
Office	0.00	50.00	0.00	0.00	0.00	50.00	0.00	0.00	0.00
Warehouse & Storage ...	0.00	0.00	0.00	0.00	50.00	0.00	0.00	0.00	50.00

SPACE COOLING ENERGY TYPE/TECHNOLOGY
(Percent of Floor Area Cooled by Each Technology)

Building Type	Evap Cooler	Pack Units	Elect Single Heat Building Pump Chiller	Steam Absorp Chiller	Water Absorp Chiller	Nat Gas Absorp Chiller	Other Absorp Chiller	District Chilled Water	Not Cooled
Single Family Detached	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	50.00
5 or More Unit Building	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Office	0.00	50.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00
Warehouse & Storage ...	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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SERVICE WATER HEATING TECHNOLOGY
(Percent of Floor Area Served by Each Water Heating Energy Type/Technology)

Building Type	Elect Resist	Elect Heat Pump	Steam	Hot Water	Oil	Nat Gas	Coal	Other	Not Heated
Single Family Detached	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 or More Unit Building	30.00	0.00	0.00	0.00	0.00	70.00	0.00	0.00	0.00
Office	50.00	0.00	0.00	0.00	0.00	50.00	0.00	0.00	0.00
Warehouse & Storage ...	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00

INDOOR LIGHTING TECHNOLOGIES
(Percent of Lighting Illumination Provided by Each Technology)

Building Type	Elect Incand	High Eff Incan	Fluor	High Eff Fluor	Mercury Vapor	Metal Halide	High Pres Sodium	Low Pres Sodium	Exit Sign
Single Family Detached	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Absent
5 or More Unit Building	90.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	Present
Office	20.00	0.00	80.00	0.00	0.00	0.00	0.00	0.00	Present
Warehouse & Storage ...	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	Present

BUILDING OPERATING HOURS

Building Type	Weekdays		Saturdays		Sundays	
	Start	End	Start	End	Start	End
Single Family Detached	1700	700	2300	2300	2300	2300
5 or More Unit Building	1700	700	2300	2300	2300	2300
Office	700	1800	1000	1600	0	0
Warehouse & Storage ...	600	2000	800	1800	1000	1600

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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FINANCIAL PARAMETERS

Discount rate	3.00%
Maximum simple payback	N/A
Minimum savings-to-investment ratio	N/A
Energy escalation rate fuel Electricity	DOE/EIA
Energy escalation rate fuel Oil	DOE/EIA
Energy escalation rate fuel Natural Gas	DOE/EIA
Energy escalation rate fuel Coal	DOE/EIA
Energy escalation rate fuel Purchased Steam	DOE/EIA
Energy escalation rate fuel Self-Gen Steam	DOE/EIA
Energy escalation rate fuel Purchased Hot Water	DOE/EIA
Energy escalation rate fuel Self-Gen Hot Water	DOE/EIA
Energy escalation rate fuel Other Fuels	DOE/EIA
Energy escalation rate fuel Chilled Water	N/A

UTILITY COST SHARING
(Percent of Installed Cost of Retrofits)

	Electric Utility	Gas Utility
Heating.....	0.00	0.00
Cooling.....	0.00	0.00
Ventilation..	0.00	0.00
Lights.....	0.00	N/A
Water Heating	0.00	0.00
Envelope.....	0.00	0.00

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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FEDS ANALYTICAL RESULTS

Summary of Retrofit Resource Potentials

First year energy and demand dollar savings due to retrofits .	86,965
Present value of life-cycle energy, demand, and O&M savings ..	1,551,096
Total estimated investment required for retrofits	285,313
Present value of capital investments	271,676
Net present value of retrofits	1,279,420
Estimated current installation energy use (MBtu)	17,256
Estimated post-retrofit installation energy use (MBtu)	14,326
Estimated installation annual energy savings (MBtu)	2,930

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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Detailed Results of Retrofits

Fuel	Annual Installation Energy Use by Fuel Type	
	Energy	Dollars (1994)
Electricity (kw-hr)		
existing	3,363,719	308,921
post-retrofit	2,443,705	226,165
difference	920,014	82,756
% change	-27	-27
Oil (gal)		
existing	20,715	21,337
post-retrofit	0	0
difference	20,715	21,337
% change	-100	-100
Natural Gas (therms)		
existing	28,545	15,614
post-retrofit	59,858	32,742
difference	-31,313	-17,128
% change	110	110
Total (MBtu)		
existing	17,256	345,872
post-retrofit	14,326	258,907
difference	2,930	86,965
% change	-17	-25

Sample 2: Office/Warehouse/Housing / Seattle / Seattle
Annual Installation Electric Demand

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	Demand (kW)	Dollars (1994)
Installation Peak Demand:		
existing	959	23,005
post-retrofit	769	18,450
difference	190	4,555
% change	-20	-20
Time of Installation	Existing	Post-Retrofit
Peak Demand:		
Month	July	July
Day Type	Saturday	Saturday
Hour	1400	1400

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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Annual Installation Energy Use by Fuel Type and End Use Technology

Fuel	Heating	Cooling	Vent	Lights	Misc Equip	Hot Water
Electricity (kw-hr)						
existing	183,323	129,236	53,250	1,431,302	1,366,083	200,525
post-retrofit	91,392	102,421	46,681	833,241	1,366,083	3,888
difference	91,931	26,815	6,568	598,062	0	196,638
% change	-50	-21	-12	-42	0	-98
Oil (gal)						
existing	6,827	0	0	0	0	13,888
post-retrofit	0	0	0	0	0	0
difference	6,827	0	0	0	0	13,888
% change	-100	0	0	0	0	-100
Natural Gas (therms)						
existing	12,569	0	0	0	0	15,976
post-retrofit	29,060	0	0	0	0	30,797
difference	-16,491	0	0	0	0	-14,822
% change	131	0	0	0	0	93
Total (MBtu)						
existing	2,845	441	182	4,885	4,662	4,241
post-retrofit	3,218	350	159	2,844	4,662	3,093
difference	-373	92	22	2,041	0	1,148
% change	13	-21	-12	-42	0	-27

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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Annual Energy Use by Building Type and Fuel Type

Building Type ... Single Family Detached

Fuel	Energy	Dollars (1994)
Electricity (kw-hr)		
existing	229,290	21,058
post-retrofit	106,074	9,817
difference	123,216	11,241
% change	-54	-53
Natural Gas (therms)		
existing	0	0
post-retrofit	4,476	2,448
difference	-4,476	-2,448
% change	n/a	n/a
Total (MBtu)		
existing	783	21,058
post-retrofit	810	12,265
difference	-27	8,792
% change	3	-42

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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Annual Energy Use by Building Type and Fuel Type

Building Type ... 5 or More Unit Buildings

Fuel	Energy	Dollars (1994)
Electricity (kw-hr)		
existing	616,941	56,659
post-retrofit	342,559	31,704
difference	274,382	24,956
% change	-44	-44
Natural Gas (therms)		
existing	20,784	11,369
post-retrofit	21,686	11,862
difference	-902	-494
% change	4	4
Total (MBtu)		
existing	4,184	68,028
post-retrofit	3,338	43,566
difference	846	24,462
% change	-20	-36

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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Annual Energy Use by Building Type and Fuel Type

Building Type ... Office

Fuel	Energy	Dollars (1994)
Electricity (kw-hr)		
existing	1,557,787	143,066
post-retrofit	1,042,713	96,503
difference	515,074	46,563
% change	-33	-33
Natural Gas (therms)		
existing	7,761	4,245
post-retrofit	7,981	4,366
difference	-220	-120
% change	3	3
Total (MBtu)		
existing	6,093	147,311
post-retrofit	4,357	100,869
difference	1,736	46,443
% change	-28	-32

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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Annual Energy Use by Building Type and Fuel Type

Building Type ... Warehouse & Storage

Fuel	Energy	Dollars (1994)
Electricity (kw-hr)		
existing	959,702	88,138
post-retrofit	952,359	88,141
difference	7,342	-3
% change	-1	0
Oil (gal)		
existing	20,715	21,337
post-retrofit	0	0
difference	20,715	21,337
% change	-100	-100
Natural Gas (therms)		
existing	0	0
post-retrofit	25,715	14,066
difference	-25,715	-14,066
% change	n/a	n/a
Total (MBtu)		
existing	6,197	109,475
post-retrofit	5,822	102,207
difference	375	7,268
% change	-6	-7

Sample 2: Office/Warehouse/Housing / Seattle / Seattle
Annual Electric Demand by Building Type

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Building Type... Single Family Detached

	Demand (kW)	
Building Type Peak Demand:		
existing	68	
post-retrofit	36	
difference	32	
% change	-47	
Time of Building Type	Existing	Post-Retrofit
Peak Demand:		
Month	December	July
Day Type	Saturday	Sunday
Hour	700	1600
Building Type Coincident	Demand (kW)	Dollars (1994)
Peak Demand		
existing	44	1,060
post-retrofit	36	857
difference	8	203
% change	-19	-19

Sample 2: Office/Warehouse/Housing / Seattle / Seattle
Annual Electric Demand by Building Type

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Building Type... 5 or More Unit Buildings

	Demand (kW)
Building Type Peak Demand:	
existing	256
post-retrofit	228
difference	28
% change	-11

Time of Building Type	Existing	Post-Retrofit
Peak Demand:		
Month	July	July
Day Type	Sunday	Sunday
Hour	1700	1600

Building Type Coincident	Demand (kW)	Dollars (1994)
Peak Demand		
existing	250	6,011
post-retrofit	225	5,392
difference	26	619
% change	-10	-10

Sample 2: Office/Warehouse/Housing / Seattle / Seattle
Annual Electric Demand by Building Type

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Building Type... Office

	Demand (kW)	
Building Type Peak Demand:		
existing	511	
post-retrofit	355	
difference	156	
% change	-31	
Time of Building Type	Existing	Post-Retrofit
Peak Demand:		
Month	July	July
Day Type	Weekday	Saturday
Hour	1600	1400
Building Type Coincident	Demand (kW)	Dollars (1994)
Peak Demand		
existing	510	12,084
post-retrofit	355	8,473
difference	155	3,611
% change	-30	-30

Sample 2: Office/Warehouse/Housing / Seattle / Seattle
Annual Electric Demand by Building Type

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Building Type... Warehouse & Storage

	Demand (kW)	
Building Type Peak Demand:		
existing	157	
post-retrofit	156	
difference	1	
% change	-1	
Time of Building Type	Existing	Post-Retrofit
Peak Demand:		
Month	December	December
Day Type	Weekday	Weekday
Hour	600	600
Building Type Coincident	Demand (kW)	Dollars (1994)
Peak Demand		
existing	154	3,694
post-retrofit	153	3,674
difference	1	20
% change	-1	-1

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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Annual Energy Use by Building Type, Fuel Type, and End Use Technology

Building Type ... Single Family Detached

Fuel	Heating	Cooling	Vent	Lights	Misc Equip	Hot Water
Electricity (kw-hr)						
existing	67,963	5,525	2,215	38,733	58,216	56,638
post-retrofit	18,892	5,266	2,320	21,381	58,216	0
difference	49,071	259	-105	17,352	0	56,638
% change	-72	-5	5	-45	0	-100
Natural Gas (therms)						
existing	0	0	0	0	0	0
post-retrofit	2,480	0	0	0	0	1,996
difference	-2,480	0	0	0	0	-1,996
% change	n/a	0	0	0	0	n/a
Total (MBtu)						
existing	232	19	8	132	199	193
post-retrofit	312	18	8	73	199	200
difference	-81	1	0	59	0	-6
% change	35	-5	5	-45	0	3

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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Annual Energy Use by Building Type, Fuel Type, and End Use Technology

Building Type ... 5 or More Unit Buildings

Fuel	Heating	Cooling	Vent	Lights	Misc Equip	Hot Water
Electricity (kw-hr)						
existing	49,929	56,663	9,341	169,166	196,476	135,366
post-retrofit	0	53,832	9,602	82,649	196,476	0
difference	49,929	2,831	-261	86,518	0	135,366
% change	-100	-5	3	-51	0	-100
Natural Gas (therms)						
existing	5,446	0	0	0	0	15,338
post-retrofit	9,630	0	0	0	0	12,056
difference	-4,184	0	0	0	0	3,282
% change	77	0	0	0	0	-21
Total (MBtu)						
existing	715	193	32	577	671	1,996
post-retrofit	963	184	33	282	671	1,206
difference	-248	10	-1	295	0	790
% change	35	-5	3	-51	0	-40

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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Annual Energy Use by Building Type, Fuel Type, and End Use Technology

Building Type ... Office

Fuel	Heating	Cooling	Vent	Lights	Misc Equip	Hot Water
Electricity (kw-hr)						
existing	65,431	67,048	39,616	851,574	525,596	8,522
post-retrofit	72,499	43,323	32,666	364,741	525,596	3,888
difference	-7,069	23,725	6,950	486,833	0	4,634
% change	11	-35	-18	-57	0	-54
Natural Gas (therms)						
existing	7,123	0	0	0	0	638
post-retrofit	7,632	0	0	0	0	349
difference	-509	0	0	0	0	289
% change	7	0	0	0	0	-45
Total (MBtu)						
existing	936	229	135	2,906	1,794	93
post-retrofit	1,011	148	111	1,245	1,794	48
difference	-75	81	24	1,662	0	45
% change	8	-35	-18	-57	0	-48

Sample 2: Office/Warehouse/Housing / Seattle / Seattle

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Annual Energy Use by Building Type, Fuel Type, and End Use Technology

Building Type ... Warehouse & Storage

Fuel	Heating	Cooling	Vent	Lights	Misc Equip	Hot Water
Electricity (kw-hr)						
existing	0	0	2,077	371,829	585,795	0
post-retrofit	0	0	2,093	364,471	585,795	0
difference	0	0	-16	7,358	0	0
% change	0	0	1	-2	0	0
Oil (gal)						
existing	6,827	0	0	0	0	13,888
post-retrofit	0	0	0	0	0	0
difference	6,827	0	0	0	0	13,888
% change	-100	0	0	0	0	-100
Natural Gas (therms)						
existing	0	0	0	0	0	0
post-retrofit	9,318	0	0	0	0	16,396
difference	-9,318	0	0	0	0	-16,396
% change	n/a	0	0	0	0	n/a
Total (MBtu)						
existing	963	0	7	1,269	1,999	1,959
post-retrofit	932	0	7	1,244	1,999	1,640
difference	31	0	0	25	0	319
% change	-3	0	1	-2	0	-16

FEDS Retrofit Options

The retrofit options for the FEDS Level-1 assessment software are listed below. This list will be continually expanded and refined as the software matures. Notes on specific end-uses are presented below under each category.

Heating Retrofit Alternatives

FEDS is currently only implemented for buildings. Hence the only retrofit of district heating systems is conversion to a building-level centralized system. Later, when central systems are implemented within the software, the analysis will also look at retrofitting a building-level system to a district system.

- Electric Resistance: Electric Base Board (retrofits only considered in buildings with ventilation systems) and Electric Furnace
 - Replace with Conventional Gas Furnace
 - Replace with Conventional Oil Furnace
 - Replace with High Efficiency Gas Furnace
 - Replace with Conventional Other Fuel (LPG) Furnace
 - Replace with High Efficiency LPG Furnace
- Electric Resistance: Electric Boiler
 - Replace with New Conventional Gas Boiler
 - Replace with Gas Pulse Condensing Boiler
 - Replace with New Conventional LPG Boiler
 - Replace with LPG Pulse Condensing Boiler
 - Replace with New Conventional Oil Boiler
- Electric Heat Pump
 - Replace with newer more efficient Heat Pump
- District Steam (retrofits considered are switching from steam supplied by the thermal loop to steam supplied by a single-building boiler--fuel switching alternatives are only considered when the fuel is available on site for Level-1 or to the building set for Level-2)
 - Replace with New Conventional Gas Boiler
 - Replace with Gas Pulse Condensing Boiler
 - Replace with New Conventional LPG Boiler
 - Replace with LPG Pulse Condensing Boiler
 - Replace with New Conventional Oil Boiler

- District High-Temperature Hot Water (retrofits considered are switching from high-temperature hot water supplied by the thermal loop to high-temperature hot water supplied by a single-building boiler--fuel switching alternatives are only considered when the fuel is available on site for Level-1 or to the building set for Level-2)

- Replace with New Conventional Gas Boiler
 - Replace with Gas Pulse Condensing Boiler
 - Replace with New Conventional LPG Boiler
 - Replace with LPG Pulse Condensing Boiler
 - Replace with New Conventional Oil Boiler

- Existing (Oil, Natural Gas, Coal, Other Fuel) Boiler (fuel switching alternatives are only considered when the fuel is available on site for Level-1 or to the building set for Level-2--performance of existing boiler depends on age, size, and fuel type)

- Add Feed water Economizers
 - Add Automatic Electric Damper
 - Replace with New Conventional Gas Boiler
 - Replace with Gas Pulse Condensing Boiler
 - Replace with New Conventional LPG Boiler
 - Replace with LPG Pulse Condensing Boiler
 - Replace with New Conventional Oil Boiler

- Existing (Oil, Natural Gas, Other Fuel) Furnace (fuel switching alternatives are only considered when the fuel is available on site for Level-1 or to the building set for Level-2--performance of existing boiler depends on age, size, and fuel type)

- Replace with Conventional Gas Furnace
 - Replace with Conventional Oil Furnace
 - Replace with Conventional Electric Furnace
 - Replace with High Efficiency Gas Furnace
 - Replace with Conventional Other Fuel (LPG) Furnace
 - Replace with High Efficiency LPG Furnace

Cooling Retrofit Alternatives

FEDS is currently only implemented for buildings. Hence the only retrofit of district cooling systems is conversion to a building-level centralized system. Later, when central systems are implemented within the software, the analysis will also look at retrofitting a building-level system to a district system.

- Package Units (cooled air output)
 - Replace with newer more efficient Single Zone Packaged AC Unit (1.5 to 20 tons cooling)
 - Replace with newer more efficient Multizone Packaged AC Unit (20 to 150 tons cooling)
- Existing Heat Pump (cooled air output)
 - Replace with newer more efficient Heat Pump
- Single Building Electric Chiller (chilled water output)
 - Replace with newer more efficient Air-Cooled Reciprocating Chiller (Small--20-75 tons cooling)
 - Replace with newer more efficient Air-Cooled Reciprocating Chiller (Large--75-200 tons cooling)
 - Replace with newer more efficient Air-Cooled Centrifugal Chiller (Small--200-500 tons cooling)
 - Replace with newer more efficient Air-Cooled Centrifugal Chiller (Large--500-1200 tons cooling)
- Single Building Absorption Chiller (fuels include: steam, high-temperature hot water, natural gas, and others--chilled water output--assumed to be recently newly retrofit--no cost effective retrofits)
- District Chilled Water (retrofits considered are switching from district chilled water to chilled water supplied by a single-building chiller)
 - Replace with single-building Air-Cooled Reciprocating Chiller (Small--20 to 75 tons cooling)
 - Replace with single-building Air-Cooled Reciprocating Chiller (Large--75 to 200 tons cooling)

Replace with single-building Air-Cooled Centrifugal Chiller
(Small--200 to 500 tons cooling)

Replace with single-building Air-Cooled Centrifugal Chiller
(Large--500 to 1200 tons cooling)

Envelope Retrofit Alternatives

FEDS currently only considers roof/ceiling and wall insulation retrofits. Retrofits to slab-on-grad and crawl space floors and windows will be implemented in Release 3.0.

- Roof/Ceiling Insulation (type depends on roof type)
 - Attic Ceiling: Increase Insulation by R-8
 - Attic Ceiling: Increase insulation by R-11
 - Attic Ceiling: Increase insulation by R-19
 - Attic Ceiling: Increase insulation by R-30
 - Attic Ceiling: Increase insulation by R-38
 - Suspended Ceiling: Increase Insulation by R-8
 - Suspended Ceiling: Increase insulation by R-11
 - Suspended Ceiling: Increase insulation by R-19
 - Suspended Ceiling: Increase insulation by R-30
 - Suspended Ceiling: Increase insulation by R-38
- Wall Insulation (applicability of retrofit depends on wall construction material, presence of existing insulation, and space available)
 - Blow-in Insulation: Increase Insulation by R-2.4
 - Blow-in Insulation: Increase Insulation by R-4.5
 - Blow-in Insulation: Increase Insulation by R-6.5
 - Blow-in Insulation: Increase Insulation by R-8.5
 - Blow-in Insulation: Increase Insulation by R-11
 - Blow-in Insulation: Increase Insulation by R-13
 - Interior Masonry Surface: Increase Insulation by R-4.3
 - Interior Masonry Surface: Increase Insulation by R-7
 - Interior Masonry Surface: Increase Insulation by R-10.9
 - Interior Masonry Surface: Increase Insulation by R-13

Service Hot Water Retrofit Alternatives

All logical combinations of the retrofits listed below are also included.

- Distributed Tank System (electric, gas, oil, other fuels)
 - Replace with Electric Water Heater
 - Replace with Heavy Insulation Electric Water Heater
 - Replace with 0.80 efficient Oil Water Heater
 - Replace with 0.76 efficient Gas Water Heater
 - Replace with 0.80 efficient Gas Water Heater
 - Replace with 0.85 efficient Gas Water Heater
 - Replace with 0.94 efficient Gas Water Heater
 - Replace with 0.76 efficient LPG Water Heater
 - Replace with 0.80 efficient LPG Water Heater
 - Replace with 0.85 efficient LPG Water Heater
 - Replace with 0.94 efficient LPG Water Heater
 - Replace with Electric Water Heater with heat trap
 - Replace with Heavy Insulation Electric Water Heater with heat trap
 - Replace with 0.80 efficient Oil Water Heater with heat trap
 - Replace with 0.76 efficient Gas Water Heater with heat trap
 - Replace with 0.80 efficient Gas Water Heater with heat trap
 - Replace with 0.85 efficient Gas Water Heater with heat trap
 - Replace with 0.94 efficient Gas Water Heater with heat trap
 - Replace with 0.76 efficient LPG Water Heater with heat trap
 - Replace with 0.80 efficient LPG Water Heater with heat trap
 - Replace with 0.85 efficient LPG Water Heater with heat trap
 - Replace with 0.94 efficient LPG Water Heater with heat trap
 - Insulate existing tank
 - Insulate Pipe near water heater
 - Install Low Flow Shower Heads (where applicable)
 - Install Faucet Aerators
 - Decrease Service Hot Water Temperature (only possible for certain building types and only done in conjunction with flow reducers)
- Electric Heat Pump Water Heater
 - Insulate Pipe near water heater
 - Install Low Flow Shower Heads (where applicable)
 - Install Faucet Aerators
- Central Tank Circulating System (oil, gas, coal, other fuels)
 - Replace existing boiler with New Conventional Gas Boiler
 - Replace existing boiler with Gas Pulse Condensing Boiler
 - Replace existing boiler with New Conventional LPG Boiler
 - Replace existing boiler with LPG Pulse Condensing Boiler
 - Replace existing boiler with New Conventional Oil Boiler

Insulate tank
Install Low Flow Shower Heads (where applicable)
Install Faucet Aerators
Decrease Service Hot Water Temperature (only possible for certain building types and only done in conjunction with flow reducers)

- Central Tank Circulating System (district steam or district high-temperature hot water)

Replace existing heat exchanger with New Conventional Gas Boiler
Replace existing heat exchanger with Gas Pulse Condensing Boiler
Replace existing heat exchanger with New Conventional LPG Boiler
Replace existing heat exchanger with LPG Pulse Condensing Boiler
Replace existing heat exchanger with New Conventional Oil Boiler
Insulate tank
Install Low Flow Shower Heads (where applicable)
Install Faucet Aerators
Decrease Service Hot Water Temperature (only possible for certain building types and only done in conjunction with flow reducers)

Lighting Retrofit Alternatives

PNL has developed the Lighting Technology Screening Matrix [LTSM] which provides an exhaustive screening approach for lighting technologies. All lighting technology configuration that are included in the LTSM (nearly 500) are also included in FEDS and can be existing or retrofit technologies. FEDS considers cross-technology substitution only where it is appropriate (e.g., HPS for fluorescent in warehouses). Additionally, FEDS only considers retrofits alternatives that provide at least 90% of the light output of the existing lighting technology configuration. All possible existing and retrofit lighting technology configuration are in Appendixes A and B.

Ventilation Retrofit Alternatives

Currently, ventilation retrofits are not available.

Plug-Load Alternatives

Currently, plug-load retrofits available

FEDS Level-2 Input File Structure

FEDS Level-2 Input File Structure

***** File #1 -- Installation Record *****

```

Begin Installation Level Section                                [BEGFLS]
This file was generated by FEDS Release: ??                    [GENSRC]
This file name: ????????.i??                                  [FILNAM]
Source file: ????????.i??                                     [SRCNAM]
Run year (cost data other than energy prices are
adjusted to this year).....[FLSYR]
                                                                [BFLSBK]
Installation Name: CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC [FACNAM]
Installation Location: CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC [FACLOC]
State in which installation is located
(2 letter abbreviation).....[ISTATE]
Weather station filename (see user's manual for weather
file names and locations): CCCCCCCCCCCCCC                  [WSFNAM]
Ground water temperature (deg F).....[GWT]

Energy consumption data time period:
Start date of continuous 12 month period:                    [BEGDT]
Month.....[BECDMN]
Year.....[BECDYR]
End date of continuous 12 month period:                      [ENDDT]
Month.....[EECDMN]
Year.....[EECDYR]

Energy consumption data:                                       [BEGECD]
Electricity (MWh).....[ECELEC]
Electricity peak demand (MW).....[ECPEAK]
Month in which peak occurred (e.g., Jan=1).....[PEAKMN]
Oil (gallons).....[ECOIL]
Natural Gas (therms).....[ECNGAS]
Coal (tons).....[ECCOAL]
Purchased Steam from Off-Site (MBtu).....[ECPSTM]
Purchased Hot Water from Off-Site (MBtu).....[ECPHW]
Other Fuels (MBtu).....[ECFUEL]

On-Site Energy Generation/Transformation:                    [BEGOSE]
District Steam (MBtu).....[EGDSTM]
District Hot Water (MBtu).....[EGDHW]
District Chilled Water (Ton-hours).....[EGDCW]
Electricity (MWh).....[EGELEC]
                                                                [ENDOSE]
                                                                [ENDECD]

```

Non-Electric Energy Price Data: (Note: A zero value [BEGNEP] indicates that a fuel is not available on the site, and that fuel will not be considered for fuel-switching retrofits--these values should be valid for the run year entered above.)

Oil (\$/gallon).....	[EPOIL]
Natural Gas (\$/therm).....	[EPNGAS]
Coal (\$/ton).....	[EPCOAL]
Purchased Steam (\$/MBtu).....	[EPPSTM]
Self-Generated Steam (\$/MBtu).....	[EPGSTM]
Purchased Hot Water (\$/MBtu).....	[EPPHW]
Self-Generated Hot Water (\$/MBtu).....	[EPGHW]
Other Fuels (\$/MBtu).....	[EPFUEL]
	[ENDNEP]

Marginal Electricity Price and Schedule Information: [BEGMEP]

Do the electricity rates vary by season?

(Y=yes; N=no).....[EPANS]
If yes: [EPYES]

Winter season begins on:

Month (e.g., 1=Jan).....[BWINMN]

Day.....[BWINDT]

Winter season ends on:

Month (e.g., 1=Jan).....[EWINMN]

Day.....[EWINDT]

[ENDEPY]

At your installation, do you have time-of-day rates, or do you pay the same price for energy and demand regardless of the time of day (flat rates)?

(T=time-of-day rates; F=flat rates).....[RTTYPE]

If you selected flat rates:

[RTFLAT]

Electric energy rate (cents/kWh).....[RTEER]

Electric demand rate (\$/kW).....[RTEDR]

If you selected time-of-day rates, please enter the rate schedule information for Winter and Summer in the sections below. If your rates do not vary between Winter and Summer, only enter data for the Winter section.

Winter Marginal Electricity Prices and Schedule:[BEGWEP]

(Note: All rate period hours should be entered as military time without a colon(:); for example, 2400 represents midnight. For a 24-hour rate period enter the same start and end times.)

Winter Weekday Rate Period 1: [WWR1]
Start time..... [BWWR1]
End time..... [EWR1]
Energy rate (cents/kWh)..... [WWR1ER]
Demand rate (\$/kW)..... [WWR1DR]
Winter Weekday Rate Period 2: [WWR2]
Start time..... [BWWR2]
End time..... [EWR2]
Energy rate (cents/kWh)..... [WWR2ER]
Demand rate (\$/kW)..... [WWR2DR]
Winter Weekday Rate Period 3: [WWR3]
Start time..... [BWWR3]
End time..... [EWR3]
Energy rate (cents/kWh)..... [WWR3ER]
Demand rate (\$/kW)..... [WWR3DR]
Winter Weekday Rate Period 4: [WWR4]
Start time..... [BWWR4]
End time..... [EWR4]
Energy rate (cents/kWh)..... [WWR4ER]
Demand rate (\$/kW)..... [WWR4DR]
Winter Weekday Rate Period 5: [WWR5]
Start time..... [BWWR5]
End time..... [EWR5]
Energy rate (cents/kWh)..... [WWR5ER]
Demand rate (\$/kW)..... [WWR5DR]

Winter Saturday Rate Period 1: [W6R1]
Start time..... [BW6R1]
End time..... [EW6R1]
Energy rate (cents/kWh)..... [W6R1ER]
Demand rate (\$/kW)..... [W6R1DR]
Winter Saturday Rate Period 2: [W6R2]
Start time..... [BW6R2]
End time..... [EW6R2]
Energy rate (cents/kWh)..... [W6R2ER]
Demand rate (\$/kW)..... [W6R2DR]
Winter Saturday Rate Period 3: [W6R3]
Start time..... [BW6R3]
End time..... [EW6R3]
Energy rate (cents/kWh)..... [W6R3ER]
Demand rate (\$/kW)..... [W6R3DR]

Winter Sunday Rate Period 1: [W7R1]
Start time..... [BW7R1]
End time..... [EW7R1]
Energy rate (cents/kWh)..... [W7R1ER]
Demand rate (\$/kW)..... [W7R1DR]

Winter Sunday Rate Period 2: [W7R2]
Start time..... [BW7R2]
End time..... [EW7R2]
Energy rate (cents/kWh)..... [W7R2ER]
Demand rate (\$/kW)..... [W7R2DR]
Winter Sunday Rate Period 3: [W7R3]
Start time..... [BW7R3]
End time..... [EW7R3]
Energy rate (cents/kWh)..... [W7R3ER]
Demand rate (\$/kW)..... [W7R3DR]
[ENDWEP]
Summer Marginal Electricity Prices and Schedule: [BEGSEP]
(Note: All rate period hours should be entered
as military time without a colon(:); for
example, 2400 represents midnight. For a 24-hour
rate period, enter the same start and end times.)

Summer Weekday Rate Period 1: [SWR1]
Start time..... [BSWR1]
End time..... [ESWR1]
Energy rate (cents/kWh)..... [SWR1ER]
Demand rate (\$/kW)..... [SWR1DR]
Summer Weekday Rate Period 2: [SWR2]
Start time..... [BWSR2]
End time..... [ESWR2]
Energy rate (cents/kWh)..... [SWR2ER]
Demand rate (\$/kW)..... [SWR2DR]
Summer Weekday Rate Period 3: [SWR3]
Start time..... [BSWR3]
End time..... [ESWR3]
Energy rate (cents/kWh)..... [SWR3ER]
Demand rate (\$/kW)..... [SWR3DR]
Summer Weekday Rate Period 4: [SWR4]
Start time..... [BSWR4]
End time..... [ESWR4]
Energy rate (cents/kWh)..... [SWR4ER]
Demand rate (\$/kW)..... [SWR4DR]
Summer Weekday Rate Period 5: [SWR5]
Start time..... [BSWR5]
End time..... [ESWR5]
Energy rate (cents/kWh)..... [SWR5ER]
Demand rate (\$/kW)..... [SWR5DR]

Summer Saturday Rate Period 1: [S6R1]
Start time..... [BS6R1]
End time..... [ES6R1]
Energy rate (cents/kWh)..... [S6R1ER]
Demand rate (\$/kW)..... [S6R1DR]

```
Summer Saturday Rate Period 2: [S6R2]
  Start time.....[BS6R2]
  End time.....[ES6R2]
  Energy rate (cents/kWh).....[S6R2ER]
  Demand rate ($/kW).....[S6R2DR]
Summer Saturday Rate Period 3: [S6R3]
  Start time.....[BS6R3]
  End time.....[ES6R3]
  Energy rate (cents/kWh).....[S6R3ER]
  Demand rate ($/kW).....[S6R3DR]

Summer Sunday Rate Period 1: [S7R1]
  Start time.....[BS7R1]
  End time.....[ES7R1]
  Energy rate (cents/kWh).....[S7R1ER]
  Demand rate ($/kW).....[S7R1DR]
Summer Sunday Rate Period 2: [S7R2]
  Start time.....[BS7R2]
  End time.....[ES7R2]
  Energy rate (cents/kWh).....[S7R2ER]
  Demand rate ($/kW).....[S7R2DR]
Summer Sunday Rate Period 3: [S7R3]
  Start time.....[BS7R3]
  End time.....[ES7R3]
  Energy rate (cents/kWh).....[S7R3ER]
  Demand rate ($/kW).....[S7R3DR]
[ENDSEP]

Does your electric rate billing structure for power
include a demand ratchet (Y=yes; N=no).....[DRANS]
If yes: [DRYES]
  Does the demand ratchet apply to the peak demand
  that occurs in the summer, winter, or all months?
  (S=summer; W=winter; A=all months).....[DRTIME]
  Enter the number of preceding months on which the
  demand ratchet is based.....[DRBASE]
  Enter the percentage of the peak demand in the
  preceding months used to calculate the minimum
  demand charge (%).....[DRPERC]
[ENDMEP]

Central Plant Information: [BEGCPI]
Central Steam Plants: [BEGCSP]
  Predominate fuel type used in central steam
  generation plants on your installation:
  (0=electric; 1=oil; 2=natural gas; 3=coal;
  8=other).....[CSPFTP]
[ENDCSP]
```

Central Hot Water Plants: [BEGCWP]

Predominate fuel type used in central hot water generation plants on your installation:

(0=electric; 1=oil; 2=natural gas; 3=coal; 8=other).....[CWPFTP]

[ENDCWP]

Central Chiller Plants: [BEGCCP]

Predominate fuel type used in central chiller plants on your installation: (0=electric; 1=oil; 2=natural

gas; 3=coal; 4=purchased steam; 5=self-generated steam; 6=purchased hot water; 7=self-generated hot water; 8=other).....[CCPFTP]

[ENDCCP]

[ENDCPI]

Financial Parameter Data: [BEGFPD]

Do you want to use the current federal government specified real discount rate? : (??.% in 199?) [DISRTE]

Y=yes; N=no).....[DISANS]

If no, enter your real discount rate (%).....[DISVAL]

Do you want to use the DOE/EIA energy escalation rates

for your area, for all fuel types? (Y=yes; N=no)..[ESANS]

If no, enter your escalation rates for the fuel types for which you do not want to use the DOE/EIA rates; enter EIA when you want to use the

DOE/EIA rates: [ESNO]

Electricity (%).....[ESELE]

Oil (%).....[ESOIL]

Natural Gas (%).....[ESNGAS]

Coal (%).....[ESCOAL]

Purchased Steam (%).....[ESPSTM]

Purchased Hot Water (%).....[ESPHW]

Other fuels (%).....[ESFUEL]

[ENDFPD]

Financial Screening Data: [BEGFSD]

Do you want FEDS to screen out projects that are life-cycle cost effective but do not meet a maximum simple payback or a minimum savings-to-investment ratio (SIR)? (Y=yes; N=no).....[FSCSIR]

If yes, answer ONE of the following:

Use the Energy Conservation Investment Program (ECIP) values of maximum simple payback and minimum savings-to-investment ratio.

(?? year, ???) (Y=yes; N=no).....[USECIP]

OR

Use user supplied maximum simple payback and minimum savings-to-investment ratio.

Maximum simple payback.....[MAXSPB]
Minimum savings-to-investment ratio.....[MINSIR]
[ENDFSD]
[BEGUCS]
Utility Cost Sharing:
Will your electric utility pay for a portion of the
energy efficiency improvements at your installation
through cost sharing, rebates, etc?
(Y=yes; N=no).....[EUANS]
If yes, enter the average percentage of the [EUYES]
total installed cost that your utility will
pay for efficiency improvements to the
following end uses:
Lights (%).....[EULT]
Heating (%).....[EUHT]
Cooling (%).....[EUCL]
Ventilation (%).....[EUVN]
Water Heating (%).....[EUWH]
Building Envelope Improvements (%).....[EUBEI]
[ENDEUY]
Will your natural gas utility pay for a portion of
the energy efficiency improvements at your
installation through cost sharing, rebates, etc?
(Y=yes; N=no).....[GUANS]
If yes, enter the average percentage of the [GUYES]
total installed cost that your utility will
pay for efficiency improvements to the
following end uses:
Heating (%).....[GUHT]
Cooling (%).....[GUCL]
Ventilation (%).....[GUVN]
Water Heating (%).....[GUWH]
Building Envelope Improvements (%).....[GUBET]
[ENDUCS]
End Installation Level Section [ENDFLS]

Use area 1: [BEGUA1]
 Use area type class and category: (Note: typically,
 the use area type class and category will be the
 same as the building type class and category for
 single use buildings.)
 Use area type class (C=Civilian; M=Military).....[UA1CLS]
 Use area type category (codes are in user's
 guide).....[UA1CAT]
 Percentage of building floor area in use area 1 (100%
 for single use buildings).....[UA1PAR]

Operating/occupancy hours for use area 1: (Note:
All operating/occupancy hours should be entered as
military time without a colon (:); for example,
2400 represents midnight. For continuous occupancy,
enter the same start and end times. For unoccupied
day types, enter 0 for the start and end times; also
see below for seasonally occupied buildings.)

Weekday operating hours: [UA1WOH]
Start [BUA1WH]
End [EUA1WH]
Saturday operating hours: [UA16OH]
Start [BUA16H]
End [EUA16H]
Sunday operating hours: [UA17OH]
Start [BUA17H]
End [EUA17H]

Number of occupants in use area 1 during the occupied
months:..... [UA1OCC]
Occupied periods..... [UA1OP]
Unoccupied periods..... [UA1UOP]
Sensible heat gain per occupant in use area 1..... [UA1SHG]
Sensible heat gain units (B=Btu/hr; W=watts)..... [UA1SHU]
Latent heat gain per occupant in use area 1..... [UA1LHG]
Latent heat gain units (B=Btu/hr; W=watts)..... [UA1LHU]
Seasonal operation for use area 1: [UA1SO]
Seasonal operation/occupancy schedule (by month):
January (0=occupied; U=unoccupied)..... [UA1SO1]
February (0=occupied; U=unoccupied)..... [UA1SO2]
March (0=occupied; U=unoccupied)..... [UA1SO3]
April (0=occupied; U=unoccupied)..... [UA1SO4]
May (0=occupied; U=unoccupied)..... [UA1SO5]
June (0=occupied; U=unoccupied)..... [UA1SO6]
July (0=occupied; U=unoccupied)..... [UA1SO7]
August (0=occupied; U=unoccupied)..... [UA1SO8]
September (0=occupied; U=unoccupied)..... [UA1SO9]
October (0=occupied; U=unoccupied)..... [UA1SOA]
November (0=occupied; U=unoccupied)..... [UA1SOB]
December (0=occupied; U=unoccupied)..... [UA1SOC]
[ENDUA1]

Use area 2: [BEGUA2]
Use area type class and category:
Use area type class (C=Civilian; M=Military)..... [UA2CLS]
Use area type category (codes are in user's
guide)..... [UA2CAT]
Percentage of building floor area in use area 2 (NA
for single use buildings)..... [UA2PAR]
Operating/occupancy hours for use area 2: (Note:

All operating/occupancy hours should be entered as military time without a colon (:); for example, 2400 represents midnight. For continuous occupancy, enter the same start and end times. For unoccupied day types, enter 0 for the start and end times; also see below for seasonally occupied buildings.)

Weekday operating hours: [UA2WOH]

Start [BUA2WH]

End [EUA2WH]

Saturday operating hours: [UA26OH]

Start [BUA26H]

End [EUA26H]

Sunday operating hours: [UA27OH]

Start [BUA27H]

End [EUA27H]

Number of occupants in use area 2 during the occupied months..... [UA2OCC]

Occupied periods..... [UA2OP]

Unoccupied periods..... [UA2UOP]

Sensible heat gain per occupant in use area 2..... [UA2SHG]

Sensible heat gain units (B=Btu/hr; W=watts)..... [UA2SHU]

Latent heat gain per occupant in use area 2..... [UA2LHG]

Latent heat gain units (B=Btu/hr; W=watts)..... [UA2LHU]

Seasonal operation for use area 2: [UA2SO]

Seasonal operation/occupancy schedule (by month):

January (O=occupied; U=unoccupied)..... [UA2S01]

February (O=occupied; U=unoccupied)..... [UA2S02]

March (O=occupied; U=unoccupied)..... [UA2S03]

April (O=occupied; U=unoccupied)..... [UA2S04]

May (O=occupied; U=unoccupied)..... [UA2S05]

June (O=occupied; U=unoccupied)..... [UA2S06]

July (O=occupied; U=unoccupied)..... [UA2S07]

August (O=occupied; U=unoccupied)..... [UA2S08]

September (O=occupied; U=unoccupied)..... [UA2S09]

October (O=occupied; U=unoccupied)..... [UA2SOA]

November (O=occupied; U=unoccupied)..... [UA2SOB]

December (O=occupied; U=unoccupied)..... [UA2SOC]

[ENDUA2]

Is this a dual use area building with a separate HVAC system for each use area? (Y=yes; N=no)..... [DUAANS]

Buildings with a common HVAC system, or for use area 1 [BEGU1C]
of dual use buildings with separate HVAC systems:

Number of HVAC zones (1=single zone; 4=four perimeter zones; 5=four perimeter zones and a core zone)..... [U1HVZN]

Perimeter zone depth (feet; NA for 1 and 4 zone buildings)..... [U1ZDEP]

Number of floors (above and below grade)..... [U1FLN]

Percentage of gross wall area that is glass area..[U1PGW]
Floor-to-ceiling height (feet).....[U1FCHT]
Floor-to-floor height (feet; greater than
ceiling height).....[U1FFHT]
[ENDU1C]

Use area 2 of dual use buildings with separate HVAC systems: [BEGU2S]

Separating plane orientation (N=facing north/south;
E=facing east/west; H=facing horizontally. NOTE:
For N, FEDS assumes that use area 2 is the southern
end of the building. For E, FEDS assumes that use
area 2 is the eastern end of the building. For H,
FEDS assumes that use area 2 is the lower part of
the building).....[U2SPO]
Number of HVAC zones (1=single zone; 4=four perimeter
zones; 5=four perimeter zones and a core zone)..[U2HVZN]
Perimeter zone depth (feet; NA for 1 and 4 zone
buildings).....[U2ZDEP]
Number of floors (above and below grade).....[U2FLN]
Percentage of gross wall area that is glass area..[U2PGW]
Floor-to-ceiling height (feet).....[U2FCHT]
Floor-to-floor height (feet; greater than
ceiling height).....[U2FFHT]
[ENDU2S]

@@Begin Building Envelope Section [BEGBE]

Envelope information for buildings with a common HVAC system, or for use area 1 of dual use buildings with separate HVAC systems: [BEGBEC]

Use Area 1 Roofs: [BEGU1R]
Roof construction type (0=built-up; 1=pre-fabricated
metal panels; 2=shingles or shakes).....[R1TYPE]
If roof construction type is built-up roof, enter
roof deck type (W=wood; C=concrete; M=metal)....[R1BUID]
Total U-value for this roof (Btu/hr-sqft-deg F)...[R1TUV]
Is the roof insulated? (Y=yes; N=no).....[R1IANS]
If yes: [R1IYES]
Insulation R-value (hr-sqft-deg F/Btu).....[R1IRV]
Insulation thickness (inches).....[R1IT]
Does the building have a suspended ceiling?
(Y=yes; N=no).....[R1ISC]
Space available for additional internal
insulation (inches).....[R1AII]
[ENDU1R]

Use Area 1 Walls: [BEGU1W]
Wall construction type (0=wood siding on wood frame;
1=masonry facade on wood frame; 2=masonry facade
on masonry frame; 3=curtain wall; 4=pre-fabricated
metal panels).....[W1TYPE]
Total U-value for this wall (Btu/hr-sqft-deg F)...[W1TUV]
Is the wall insulated? (Y=yes; N=no).....[W1IANS]
If yes: [W1IYES]
Insulation R-value (hr-sqft-deg F/Btu).....[W1IRV]
Insulation thickness (inches).....[W1IT]
Space available for additional internal
insulation (inches).....[W1AII]
[ENDU1W]
Use Area 1 Windows: [BEGU1D]
Total window U-value (Btu/hr-sqft-deg F).....[D1TWUV]
-Number of glazings (1, 2 or 3).....[D1NUMG]
-Window frame type (W=wood or vinyl; M=metal;
T=metal with thermal breaks).....[D1FMTP]
Shading coefficient for use area 1 windows
(solar transmission fraction).....[D1SC]
-Are windows shaded? (Y=yes; N=no).....[D1SHD]
-Are windows tinted? (Y=yes; N=no).....[D1TIN]
-Do windows have reflective film? (Y=yes; N=no).....[D1RFLM]
[ENDU1D]
Use Area 1 Floors: [BEGFLR]
Floor type (0=slab on grade; 1=crawl space).....[FLRTYP]
For slab on grade floors:
Is the slab perimeter insulated? (Y=yes; N=no).....[FLRPSI]
For floors with crawl spaces:
Total U-value for the floor (Btu/hr-sqft-deg F).....[FLRUVL]
Is the floor carpeted? (Y=yes; N=no).....[FLRCPT]
Is the floor insulated? (Y=yes; N=no).....[FLRINS]
If yes:
Insulation R-value (hr-sqft-deg F/Btu).....[FLRRVL]
Insulation thickness (inches).....[FLRITH]
Space available for additional internal
insulation (inches).....[FLRSPA]
[ENDFLR]
[ENDBEC]
Envelope information for use area 2 of dual use [BEGBES]
buildings with separate HVAC systems:
Use Area 2 Roofs: [BEGU2R]
Roof construction type (0=built-up; 1=pre-fabricated
metal panels; 2=shingles or shakes).....[R2TYPE]
If roof construction type is built-up roof, enter
roof deck type (W=wood; C=concrete; M=metal)....[R2BUID]

Total U-value for this roof (Btu/hr-sqft-deg F)...[R2TUV]
Is the roof insulated? (Y=yes; N=no).....[R2IANS]
If yes: [R2IYES]
 Insulation R-value (hr-sqft-deg F/Btu).....[R2IRV]
 Insulation thickness (inches).....[R2IT]
Does the building have a suspended ceiling?
 (Y=yes; N=no).....[R2SC]
Space available for additional internal
 insulation (inches).....[R2AII]
[ENDU2R]
Use Area 2 Walls: [BEGU2W]
Wall construction type (0=wood siding on wood frame;
 1=masonry facade on wood frame; 2=masonry facade
 on masonry frame; 3=curtain wall; 4=pre-fabricated
 metal panels).....[W2TYPE]
Total U-value for this wall (Btu/hr-sqft-deg F)...[W2TUV]
Is the wall insulated? (Y=yes; N=no).....[W2IANS]
If yes: [W2IYES]
 Insulation R-value (hr-sqft-deg F/Btu).....[W2IRV]
 Insulation thickness (inches).....[W2IT]
Space available for additional internal
 insulation (inches).....[W2AII]
[ENDU2W]
Use Area 2 Windows: [BEGU2D]
Total window U-value (Btu/hr-sqft-deg F).....[D2TWUV]
-Number of glazings (1, 2 or 3).....[D2NUMG]
-Window frame type (W=wood or vinyl; M=metal;
 T=metal with thermal breaks).....[D2FMTP]
Shading coefficient for use area 1 windows
 (solar transmission fraction).....[D2SC]
-Are windows shaded? (Y=yes; N=no).....[D2SHD]
-Are windows tinted? (Y=yes; N=no).....[D2TIN]
-Do windows have reflective film? (Y=yes; N=no). [D2RFLM]
[ENDU2D]

```
Use Area 2 Floors: [BEGFL2]
Floor type (0=slab on grade; 1=crawl space).....[FL2TYP]
For slab on grade floors:
  Is the slab perimeter insulated? (Y=yes; N=no)..[FL2PSI]
For floors with crawlspaces:
  Total U-value for the floor (Btu/hr-sqft-deg F).[FL2UVL]
  Is the floor carpeted? (Y=yes; N=no).....[FL2CPT]
  Is the floor insulated? (Y=yes; N=no).....[FL2INS]
If yes:
  Insulation R-value (hr-sqft-deg F/Btu).....[FL2RVL]
  Insulation thickness (inches).....[FL2ITH]
Space available for additional internal
  insulation (inches).....[FL2SPA]
                                [ENDFL2]
                                [ENDBES]

&&End Building Envelope Section [ENDBE]

@@Begin Lighting End Use Section [BEGLEU]
  Number of Lighting Technology Configuration Records for
  this building set.....[LTCRN]

##Begin Lighting Technology Configuration Record [BGLTLC]
  Technology configuration (see user's manual for
  code numbers).....[TCID]
  Technology mounting method (R=recessed; F=flush
  mounted; P=pendant).....[TMMID]
  Use area served by this technology configuration....[TCUA]
  Percentage of the lighting heat to the
  conditioned space.....[PLH]
  Fixtures per sqft (average for use area).....[FXPSF]
  Percentage of use area illumination provided by this
  technology configuration (or percent of use area
  floor area served; will be ignored if Fixture per
  sqft has been changed).....[PUAI]
  Utilization factors (during seasonally occupied months):
    Occupied periods (%).....[UFOP]
    Unoccupied periods (%).....[UFUOP]
##End Lighting Technology Configuration Record [ENDLTC]

&&End Lighting End Use Section [ENDLEU]
```

@@Begin Heating End Use Section [BEGHEU]
Control/operational information for buildings with a [BEGHUC]
common HVAC system, or for use area 1 of dual use
buildings with separate HVAC systems:
Heating supply temperature (deg F).....[H1HST]
Occupied season heating thermostat setting (deg F):
Occupied periods.....[H1OHTS]
Unoccupied periods.....[H1UHTS]
Unoccupied season heating thermostat
set-point (deg F).....[UA1UHT]
Thermostat dead band (deg F).....[H1TDB]
Portion of unheated buildings in this set (common
HVAC systems), or portion of dual use buildings
with separate HVAC with no heating in use area 1:
Answer ONE of the following:
Floor area of unheated buildings or floor area
of buildings with unheated use area 1 (dual
use buildings with separate HVAC only).....[H1FAUB]
OR
Number of unheated buildings or number of
buildings with unheated use area 1 (dual use
buildings with separate HVAC only).....[H1NUHB]
OR
Percent of unheated buildings or percent of
buildings with unheated use area 1 (dual use
buildings with separate HVAC only).....[H1PUHB]
Number of heating types in this use area
(unique fuel/equipment combinations).....[H1HTN]
[ENDHUC]
##Begin Use Area 1 Heating Type Record [BEG1HR]
Heating technology information for equipment serving
buildings with common HVAC systems, or for use area
1 of dual use buildings with separate HVAC systems:
Answer ONE of the following:
Floor area of buildings served by this heating type
or floor area of buildings with use area 1 served
by this heating type (dual use buildings with
separate HVAC only) (square feet).....[H1FLAR]
OR
Number of buildings served by this heating type
or number of buildings with use area 1 served


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    by this heating type (dual use buildings with
    separate HVAC only).....[H1BDGN]
OR
    Percent of buildings served by this heating type
    or percent of buildings with use area 1 served
    by this heating type (dual use buildings with
    separate HVAC only).....[H1BDGP]

Fuel type: (0=electric; 1=oil; 2=natural gas; 3=coal;
4=purchased steam; 5=self-generated steam; 6=purchased
hot water; 7=self-generated hot water; 8=other)...[H1FTID]

Equipment type (0=Electric resistance baseboard; 1=forced
air furnace; 2=air source heat pump; 3=water source
heat pump; 4=radiator using central steam or hot water;
5=fan coil unit using central steam or hot water;
6=air handling unit using central steam or hot water;
7=radiator using single-building boiler;
8=fan coil unit using single-building boiler;
9=air handling unit using single-building boiler).[H1ETID]

Equipment output capacity (total per building).....[H1EOC]
Capacity units (K=kW; M=MBtu/hr; T=tons).....[H1EOCU]
Number of pieces of equipment (per building).....[H1ENUM]
Enter ONE of the following:
    Nominal efficiency (%).....[H1EEFF]
OR
    Nominal COP (for heat pumps).....[H1NCOP]
    Equipment vintage (year of installation).....[H1EQYR]
##End Heating Use Area 1 Type Record                [END1HR]

Control/operational information for use area 2 of dual[BEGHUS]
use buildings with separate HVAC systems:
    Heating supply temperature (deg F).....[H2HST]
    Occupied season heating thermostat setting (deg F):
    Occupied periods.....[H2OHTS]
    Unoccupied periods.....[H2UHTS]
    Unoccupied season heating thermostat
    set-point (deg F).....[UA2UHT]
    Thermostat dead band (deg F).....[H2TDB]
    Portion of dual use buildings with separate HVAC with
    no heating in use area 2:
    Answer ONE of the following:
        Floor area of buildings with unheated use
        area 2.....[H2FAUB]
OR

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Number of buildings with unheated use area 2..[H2NUHB]
OR
Percent of buildings with unheated use area 2.[H2PUHB]
Number of heating types in this use area
(unique fuel/equipment combinations).....[H2HTN]
[ENDHUS]

##Begin Use Area 2 Heating Type Record [BEG2HR]
Heating technology information for equipment serving use
area 2 of dual use buildings with separate HVAC systems:
Answer ONE of the following:
Floor area of buildings with use area 2 served by this
heating type (square feet).....[H2FLAR]
OR
Number of buildings with use area 2 served by this
heating type.....[H2BDGN]
OR
Percent of buildings with use area 2 served by this
heating type.....[H2BDGP]

Fuel type: (0=electric; 1=oil; 2=natural gas; 3=coal;
4=purchased steam; 5=self-generated steam; 6=purchased
hot water; 7=self-generated hot water; 8=other)...[H2FTID]

Equipment type (0=Electric resistance baseboard; 1=forced
air furnace; 2=air source heat pump; 3=water source
heat pump; 4=radiator using central steam or hot water;
5=fan coil unit using central steam or hot water;
6=air handling unit using central steam or hot water;
7=radiator using single-building boiler;
8=fan coil unit using single-building boiler;
9=air handling unit using single-building boiler).[H2ETID]
Equipment output capacity (total per building).....[H2EOC]
Capacity units (K=kW; M=MBtu/hr; T=tons).....[H2EOCU]
Number of pieces of equipment (per building).....[H2ENUM]
Enter ONE of the following:
Nominal efficiency (%).....[H2EEFF]
OR
Nominal COP (for heat pumps).....[H2NCOP]
Equipment vintage (year of installation).....[H2EQYR]
##End Heating Use Area 2 Type Record [END2HR]

&&End Heating End Use Section [ENDHEU]

@@Begin Cooling End Use Section [BEGCEU]
Control/operational information for buildings with a [BEGCUC]
common HVAC system, or for use area 1 of dual use
building with separate HVAC systems:
Cooling supply temperature (deg F).....[C1CST]
Occupied season cooling thermostat setting (deg F):
Occupied periods.....[C1CTSO]
Unoccupied periods.....[C1CTSU]
Thermostat dead band (deg F).....[C1TDB]
Portion of uncooled buildings in this set (common
HVAC systems), or portion of dual use buildings
with separate HVAC with no cooling in use area 1:
Answer ONE of the following:
Floor area of uncooled buildings or floor area
of buildings with uncooled use area 1 (dual
use buildings with separate HVAC only).....[C1FAUB]
OR
Number of uncooled buildings or number of
buildings with uncooled use area 1 (dual use
buildings with separate HVAC only).....[C1NUHB]
OR
Percent of uncooled buildings or percent of
buildings with uncooled use area 1 (dual use
buildings with separate HVAC only).....[C1PUHB]

Number of cooling types in this use area
(fuel/equipment combination).....[C1CTN]
[ENDCUC]

##Begin Use Area 1 Cooling Type Record [BEG1CR]
Cooling technology information for equipment serving buildings
with common HVAC systems, or for use area 1 of dual use
buildings with separate HVAC systems:
Answer ONE of the following (NOTE: if this is a Cooling
Type Record for heat pumps, the value entered below
must match the corresponding value entered in the
corresponding Heating Type Record):
Floor area of buildings served by this cooling type
or floor area of buildings with use area 1 served
by this cooling type (dual use buildings with separate
HVAC only)(square feet).....[C1FLAR]
OR
Number of buildings served by this cooling type
or percent of buildings with use area 1 served
by this cooling type (dual use buildings with
separate HVAC only).....[C1BDGN]

OR

Percent of buildings served by this cooling type
or percent of buildings with use area 1 served
by this cooling type (dual use buildings with
separate HVAC only).....[C1BDGP]

Fuel type: (0=electric; 1=oil; 2=natural gas; 3=coal;
4=purchased steam; 5=self-generated steam; 6=purchased
hot water; 7=self-generated hot water; 8=other;
9=central chilled water).....[C1FTID]

Equipment type (0=evaporative cooler; 1=window/through
wall AC units; 2=air source heat pump; 3=water source
heat pump; 4=rooftop packaged unit; 5=fan coil unit using
single-building conventional chiller; 6=air handling unit
using single-building conventional chiller; 7=fan coil
unit using single-building absorption chiller; 8=air
handling unit using single-building absorption chiller;
9=fan coil unit using central chilled water; 10=air
handling unit using central chilled water).....[C1EQID]

Equipment output capacity (total per building).....[C1EOC]
Capacity units (K=kW; M=MBtu/hr; T=tons).....[C1EOCU]
Number of pieces of equipment (per building).....[C1ENUM]
Nominal COP.....[C1ECOP]
Equipment vintage (year of installation).....[C1EQYR]
##End Cooling Use Area 1 Type Record [END1CR]

Control/operational information for use area 2 of dual[BEGCUS]
use buildings with separate HVAC systems:

Cooling supply temperature (deg F).....[C2CST]
Occupied season cooling thermostat setting (deg F):
Occupied periods.....[C2CTS0]
Unoccupied.....[C2CTSU]
Thermostat dead band (deg F).....[C2TDB]
Portion of dual use buildings with separate HVAC with
no cooling in use area 2:

Answer ONE of the following:

Floor area of buildings with uncooled use
area 2.....[C2FAUB]

OR

Number of buildings with uncooled use area 2..[C2NUHB]

OR

Percent of buildings with uncooled use area 2.[C2PUHB]

Number of cooling types in this use area
(fuel/equipment combination).....[C2CTN]
[ENDCUS]

##Begin Use Area 2 Cooling Type Record [BEG2CR]
Cooling technology information for equipment serving use
area 2 of dual use buildings with separate HVAC systems:
Answer ONE of the following (NOTE: if this is a Cooling
Type Record for heat pumps, the value entered below
must match the corresponding value entered in the
corresponding Heating Type Record):
Floor area of buildings with use area 2 served by this
cooling type (square feet).....[C2FLAR]
OR
Number of buildings with use area 2 served by this
cooling type.....[C2BDGN]
OR
Percent of buildings with use area 2 served by this
cooling type.....[C2BDGP]

Fuel type: (0=electric; 1=oil; 2=natural gas; 3=coal;
4=purchased steam; 5=self-generated steam; 6=purchased
hot water; 7=self-generated hot water; 8=other;
9=central chilled water).....[C2FTID]

Equipment type (0=evaporative cooler; 1=window/through
wall AC units; 2=air source heat pump; 3=water source
heat pump; 4=rooftop packaged unit; 5=fan coil unit using
single-building conventional chiller; 6=air handling unit
using single-building conventional chiller; 7=fan coil
unit using single-building absorption chiller; 8=air
handling unit using single-building absorption chiller;
9=fan coil unit using central chilled water; 10=air
handling unit using central chilled water).....[C2EQID]

Equipment output capacity (total per building).....[C2EOC]
Capacity units (K=kW; M=MBtu/hr; T=tons).....[C2EOCU]
Number of pieces of equipment (per building).....[C2ENUM]
Nominal COP.....[C2ECOP]
Equipment vintage (year of installation).....[C2EQYR]
##End Cooling Use Area 2 Type Record [END2CR]

&&End Cooling End Use Section [ENDCEU]

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@@Begin Ventilation End Use Section [BEGVEU]
Ventilation system information for buildings with a [BEGVUC]
common HVAC system, or for use area 1 of dual use
buildings with separate HVAC systems:
Ventilation control mode (0=cycle with heating and
cooling system; 1=constant operation; 2=constant
operation during occupied hours, cycle during
unoccupied hours; 3=constant during occupied
hours, off during unoccupied hours; 4=no mechanical
ventilation).....[V1VCM]
Design supply air (cu. ft. per min.).....[V1TSA]
Design outdoor ventilation air (do not include
infiltration here).....[V1MOVA]
Outdoor ventilation air units (C=cu. ft/min; A=air
changes/hour; P=percent of total supply air)....[V1OVAU]
Infiltration rate.....[V1IR]
Infiltration rate units (C=cu. ft./min.; A=air
changes/hour; P=percent of total supply air)....[V1IRU]
Fan motor location (A=in the air stream; N=outside
of the air stream and the conditioned space).....[V1FML]
Total fan motor capacity .....[V1TFMC]
Capacity units (H=horsepower; K=kW).....[V1FCU]
Fan motor efficiency (%).....[V1FME]
Fan efficiency (%).....[V1FE]
Ventilation system static pressure (in. of water)...[V1VSSP]
[ENDVUC]

Ventilation system information for use area 2 of dual [BEGVUS]
use buildings with separate HVAC systems:
Ventilation control mode (0=cycle with heating and
cooling system; 1=constant operation; 2=constant
operation during occupied hours, cycle during
unoccupied hours; 3=constant during occupied hours
off during unoccupied hours; 4=no mechanical
ventilation).....[V2VCM]
Design supply air (cu. ft. per min.).....[V2TSA]
Design outdoor ventilation air (do not include
infiltration here).....[V2MOVA]
Outdoor ventilation air units (C=cu. ft/min; A=air
changes/hour; P=percent of total supply air)....[V2OVAU]
Infiltration rate.....[V2IR]
Infiltration rate units (C=cu. ft./min.; A=air
changes/hour; P=percent of total supply air)....[V2IRU]
Fan motor location (A=in the air stream; N=outside
of the air stream and the conditioned space).....[V2FML]
Total fan motor capacity .....[V2TFMC]
Capacity units (H=horsepower; K=kW).....[V2FCU]

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Fan motor efficiency (%).....[V2FME]
Fan efficiency (%).....[V2FE]
Ventilation system static pressure (in. of water)...[V2FSSP]
                                                    [ENDVUS]
&&End Ventilation End Use Section                    [ENDVEU]

@@Begin Service Hot Water End Use Section            [BEGWEU]
Hot water consumption information for use area 1      [BEGWU1]
(Average per building for buildings with hot water)
Total daily hot water use:
  Weekdays (gallons/day).....[W1HWUW]
  Saturdays (gallons/day).....[W1HWU6]
  Sundays (gallons/day).....[W1HWU7]
Number of faucets in this use area.....[W1NUMF]
Percentage of faucets with aerators in this use
area.....[W1PFWA]
Number of showerheads in this use area.....[W1NUMS]
Percentage of low flow showerheads in this use area.[W1PLFS]
                                                    [ENDWU1]
Hot water consumption information for use area 2:    [BEGWU2]
(Average per building for buildings with hot water)
Total daily hot water use:
  Weekdays (gallons/day).....[W2HWUW]
  Saturdays (gallons/day).....[W2HWU6]
  Sundays (gallons/day).....[W2HWU7]
Number of faucets in this use area.....[W2NUMF]
Percentage of faucets with aerators in this use
area.....[W2PFWA]
Number of showerheads in this use area.....[W2NUMS]
Percentage of low flow showerheads in this use area.[W2PLFS]
                                                    [ENDWU2]

Portion of buildings in this set with no water heating:
For all buildings answer ONE of the following:
  Floor area of buildings with no water heating
  or floor area of buildings with no water heating
  in use area 1 (dual use buildings with separate
  HVAC only).....[W1FLAR]
OR
  Number of buildings with no water heating
  or number of buildings with no water heating
  in use area 1 (dual use buildings with separate
  HVAC only).....[W1BDGN]
OR
  Percentage of buildings with no water heating
  or percentage of buildings with no water heating
  in use area 1 (dual use buildings with separate
  HVAC only).....[W1BDGP]

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For dual use buildings with separate HVAC only, answer
ONE of the following:

Floor area of buildings with no water heating
in use area 2.....[W2FLAR]

OR

Number of buildings with no water heating
in use area 2.....[W2BDGN]

OR

Percentage of buildings with no water heating
in use area 2.....[W2BDGP]

Number of SHW system records in this building set.....[HWREC]

##Begin Service Hot Water System Record [BEGHWR]

Answer ONE of the following:

Floor area of buildings served by this system type
(square feet).....[HWFLAR]

OR

Number of buildings served by this system type....[HWBDGN]

OR

Percent of buildings served by this system type...[HWBDGP]

Fuel type: (0=electric; 1=oil; 2=natural gas; 3=coal;

4=purchased steam; 5=self-generated steam;

6=purchased hot water; 7=self-generated hot water;

8=other).....[WFTID]

Service hot water supply temperature (deg F).....[WSHWST]

Service hot water system type

(D=distributed; L=loop).....[WHWST]

Use area served by this system type (1 for single
use buildings; 1 or 2 for distributed hot water
systems in dual use buildings, common or separate
HVAC; 1 or 2 for loop systems in dual use
buildings with separate HVAC; NA for loop systems
in dual use building with common HVAC.....[WUAID]

For distributed system types:

Do the hot water tanks have electronic pilots?

(Y=yes; N=no).....[WDTKEP]

Average vintage (year of installation) of the service

hot water tanks.....[WDTKYR]

Water heater conversion efficiency (%).....[WDWHCE]

Service hot water tank insulation R-value

(hr-sqft-deg F/Btu).....[WDTKRV]

Service hot water tank insulation thickness

(inches).....[WDTKIT]


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Total hot water storage capacity per building
(gallons).....[WDCAP]
Do the tanks have external insulating wraps?
(Y=yes; N=no).....[WDEIW]
If yes: [WDEIOK]
    Tank wrap insulation thickness (inches).....[WDTKWT]
    Tank wrap R-value (hr-sqft-deg F/Btu).....[WDWRV]
Do the tanks have insulating bottom boards?
(Y=yes; N=no).....[WDIBB]
Do the tanks have heat traps? (Y=yes; N=no).....[WDTKHT]
Are the pipes insulated near the tanks?
(Y=yes; N=no).....[WPINT]

For loop system types:
Number of storage tanks (per building).....[WLNTK]
Average capacity per tank (gallons).....[WLTKCP]
Storage tank insulation R-value
(hr-sqft-deg F/Btu).....[WLTKRV]
Storage tank insulation thickness (inches).....[WLTKIT]
For all fuel types except steam (self-generated or
purchased) and hot water (self-generated or purchased):
    Boiler output capacity (building total, per
    building).....[WLBOC]
    Capacity units (K=kW; M=MBtu/hr; T=Tons).....[WLBOCU]
    Boiler efficiency (%).....[WLBE]
    Boiler vintage (year of installation).....[WLBYR]
For self-generated or purchased steam or self-generated
or purchased hot water fuel types:
    Heat exchanger output capacity (building total,
    per building).....[WHEOC]
    Capacity units (K=kW; M=MBtu/hr; T=Tons).....[WHEOCU]
##End Service Hot Water System Record [ENDHWR]

&&End Service Hot Water End Use Section [ENDWEU]

@@Begin Miscellaneous Equipment End Use Section [BEGMEE]
This section contains information about miscellaneous
energy using equipment, such as cooking equipment,
computers or other office equipment, refrigeration
equipment, etc.

Number of Miscellaneous Equipment Type Records for this
building set.....[METNUM]

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!!End Building [ENDBLG]

FEDS Level-1 Error Messages

The FEDS software will cease to function and will display an error message whenever (1) the user provides inputs that are incompatible with the inputs expected by the software, (2) when the user's platform configuration is incompatible with software requirements (e.g. not enough memory or disk space or the presence of incompatible memory-resident software), or (3) as a result of a FEDS coding error.

The first case will typically occur when the user is entering information into the FEDS user interface program. The user will be notified of the entry error by a pop-up dialog box on the FEDS screen. The user needs to re-enter appropriate information in the appropriate format. The user can request an explanation of the information required by the program by pressing the "F1" key when the cursor is in the box requesting the information. The help messages provided by the program are listed in Appendix E of this document.

The second type of error messages indicates a platform configuration problem, and can occur either when the user is entering data directly into the FEDS user interface program, or when the user is running the FEDS model. If the error occurs when the user is running the FEDS model, the error message will appear at the DOS prompt (FEDS switches back to DOS when running the FEDS model). The user will be notified of a problem within the FEDS user interface if the problem occurs when the user is entering information into the FEDS user interface program. When an error indicating a platform configuration problem appears the user needs to quit the program and either move to another computer with adequate memory and disk storage, or else free up memory and/or disk storage on the same machine. Oftentimes unknown to the user, he/she may have memory resident programs present on the computer which either use up too much memory or somehow interfere with FEDS execution.

The third type of errors occur when the FEDS software model is run and may indicate an error in the FEDS software. Despite extensive testing of the FEDS software, internal coding errors may still exist. FEDS internal errors should be reported to FEDS support staff for prompt resolution. Error messages resulting from running the FEDS model will appear at the DOS prompt. If an error occurs when running the FEDS model, an error message specific to the problem will appear at the DOS prompt followed by a more general error message indicating the software module in which the error occurred. Please note this information when reporting an error.

Following is a brief description of each class of error message that may be encountered from within FEDS:

Error opening file (file not found is specified)

The FEDS model can not find the specified file. If this is an input file you need to specify it correctly. If it is a program file then the FEDS software may need to be re-installed.

Error opening file (error-specific message follows)

If your CONFIG.SYS has less than 50 files it needs to be changed and you need to reboot your computer.

Out of Memory routine: (error-specific message follows)

FEDS model (FEDSCALC) has run out of memory. Your computer has insufficient memory. Please see Section 1.2.1 for platform requirements.

Internal Error routine: (error-specific message follows)

FEDS model (FEDSCALC) error messages which can result from a missing file, a corrupted file, insufficient memory, or a bug in the FEDSCALC program. If reinstalling MODEL.EXE does not correct the problem, please report it to the FEDS support staff for resolution.

INTRN (error-specific message follows)

FEDS user interface error messages which can result from either a missing file, a corrupted file, insufficient memory, or a bug in the FEDS program. If reinstalling UI.EXE does not correct the problem, please report it to the FEDS support staff for resolution.

Mn Sys Err (error-specific message follows)

A user interface error message that may be encountered from the user interface. This results from either insufficient disk space or memory. As specified in Section 1.2.1, FEDS requires at least 580 KBytes of available memory (RAM) and 40 Mbytes of available disk space. If you have sufficient memory and disk space and you still get this message, report this error to the FEDS support staff.

Sys-Err Sector not found

A DOS error resulting from a file or portion of a file not found during a read operation. This error can occur in FEDS if there is not sufficient disk space available to the program. See Section 1.2.1 for FEDS disk space requirements.

FEDS Level-2 Error Messages

Level-2 errors can occur in either the Level-2 user interface or when using an ASCII input file in the Level-1 user interface. These error are described in separate sections below.

LEVEL-2 USER INTERFACE ERRORS

Following is a listing of Level-2 user interface errors. One of the items from a list enclosed in brackets [] will be present. These errors messages typically identify the source of the error and the solution. Where the solution is not obvious comment in *italics* have been added.

Start-up Errors

"Error Initializing binary files" *The binary files have been corrupted or were produced using the incorrect version of FEDS. Regenerate the binary files from the Level-1 user interface using Release 2.10.*

Creation Errors

"Exceeded list limit" *The number of possible technologies for a particular end use has been exceeded. Reduce the number of technologies to a value less than or equal to the maximum number provide in Section 3.2.5.*

Update Inference Errors

"inapplicable value, [description], tech [tech #]"

"Error: fractions for [heat, cool, shw] area [1, 2], add up to [frac <>100%]"

"Error: tech ducting scenario for [heat, cool] [tech #] does not match preceding techs" *See Appendix L.*

"Error: tech ventilation linking scenario for [heat, cool] [tech #] does not match preceding techs" *See Appendix L.*

"missing minset at level [default level, NOTE: not used], missing [description] [tech #]"

"Unable to FIND weather file [filename]"

Mapping and Conversion Errors

VENTILATION "need supply volume to convert to %"

VENTILATION "need total building volume, unavailable, run building inferences"

OCCUPANCY GENERAL "occupancy stored as occ/sq.ft.: check use area percent floor area"

LIGHTS, MISC EQUIP "L2Backend_Cvt_Density requires positive floor area. Check for missing building floor area or use area fraction"

HEAT, COOL, SHW "L2Backend_Convert[[HEAT, COOL, SHW][EQUIP, FUEL]] - [Fetching, Saving] inappropriate combination: fuel [fuel #], equip [equip #], etc.

LEVEL-2 ASCII FILE ERRORS

Following is are examples and listings of the error messages that can occur when producing Level-2 input files as described in Section 3.5.4. Parser errors will be written to a file with the name <case>.err. There will be an approximate line number and a keyword that can be used to help locate the error in the input file. Text of the validation errors are written to a file with the name <case>.val. The line will give the building set number, the keyword associated with the error, and the value(s) that cause the error. In both cases some error are simply warnings (when a value is outside of the expected range but still physically possible) and in other case the errors are fatal (when the value will result is a situation that cannot be modelled).

Parser Errors

Example:

Error #115 near line 455: Input line is in wrong place.

system for each use area? (Y=yes; N=no).....[DUAANS]

N| |

Listing of Parser Errors:

"Warning near line ???: Value considered acceptable but extreme."

"Block stack is full (caused by unbalanced begin and end keywords)."

"Block stack is empty (caused by unbalanced begin and end keywords)."

"Missing one of more end block keywords."

"Block name is invalid."

"Keyword is invalid."

"Input line is in wrong place."

"Data type is invalid for default or user value."

"Either default or user value is out of range."

"Missing '|' between default and user value."

"Missing ']' between default and user value."

"Missing energy price rate type."

"Missing demand ratchet Yes/No response."

"Invalid demand ratchet Yes/No response."

"Missing discount rate Yes/No response."

"Invalid discount rate Yes/No response."

"Missing energy escalation rate Yes/No response."

"Invalid energy escalation rate Yes/No response."

"Missing electric utility pay Yes/No response."

"Invalid electric gas utility pay Yes/No response."

"Missing gas utility pay Yes/No response."

"Invalid gas utility pay Yes/No response."

"Missing central steam plant record count entry."

"Missing central hot water plant record count entry."

"Missing central chiller plant record count entry."

"It is beyond the capabilities of FEDS to model linked

"It is beyond the capabilities of FEDS to model ducted and unducted systems in the same building."

"Percentage option is invalid if no total supply air value entered"

"Number of heating blocks does not match the number of tech entered, Area 1"

"Number of cooling blocks does not match the number of tech entered, Area 1"

"Number of heating blocks does not match the number of tech entered, Area 2"

"Number of cooling blocks does not match the number of tech entered, Area 2"

"Total of percentages of heating techs not equal to 100, Area 1"

"Total of percentages of cooling techs not equal to 100, Area 1"

"Total of percentages of heating techs not equal to 100, Area 2"

"Total of percentages of cooling techs not equal to 100, Area 2"

"Number of service hot water blocks does not match the number of tech entered"

"Number of lighting blocks does not match the number of tech entered"

"Number of misc equipment blocks does not match the number of tech entered"

"Total of percentages of use areas not equal to 100"

"Fuel not available for this building"

"Equipment type does not map to given fuel type"

"Unable to locate weather station for this input"

Validation Errors

Example:

Input File: SMALLODG.I2
Facility :
Buildings : 1
Generated : Fri Mar 04 14:28:30 1994

Building Record 2 --- FATAL ERROR:
 UIFCHT: floor to floor height less than floor to ceiling height.
Building Record 2 --- FATAL ERROR:
 UIZDEP: Zone depth impossibly large.
Building Record 2 --- FATAL ERROR:
 VIVCM: NONE chosen with LINKED or EVAP_COOLED cooling

Listing of Validation Errors:

"Aspect ratio extreme, < 0.2"

"Aspect ratio extreme, > 5.0"

"Aspect ratio extreme. NS or EW side length < 10 feet."

"Since number of use areas = 1, fraction of bldg ??? for use area 1 must equal 100.0"

"Zone depth impossibly large."

"Zone depth improbably large."

"Zone depth < half the length of the short side."

"Floor to floor height less than floor to ceiling height."

"FEDS will assign default value for roof deck type."

"Superseded by the roof U-Value RITUV."

"Building's roof not insulated."

"Superseded by the wall U-Value."

"Building's wall not insulated."

"Eclipsed by entered U-value."

"Eclipsed by entered shading coefficient."

"Light tech #%d is type EXITSIGN so UFOP must be 100%."

"Cooling deadband not equal to heating deadband."

"OFFUNOCC chosen with linked heat."

"OFFUNOCC chosen with linked cool."

"NONE chosen with linked heat."

"NONE chosen with LINKED or EVAP_COOLED cooling."

"Heat supply less than 20 degrees F above a thermostat setting."

"Heat supply must be above thermostat setting."

"Cool supply less than 10 degrees F below a thermostat setting."

"Cool supply must be below thermostat setting."

"Heat thermostat setting > Cool thermostat setting."

"Should be less than or equal to H1OHTS."

"Heat thermostat setting > Cool thermostat setting."

"Unoccupied thermostat setting high than Occupied (UA1UHT > H1OHTS)."

"Heat thermostat setting > Cool thermostat setting."

"If entering ventilation as a percentage you must also enter the total supply air."

"Cannot have higher outdoor ventilation than total supply volume."

"If entering infiltration as a percentage you must also enter the total supply air."

FEDS Wall and Roof Types

FEDS Wall Types

<u>Description</u>	<u>Wall Construction Type Category</u>
Wood siding on wood frame	0
Masonry facade on wood frame	1
Masonry facade on masonry frame	2
Curtain wall	3
Pre-fabricate metal panels	4

- Wood siding over wood frame--also includes plastic or metal siding.
- Masonry facade on wood frame--standard wood frame with brick, stone, stucco, or other masonry exterior.
- Masonry facade on masonry frame--represents a solid masonry wall where both the outside surface and the structural wall is masonry. Also includes wood, plastic, or metal siding on masonry frame; or concrete wall construction panel whether pre-fabricated or poured in place.
- Curtain wall--steel frame with brick, stone, stucco, or other masonry exterior.
- Pre-fabricate metal panels--outside walls which are factory fabricated aluminum or galvanized steel panel which are fasted to the building frame.

FEDS Roof Types

<u>Description</u>	<u>Roof Construction Type Category</u>
Built-up	0
Pre-fabricate metal panels	1
Shingles or shakes	2

- Built-up roof--several layers of roofing felt with asphalt between and covered by a mineral-surfaced layer of a heavy asphalt coat embedded with gravel. Roof deck can be wood, concrete, or metal.
- Pre-fabricate metal panels--light gauge metal roofing sheets (often corrugated).
- Shingles or shakes--a series of overlapping rows of roofing material including wood, plastic, fiber glass, baked clay, tile, slate, asbestos, asphalt, and aluminum.

FEDS Allowable HVAC Combinations

Unlinked, Unducted heating types

Any combination of:

- Electric resistance baseboard
- Radiator using central steam or hot water
- Radiator using single-building boiler
- Window/through wall AC units
- Fan coil units using single-building conventional chiller
- Fan coil units using single-building absorption chiller
- Fan coil units using central chilled water
- No heating
- No cooling

Linked, Unducted heating and cooling types

Any combination of:

- Fan coil unit using central steam or hot water
- Fan coil unit using single-building boiler
- Window/through wall AC units
- Fan coil units using single-building conventional chiller
- Fan coil units using single-building absorption chiller
- Fan coil units using central chilled water
- No heating
- No cooling

Linked, Ducted heating and cooling types

Any combination of:

- Force air furnace
- Air source heat pump (heating)
- Water source heat pump (heating)
- Air handling unit using central steam or hot water
- Air handling unit using single-building boiler
- Air source heat pump (cooling)
- Water source heat pump (cooling)
- Rooftop packaged unit
- Air handling unit using single-building conventional chiller
- Air handling unit using single-building absorption chiller

- Air handling unit using central chilled water
- No heating
- No cooling

Evaporative Coolers

Evaporative coolers are compatible with any linked or unlinked heating type that is unducted. Evaporative coolers may not be combined with any other cooling equipment types, though they may be combined with no cooling.

FEDS Level-2 User Interface Help and Troubleshooting

This appendix provides additional information that is not contained in Section 3.2 or in Appendix J. Specific difficulties that might occur during installation or operation of the Level-2 User Interface (L2UI) and their solutions are provided.

INSTALLATION AND WINDOWS

Windows Files: During the execution of setup a number of Windows files will be updated (e.g., DDEML.DLL) if newer versions appear on the FEDS installation disks. If other applications or users are using some of these files, you may get an error message. *If you are using Windows for Workgroups, restart Windows without being connected to the network. If you are using Windows in stand-alone mode, and have other applications open, close all applications and rerun setup.* The L2UI program group and icon should be successfully created.

Full Screen Operation: The PIF file created for running the computational portion of the model will automatically be defaulted to full screen operation. On most computers it will run successfully in a window. If upon going to a window the screen is blank except for the blinking cursor, this application will not run within a window with your current configuration. *Return to full screen operation by striking Alt-Enter.*

VGA Display: The L2UI is expecting the video display to be set to VGA. Other settings should not affect the operation of the model; however, the display may be small and more difficult to work with. *Go to Windows Setup and set the display to VGA.*

Windows 3.0: Some of the text in the screens seems to be missing or is out of place. This is a problem in Windows 3.0. This not known to affect the operation of the software but is annoying. *Get and install Windows 3.1.*

OPERATION

Using the Mouse: The only places in the model where a double mouse click is required is in the list objects and for locking (See Section 3.2.3). In the "Select A Case Name to Open", "Installation Inputs: General Information", and "Building Inputs: General Information" screens there are list objects; these are the only three occurrences of list objects in the user interface. A single mouse click is required elsewhere. Double clicking on an object can

cause problems if that object results in exiting a screen; the second click will potentially initiate action in the parent screen if there is an object where the mouse was clicked. That is, the first mouse click closes the screen you are in and the second mouse click is interpreted in the screen behind the one that is closing. ***Do not double mouse click except on list objects.***

Updating Inferences: Inferences are updated at 2 points: when the user explicitly requests this action and just before the Optimizer is run. Updating inferences catches any input errors and makes sure that the minimum set of inputs is provided. Appendix J describes the error messages. ***Update inferences often; it will help you to assess the reasonableness of your inputs.***

ADDITIONAL SCREEN INSTRUCTIONS

Lighting Technologies and Default Configurations: In the Level-2 user interface you are only required to enter a fixture type under "Lighting Technology Choices". If you do not enter a fixture configuration the default configuration for that technology (fixture type) will be assigned when defaults are updated. The defaults configurations are IN8, HI2, FL1, MV5, HS15, LS4, and EX1 (configuration codes are explained in Appendix B).

Lighting Percentage of Use-Area Illumination: In Level-1 it is assumed that all buildings have the "correct" lighting levels; hence, the percentage of illumination is required to add up to 100%. In Level-2, the user can enter the number of fixtures, or fixtures per square foot, for any lighting technology; no requirement is made that the illumination from the fixtures match the "correct" lighting level (the space may be over-lit or under-lit). Similarly, the user can increase or decrease the percentage of illumination for any technology to indicate that a space is under-lit or over-lit. For example, the user might have entered in Level-1 that 30% of the illumination was provided by incandescent and 70% by fluorescent. If the space is over-lit by 30% the user could enter 39% for incandescent and 91% for fluorescent.

SHW--Buildings Without SHW: This input is intended to indicate *whole* buildings within a building set that do not have SHW. Whether the input is provided as "percentage of buildings", "number of buildings", or "square footage of buildings" it indicates the portion of the buildings within the building set that do not have SHW.

SHW in Dual-Use Buildings:

- Any loop SHW system in a dual-use building is assumed to serve both use-areas. If there is no SHW consumption in a use-area set the consumption and storage capacity for that use-area to zero.

- The percentages for "portion of the building set served" must add up to 100% for both use-areas. The portion of buildings with SHW value is added to both use-areas as is any loop SHW. The rest of the SHW is provided by distributed systems within each use-area.
- Loop systems are only entered in use-area 1. If you enter a SHW fuel type in use-area two that is typically associated with loop systems (e.g., district steam), or the building type typically has loop systems (e.g., lodging) and do not specify whether it is a loop or distributed system, the model may infer that it is a loop system and move the record to use-area 1. The next time you update the inferences the percentages will no longer add up to 100%.

SHW Heat-Pumps: In the Level-1 user interface you can select SHW heat-pumps directly. When you bring your file into Level-2 the model will know it is a heat-pump. In Level-2 you are only requested to enter a fuel for the SHW technology and the model will infer the efficiency if you do not provide one. If you enter an efficiency greater than 100% (e.g., COP of 2.6 ==> 260%) the model will assume it is a heat-pump.

Multiple SHW Technologies in a Single Building: The storage capacities and output capacities (for loop systems) are entered on a per building basis and it is assumed that there is only a single SHW technology in a building. If there are multiple SHW technologies in an individual building, then the capacities need to be extrapolated to the total building level. Assume for example that there are two SHW heaters in a building, one electric and one gas, and they are both 80 gallons. You would enter 160 gallons storage capacity *for each technology* and enter that they each provide 50% of the service.

CHANGES TO LOCKED INPUTS

Number of HVAC Zones/Perimeter Zone Depth: You entered 5 for the number of HVAC zones but after updating inferences you notice that the number of HVAC zones is 4. For the building size and aspect ratio, the length of the short side of the building is less than twice the zone depth plus 15 feet (the minimum core zone width). When this occurs FEDS automatically sets the number of zones to 4. *Go to "Use-Area Inputs: Geometry" and reset the perimeter zone depth to a value less than one-half the length of the short side of the building minus 15 feet.*

Design Outdoor Ventilation Air: You entered a percentage for the design outside air but after updating inferences you notice that the number you entered is somewhat different. Because the total supply air depends on the amount of outside air, and you entered the outside air as a percentage of the total supply air, this is an iterative calculation and will not return the

exact entered value. If you are not satisfied with the returned value: *Go to Ventilation End Use Inputs, enter the percentage, and update inferences. Repeat this process until the percentage is satisfactory.*

UNEXPECTED OUTPUT

Low Energy Use in All End Uses: Your output shows low energy use in all end uses for a particular building set. You created a new building set in Level-2 and did not visit the Use-Area Inputs (Occupancy: General)--the model assumed the building was unoccupied. *Go to Use-Area Inputs (Occupancy: General) and enter the occupancy hours for that building set.*

Lighting Energy Use: Your output shows 0 consumption for lights and/or that exit signs are not present for a particular building set. You created a new building set in Level-2 and did not visit the Lighting Configuration Inputs--the model assumed there were no lights. *Go to Lighting Configuration Inputs and create the necessary records for the types of lighting types that you have.*

Miscellaneous Equipment Energy Use: Your output shows 0 consumption for miscellaneous equipment for a particular building set. You created a new building set in Level-2 and did not visit the Miscellaneous Equipment Inputs--the model assumed there was no miscellaneous equipment. *Go to Miscellaneous Equipment Inputs and create the necessary records for the types of miscellaneous equipment that you have.*

All Retrofits Are Electric: Your output shows that all retrofits are electric but you expected to see different fuels for a particular building set. You created a new building set in Level-2 and did not visit the Fuel Type Inputs--the model assumed the only fuel available for retrofits was electricity. *Go to Fuel Type Inputs and select the fuels that are available to that building set.*

MODEL LIMITATIONS AND EXECUTION ERRORS

Dual-Use Separate HVAC Building Sets: Release 2.1 of the L2UI does not support dual-use separate HVAC building sets. *To run a case containing a dual-use separate HVAC building set follow the instructions in Section 3.4.*

Residential and Dual-Use Combinations: The model will allow the user to use residential building or use-area types in dual-use buildings; that is, a residential building type that is dual-use or a non-residential building type with a residential use-area type. Because there are significant differences in some of the assumptions behind the design and operation of these building types unreasonable inferences and/or output may occur. *Exercise care when*

using residential building or use-area types in dual-use combinations. After updating inferences check all inferred values for reasonableness.

Unreasonable But Valid Input: The model will accept unreasonable but valid inputs. For example, you could enter 1000 for the number of floors--this is clearly an unreasonable input. Unreasonable inputs will often generate very large or very small values for other variables that can result in overflow errors. Most of these errors are caught when inferences are updated. *Update inferences often and check your inputs.*

Truncation of Occupancy Hours and Time-of-Use Hours: The user interface will allow you to enter occupancy hours and time-of-use hours in the electric rate schedule in other than whole hours (e.g., 1230). The model does hourly calculations only and will truncate the input hours (e.g., 1230 becomes 1200). *Be aware of this limitation and ensure that the total number of hours is correct.*

Space Available for Roof Insulation: This option, while present in the L2UI (i.e., can be selected as present by the user), currently has no impact on the baseline consumption or the optimization (the input is ignored). This functionality is present in walls and similar functionality will be available in Release 3.0.

SHW Baseline Parameters: The following information, while present in the L2UI (i.e., can be selected as present by the user), is not currently used by the model: electronic pilot lights, bottom boards, heat traps, pipes insulated near tanks, and external insulation wraps. These options currently have no impact on the baseline consumption or the optimization (the input is ignored). This functionality will be part of Release 3.0.