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ENERGY AND POWER EVALUATION PROGRAM (ENPEP) DOCUMENTATION AND USER'S MANUAL

Volume 2

by

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INTRODUCTION

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ENERGY AND POWER EVALUATION PROGRAM (ENPEP) DOCUMENTATION AND USER'S MANUAL

Abstract

Argonne National Laboratory has developed a microcomputer-based energy planning package entitled Energy and Power Evaluation Program (ENPEP). It consists of an executive module, seven technical modules, and four commercial software packages that conveniently integrate the many tasks associated with performing energy studies. The modules and their functions are as follows:

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- *EXECUTIVE* integrates the technical modules and coordinates the storage and retrieval of information used in those modules.
- *MACRO* allows the user to specify macroeconomic growth (global or sectoral) that will drive energy demand.
- *DEMAND* projects energy demand based upon the macroeconomic growth information supplied in MACRO.
- *PLANTDATA* provides a library of technical data on electrie generating plants that is used by BALANCE and ELECTRIC.
- *BALANCE* computes marketplace energy supply and demand balances over the study period.

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- *LOAD* computes and projects detailed electric load information for use in ELECTRIC.
- *ELECTRIC*, the microcomputer (PC) version of WASP-III, calculates a minimum cost electric supply system to meet electric demand and reliability goals.
- *IMPACTS* calculates environmental impacts and resource requirements associated with energy supply system options.

Overview of ENPEP

The Energy and Power Evaluation Program (ENPEP), a microcomputer-based energy planning program, was specifically created to provide a state-of-the-art energy analysis capability to developing countries. The models on which the ENPEP modules are based were dimensioned to accommodate small- and moderate-sized economies, as well as the more complex economies of larger industrialized countries. Since ENPEP is expected to get widespread distribution and use, it was developed for use on an IBM or IBM-compatible microcomputer. IBM was chosen because it is the most widely used and supported PC on a worldwide basis, particularly in developing countries.

ENPEP consists of an executive module, seven technical modules, and four commercial software packages that conveniently integrate the many tasks associated with performing energy planning studies. Although the components of ENPEP are fully integrated, you can also use any of the technical modules or commercial software packages independently. The four commercial packages used by ENPEP are: (1) Framework II* (spreadsheets), (2) dBASE III+‡ (data management), (3) GrafTalk§ (graphics), and (4) an ASCII file editor.

ENPEP has a library classification system that automatically catalogues input data and calculated information. A *planning study* is the highest level of organization in the library classification. All analyses performed by ENPEP modules (one or more) must be assigned to a planning study. Within a single module, you can process data several times (each of these analyses is called a *case*). You can copy information entered from a previous case to a new case and change it as necessary. Input and output from each of these cases, as well as relevant status information, can be stored for future use. In the ELECTRIC Module, several of the models require iterative analysis to arrive at the solution. Each of these iterative analyses is called a *run*. The ENPEP glossary at the end of this introduction provides a more complete description of these cataloguing terms (planning study, case, run). Much of the information presented in this Introduction is based on Ref. 1.

EXECUTIVE Module

The EXECUTIVE Module integrates the technical modules. It guides you through each of the major components and modules and coordinates the storage and retrieval of information used by the technical modules. The EXECUTIVE Module appears as a set of menus and forms that guide you to various parts of the ENPEP system. EXECUTIVE uses

*Framework is a trademark of Ashton-Tate, Culver City, Calif.

‡dBASE and dBASE III are trademarks of Ashton-Tate, Culver City, Calif.

§GrafTalk is a trademark of Redding Group, Inc., Ridgefield, Conn.

a forms package that has been standardized for use by the other modules. An invisible part of EXECUTIVE is the Data Dictionary that is used as a common repository of information that is shared between two or more ENPEP modules. The EXECUTIVE Module automatically coordinates this data sharing.

The process of executing the various modules and programs within ENPEP is automated through the use of a form and menu hierarchy. This tree structure allows you to select the path and order for program execution. Figure 1 outlines the ENPEP hierarchy. The hierarchy for each module is shown in the chapter describing that module.

MACRO Module

The objective of the MACRO Module is to format macroeconomic growth projections for use in developing energy demand projections. MACRO is not an economic planning model or a forecasting model, but is an analytical methodology based on the

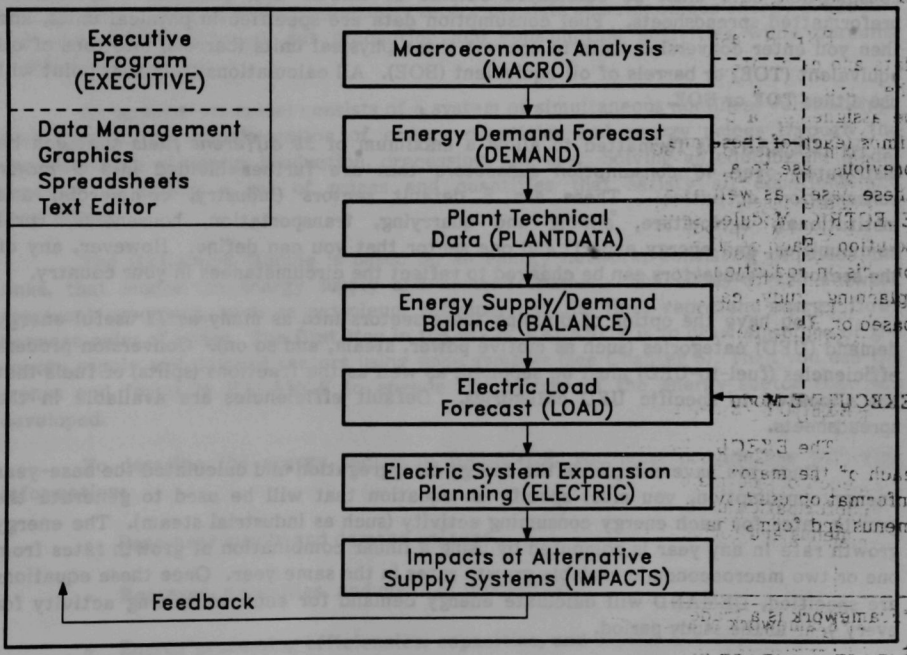

FIGURE 1 ENPEP Hierarchy

assumption that energy growth (or decline) is driven by macroeconomic variables. Macroeconomic variable forecasts are developed outside of ENPEP and are input to the MACRO Module. MACRO uses the Framework II program to allow you to enter these data in formatted spreadsheets. Four types of macroeconomic data can be input to MACRO: (1) economic data, such as the gross national product, (2) population characteristics, such as growth rates, (3) special parameters, such as sectoral growth, and (4) computed parameters, which are computed combinations of the first three types. MACRO also allows you to select the national currency to be used and whether it is constant or current currency.

DEMAND Module

The purpose of the DEMAND Module is to compute projections of useful energy or fuel demand based on the macroeconomic growth rates generated by the MACRO Module and to generate a set of energy demand growth rates for use by the BALANCE Module. Computations are performed automatically by using spreadsheets, data-base programs, and several Basic programs. You must define the energy demand sectors and the base-year energy consumption by fuel type for those sectors. These base-year fuel consumption data must be calculated outside of ENPEP and entered in DEMAND's preformatted spreadsheets. Fuel consumption data are specified in physical units, and then you enter conversion units to convert these physical units (barrels) into tons of oil equivalent (TOE) or barrels of oil equivalent (BOE). All calculations from that point will use either TOE or BOE.

DEMAND is formatted to allow a maximum of *38 different fuels* that can be distributed over *48 consumption subsectors* that are further divided into *9 major consumption activities*. There are 8 default sectors (industry, commercial and institutional, agriculture, mining and quarrying, transportation, households, rural communities, and energy export) and one sector that you can define. However, any of the sectors or subsectors can be changed to reflect the circumstances in your country.

You have the option of dividing these sectors into as many as 72 useful energy demand (UED) categories (such as motive power, steam, and so on). Conversion process efficiencies (fuel-to-UED) must be supplied, as well as the fractions (splits) of fuels that are allocated to specific UED categories. Default efficiencies are available in the spreadsheets.

Once you have completed the energy disaggregation and calculated the base-year energy consumption, you must specify an equation that will be used to generate the growth rates for each energy consuming activity (such as industrial steam). The energy growth rate in any year is computed by using a linear combination of growth rates from one or two macroeconomic variable growth rates in the same year. Once these equations are specified, DEMAND will calculate energy demand for each consuming activity for every year in the study period.

PLANTDATA Module

The PLANTDATA Module serves as a library of basic information about thermal and hydroelectric generating facilities for both the BALANCE and ELECTRIC Modules. Since these two modules share common information, PLANTDATA was created to reduce redundancy and provide a convenient way to enter the large quantity of data required. Once you enter electric power plant information in PLANTDATA, this information can be made available to the other modules through simple commands in those modules. You use a unique four-character designation to identify a particular plant (a plant may consist of a large number of identical units). Then you can use these designations to select facilities for use in the BALANCE and ELECTRIC Modules.

BALANCE Module

The purpose of the BALANCE Module is to project an energy supply and demand balance for any study period up to 30 years. BALANCE is based on the approach of generalized equilibrium modeling,[2] which is applicable to modeling the energy systems of countries having different energy-sector characteristics. The basic assumptions in the equilibrium approach are that the energy sector consists of autonomous energy producers and consumers that carry out production and consumption activities while pursuing individual objectives.

An equilibrium model consists of a system of simultaneous nonlinear relationships that specify the transformation of energy quantities and energy prices through the various stages of energy production, processing, and use. Solving an equilibrium model consists of finding a set of prices and quantities that satisfy all equations and inequalities.

The BALANCE Module is based on an energy network, consisting of nodes and links, that model the energy supply and demand sectors. The nodes of the network represent processes, such as petroleum refining, and the links represent energy flows between pairs of nodes. The first step in the use of BALANCE is to draw a picture of the energy supply and demand sectors using node symbols (see Chapter 5). Then you use the menus and forms in BALANCE to encode the picture of the energy sector that you developed.

To describe the energy sector to BALANCE, you must provide the following information:

- Base-year supply and demand balance,
- Reserves, capacities, and costs of production,
- Energy processing efficiencies, capacities, and capital and operating costs,

- Electric sector data, such as load duration curves,
- Demand projections for the study period (which can be developed by the DEMAND module), and
- Import fuel price projections.

BALANCE uses this description of the energy sector and the demand projections to balance energy supply and demand using the equilibrium approach. BALANCE computes annual energy flows and energy prices for all energy activities (each link of the energy network). BALANCE is not an optimization model, but instead simulates and describes energy market choices that are made by producers and consumers.

LOAD Module

The LOAD Module allows you to transform data and perform calculations necessary to prepare input data on electricity generation requirements for the ELECTRIC Module. LOAD does not "forecast" future electrical demands. Instead, it uses data from BALANCE, data you enter, or a combination to calculate and specify the character of the electric demand, that is, annual electricity generation requirements, annual peak loads, period generation requirements (up to 12 periods per year), period peak loads, period load duration curves, and annual load duration curves.

LOAD was designed with a variety of users in mind. The major objective was to provide a convenient way to prepare load data for ELECTRIC and to assist you when you do not have a method for projecting the shapes of future load duration curves, but you do have a basis for expecting period load factors to change over the years. On the other hand, LOAD can use information that you have if you are able to project these curves outside ENPEP. Therefore, options are provided to estimate load duration curves having specified load factors when you have: (1) no data other than period load factors, (2) historical load duration curves, or (3) specific load duration curve projections.

In an ELECTRIC study that does not use LOAD, it would be unusual to change information such as load factors or ratios of period peaks to annual peaks more often than every 5 to 10 years. The LOAD Module provides an automated procedure for adjusting these data year by year so that large discontinuities do not appear in the load data. For example, interpolation routines are built into some of the spreadsheets so that you can generate load duration curves that have variations from year to year by specifying only the beginning- and end-year values.

LOAD can also compute annual load duration curves by aggregating the period load duration curves and the period peak load fractions. These annual load duration curves can be useful for graphics for reports or for general interest, but are not used by the ELECTRIC Module except when each year consists of only one period.

ELECTRIC Module

The ELECTRIC Module calculates an electrical generating system expansion plan that meets demand at the minimum cost, subject to system requirements (e.g., reliability). It is a microcomputer version of the Wien Automatic System Planning Package (WASP-III), the well-known mainframe system planning model distributed by the International Atomic Energy Agency (IAEA).[3]

WASP-III handles most of the critical issues of generation planning well. These issues include:

Generating unit size,

System reliability representation,

Existing system representation,

Varying types of hydroelectric plants,

Seasonal variations of loads and hydroelectric energy,

Annual variations in hydroelectric energy,

Domestic vs. foreign expenditures, and

Method for production-cost calculations.

WASP-III was chosen for the ELECTRIC Module because these critical issues are treated well, it is widely used throughout the world (including international lending organizations), it is a public sector model, and training in its use is available through IAEA-sponsored courses. Also, this model can be used for very sophisticated studies, while, in its simplest mode, it can be used for rapid approximations of the long-run expansion plan.

ELECTRIC is a microcomputer version of the WASP-III model. The major effort that went into producing ELECTRIC was in making it user-friendly and providing convenient forms for preparing data, executing the various components of WASP-III, and examining output. Over 100 separate forms were developed to help you use ELECTRIC. However, the data sets produced by those forms are identical to WASP-III data sets described in IAEA's WASP-III Users' Manual.[3] In addition, provisions have been made to allow you to directly edit the input files if you want to make minor changes without paging through the forms.

IMPACTS Module

The purpose of the IMPACTS Module is to calculate the environmental burdens and resource requirements for the energy supply systems (electric and nonelectric) that are computed by the BALANCE and ELECTRIC Modules. Data from these modules are automatically transferred to IMPACTS for analysis. As with the other modules, you use a hierarchy of menus to define the case study and advance through the module.

IMPACTS uses Framework II spreadsheets for entering data. Environmental burdens and resource impacts are computed by multiplying the appropriate impact factor by the activity for any given year (impact = impact coefficient x energy source activity). Default values are available for all impact coefficients, but you can change any of these coefficients (e.g., kilograms of pollutant emitted per metric ton of fuel burned) by using a scalar function that is incorporated into the spreadsheets.

Impacts are broken down into mining, transportation, and power plants for the electric system. This breakdown was made because the boundary for impacts is the study region. In cases where fuel for power plants is imported (from outside the region), the impacts associated with mining and transportation would not be included. If the fuels were obtained from within the boundary, then the impacts associated with resource extraction and transportation would be included.

ENPEP Components

ENPEP consists of a series of menus, forms, and spreadsheets that appear on the computer screen to guide you through the program; allow you to enter, view, or change information; and ensure that the required data sets are complete. This section contains brief descriptions of the important components of ENPEP. More details of the ENPEP microcomputer configuration can be found in a paper on WASP-III microcomputer implementation.[4]

Forms

In general, all ENPEP forms and menus have a similar physical layout.* At the top-left corner is the name of the ENPEP module, and at the top-right corner is the name of the form, which generally starts with the first letter of the module that you are using. For example, all of the names of the forms in the LOAD Module begin with "L"; the principal exceptions to this are the forms in the EXECUTIVE Module, which begin with an "X." The top line of each form will also contain the names of the planning study and case you have selected.

*Unless otherwise noted, this discussion uses the word "form" to refer to both forms and menus.

Each form has a title that is displayed in the second line from the top. At the bottom of each form is a short list of the important keystrokes that you can use. Usually, this list consists of **F10**, **F1**, and **Esc** keys. In general, you view or change data on a form or enter an option on a menu and then press the **F10** key to advance to the next form, menu, or function in the hierarchy. Press the **Esc** key at any time to return to the form or the step you were at when you last pressed **F10**. Pressing **F1** allows you to view one or more Help files that explain how to use ENPEP keystrokes and modules.

The body of each menu contains a list of options from which to choose. Once you enter an option, you must press **F10** before you can continue. See Fig. 2 for an example of an ENPEP menu. The body of each form contains one or more data fields. Use the cursor-control keys to move the cursor to the appropriate field(s) to enter or change data, and press **F10** to save the value(s) and advance to the next form. See Fig. 3 for an example of an ENPEP form. Most forms and menus also display a one-line prompt that briefly describes the purpose of the form.

Spreadsheets

Four ENPEP modules, MACRO, DEMAND, LOAD, and IMPACTS, use spreadsheets generated by Framework II to help you organize and manipulate large amounts of data. Framework II is an integrated software package that also provides data base, graphics, and word-processing capabilities. All spreadsheets are preformatted and

```
ENPEP Module: LOAD        Planning Study:            Case:        (L003)

                    Selecting a Function for Load

        Description of Function                  Status    Last Update

 1. Enter base year, end year and number of periods

 2. Determine Annual Generation
 3. Determine Annual Load Factors
 4. Compute Annual Peak-Load

 5. Determine Period Generation, Load Factors and
    Peak-Load Fractions
 6. Determine Period Load Duration Curves

 7. Compute Annual Load Duration Curve

 Function Selection:    (1-7, from above list)

 To complete the Load module, functions 1-7 must be completed in order.

         Press "F1" for HELP, "F10" to CONTINUE, or "ESC" to QUIT.
```

FIGURE 2 Sample ENPEP Menu (Menu L003 from the LOAD Module)

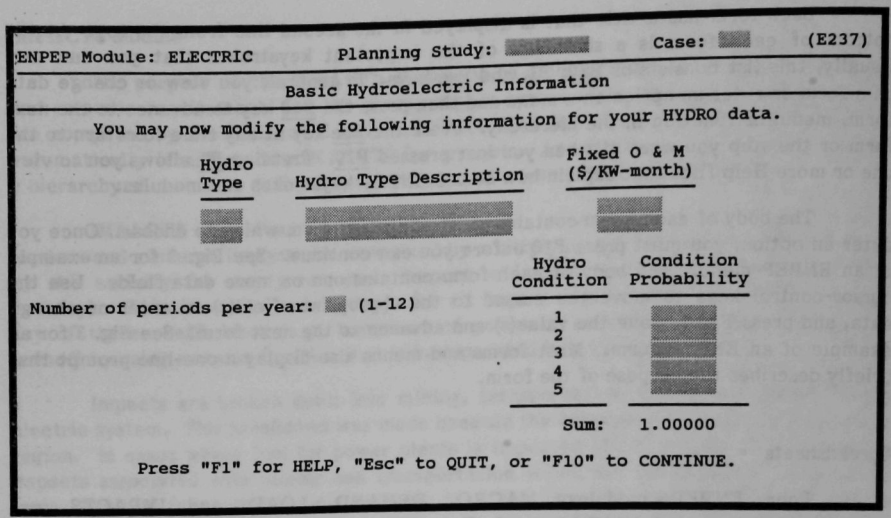

FIGURE 3 Sample ENPEP Form (Form E237 from the ELECTRIC Module)

consist of a two-dimensional array that displays the values for a particular category of data (such as electrical consumption growth rates). Thus, changes over time can be easily seen and adjusted.

As with the forms, each spreadsheet has a name and title. Most spreadsheet names consist of five letters, and the first letter is the first letter of the name of the module (M, D, L, or I). Each spreadsheet contains other information in addition to its name and title. Typically, the third line identifies the source from which the data values were calculated, the fourth line identifies the units of the values (if applicable), and, on some spreadsheets, a short description of the spreadsheet's purpose begins on the fifth line. In addition, at the bottom of each spreadsheet is a brief description of the available functions and the keystrokes necessary to execute them. See Fig. 4 for an example of a spreadsheet.

The keystrokes for spreadsheets are different from the keystrokes for forms. There are three keystrokes that are common to most spreadsheets: **F9**, **Alt-C**, and **Ctrl-D Q**. Once you have entered Framework II, press **F9** to access the appropriate spreadsheet. In general, **Alt-C** allows you to save the displayed data, advance to the next spreadsheet, and, in some cases, perform calculations. **Ctrl-D Q** allows you to quit (return to the forms). On spreadsheets that require **Alt-C** to save data, pressing **Ctrl-D Q** first will interrupt Framework II and any changes to the data will be canceled. See the Framework II documentation for more information about Framework II keystrokes and functions.

Name: ITAEC
Title: Default air emissions coefficients for transportation of fuel to electric power plants*
Source: Hittman Associates
Units: Short tons/10^12 Btu-mile

Transport Mode	Emission Type SO2	NOX	TSP	CO	HC
Train - coal	2.6500E+0	3.0500E+0	3.3800E+1	2.8500E+0	2.0600E+0
Barge - coal	7.3800E-1	6.8900E-1	1.7400E+1	5.9000E-1	4.4300E-1
Truck - coal	8.9100E-2	1.2200E+0	1.6400E+1	7.4300E-1	1.2200E-1
Pipeline - oil	3.5700E-1	4.8900E+0	1.7200E-1	2.9800E+0	4.9000E-1
Tanker - oil	5.1500E-1	3.3700E-1	3.7500E-2	6.1400E-3	1.9000E-2
Truck - oil	1.3700E+0	1.8700E+1	6.5800E+1	1.1400E+1	1.8700E+0
Barge - oil	0.0000E+0	0.0000E+0	0.0000E+0	0.0000E+0	0.0000E+0
Pipeline - gas	0.0000E+0	1.0300E+2	0.0000E+0	0.0000E+0	0.0000E+0

* Emission coefficient = default coefficient * scaling factor (in ITAEM)

FIGURE 4 Sample Spreadsheet (Spreadsheet ITAEC from the IMPACTS Module)

ENPEP Keystrokes and Function Keys

Tab, →, or Enter	Press any of these keys to move the cursor forward one data field.
Backtab or ←	Press either of these keys to move the cursor backward one data field.
PgDn	Press this key to move the cursor forward five data fields.
PgUp	Press this key to move the cursor backward five data fields.
Ctrl-PgDn	Press these keys simultaneously to move the cursor forward ten data fields.
Ctrl-PgUp	Press these keys simultaneously to move the cursor backward ten data fields.
→	Press this key to move the cursor forward one character.
←	Press this key to move the cursor backward one character.
Ins	Press this key to enter the insert mode.

Backspace When the insert mode is on, press this key to delete the character preceding the current cursor position.

Home Press this key to move the cursor to the first data field on the form.

End Press this key to move the cursor to the last data field on the form.

F1 On ENPEP menus and forms, press this key to access the on-line help. You will be presented with a screen that describes the functions of ENPEP keystrokes.

F2 Some menus and forms have additional help information specific to the menu or form; press **F2** to view this additional information. If you press **F2** while viewing a form that does not have additional help information, you will access an abstract of the module that you are using.

F3 Press this key to restore the contents of a data field that you have accidentally deleted. This function will not work unless you press **F3** immediately after pressing **Del**.

Del Press this key to delete the contents of a data field.

Esc On ENPEP menus and forms, press this key if you want to cancel a function or escape from the form. You will return to the previous form or function. If you make any changes to the data fields on a form and press **Esc**, those changes will be canceled. If you have already saved the data on a form (with **F10**), those data will not be lost. Likewise, the functions on a menu that are displayed as *COMPLETE* will not be affected by pressing **Esc**.

F10 On ENPEP menus, press this key to execute the option that you have selected and continue. On ENPEP forms, press this key to save the values that are displayed in the data fields and continue.

On-Line Help

You can access an on-line help from every form in the ENPEP program. All on-line Help is displayed with the ENPEP Paging Routine. You can access the first screen of on-line help by pressing **F1**; you will then see a screen that describes ENPEP keystrokes and cursor-control function keys. These keystrokes are valid for all ENPEP forms and menus. When you finish viewing the help information, press **Esc** to return to the form.

On some forms, you can view additional information specific to the form that you are using by pressing **F2**. You can press **F2** while you are viewing the form or the first screen of information. If no additional information is available, the message *No additional help is available for this form...* will be displayed at the bottom of the screen; press any key to continue. If the on-line help file is too big to be displayed on one screen, you can view additional "pages" with ENPEP Paging Routine keystrokes.

In addition, the introductory menu for each module allows you to access an abstract that describes the purpose of the module. You can select an option provided for this purpose or press **F2** to view this abstract, which can be from 5 to 40 "pages" long. As with the on-line help, these abstracts are displayed with the ENPEP Paging Routine.

ENPEP Utilities

This section briefly describes three utility programs that were written for ENPEP. The utilities were designed to make ENPEP as easy to use as possible; they are the ENPEP Data Dictionary, Forms Package, and Paging Routine. The commercial software packages that are distributed with ENPEP (dBASE III+, Framework II, GrafTalk, and an ASCII file editor) were chosen to complement ENPEP and perform certain functions for ENPEP because of their widespread use and proven reliability. For more information about the commercial software, refer to the appropriate users' manual.

Data Dictionary

The Data Dictionary is a system of files and programs that coordinate the storage and retrieval of the input and output files for the ENPEP modules. Its operation is transparent to you. To retrieve data, all you need to do is select a planning study and case from a list, and to store data, you merely respond to a prompt. To execute directory functions (such as archiving), all you do is press one or more function keys and identify the appropriate disk drive. Each module contains one or more forms for these purposes. Because the Data Dictionary is a critical component of ENPEP, you should back it up regularly. (See options on page 1.3-6 of the EXECUTIVE Module.)

The programs and work files needed by the seven technical modules are stored in separate subdirectories of the same name as the module. (For example, all the ELECTRIC Module programs are stored in the C:/ELECTRIC/ subdirectory on disk-drive C:.) When you select a planning study, status information is written into the Data Dictionary that allows each submodule of each module to retrieve the appropriate data files from the subdirectory of the planning study. Typically, files are copied from the planning study subdirectory to the subdirectory of the module. Then you can change the files by executing the module and copy them back into the subdirectory of the planning study.

Forms Package

In general, those portions of ENPEP that you can see on the screen are generated by the ENPEP Forms Package. This includes all menus and forms, but excludes screens generated by dBASE III+, Framework II, GrafTalk, and the IBM Professional Editor. The Forms Package gives ENPEP a clearly defined structure and associates keystrokes with the appropriate functions. Thus, you can advance through the ENPEP hierarchy by selecting an option on a menu or completing a form. In addition, the Forms Package makes it easier to enter information by providing clearly defined data fields.

The ENPEP Forms Package is designed to help you avoid errors. If you enter an option that does not exist on a menu or attempt to execute an unavailable function on a form, then the Forms Package will produce a beep and display an error message. Normally, this message will tell you that you have selected an invalid option or function. When an error message is displayed, press any key to remove it from the screen and continue; then you can select a correct option or function.

Paging Routine

The ENPEP Paging Routine is a Basic program that allows you to view output from the technical modules and the on-line help library. You access it automatically after executing a module function or a help command. If a document contains more than one page, a message at the bottom of the screen will display the current page and the total number of pages; to advance to a specific page number, enter the number and press **F10**.

You can view a help screen for the Paging Routine by pressing **F1**. This help screen, which is summarized in the following list, briefly describes the keystrokes that you can use in the Paging Routine.

↑	Press this key to move the screen display up one line.
Ctrl-**PgUp**	Press these keys simultaneously to move the screen display up 20 lines.
↓	Press this key to move the screen display down one line.
Ctrl-**PgDn**	Press these keys simultaneously to move the screen display down 20 lines.
←	Press this key to move the screen display one character to the left.
Ctrl-←	Press these keys simultaneously to move the screen display 20 characters to the left.

→	Press this key to move the screen display one character to the right.
Ctrl-→	Press these keys simultaneously to move the screen display 20 characters to the right.
PgDn	Press this key to display the next page.
PgUp	Press this key to display the previous page.
Home	Press this key to move the screen display to the top of the page (row one of the page will correspond to row one of the screen).
End	Press this key to move the screen display to the bottom of the page.
gray +	Press this key to "freeze" the top three rows of the page; this function allows you to leave column headings on the screen while you view other portions of the page.
gray -	Press this key cancel the "freeze" function.
PrtSc	Press this key to print all or parts of the document that you are viewing.
Esc	Press this key to exit from the Paging Routine.
F10	Press this key to return to the Paging Routing from the help screen.

How to Use This Document

This section discusses the organization and conventions used in this report to describe the purpose, functions, and use of each ENPEP module. The format of this report is designed to help you easily locate information about ENPEP, whether you need to know what the purpose of a particular function is or how you can advance to the appropriate form to execute that function.

Organization

Each chapter of this report is organized according to the following outline (where "C" represents the chapter number):

C.1 Introduction

C.1.1 Objective

C.1.2 · Background (if applicable)

C.1.3 Approach

C.1.4 Functions

C.1.5 References (if applicable)

C.2 Structure

C.3 Forms

C.4 Spreadsheets (if applicable)

C.5 Appendix (if applicable)

Each *Introduction* describes the module and discusses its overall purpose and relationship to the other modules. The "Structure" sections present diagrams that depict the hierarchy of the menus and forms in each module.

The *Forms* sections describe the forms and menus of each module and how to use them. The forms are presented in an order that reflects the relationships between forms to the extent possible. However, most modules have a complex hierarchy that contains many branches. To help you locate the description for a specific form easily, the chapters that describe the more complex modules contain both a standard table of contents and an alphabetic/numeric listing of the forms.

The *Spreadsheets* sections describe the spreadsheets and their use for those modules that have spreadsheets. In general, the order in which the spreadsheets are presented is functional, since the data on many spreadsheets are derived from data on previous spreadsheets. As with the forms, an alphabetic table of contents is provided for the chapters that describe the more complex modules that have spreadsheets.

Some chapters have one or two additional sections: a list of references and an appendix. Normally, the appendices provide a more detailed description of the module functions that are summarized in the Introduction.

Form and Spreadsheet Conventions

This document uses a consistent organization within the sections that describe menus, forms, and spreadsheets. This organization is designed to help you distinguish between text that discusses a particular form or spreadsheet and text that describes what action(s) you need to take to use the form or spreadsheet. Within each of these sections, an image of the form or spreadsheet will appear first, followed by a discussion about the form or spreadsheet entitled *Purpose* and a list of actions that you can take entitled *Options*. For many forms and spreadsheets, there is additional discussion entitled *Background*.

The discussion within *Purpose* will tell you basic information that is most essential for using the form or spreadsheet. For each form or spreadsheet, this information includes its name, a summary of its purpose, and its position in the hierarchy of the module (that is, how you advanced to the form or spreadsheet). In addition, other important information is presented (for example, a requirement that you complete the options sequentially).

The organization of the list of options is different for menus and forms. For menus, each function in the list is preceded by the keystroke that executes that function. For forms (and spreadsheets), each function in the list is preceded by a bullet (•) since the keystrokes can vary (for example, to enter a case number). For all menus, forms, and spreadsheets, the list of options identifies the menu, form, or spreadsheet that you will advance (or return) to after selecting an option or executing a function.

The discussion within *Background* will vary. In some cases, the discussion describes the equation(s) that are used when you execute a function. In other cases, information is presented to help you better understand the purpose of the form or spreadsheet.

Some forms have an additional subsection entitled *Data Fields*, which describes the purpose of and constraints on the values that you can enter. In such instances, the name of the data field will appear in italics (for example, *Domestic Fuel Cost*).

Since computer screens cannot display superscripts, there are differences between the ways that scientific notation is expressed in the text and on spreadsheets and forms. In the text, one million is expressed as 10^6, but on a spreadsheet, one million may be expressed as E+6, 10**6, or 10^6. Likewise, a computer screen cannot display subscripts; thus SO_2 and NO_x are expressed as SO2 and NOx.

Keystroke Conventions

This document uses a typographical style to help you clearly identify the symbols that represent keys that you need to press to execute a function. When you need to press a specific key, it will appear in an underscored, bold typeface (for example **1**, **Y**, or **Esc**). This convention does not apply to keystrokes that can vary, such as to enter a value in a data field.

When a hyphen (-) links two keystroke symbols together, this indicates that you need to press those keys simultaneously; for example, to execute a function with the Alt-C keystroke, press the "Alternate" and "C" keys at the same time. When two keys are separated by a space, this indicates that you press one key before the other; for example, to execute a function with the Ctrl-D Q keystroke, first press the "Control" and "D" keys (simultaneously), and then press the "Q" key.

Although this document fully describes all the keystrokes specific to ENPEP, it does not describe all of the keystrokes for dBASE III+, Framework II, GrafTalk, and the IBM Professional Editor. Instead, it refers to only the most important keystrokes: those that you need for entering and exiting from these software packages. You can find detailed information about using dBASE III+, Framework II, GrafTalk, and a text editor in the appropriate users' manual.

ENPEP Glossary

case: A case is the second highest level of ENPEP data organization and it represents a different set of circumstances on which the planning study will be based. The ENPEP program assigns each case a unique three-digit number and appends this number to the end of the data files used by the ENPEP modules. All of the cases that are associated with the same planning study reside in the subdirectory that has the name of the planning study. After you choose or create a planning study, you must also choose or create a case before you can begin executing the ENPEP modules. An example of a case is "High GDP Growth Rate, Low Population Growth." See *planning study*.

cursor-control functions: The cursor-control functions are a set of keys that allow you to move the cursor on the screen when you want to change data on a form. See "ENPEP Keystrokes and Function Keys" in this Introduction for a detailed description of each keystroke and its function.

Data Dictionary: The Data Dictionary is a BASIC program and its data files that were designed specifically for ENPEP. It serves as a repository of information that two or more ENPEP modules share. The interactions between the Data Dictionary and the ENPEP modules are automatic and transparent to you. See *status variables*.

data fields: In this report, data fields refer to those portions of the forms that contain values that you can enter or change. Typical data fields contain base and end years for a planning study, load duration curve coordinates, the available capacity for a hydro plant description, and so on.

dBASE III+: The commercial software package that manipulates and maintains DEMAND Module data sets is dBASE III+.

form: A form is a screen display that guides you through the ENPEP hierarchy of data compilation and processing. Most forms allow you to enter or change data from a keyboard by using keystrokes that are common to most forms. Typical forms contain information such as heat rates, period peak load fractions, thermal plant descriptions, and so on. See *menu*.

Forms Package: The ENPEP Forms Package is a BASIC program that generates all of the ENPEP forms and menus. It maintains and guides you through the ENPEP software hierarchy and allows you to enter data.

Framework II: Framework II is the commercial software package that generates the spreadsheets used by the MACRO, DEMAND, LOAD, and IMPACTS Modules.

GrafTalk: GrafTalk (version 4.1) is a commercial software package that allows you to graph the data generated by ENPEP.

menu: A menu is a special form. Menus allow you to choose from a list of functions. Some menus advance you to a path through the ENPEP program hierarchy; other menus allow you to select module or submodule data processing options. See *form*.

module: A module is one of the eight ENPEP programs that coordinate or perform all technical analyses. Each consists of one or more separate Fortran or Basic programs, and several also use Framework II spreadsheets or dBASE III+ data bases. All of the modules can produce reports that you can view and print, and most of the modules allow you to generate graphs. The eight modules are: EXECUTIVE, MACRO, DEMAND, PLANTDATA, BALANCE, LOAD, ELECTRIC, and IMPACTS. They may be run independently, but ENPEP is designed to integrate all the modules into one system. Information can be passed from one module to another through the use of the Data Dictionary.

Paging Routine: The ENPEP Paging Routine is a BASIC program that allows you to selectively view pages of the abstracts in the ENPEP help files and reports generated by ENPEP. This program is called when you select an option to view ENPEP output or when you enter a help command.

planning study: A planning study is the highest level of ENPEP data organization. The data within a planning study defines an energy analysis, and each planning study can cover a period of up to 30 years. Each planning study resides in one disk subdirectory that has a name consisting of up to eight characters. Associated with the name is a label for each planning study (such as "Country Energy Assessment"). You must choose or create a planning study before you can begin executing one of the ENPEP modules. See *case*.

screen: In this report, a screen refers to the actual image that you see on a computer screen, whether it is a form, menu, or spreadsheet.

spreadsheet: A spreadsheet is a preformatted screen display that you use to view, organize, or manipulate data. The ENPEP program uses a software package called Framework II to provide the spreadsheet formats and make the calculations that the modules perform more transparent. See *Framework II.*

status variables: The status variables are displayed on various menus and forms to indicate the status and the date on which you last modified a planning study or case or executed a function. The status is either *COMPLETE* or *INCOMPLETE.* The status variables are generated and maintained by the Data Dictionary.

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2. Debreu, G., *Theory of Value: An Axiomatic Analysis of Economic Equilibrium*, Cowles Foundation for Research in Economics, Yale University, New Haven, Conn. (1971).

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CHAPTER 5

BALANCE MODULE

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BALANCE MODULE

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5.1.1 Objective

The principal objective of the BALANCE Module is to project an energy supply/demand balance for up to 30 years. These data are then used in calculations in subsequent modules of the ENPEP system.

5.1.2 Background

General

BALANCE allows you to design a comprehensive model of the energy-producing sector and energy-utilizing activities in the major energy-consuming sectors of a country. There are two major aspects of BALANCE: the forms that allow full-screen data entry, and the Integrated Demand and Energy Supply (IDES) FORTRAN model. The IDES model was previously developed at Argonne to analyze energy planning issues characteristic of developing countries.

The BALANCE Module processes a representative network of all energy production, conversion, transport, distribution, and utilization activities in a country or region, as well as the flows of energy and fuels among those activities. Nodes of the network represent energy activities or processes such as refining, while the links of the network represent energy and fuel flows and associated costs among those specific activities. Data associated with nodes and links, as well as data to control the execution of the IDES FORTRAN program, are accessible through a hierarchy of menus and forms developed for ENPEP.

The objective of the module is to project the base-year energy flows associated with the links of a network over a given period of up to 30 years. Input data in the form of imported fuel price projections, final demand projections, and costs and technical data concerning energy resources and conversion activities (such as electricity generation and refining) are used in the module process representations to project future balances. The balances are constructed based on the relative economics of the alternative sources of supply and technology needed to meet the final demand, subject to the constraints that may exist on processing capacity and government regulations affecting energy uses and prices.

Typical alternative cases may be designed by varying the input data file to address issues such as the following:

- The relative contributions of hydroelectric power, fuel oil, coal, and peat for central station electric power generation,

- The economic potential for decentralized electric power generation and its impacts on the central station power system,

- Imported crude and petroleum products and the production by domestic refineries,
- Economic potential for biomass to reduce imported fuel requirements, including the production of ethanol, wood, charcoal, and agricultural residues,
- Economic potential for solar and wind energy sources,
- Impact on energy consumption of assumptions regarding sector growth rates,
- Fuel switching alternatives and imported fuel prices, and
- Potential for reducing energy consumption through conservation in the demand sectors.

You may run several variations on these and other cases by appropriately modifying the data that are entered in the model.

BALANCE Processes and Nodes

The BALANCE Module works with an energy sector network that consists of nodes and links. The nodes of the network represent processes, such as petroleum refining, and the links represent energy flows between pairs of nodes. The energy network is developed by defining the energy flows among 10 types of nodes. Each node type corresponds to a different submodel in BALANCE and is associated with specific equations that relate the prices and energy flows on the input and output links of the node. The node types are described as follows:

- *Depletable Resource Node* -- This models the production of a depletable resource that is either imported or domestically produced, such as crude petroleum or coal.
- *Renewable Resource Node* -- This models the production of a renewable resource, such as agricultural residues or solar energy.
- *Conversion Node* -- This models the conversion of a resource, fuel, or product to another form. Examples include a boiler that converts fuel oil to steam, an automobile that converts gasoline to miles traveled, and a distillation process that converts agricultural residues to ethanol.
- *Refining Node* -- This node, also called a multiple-output-link node, is typically used to model the petroleum refining process in an aggregate form. More generally it can be used to model any process with two or more products.

- *Stockpile Node* -- This models stockpiling of resources for use at some future time.

- *Multiple-Input-Link Conversion Node* -- This models special conversion processes that have more than a single form of input fuel, such as a solar heater that uses LPG as a backup fuel.

- *Decision Node* -- This models the selection of fuels or energy forms from alternative sources of supply.

- *Pricing Node* -- This models government price regulations and pricing policies.

- *Demand Node* -- This models the final demand for a fuel or a form of useful energy such as steam.

- *Electricity Generation* -- This submodel of IDES models the loading and output of electricity generating units.

Different symbols are used to represent each of the node types in the energy network, as seen in Fig. 5.1. The structure of the energy network (that is, how the nodes are connected in the network) is specified as part of the input data for the model. Each link of the network is assigned a unique number between 1 and 500, and the number of input and output links for each node of the network is specified in the input data for the node.

The components (subsectors) of a typical country's energy system and the energy flows among the components are presented in Fig. 5.2. Energy is either imported (comes into the system through the imports sector) or is produced domestically (in the coal, gas, oil, or wood sectors). Fuel conversion occurs in the refining sector (crude oil is converted to refined products) and in the electricity generation sector (coal, oil, or gas is converted to electricity). The transmission/distribution sector routes the fuels to the various demand sectors (industry, households, commercial, transport and agriculture) as well as to the export sector. A specific country may include more or fewer sectors and fuels than shown in Fig. 5.2. The IDES model is sufficiently flexible that almost any type of energy network structure can be represented.

Figures 5.3-5.9 illustrate the detailed network structures within each of the energy subsectors. These energy networks consist of processes and nodes of the types previously described (Fig. 5.1) and links connecting the nodes that represent energy flows. Links of the network are labelled with the link numbers (whole numbers) and the base year energy flows (decimal numbers) that are used in the *generic country model*. The nodes of the network are labelled by the process type and number that are used in the generic country model. The abbreviations used for the node types are as follows:

RS - depletable resource

RN - renewable resource

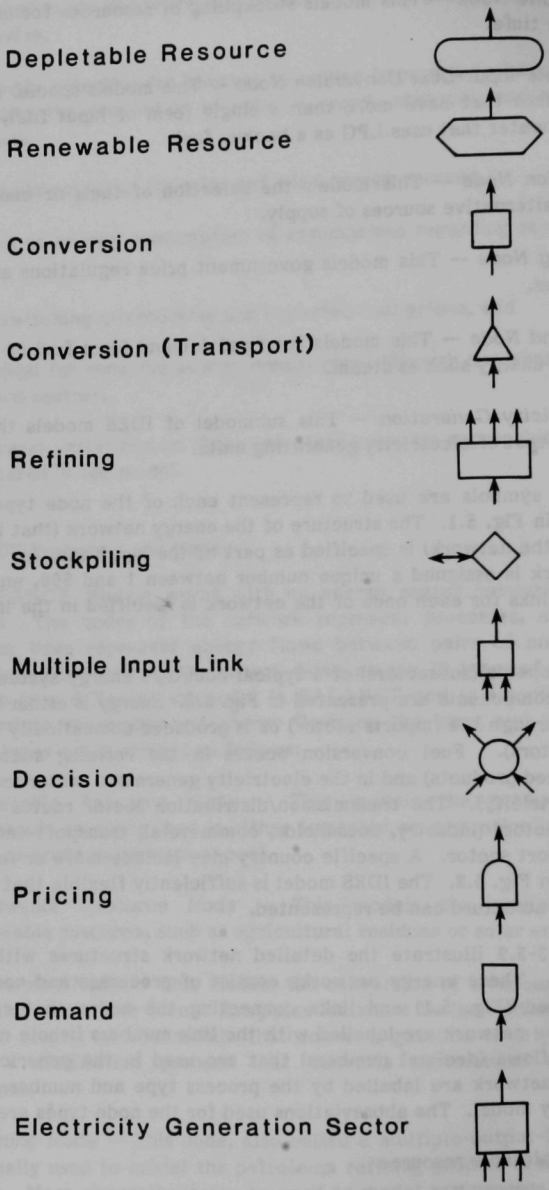


FIGURE 5.1 Symbols for Network Nodes

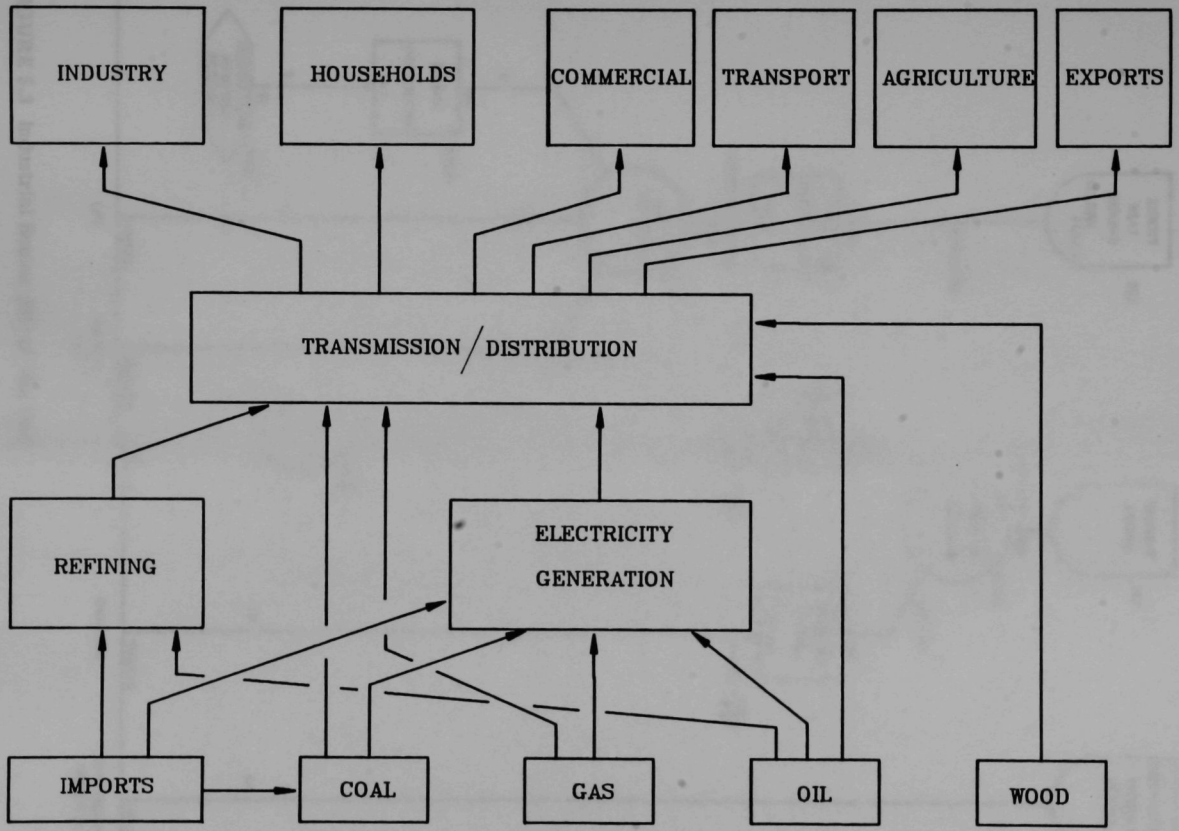
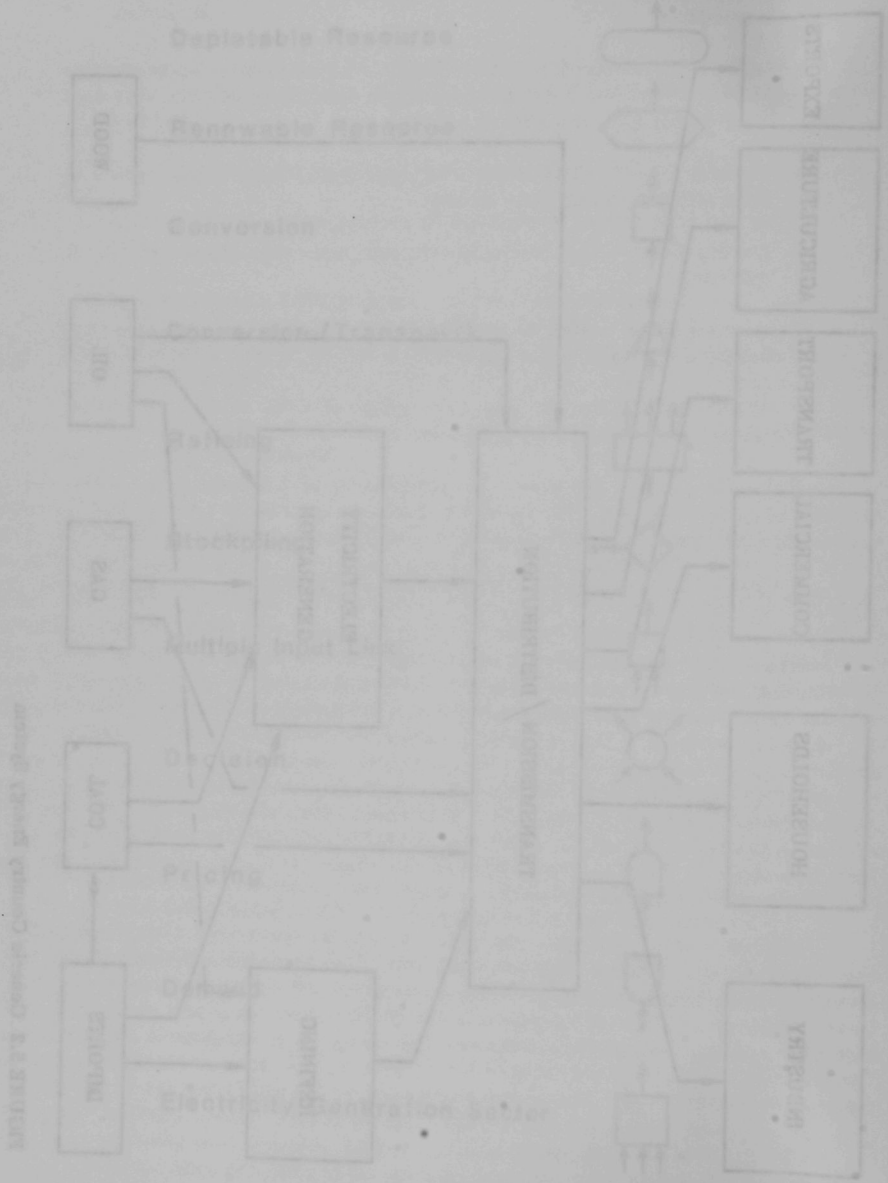
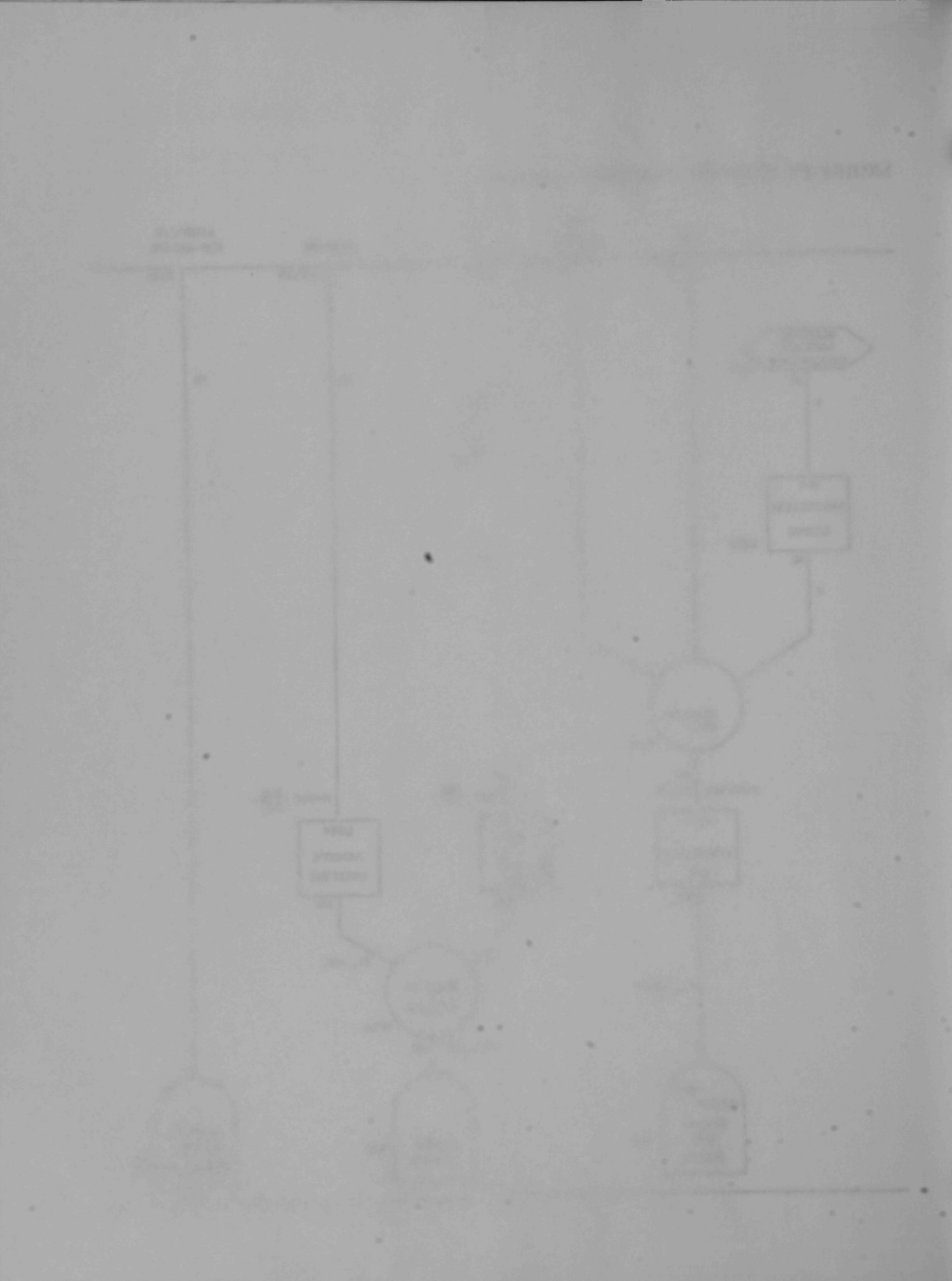
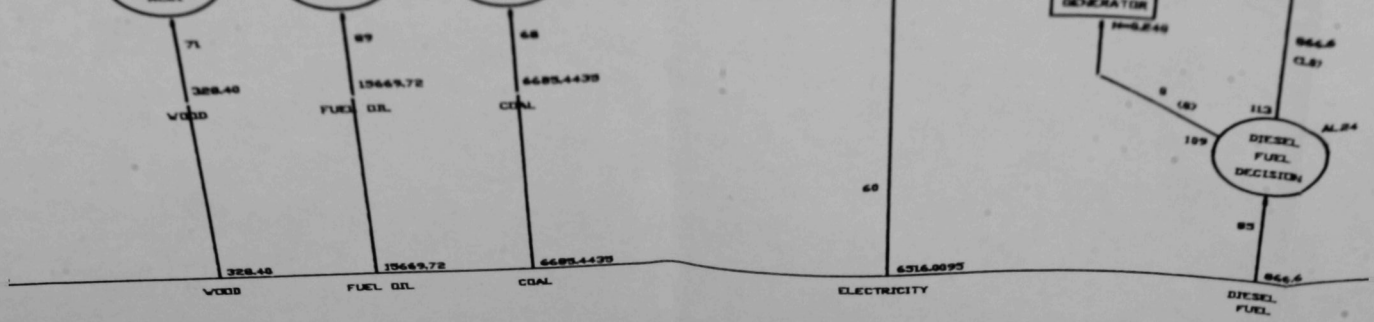


FIGURE 5.2 Generic Country Energy System







: Generic Country Energy System

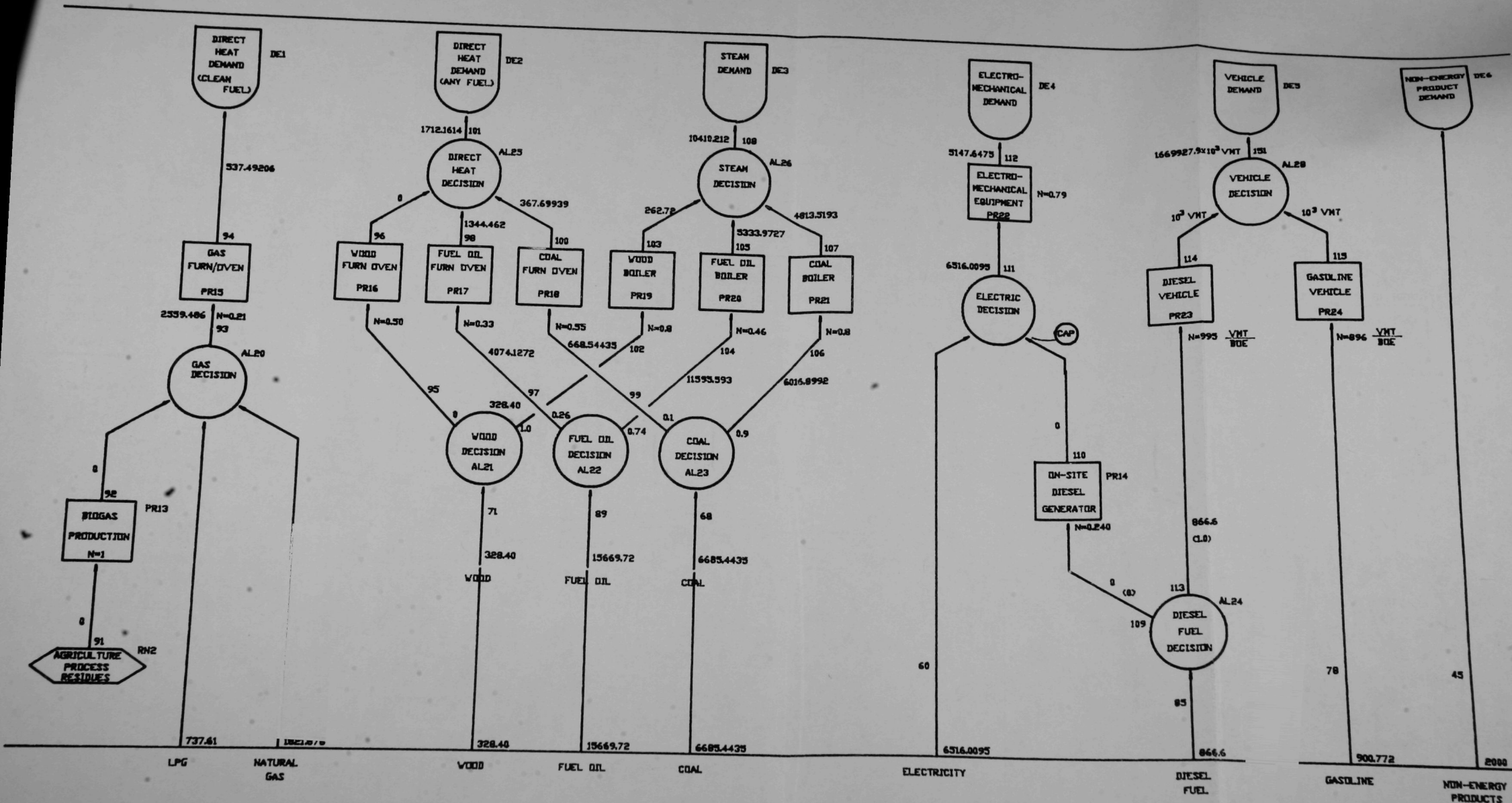
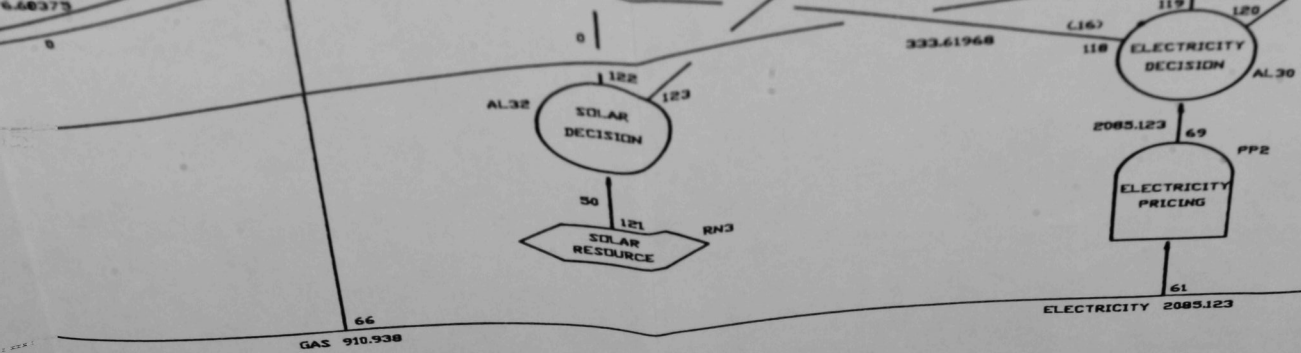


FIGURE 5.3 Industrial Sector (IN) of the Generic Country Energy System



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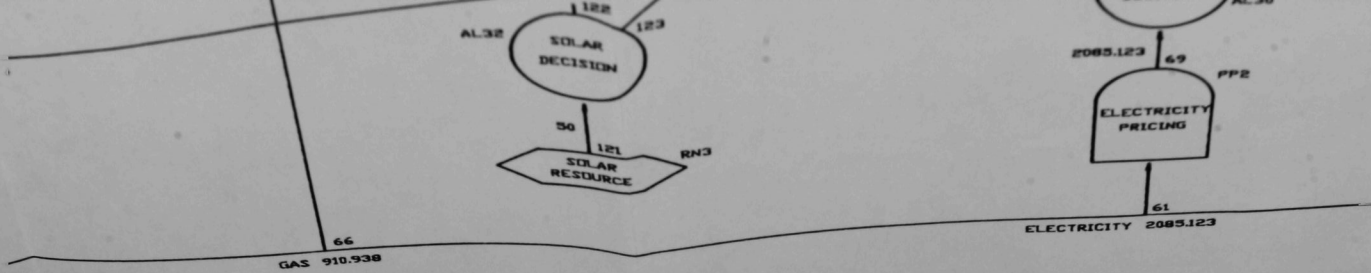


; Generic Country Energy System

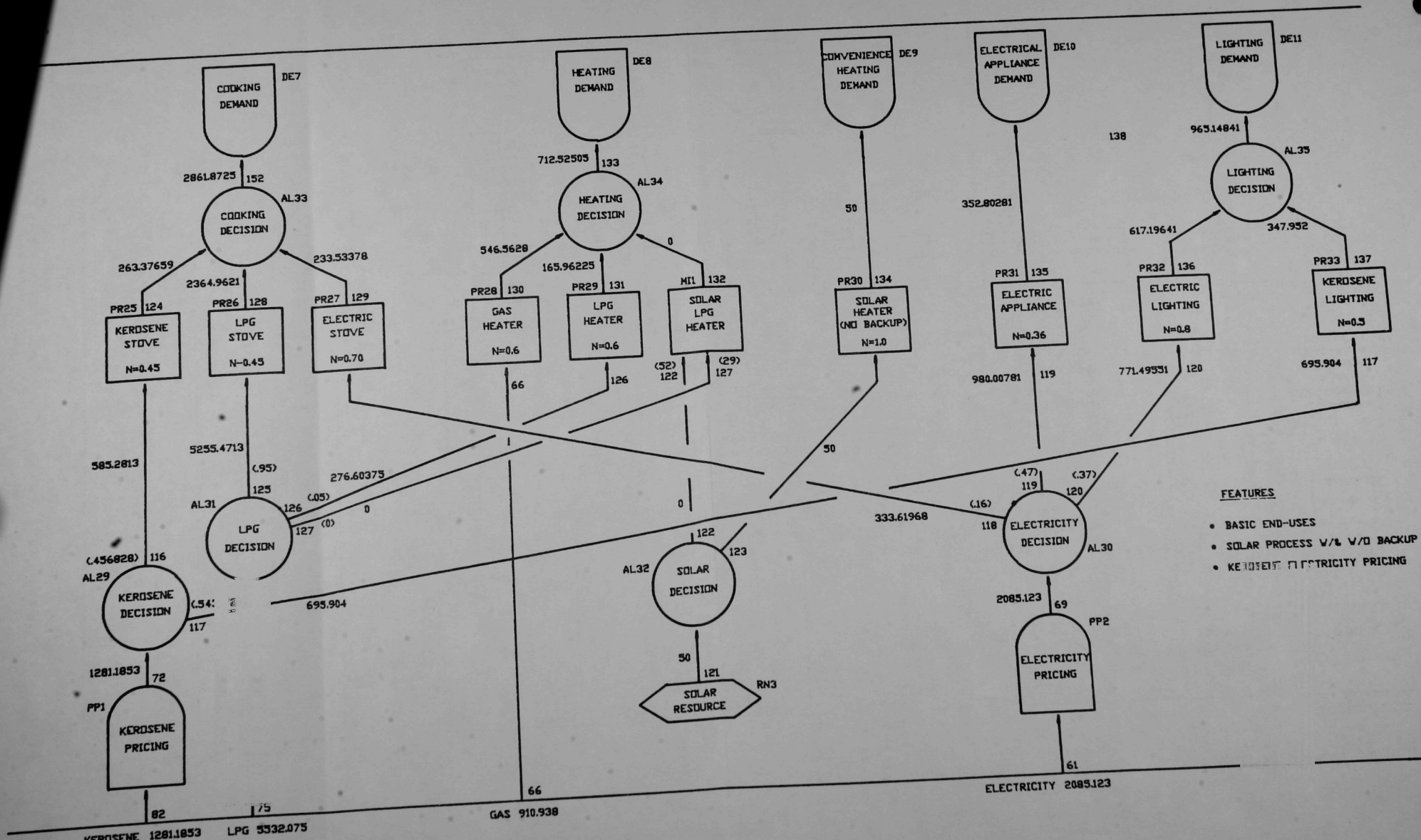


FIGURE 5.4 Household (HH) Sector of the Generic Country Energy System

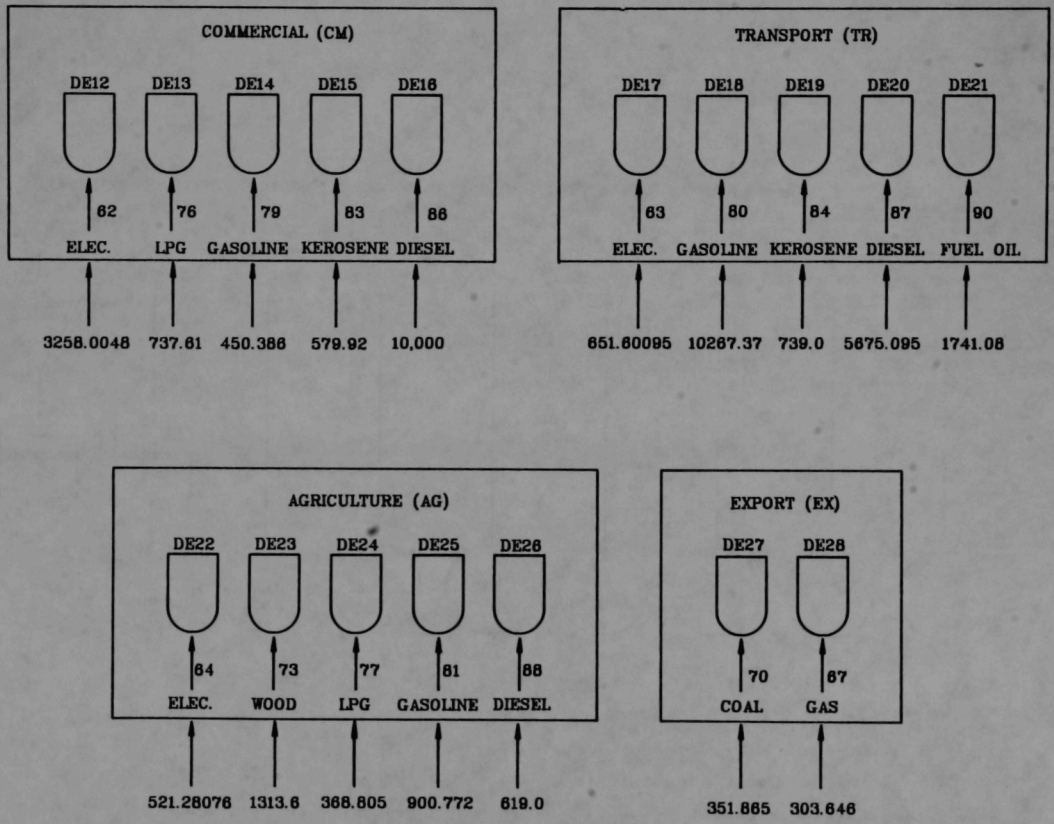


FIGURE 5.5 Demand Sectors (fuel demand only) of the Generic Country Energy System

INDUSTRY	60	(50%)	65	(60%)	68	(95%)	71	(20%)	74	(10%)	78	(.0719507)	—	(—)	85	(.0504991)	89	(90%)	45	(100%)
HOUSEHOLD	61	(16%)	66	(30%)	—	(—)	—	(—)	75	(75%)	—	(—)	82	(.4927436)	—	(—)	—	(—)	—	(—)
COMMERCIAL	62	(25%)	—	(—)	—	(—)	—	(—)	76	(10%)	79	(.0359753)	83	(.2230371)	86	(.582727)	—	(—)	—	(—)
TRANSPORT	63	(5%)	—	(—)	—	(—)	—	(—)	—	(—)	80	(.8201233)	84	(.2842193)	87	(.3307031)	90	(10%)	—	(—)
AGRICULTURE	64	(4%)	—	(—)	—	(—)	73	(80%)	77	(5%)	81	(.0719507)	—	(—)	88	(.0360708)	—	(—)	—	(—)
EXPORT	—	(—)	67	(10%)	70	(5%)	—	(—)	—	(—)	—	(—)	—	(—)	—	(—)	—	(—)	—	(—)

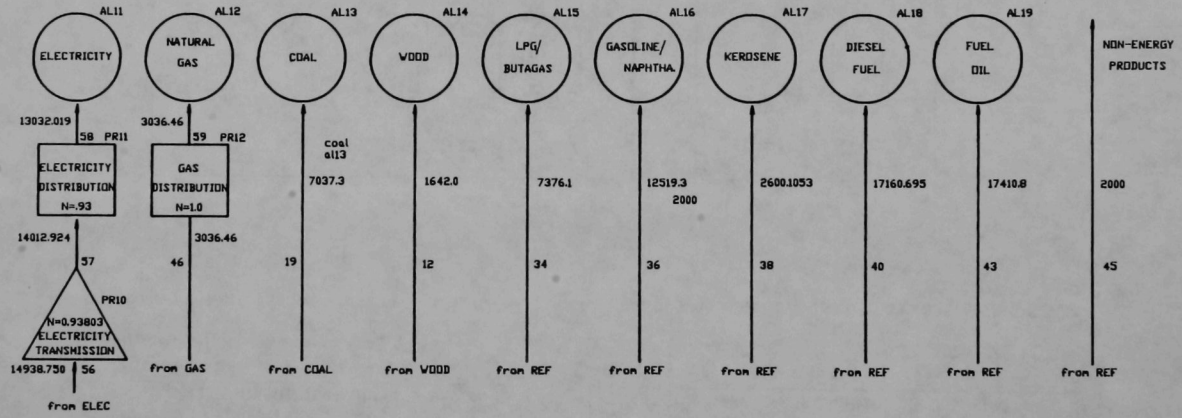


FIGURE 5.6 Transmission/Distribution (TD) Sector of the Generic Country Energy System

(IM) Sectors of the Generic Country Energy System

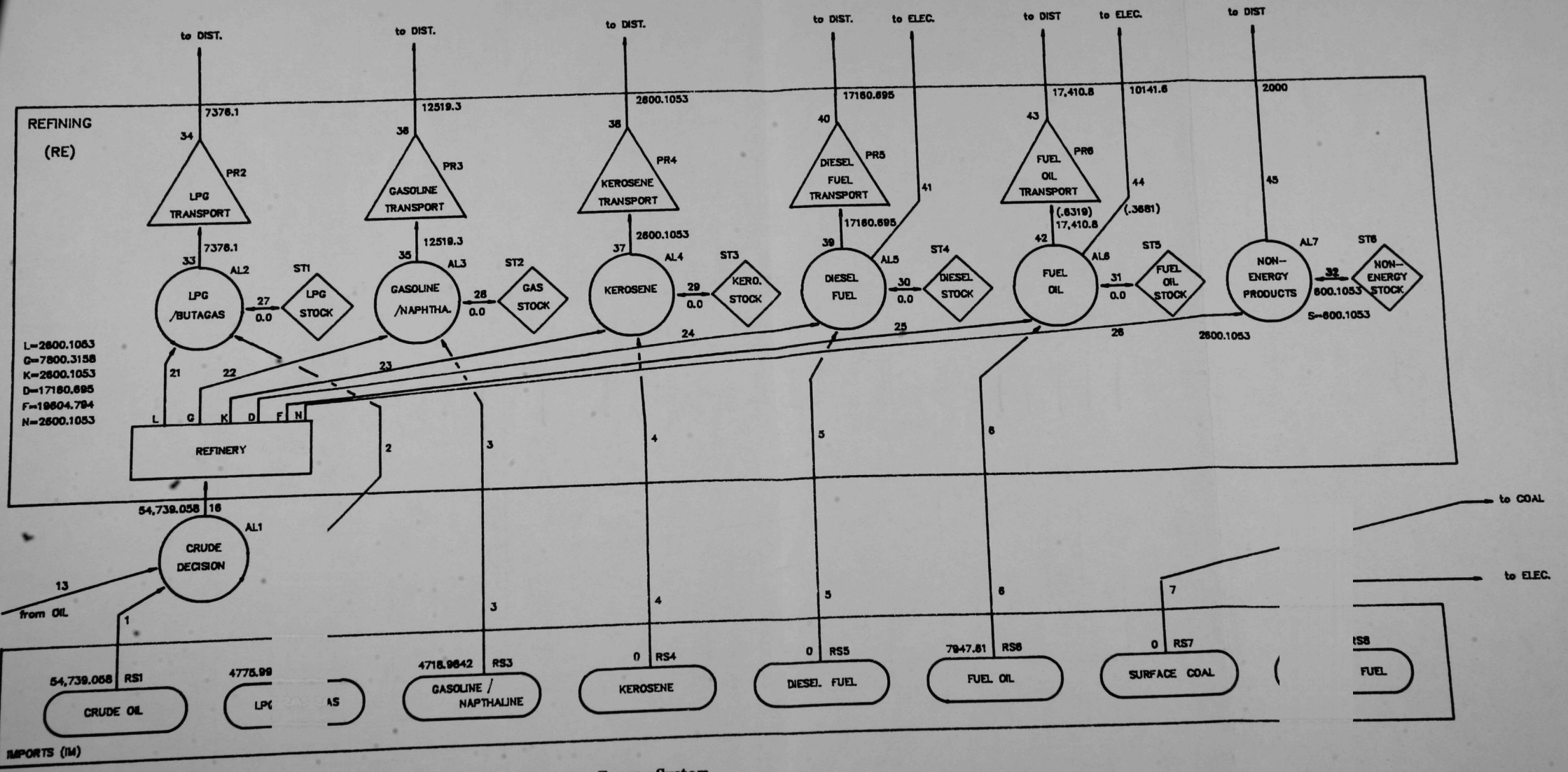
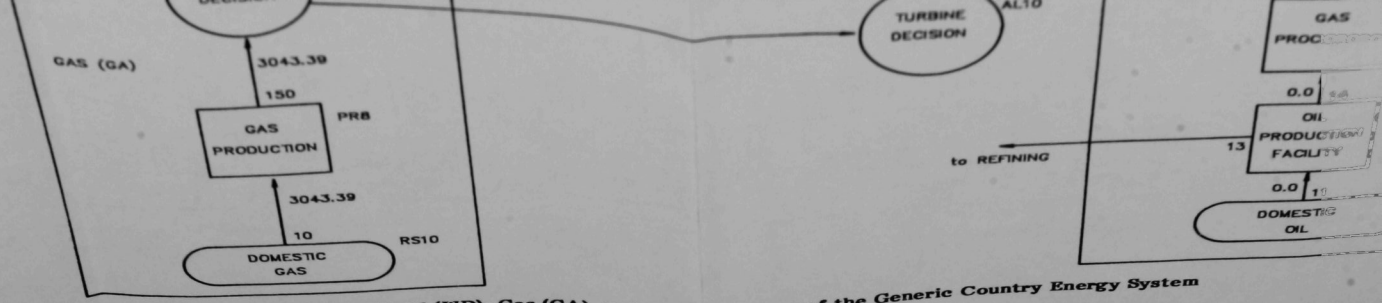


FIGURE 5.7 Refining (RE) and Imports (IM) Sectors of the Generic Country Energy System



URE 5.8 Electricity (EL) Generation, Wood (WD), Gas (GA), and Oil (OI) Sectors of the Generic Country Energy System

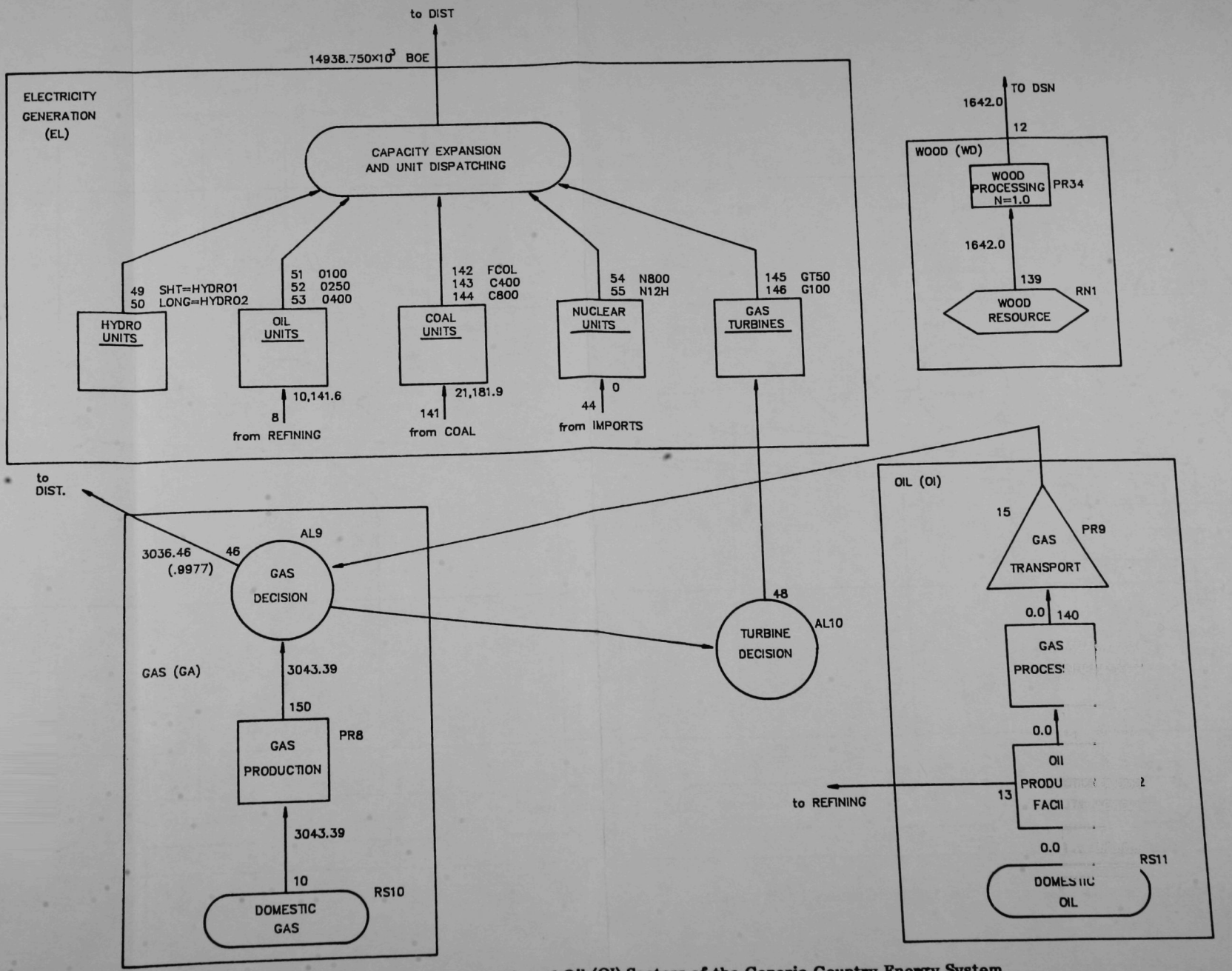


FIGURE 5.8 Electricity (EL) Generation, Wood (WD), Gas (GA), and Oil (OI) Sectors of the Generic Country Energy System

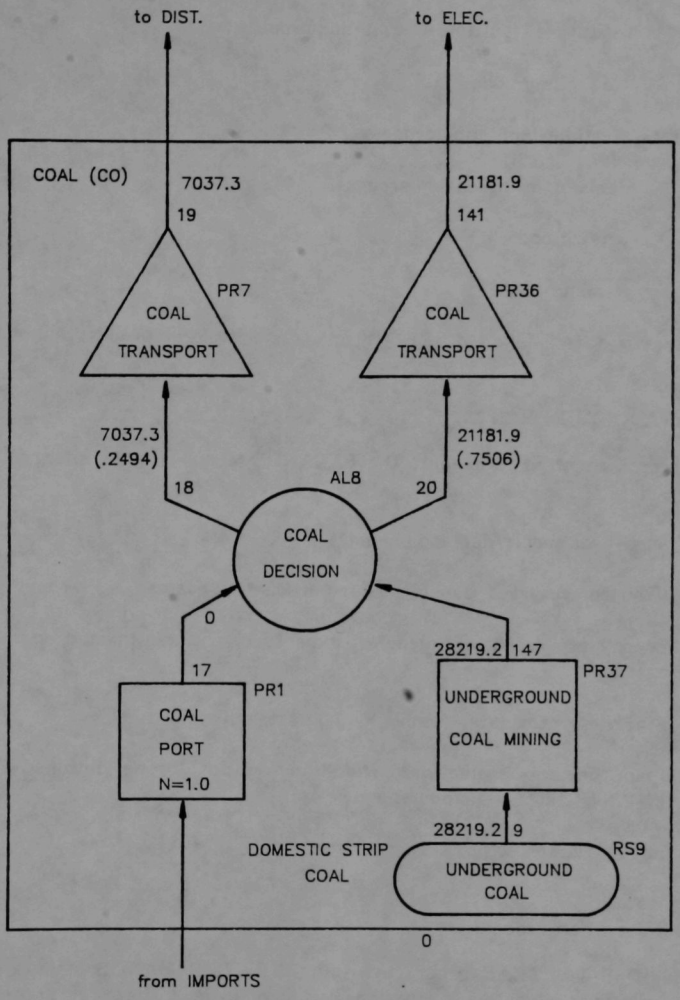


FIGURE 5.9 Coal (CO) Sector of the Generic Country Energy System

PR - conversion process

RE - refining or multiple-output-link proces

ST - stockpiling node

MI - multiple-input-link process

AL - decision or allocation process

PP - pricing node

DE - demand node.

For example, if a node is labelled PR13, this node is conversion process number 13.

DATA REQUIREMENTS

The data required to execute the BALANCE Module for the energy network are as follows:

- Base-year supply/demand balance;
- Resource reserves, capacities, and production costs;
- Energy processing efficiencies, capacities, and capital and operating costs;
- Electric sector data, such as load duration curves;
- Final demand projections, which can optionally be obtained from ENPEP's DEMAND module; and
- Import fuel price projections.

IDES Iteration Procedure

The IDES FORTRAN program within ENPEP's BALANCE Module processes a system of simultaneous nonlinear equations and inequalities. These relationships, defined by input parameters associated with each node in your network, specify the transformation of energy quantities and energy prices through the various stages of energy production, processing, and use within your network. An equilibrium model represented by your network is solved by finding a set of prices and quantities that satisfy all relevant equations and inequalities.

To find the equilibrium solution to your network, the model makes initial estimates of values of fuel importation and production quantities at the bottom of the network. After the initial estimates are made, the prices of fuel on each successive link going up the network are computed from the price equations defined by the various nodes. Next, the solutions to all the quantity equations associated with the nodes of your network are computed for successive links going down the network. If all equations in the network are satisfied by the initial estimated quantities, a solution to the model has been found. Otherwise, the quantities at the bottom of the network are automatically adjusted, and all equations are solved again. This iteration process continues until the proper values for the quantities at the bottom of the network have been found.

The model's solution procedure is summarized in the following five steps:

1. Estimate quantities at the bottom of the network for all depletable and renewable resource nodes. (The previous year's quantities of resource production are used as these estimates.)

2. Solve the price equations in order, starting with the price equations for the depletable and renewable resource nodes and going up the network. This phase is referred to as the up-pass.

3. Compute the quantities demanded, based on the prices computed for the input links to the demand processes.

4. Solve the quantity equations successively in reverse order going down the network starting with the demand quantities. This is referred to as the down-pass.

5. Compare the quantities computed on the down-pass for the resource processes with the initial estimates. If these quantities are approximately equal (within an amount referred to as the convergence tolerance), the model is said to be converged, and an equilibrium solution has been found. If the model is not converged, the initial estimates for the depletable and renewable resource quantities are automatically adjusted, and another iteration is begun, starting at Step 2. The procedure for adjusting the quantities is referred to as the algorithm.

Interpreting IDES Equilibrium Solutions

The equilibrium modeling approach used in the BALANCE Module is based on the concept that the energy sector consists of autonomous energy producers and consumers that carry out production and consumption activities, each optimizing individual objectives. In contrast, optimization models of the entire energy sector, such as linear programming formulations, can take in the interpretation of a central planning authority that has control over all energy flows and prices in the entire energy sector.

The solution of an equilibrium model, such as the IDES program, should be interpreted as what is likely to happen, given that the assumptions about the relationships and data in the model are correct. In some circumstances, the output can also be interpreted as prescriptive, indicating what should happen or what will happen. For example, the model solution may prescribe what value energy prices should be set at in order to recover all costs of production and processing, if all government price controls are removed in a run of the model and prices are allowed to reflect only costs.

5.1.3 Approach

The BALANCE Module guides you to a set of submodules through a hierarchy of menus and forms displayed on your screen. You can use these forms to enter data to design an energy network illustrating energy flows from supply to demand activities. Once all data are entered, the IDES FORTRAN program processes the data to project an energy supply/demand balance and generates several output files. These output files can then be viewed or printed by branching to the appropriate BALANCE submodule.

5.1.4 Functions

The IDES FORTRAN program performs three major functions:

- Computing annual energy flows from resource production, conversion, and utilization activities;
- Computing energy prices for all energy activities (each link of the energy network);
- Passing relevant data to the LOAD, ELECTRIC, and IMPACTS Modules.

Data are passed to the FORTRAN program through a series of forms with which you may view, define, change, delete, or add data on up to several dozen records of various types. Special function keys are used to manipulate and display records. On some forms, you can move forward or backward through all records associated with that form. By using a combination of the special function keys, you can quickly display any of the available records. You can then use the standard cursor-control functions and keys (as discussed in the *Introduction* in the front of this volume) to change the data in the displayed record. In most cases, once you change data records, the data will be copied to a temporary file and subsequently can be permanently saved.

5.2 Structure

The following diagram (Fig. 5.10) illustrates the relationships among the various menus and forms used in this module. The numbers outside the boxes indicate the keystroke that you must enter or the option you must select to advance to a particular form or carry out a specific function when more than one option is available.

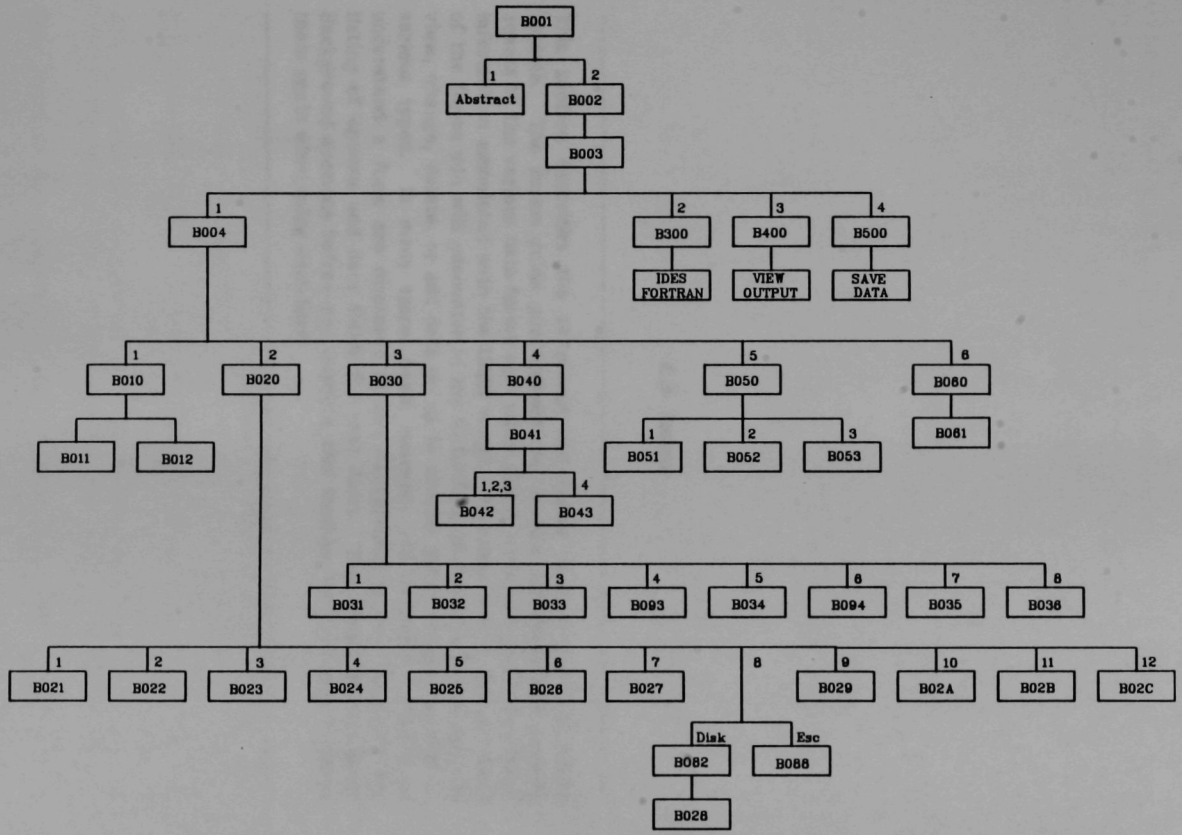
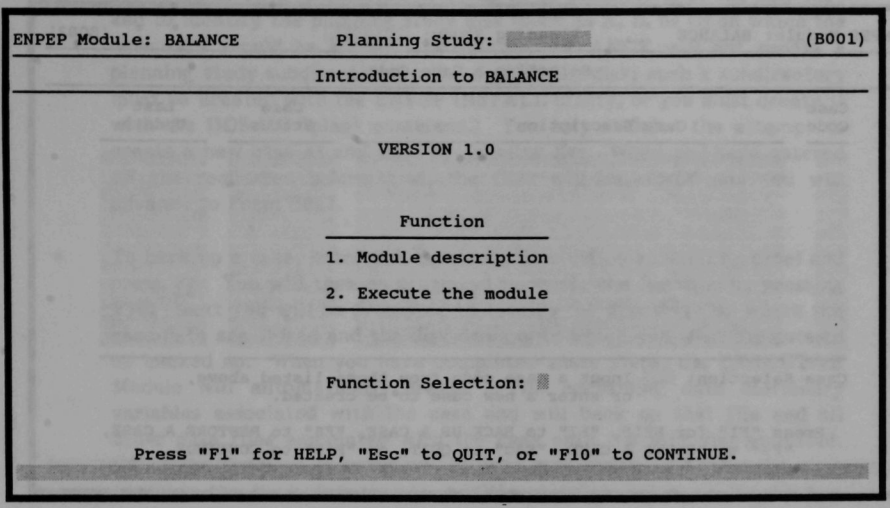


FIGURE 5.10 BALANCE Module Hierarchy

5.3 Forms

This section describes the 44 menus and forms used in the BALANCE Module. The forms guide you through the module hierarchy and provide access to the various data forms that allow you to view and modify technical information associated with the IDES model. You should note that on many of the forms you will encounter in the BALANCE Module you are allowed to view, change, delete, or add data on up to several dozen process records of various types. In many cases, basic concepts and definitions needed to understand a form are discussed in the Background section following the listing of options and data fields for that form. You should review those Background sections before you execute this module, and you may refer to them again when using each form.

5.3.1 Menu B001 — Introduction to BALANCE



Purpose

Menu B001 is the introductory menu for the BALANCE Module. It allows you either to view an abstract describing the module or to begin execution of the module. You advanced to this menu by selecting to execute the BALANCE Module while in Menu X003 of the EXECUTIVE Module.

Options

1 Select this option to view an abstract describing the BALANCE Module. You will be placed in the ENPEP Paging Routine and you will be able to move from page to page in the abstract.

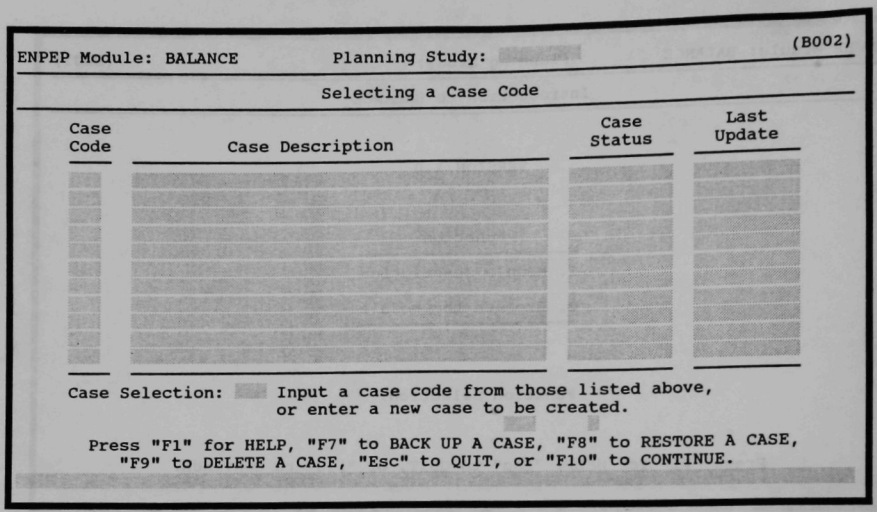
2 Select this option to begin execution of the BALANCE Module. You will advance to Form B002.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help. (See the Introduction in the front of this volume for information on the on-line help available in ENPEP.)

Esc Press this key to return to Menu X003 in the EXECUTIVE Module.

5.3.2 Form B002 — Selecting a Case Code



Purpose

This form allows you to select a case (identified by a three-digit case code) that contains data needed to execute this module. You also can perform a number of data management and maintenance operations from this form. You advanced to this form by selecting option 2 in Menu B001. Four items of information for each case associated with your previously selected planning study are displayed on this form: a case code, a case description, a status variable indicating whether the case is complete or incomplete, and a date indicating the last time the specific case was modified.

Options

- To select an existing case, enter a case code from those displayed on the screen and press **F10**. You will be prompted to identify the disk drive (such as A, B, or C) on which the data are stored. The data files for the case you have selected will be copied into the C:\BALANCE\ working subdirectory and you will advance to Menu B003. (If you enter a case number that does not exist, it is assumed that you wish to create a new case, as discussed below.)

- To create a new case, enter a nonexistent case number and press **F10**. You will then be prompted to enter the case code (from those displayed

on the screen) to be copied to your new case. Next you will be prompted to enter a description (of up to 40 characters) of the new case and to identify the planning study disk (such as A, B, or C) on which the new case should be stored. (Note that BALANCE will not create a planning study subdirectory on the destination disk; such a subdirectory must be created with the ENPEP INSTALL utility, or you must create it with the DOS MD \plan\ command.) You may abandon the attempt to create a new case at any time by pressing **Esc**. When you have entered all the requested information, the files will be stored and you will advance to Form B003.

- To back up a case, enter the case code (it must be an existing case) and press **F7**. You will then be prompted to verify the function by pressing **F10**. Next you will be prompted to specify the disk drive on which the case data are stored and the disk drive onto which you wish the data to be backed up. When you have completed these steps, the EXECUTIVE Module will automatically create a file containing data dictionary variables associated with the case and will back up that file and all other data files associated with the case onto the disk you specified. (When the function is complete, be sure to properly label the disk that contains the backedup case.) Additional information on the backup option is provided in the Background section below.

- To restore a case, enter the case code that has been previously backed up and press **F8**. The case you select must not be already displayed on this form. You will be prompted to enter the identity of the disk drive onto which the data are to be restored and the identity of the disk drive from which the data are to be obtained.

- To delete a case, enter the three-digit case code and press **F9**. You will then be prompted to reenter the case code to verify your initial selection, and finally you will be asked to enter the identity of the disk drive (such as A, B, or C) that contains the BALANCE data for the current planning study. Unless you press **Esc** in response to these prompts, all files for this case (and all other relevant Data Dictionary variables) will be deleted.

- Press **F1** to obtain on-line help.

- Press **Esc** to return to Menu B002.

Background

Two DOS files are created when the backup function is selected in Form B002: DEFIN.BCK and BSTAT.BCK. These files, as well as all data files on the source disk associated with a case, are backed up onto the

destination disk using the DOS utility BACKUP. The destination files do not contain the name of the source (planning study) subdirectory because of the use of the SUBST command available in DOS 3.1. This command allows ENPEP to avoid tagging backedup cases with a planning study subdirectory name that would prevent you from restoring cases from one planning study to another.

5.3.3 Menu B003 — Selecting a Major BALANCE Module Function

```
ENPEP Module: BALANCE      Planning Study:          Case:          (B003)
                  Selecting a Major BALANCE Module Function

                                                          Last
      Major BALANCE Function                  Status      Update
    1. View or change network information
    2. Execute model using existing network
    3. View model output
(a) 4. Save selected data sets

                  Function Selection:   (1-4, from above list)
(a) Option 4 should be run BEFORE you press "Esc" to exit this form.

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu B003 allows you to branch to the various functions that are available in the BALANCE Module. You advanced to this menu after selecting a case to execute in Form B002. You can perform the following functions in this menu: (1) view or change the BALANCE network and all associated input data, (2) execute the BALANCE FORTRAN program, which uses the network input data and produces several output files, (3) view the output files produced by the BALANCE FORTRAN program, and (4) save the temporary data files, originally copied from your planning subdirectory to C:\BALANCE\, back to your planning subdirectory.

Options

1 Select this option to view or change network information (the types of information available to you are listed below in the Background section). You will advance to Menu B004.

2 Select this option to execute the BALANCE FORTRAN program using the existing network. You will advance to Form B300. (In Form B300, you will be prompted to enter several additional data items. When that information is complete, BALANCE will format all required data for the IDES FORTRAN program, and the program will begin execution.

After execution is complete, you will be returned to Menu B003 and will be able to view the program's output by selecting option 3 below.)

3 Select this option to view the output files generated by the BALANCE FORTRAN simulation program. You will advance to Form B400. After viewing the output, you will be returned to Menu B003.

4 Select this option to save any data files you have changed. You will advance to Form B500 to carry out this task, and then return to Menu B003. *(If you do not use this option, any changes you make while in this menu will be lost when you press Esc.)*

F10 Press this key to continue after you select an option.

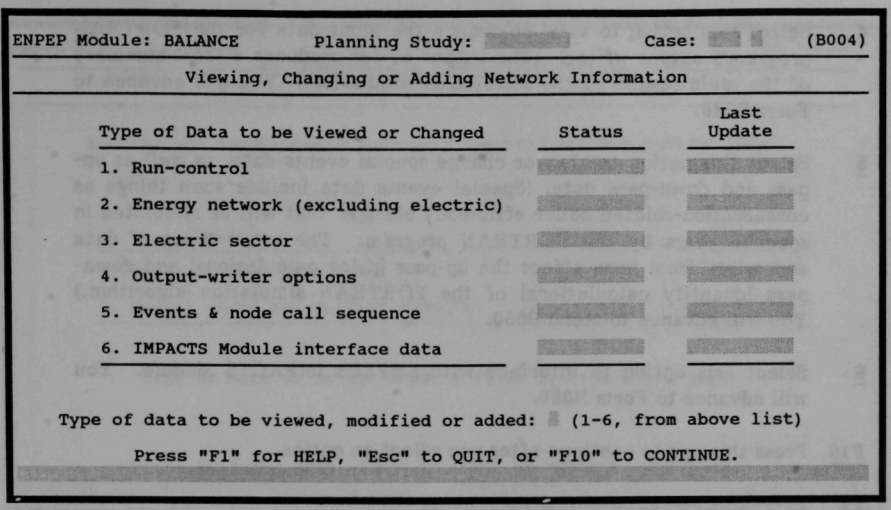
F1 Press this key to obtain on-line help.

Esc Press this key to exit Menu B003 and return to Form B002. (Note: If you select this option, data changes not saved under option 4 above will be lost.)

Background

All data that can be entered into the BALANCE FORTRAN program can be viewed or changed by selecting option 1 on Menu B003. The types of data include: (1) FORTRAN run control information, (2) network information for the electric and nonelectric sectors, including ELECTRIC Module interface information, (3) output-writer control information, (4) special time-dependent events for the FORTRAN program, (5) node-call sequences for the FORTRAN program's up-pass and down-pass algorithms, and (6) IMPACTS Module interface information.

5.3.4 Menu B004 — Viewing, Changing, or Adding Network Information



ENPEP Module: BALANCE Planning Study: Case: (B004)

Viewing, Changing or Adding Network Information

Type of Data to be Viewed or Changed	Status	Last Update
1. Run-control		
2. Energy network (excluding electric)		
3. Electric sector		
4. Output-writer options		
5. Events & node call sequence		
6. IMPACTS Module interface data		

Type of data to be viewed, modified or added: (1-6, from above list)

Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.

Purpose

From Menu B004 you can branch to functions that enable you to view, change, delete, or add to the six categories of data needed by the IDES FORTRAN program. You advanced to this menu by selecting option 1 in Menu B003.

Options

1 Select this option to view or change run-control data. (These data include the base year of the study, number of years in the study period, and iteration and convergence parameters. These data also affect the level of output printed during the IDES FORTRAN execution.) You will advance to Menu B010.

2 Select this option to view or change the network data for nonelectric sectors. (These data consist of information on the nodes and links in the nonelectric sectors of the energy network.) You will advance to Menu B020.

3 Select this option to view or change data associated with the electric generation submodel of the FORTRAN program. (These data include FORTRAN output control options, information from the PLANTDATA Module, information for electric unit conversions, and data for

interfacing to ENPEP's ELECTRIC Module.) You will advance to Menu B030.

4 Select this option to view or change the input data for the FORTRAN program's output writer. (The output writer produces a short summary of the main results of the FORTRAN simulation.) You will advance to Form B040.

5 Select this option to view or change special events data, as well as up-pass and down-pass data. (Special events data include such things as conservation-related boiler efficiency changes that will be simulated in specific years by the FORTRAN program. The other types of data accessible from here affect the up-pass [price calculations] and down-pass [quantity calculations] of the FORTRAN simulation algorithm.) You will advance to Menu B050.

6 Select this option to interface with ENPEP's IMPACTS Module. You will advance to Form B060.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu B003.

5.3.5 Menu B010 — Viewing or Changing Basic Run Control Data

```
ENPEP Module: BALANCE      Planning Study:          Case:        (B010)
                Viewing or Changing Basic Run Control Data

      You can now access basic program parameters and run control data.

                                                          Last
            Option                              Status    Update
      1. Basic program parameters
      2. Output codes and scaling factors

          Type of data to be accessed:  (1 or 2, from above list)

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu B010 allows you to view or change basic program parameters and output codes and scaling factors used by the FORTRAN simulation program. You advanced to this menu by selecting option 1 in Menu B004.

Options

1 Select this option to view, change, or add program parameters such as convergence errors, echo flags, relaxation ranges, and the base year and number of years in the simulation. You will advance to Form B011.

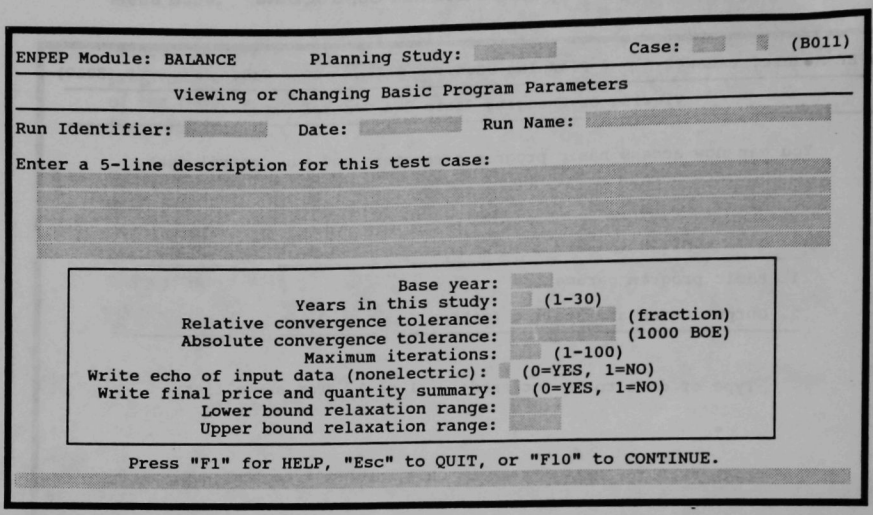
2 Select this option to view or change output codes and scaling factors. You will advance to Form B012.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu B004.

5.3.6 Form B011 — Viewing or Changing Basic Program Parameters



Purpose

Form B011 contains the first half of the run control data and allows you to change the basic bookkeeping and technical input parameters used by the IDES FORTRAN simulation program. You advanced to this form by selecting option 1 of Menu B010. There are a number of data fields on Form B011, and you can position the cursor to any of them by using the standard ENPEP cursor-control keys. Additional run control data are presented on Form B012.

Options

- View or change the values in the data fields described below by using standard cursor-control functions.
- Press **F10** to save the changed values and return to Menu B010.
- Press **Esc** to return to Menu B010 without saving any changes you have made.
- Press **F1** to obtain on-line help.

Data Fields

Run Identifier: This field contains an eight-character string that can be used to identify the current simulation. It is not used by the IDES FORTRAN simulation; it is simply printed in the output reports.

Date: This field contains the current date. It is printed in the output reports.

Run Name: This field, 23 characters long, is similar to the run identifier above. It is printed in the output reports.

Description: There are five fields, each of 76 characters, that can be used to briefly describe the current simulation. It is printed in the output reports.

Base-year: This field contains the initial year (such as 1991) of the simulation period.

Years in This Study: This field contains a two-digit integer representing the length (in years) of the simulation period. The length includes the base year. For example, if the model is to be run for the period that starts at the beginning of 1991 and ends at the end of 2010, this value should be 20.

Relative Convergence Tolerance: This field contains a decimal fraction (1% should be entered as .01) representing the allowable convergence tolerance. If the relative convergence error is less than the value entered, the system is said to be converged for that particular year. The model then advances to the next year and resumes the iteration process.

Absolute Convergence Tolerance: This field contains an integer representing the convergence tolerance in terms of absolute energy flow units, such as thousands of barrels-oil-equivalent (10^3 BOE). If the convergence error is less than the amount entered, the system is said to be converged for that particular year, and the model advances to the next year and resumes the iteration process.

Maximum Iterations: This field contains a three-digit integer representing the maximum number of iterations allowed for model convergence in a single year. If the system is not converged in a particular year after having performed the maximum iterations, the model terminates and a message to that effect is displayed.

Write Echo of Input Data (nonelectric): This field is used as a flag to indicate if you want nonelectric data printed in the output file DATA.OUT. If you do want the data printed, set the flag at 0. If you do not want it printed, set the flag at 1.

Write Final Price and Quantity Summary: This field is used as a flag to indicate whether you want the final price and quantity summary printed in the output file TIME.OUT. If you set the flag at 0, the summary will be printed; if you set it at 1, the summary will not be printed.

Lower Bound Relaxation Range: This field is a five-place value representing the lower bound on the iteration relaxation parameter. It usually should be set at 0.1. This parameter indicates the fraction of the interval between successive estimates of the equilibrium quantity that will be used as a lower bound for the estimate of the equilibrium quantity on the next iteration.

Upper Bound Relaxation Range: This field contains a five-place value representing the upper bound of the iteration relaxation parameter. It usually should be set at 0.9. This parameter indicates the fraction of the interval between successive estimates of the equilibrium quantity that will be used as an upper bound for the estimates of the equilibrium quantity on the next iteration.

Background

When the information on this form is saved, you must indicate whether that information is complete or if it is incomplete and you intend to return and complete it later. Before the FORTRAN program's input data file is created from all the information on all the forms, BALANCE verifies that this information is complete. If any data needed by the FORTRAN program are incomplete, the program will not be run and an appropriate message will be displayed on your screen.

5.3.7 Form B012 — Viewing or Changing Output Codes and Scaling Parameters

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B012)

          Viewing or Changing Output Codes and Scaling Parameters

   Output Code for       (enter: 1=output, 0=no output)
   Final Prices    1 2 3 4 5 6 7 8 9   1 2 3 4 5 6 7 8 9   1 2 3 4 5 6 7 8 9
   and Quantities:

                         (enter: 2=output for converged iteration only
Output Code for          1=output for specified iterations, 0=no output)
Price and Quantity 1 2 3 4 5 6 7 8 9   1 2 3 4 5 6 7 8 9   1 2 3 4 5 6 7 8 9
Calculations:

                  1   2   3   4   5   6   7   8   9   10  11  12  13  14  15
   First Iteration:
    Last Iteration:

                          Scaling Factor    Unit Label
                Quantity:
                   Price:

        Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Form B012 contains the second half of the run control data (the first half being in Form B011). You advanced to this form by selecting option 2 of Menu B010. On this form you can change several basic technical parameters used by the IDES FORTRAN simulation program. These include output codes and scaling parameters.

Options

- View or change the values in the data fields described below using standard cursor-control keys.
- Press **F10** to save the changed values. You will be prompted to indicate if the information on the form is complete and ready for insertion into the FORTRAN input file. To affirm this, press **F10** again, otherwise press **Esc**. In either case, you will return to Menu B010.
- Press **Esc** to return to Menu B010 without saving any changes you have made. (Pressing **Esc** will not alter the completeness or incompleteness of the previous data.)
- Press **F1** to obtain on-line help.

Data Fields

Output Code for Final Prices and Quantities: These fields are used as flags to indicate whether you wish to record the prices and quantities for various years of the planning study. There is one field of this type for each year of the planning study. For a given year, output-writer results, as well as the prices and quantities computed on all links of the network, will be recorded for eventual display if you set the output code for that year at 1. Such information will not be stored if you set that code at 0. The file containing this report is TIME.OUT.

Output Code for Price and Quantity Calculations: These fields are used as flags to indicate whether you wish to record the detailed price and quantity calculations. There is one field of this type for each year of the planning study. For a given year, detailed information calculated during the iteration process is printed in SUM.OUT if you set the associated output code at 1, but is not printed if that code is 0. If an output code is 1, there must be appropriate entries in the next two field types discussed below.

First Iteration: This field type is used to indicate the first algorithm iteration for which detailed results of the price and quantity calculations are to be output. This information must be entered for each year such results are desired. For example, if you enter a 1 to indicate you want detailed results of price and quantity calculations for the fifth year of the study in the previous field type, you must also enter, in this field, the number of the first iteration for which those results are to be printed. Similarly, you must enter the last iteration for which those results are desired in the next field type described below. These fields are not used if corresponding entries in the previous field type are 0.

Last Iteration: This field is used to indicate the last algorithm iteration for which detailed results of the price and quantity calculations are to be output. This information must be entered for each year these results are desired. For example, if you enter a 1 to indicate you want detailed results of price and quantity calculations for the fifth year of the study in the field *Output Code for Price and Quantity Calculations* (above), in this field you must also enter the number of the last iteration for which those results are to be printed. Similarly, you must enter the first iteration for which those results are desired in the previous field type described above. These fields are not used if corresponding entries in the output field above are 0.

Scaling Factor for Quantities: This field is used to indicate quantity scaling factor on links of your network. Although all quantities must be entered in thousands of BOE/year because of field width constraints, you can scale the quantities displayed in your output report (in the TIME.OUT file) by this factor. Unless you want to change the quantity units from thousands of BOE/year, this field should be set at 1.

Label for Final Quantity Units: This field is used to set the label for final quantity units on links of your network. This label is printed in the output file as a heading for the list of quantities on the network links. If the quantity scaling factor in the previous field above is 1, the label in this field should be *1000 BOE/year*.

Scaling Factor for Prices: This field is used to set the scaling factor on links of your network. Although all prices must be entered in $U.S./BOE because of field width constraints, you can scale the prices displayed in your output report (in the TIME.OUT file) by this factor. Unless you want to change the price units from $U.S./BOE, this field should be set to 1.

Label for Final Price Units: This field is used to set the label for the final price units on links of your network. This label is printed in the output file as a heading for the list of prices on the network links. If the price scaling factor field above is 1, the label in this field should be $U.S./BOE.

5.3.8 Menu B020 — Viewing or Changing Energy Network Data

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B020)

                Viewing or Changing Energy Network Data

                                                          Status   Last Update
      Type of Data to be Viewed or Changed
  1. Depletable resource / import fuel process
  2. Depletable resource price projections
  3. Renewable resource process
  4. Decision / allocation process
  5. Conversion process
  6. Multiple-input-link process
  7. Demand process
  8. Demand growth projections
  9. Multiple-output-link process
 10. Stockpile
 11. Price regulation process
 12. Capacitated links

Type of data to be viewed, changed or added:    (1-12, from above list)
        Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu B020 allows you to view, change, or add 12 types of network and control data used by the IDES FORTRAN simulation program. You advanced to this menu by selecting option 2 on Menu B004. Data associated with the 12 options displayed here are labeled with a *Complete/Incomplete* status, as well as with a date on which they were last changed.

Options

1 Select this option to view or change depletable resources and import fuel process data. You will advance to Form B021. The information associated with each of these processes includes process number, name and sector, link number, price projection set identifier, and information on the supply curve, the base-year quantity, and an annual capacity.

2 Select this option to view or change depletable resource price projection growth rates. You will advance to Form B022, where up to 30 growth rate sets can be defined.

3 Select this option to view or change renewable resources data. You will advance to Form B023. You will have access to output link number, production cost curve information, a base-year quantity, and an annual capacity.

4 Select this option to view or change decision and allocation process data. You will advance to Form B024, which contains data on input and output links, premium multipliers, stockpile information, base-year splits, and pricing.

5 Select this option to view or change conversion process data. You will advance to Form B025. Information on each of these processes includes an input and output link, and technical characteristics such as efficiency, capacity, capacity factor, and an interest rate fraction.

6 Select this option to view or change multiple-input-link process data. You will advance to Form B026. Information on each of these processes includes an input and output link, and technical characteristics such as efficiency, capacity, capacity factor, and an interest rate fraction.

7 Select this option to view or change energy demand process data. You will advance to Form B027 and have access to all process data, including process numbers and names, sector abbreviations, input links, and demand growth projection set identifiers.

8 Select this option to view or change energy demand growth rate data. You will be prompted to indicate whether you want to add new growth rates from the DEMAND Module, or if you want to access the growth rates already defined in BALANCE. If you choose to add new DEMAND growth rates to those already existing in BALANCE, you must respond to the prompt with the letter of the disk drive on which your desired DEMAND case exists (such as A, B, or C) (do not press Enter after you enter the disk drive letter). You will advance to Form B082 to select a DEMAND Module case and hence to Form B028 to add new growth rates. If you choose not to add any new DEMAND growth rates, you must respond to the original prompt by pressing Esc. You will advance to Form B088 and be able to change growth rates already defined in your BALANCE case. The data associated with each of the 30 demand growth rate sets include a projection set identifier and sector, as well as the actual energy demand growth rates.

9 Select this option to view or change multiple-output-link (refinery) process data. You will advance to Form B029 and be able to view, add, delete or change such data as an input link, refinery slate information, output links, price ratios, stockpile identification, and technical characteristics for each process.

10 Select this option to view or change stockpile data. You will advance to Form B02A, where you will have access to the stockpile number and label, a sector, a link number, and the quantity removed in the base

year, as well as the quantity remaining in the base year for each stockpile.

11 Select this option to view or change price regulation data. You will advance to Form B02B. Data related to each of these processes include an input and output link, a price multiplier and additive factor, and an adjusted price reference link.

12 Select this option to view or change information on capacitated links. You will advance to Form B02C; such information as link numbers, decision/allocation node numbers, and link capacities will be displayed.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu B004.

5.3.9 Form B021 — Viewing or Changing Depletable Resource and Import Fuel Process Node Data

```
ENPEP Module: BALANCE        Planning Study:          Case:      (B021)

     Viewing or Changing Depletable Resource and Import Fuel Process Data

                  Process number:    (1-30, or 0 to delete record)
                    Process name:
              Sector abbreviation:

                Output link number:    (1-500)
              Price projection set:    (1-30)

                Intercept of supply curve:              $/BOE
                    Slope of supply curve:
  Quadratic Coefficient of supply curve:

                     Base-year quantity:              1000 BOE
                   Annual capacity limit:             1000 BOE/year

                            This is record    of 30.

        Press "F5" to GO BACK 25 RECORDS, "F6" to ADVANCE 25 RECORDS,
              "F7" to GO BACK  5 RECORDS, "F8" to ADVANCE  5 RECORDS,
        "F9" to GO BACK  1 RECORD, "F10" to ADVANCE  1 RECORD,"F1" for HELP,
        "Esc" to IGNORE CHANGES AND QUIT , or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

In Form B021 you are allowed to view, change, delete, or add up to 30 depletable resource or import fuel process records. You advanced to this form by selecting option 1 in Menu B020. Depletable resource nodes are used to model the domestic production and importation of depletable resources such as crude oil, coal, and petroleum products. The general options available in this form are listed below, followed by a description of the data fields and then, under Background, a general description of depletable resource data.

Options

- To view or change values in data fields described below on up to 30 records, use the standard cursor-control functions and the following special record-manipulation functions: press **F6** to advance 25 records, **F8** to advance 5 records, **F10** to advance 1 record, **F5** to go back 25 records, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to a 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and then enter the information required on the form. The new record will be saved when you press **F4**.
- Press **F4** to save changes and return to Menu B020.
- Press **Esc** to ignore changes and return to Menu B020.
- Press **F1** to obtain on-line help.

Data Fields

Process Number: Valid values for this integer range from 1 to 30, but you may enter a 0 to indicate that the process record currently displayed on the screen is not to be kept after you press **F4** to save the data. If the record is deleted by entering a 0 for the process number, all other numeric data field values will be ignored. There is no required relationship between this process number and the current record number displayed at the bottom of the screen.

Process Name: This 12-character name can contain any text that will help you identify the current depletable resource process.

Sector Abbreviation: Use this three-character abbreviation to help you identify the process.

Output Link Number: In this data field, an integer ranging from 1 to 500 must be entered for each depletable resource process. This is the number of the output link for the process, as represented in the energy network. If the current record has been deleted, this link number may be 0.

Price Projection Set: Each projection set must be identified with a number from 1 to 30, and you must select one of the sets for each depletable resource process. The actual price projection sets, defined in Form B022 when you select option 2 on Menu B020, establish the values R_t used in the supply curve equation described in Eq. 5.1 (see Background section below). A supply curve that relates a price with a cumulative quantity of a resource must be established for each renewable resource, and is defined by this and the other parameters defined below.

Intercept of Supply Curve: This field represents the value of A(Q) for the base year in Eq. 5.1. The units are $U.S./BOE.

Slope of the Supply Curve: This value is represented by the coefficient B in Eq. 5.1.

Quadratic Coefficient of the Supply Curve: This coefficient is the value C in Eq. 5.1.

Base-year Quantity: This field represents the base-year energy flow for a depletable resource.

Annual Capacity Limit: This field represents the annual capacity limit (in the base year) of the energy flow from a depletable resource node. If no capacity limit exists, this value should be set to a very large number, such as 100,000,000.

Background

By convention, a depletable resource node has a single output link and no input links. Depletable resource nodes are used to model the domestic production and/or importation of depletable resources such as crude oil, coal, and petroleum products.

A single equation is associated with a depletable resource node. The equation relates the cost (or price, depending upon the use of the resource node) of producing or importing the resource to the total, cumulative (over all periods) amount of the resource produced or imported. Effectively, the equation represents a long-run supply curve for the resource (see Fig. 5.11). The price of a depletable resource can be computed from the following equation:

$$P_t = A(Q) \times (1 + R_t) + B \times Q_t + C \times Q_t^2 \qquad (5.1)$$

where:

P_t = cost (price) of the resource in period t.

Q_t = quantity of the resource produced or imported in period t.

A(Q) = intercept of the supply curve for the resource after having extracted a cumulative amount Q of the resource previous to time t. This value is adjusted at the end of each year in the simulation period based on the amount of the resource produced or imported during the year. [The initial value of A(Q) in the base year can be taken as the price of the resource in the base year.]

R_t = growth rate in real terms of the cost (price) of the resource.

B = slope of the supply curve for the resource.

C = a quadratic coefficient for the supply curve.

The base-year value of A(Q) and the values of B and C vary by resource and are part of the data you enter in the model. To model the price projection of an imported fuel, use Eq. 5.1 in the following way: (1) set A(Q) equal to the price of the imported fuel in the base year; (2) set B = 0 and C = 0 to nullify the effect of the amount of imported fuel on its price; and (3) provide the annual growth rates for the imported fuel price projections as data entered in the model.

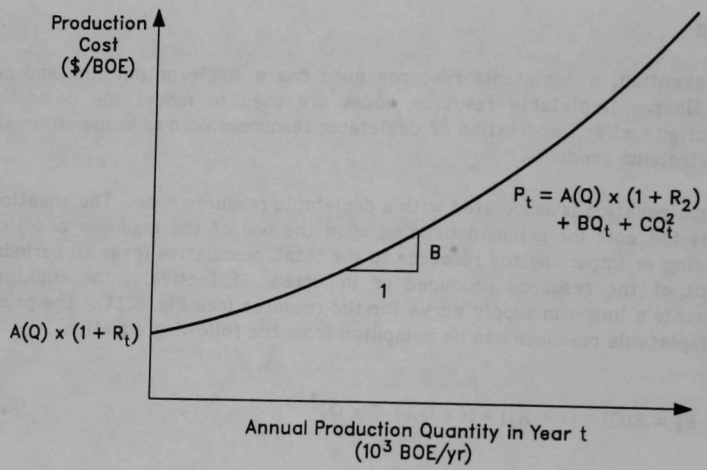


FIGURE 5.11 Depletable Resource Supply Curve

5.3.10 Form B022 — Viewing or Changing Depletable Resource Price Projections

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B022)

          Viewing or Changing Depletable Resource Price Projections

          Projection set number:    (1-30, or 0 to delete record)
            Projection set name:

                        Fractional Growth Rates
                        Between Successive Years

                    1     2     3     4     5
                   ____  ____  ____  ____  ____
                   ____  ____  ____  ____  ____
                   ____  ____  ____  ____  ____
                   ____  ____  ____  ____  ____
                   ____  ____  ____  ____  ____
                   ____  ____  ____  ____  ____

                        This is record    of 30.
    Press "F5" to GO BACK 25 RECORDS, "F6" to ADVANCE 25 RECORDS,
          "F7" to GO BACK  5 RECORDS, "F8" to ADVANCE  5 RECORDS,
    "F9" to GO BACK  1 RECORD, "F10" to ADVANCE  1 RECORD,"F1" for HELP,
    "Esc" to IGNORE CHANGES AND QUIT, or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

Form B022 allows you to define projections of annual fuel price growth rates for the depletable resource nodes you requested on Form B021. You advanced to this form by selecting option 2 in Menu B020. As discussed above for Form B021, the data you enter here define the values R_t of Eq. 5.1 that are used in computing the supply curve for a resource. Generally, Form B022 is associated with imported fuels, the price growth rates (real escalation rates) of which are usually taken from exogenous sources. You are allowed to define up to 30 sets of growth rates using Form B022.

Options

- To view or change values in data fields described below on up to 30 records, use the standard cursor-control keys and the following special record-manipulation functions: press **F6** to advance 25 records, **F8** to advance 5 records, **F10** to advance 1 record, **F5** to go back 25 records, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and then enter the information required on the form. The new record will be saved when you press **F4**.
- Press **F4** to save changes and return to Menu B020.
- Press **Esc** to ignore changes and return to Menu B020.
- Press **F1** to obtain on-line help.

Data Fields

Projection Set Number: This field contains a two-digit integer, which must range from 1 to 30, used to identify the price projection growth rates for the depletable resource nodes as described on Form B021 above. If a record is deleted by entering a 0 for the projection set number, all other numeric input fields for that record should also be 0. There is no required relationship between this projection set number and the current record number displayed at the bottom of the form.

Projection Set Name: This is a 16-character field in which you are able to assign a price projection set name for each record in Form B022.

Real Escalation Rates between Successive Years: These fields are used for the actual growth rates for each year of your current BALANCE planning study. Each escalation rate must be specified as a decimal fraction (such as 0.05) rather than as a percentage (such as 5). You can leave the extra fields blank if your planning study period is less than 30 years.

5.3.11 Form B023 — Viewing or Changing Renewable Resource Node Process Data

```
ENPEP Module: BALANCE      Planning Study:          Case:      (B023)
          Viewing or Changing Renewable Resource Process Data

                          Process number:    (1-17)
                            Process name:
                       Sector abbreviation:
                         Output link number:    (1-500)
                  Steps in production cost curve:  (1-5)

  Quantity and Cost of Production for Each Step in Production Cost Curve

Quantity:                                                    1000 BOE
   Price:                                                    $/BOE

                  Update resource curve:  (1=YES, 0=NO)
                     Base-year quantity:          1000 BOE
                        Annual capacity:          1000 BOE

                        This is record    of 17.
        "F7" to GO BACK 5 RECORDS, "F8" to ADVANCE 5 RECORDS,
    "F9" to GO BACK 1 RECORD, "F10" to ADVANCE 1 RECORD,"F1" for HELP,
    "Esc" to IGNORE CHANGES AND QUIT , or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

In Form B023 you are allowed to define up to 17 renewable resource or import fuel process records. You advanced to this form by selecting option 3 in Menu B020. Renewable resource nodes are used to model the domestic production of renewable energy resources such as solar energy and biomass residues. A general discussion of renewable resource data entered on this form is provided under Background at the end of this section (following presentation of the options available in this form and descriptions of the data fields displayed).

Options

- To view or change values in data fields described below on up to 17 records, use the standard cursor-control functions and the following special record-manipulation functions: press **F8** to advance 5 records, **F10** to advance 1 record, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and then enter the information required on the form. The new record will be saved when you press F4.
- Press F4 to save changes and return to Menu B020.
- Press Esc to ignore changes and return to Menu B020.
- Press F1 to obtain on-line help.

Data Fields

Process Number: This field contains an integer up to two digits used to specify the process represented by the record. Valid values for this integer range from 1 to 17, but you may enter a 0 to indicate that the process record currently displayed on the screen is not to be kept after you save the data. If the record is deleted by entering a 0 for the process number, all other numeric data field values should also be 0. There is no required relationship between this process number and the current record number displayed at the bottom of the screen.

Process Name: This 12-character field can contain any name or text that will help you identify the current process.

Sector Abbreviation: This field contains a three-character abbreviation to help you identify each renewable resource process.

Output Link Number: An integer ranging from 1 to 500 must be entered in this field for all renewable resource processes. This is the number of the output link for the process, as represented in the energy network. If the current record has been deleted, this link number may be 0.

Steps in Production Cost Curve: The number of steps (1 to 5) in the production cost curve must be entered in this field. For each step you indicate here, you must supply both a quantity and cost as described for the next two field types.

Quantity of a Resource: This field must contain the resource quantity (in thousands of BOE) for each step of the renewable resource supply curve. One value must be entered for each step specified in the previous field.

Cost of Resource Production: This field must contain the cost of resource production (in $U.S./BOE) for each step of the renewable resource supply curve. One value must be entered for each step specified above.

Update Resource Curve: This field serves as a flag to indicate whether the production in each year should be subtracted from the production cost function. Set this flag at 0 if the quantity should not be subtracted and at 1 if the value should be subtracted. This option allows you to specify that the cost of production tracks the cumulative amount of the resource produced (as with depletable resource nodes) as the model progresses from year to year. In general, this flag should be set at 0 for renewable resources.

Base-year Quantity: This field displays the base-year quantity (in thousands of BOE) of the renewable resource.

Annual Capacity: This field displays the annual production capacity (in thousands of BOE) of the renewable resource. This value represents the maximum quantity of the resource available in any year.

Background

By convention, a renewable resource node has a single output link and no input links, just as a depletable resource node. Renewable resource nodes are used to model the production of renewable energy resources such as solar energy and biomass residues. Examples of renewable resource nodes include solar energy in the household sector, sugar cane production in the sugar sector, wood produced for fuel in the biomass sector, and agricultural residues (such as coconut shells) in the biomass sector.

A step function is associated with a renewable resource node, as seen in Fig. 5.12. The step function relates the cost (or price, depending upon the use of the resource node) of producing the resource to the annual production of that resource. Effectively, the step function represents an annual supply curve. A resource node also models any physical limits on the annual production of the resource. For example, the amount of solar insolation determines an upper limit on the annual amount of solar energy that can be used, or the amount of land devoted to wood production for energy needs allows you to estimate an upper limit on annual wood production.

The form of the step function for a renewable resource node is:

$$P_t = C_1 \text{ if } Q_t \le L_1 \qquad (5.2)$$

$$= C_2 \text{ if } Q_t \le L_2$$

$$= C_3 \text{ if } Q_t \le L_3$$

$$= C_4 \text{ if } Q_t \le L_4$$

$$= C_5 \text{ if } Q_t \le L_5$$

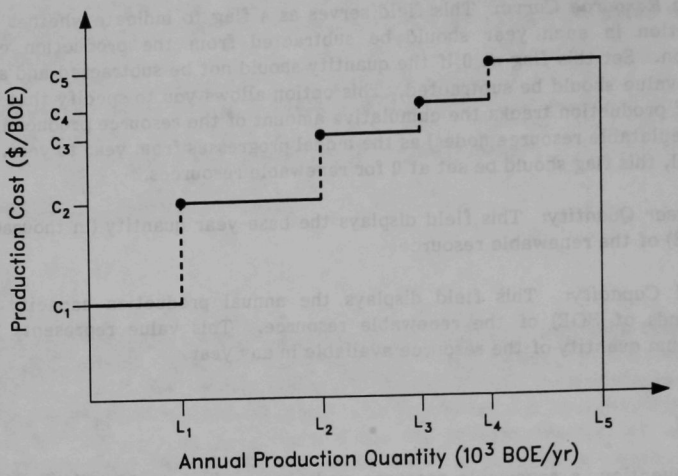


FIGURE 5.12 Renewable Resource Supply Curve

where:

P_t = cost (price) of the resource in period t.

Q_t = quantity of the resource produced in period t.

C_i = cost of producing each unit of the resource from step i. (The maximum number of steps is 5.)

L_i = amount of the resource for step i.

Generally, each step represents a different source of production for the resource, and sources are ordered in terms of increasing costs. The following example illustrates the use of a renewable resource node. Suppose that land is to be devoted to growing trees to produce firewood. Each step of the step function could represent a different section of land. The sections vary by soil type, growing conditions, accessibility, and other factors that cause the cost of producing wood to vary. The cost variance among sections can be captured by the step function; the amount of the resource for each step would be the annual production capacity of wood for the section to which the step corresponds.

Some resources, such as solar energy, are more appropriately modeled as having only one step because the cost of using more solar energy (on a BOE output basis) does not necessarily increase as more is used.

In some cases, the renewable resource model provides a better means of modeling a depletable resource. Peat is such a case. This is because it is more appropriate to represent the cost of peat production as a function of the amount available as a step function (as in Eq. 5.2) rather than as a linear function (as in Eq. 5.1). A special modification has been made to the renewable resource node to model peat. You may specify that the cost of production tracks the cumulative amount of the resource produced from the base year (as in the case of a depletable resource node) as the model progresses through the simulation period.

5.3.12 Form B024 — Viewing or Changing Decision/Allocation Node Data

```
ENPEP Module: BALANCE        Planning Study:            Case:      (B024)
                Viewing or Changing Decision/Allocation Node Data

                              Process number:     (1-99)
                                Process name:
                            Sector abbreviation:

                      1    2    3    4    5    6    7    8    9    10
          Input links:
       Priority links:
 Premium multipliers:

         Output links:
    Base-year splits:
    Stockpile number:    (1-20)
  Grid/nongrid node:     (0=not active, otherwise input link of electric grid)
   Price sensitivity:     (0-15)
       Lag parameter:     (1.0 = no lag, 0.0 = maximum lag)
                          This is record     of 99.
      Press "F5" to GO BACK 25 RECORDS, "F6" to ADVANCE 25 RECORDS,
            "F7" to GO BACK  5 RECORDS, "F8" to ADVANCE  5 RECORDS,
      "F9" to GO BACK  1 RECORD, "F10" to ADVANCE  1 RECORD,"F1" for HELP,
      "Esc" to IGNORE CHANGES AND QUIT , or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

In Form B024 you can define up to 99 decision or allocation node records. You advanced to this form by selecting option 4 on Menu B020. Decision nodes select the amounts of fuel to be supplied from alternative sources (the input links of the node) at various points in the energy network and route the energy to satisfy energy flow requirements of the output links of the node. A general description of decision node data entered in Form B024 is provided under Background at the end of this section (following a listing of the options available and a description of the data fields displayed).

Options

- To view or change values in data fields described below on up to 99 records, use the standard cursor-control functions and the following special record-manipulation functions: press **F6** to advance 25 records, **F8** to advance 5 records, **F10** to advance 1 record, **F5** to go back 25 records, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and enter the information required on the form. The new record will be saved when you press **F4**.
- Press **F4** to save changes and return to Menu B020.
- Press **Esc** to ignore changes and return to Menu B020.
- Press **F1** to obtain on-line help.

Data Fields

Process Number: This field contains a two-digit integer used to identify the process. Valid values for this integer range from 1 to 99, but you may enter a 0 to indicate that the record currently displayed on the screen is not to be saved after you press **F4**. If the record is deleted by entering a 0 for the process number, all other numeric data field values for the record should also be set at 0. There is no required relationship between this process number and the current record number displayed at the bottom of the screen.

Process Name: This field can contain a name or other text of up to 12 characters that will help you identify decision and allocation nodes.

Sector Abbreviation: This three-character field should contain an abbreviation that will help you identify each process.

Input Links: This field contains input link numbers for a decision node. These integers must range from 1 to 500, unless the current record is marked as deleted by a 0 in the process number field at the top of the screen. If the record is marked as deleted, these values should be 0.

Priority Links: This field contains numbers indicating the priority links for decision nodes. Links should be listed in order of descending priority. They allow you to model government regulations, as described in the Background section. All link numbers are optional, but if they are specified they should be input links to this node.

Premium Multipliers: These five-place values are used to multiply the prices on the input links to the node to reflect premiums associated with a fuel not reflected in its price. For example, even though electricity costs more than kerosene, people generally prefer to use electric lighting. The price premium multiplier would be used to reduce the relative price of electricity to reflect the preference for it over kerosene. If no price premium is associated with an input link, you must use a value of 1.0 in the appropriate field.

Output Links: This field contains numbers representing the output links for an allocation node. These integers must range from 1 to 500, unless the current record is marked as deleted by a 0 in the process number field at the top of the screen. If the record is marked as deleted, these values also should be set at 0. For each output link you supply here, you also must supply a corresponding base-year energy fraction as described in the next field.

Base-year Splits: The values displayed in this field represent decimal fractions of base-year energy flowing through an allocation node. For each output link, you must also supply a fraction in these fields. For example, a value of 0.52 in one of these 5-place fields indicates that 52% of the base-year energy flow through the allocation node will be allocated to the associated output link.

Stockpile Number: This field contains an integer representing the stockpile number that will be associated with the decision node. This integer may range from 1 to 20, unless the node is marked as deleted. The significance of a stockpile is described below under Background.

Grid/Nongrid Node: This field is used as a flag to indicate whether the electric grid allocation feature should be used for the current record. If you enter a link number between 1 and 500 in this field, any excess supply capacity will be allocated to that grid link number. That link must be the link for grid-supplied electricity. If the value you supply in this field is 0, the electric grid allocation feature will not be used for the current record.

Price Sensitivity: This field contains a value representing the price sensitivity parameter. This five-place value must range from 0 to 15. A value of 15 is the maximum price sensitivity and will simulate selection of input from the least-cost source. A value of 0 implies there is no price sensitivity during input selection.

Lag Parameter: This field contains a five-place value ranging from 0 to 1. A value of 1 indicates that there is no lag, and shares respond immediately to current prices. A value of 0 indicates no response to prices; base-year shares will be maintained throughout the study period. Therefore, smaller values for the lag parameter indicate a relatively slow response of shares to prices, and values close to 1 indicate a relatively fast response of shares to prices.

Background

By convention, a decision node has one or more input links and one or more output links. Decision nodes select the amounts of fuel to be supplied from alternative sources (the input links of the node) at various points in the energy network, and route the energy to satisfy energy flow requirements of

the output links of the node. Price and quantity equations are associated with a decision node. The quantity equation equates the total energy flow on the output links of the node to the total energy flow on the input links to the node; energy flow is conserved at a decision node. The price equation relates the prices of the fuels on the input links of the node to the price of fuel on the output links of the node. In addition, several other equations indicate the shares of fuel selected from the input links to the node. Shares are based on the relative prices of fuel from the alternative sources, capacity limits on the supply sources, and government policies. It should be noted that one of the features of the decision node algorithm is that energy requirements may be met by selecting fuels from several supply sources simultaneously rather than from a single source, as would be the case if fuel choice were based strictly on least cost. However, the decision node parameters can also be specified so the node selects fuel only from the least-cost source.

Decision nodes are positioned in the energy network to indicate the points at which fuel choices are made from alternative supply sources. Examples of decision nodes include (1) petroleum products from refineries and foreign sources in the oil sector; (2) charcoal produced from wood and agricultural residues in the distribution sector; (3) auto-travel demand met by gasoline and diesel autos in the transport sector; (4) cooking heat requirements satisfied by charcoal, kerosene, wood, electricity, and LPG in the household sector; and (5) on-site generation and grid-produced electricity in the other-industry sector.

Given the quantity of energy required on each output link of a decision node, the quantity equation equates the total energy flow into the node to the total energy flow out of the node:

$$Q = \sum_{o \in L} Q_o \qquad (5.3)$$

where:

Q = total quantity on all input links of the decision node,

Q_o = quantity on output link o of the decision node, and

L = set of output links of the decision node.

If a decision node has a stockpile node associated with it, as large a quantity as possible is taken from the stockpile to supply the quantity demanded on the output links of the decision node. The remaining quantity, the quantity not satisfied by the stockpile reserves, is referred to as the net output quantity and is met by sources that are input links to the decision node. The quantity

on any input link i of a decision node is the product of the net output quantity and the share allocated to source i, as the following equation indicates:

$$Q_i = NQ \times S_i \tag{5.4}$$

where:

Q_i = quantity on input link i,

NQ = net output quantity of the decision node. The value of NQ is the sum of the quantities on all output links minus the amount in the stockpile, if this value is greater than zero. Otherwise, NQ is assigned a value of 0.

S_i = fraction (share) of input quantity allocated to input link i ($0 \leq S_i \leq 1$).

The share S_i is in general a function of the relative prices on the input links of the decision node. A higher price on an input link results in a smaller share of the quantity allocated to the input link. The share for an input link is given by the formula

$$S_1 = (1/P_i)^r / \sum_{j=1}^{n} (1/P_j)^r \tag{5.5}$$

where:

P_i = price on input link i,

P_j = price on input link j,

n = number of input links to the decision node, and

r = price sensitivity parameter (provided by user).

Note that Eq. 5.5 ensures that all shares are between 0 and 1, and that shares on all input links sum to 1.

The price allocation formula, Eq. 5.5, is motivated by the empirical observation that all demand is not necessarily allocated to the least-cost source of supply. Rather, the allocation formula models the more general case in which shares depend on relative prices, with the more costly sources receiving relatively smaller shares. Nonprice factors often enter into consumption decisions, resulting in a skewed distribution of consumption based on

prices. A theoretical justification for the price allocation formula can be found in the energy modeling literature.

The price sensitivity parameter, r in Eq. 5.5, determines the degree to which differences in relative prices result in differences in market share. A value of 0 for r is an extreme case and indicates the least degree of share sensitivity to prices. A large value for r, such as 15, indicates a high degree of share sensitivity to relative prices and approximates a situation in which 100% of the quantity is allocated to the single source having the lowest price. Thus, by varying the value of r, the complete range of share-sensitivity cases can be modeled, including the case in which 100% of the quantity is allocated to the least-cost source. In general, you should analyze recent historical price and quantity data to determine a reasonable value for the price sensitivity parameter at each of the decision nodes located throughout the energy network.

The decision node has several other features that are used to model situations in which quantity shares do not respond instantly and unimpeded to changes in relative prices alone. These features include lagged adjustment of shares to changes in relative prices, whether physical capacities exist on input links, and government policies that result in the allocation of quantities to sources of supply without regard to relative prices. A lagged adjustment parameter is included in the decision node submodel to represent the lag that often occurs between a change in relative prices and an observed change in the shares of the sources of supply. You may use a parameter for each decision node to indicate the weighting given to the shares implied by the current-year prices versus the shares that were used in the previous year.

In some cases, the quantity computed by Eqs. 5.3-5.5 for an input link to a decision node may exceed the supply capacity of that source. In such a case, the quantity allocated to the source is set equal to its capacity, and the excess supply is reallocated to the remaining input links of the decision node. If several supply sources have capacity constraints, this procedure is repeated until the entire net output quantity has been allocated to the sources.

Government policies may exist that override allocation decisions based strictly on relative fuel prices. To model this situation, the decision node submodel can allocate a demand quantity to sources (input links) in a specified order. This priority allocation scheme is done without regard to the relative prices on the input links. You can specify this option through the data entered in the *Priority Links* field, as discussed above in the *Data Fields* section. A quantity is allocated to an input link up to the capacity of the source, if a capacity exists. This procedure is repeated until the entire net output quantity has been allocated to all input links.

An additional option for a decision node is to use it as a source of electricity to the electrical grid if an excess supply of electricity exists at a decentralized source of electric power generation. If a decision node has at least two input links, one link being central station electric power generation and the other being a decentralized source of electricity generation (such as an on-site diesel electric generator in the other-industry sector), this option may be used. If this option is specified, electricity demand will first be allocated to the sources based on either relative prices or priority allocation (whichever option you have specified). If the capacity specified for the decentralized source has not been exceeded, but the price of electricity from the decentralized source is less than the price of electricity from the grid, the decentralized source is assumed to produce at its full capacity. The excess power is routed through the decision node as a negative quantity and assigned to the grid link. This effectively reduces the demand for central station electricity in other parts of the energy network.

The price assigned to the output links of a decision node is equal to the average price of the inputs to the node, excluding the inputs from stockpiles. The output price is computed from the following:

$$P_o = \sum_{i=1}^{n} (P_i \times S_i) \qquad (5.6)$$

where:

P_o = price assigned to output links of decision node,

P_i = price on input link i, and

S_i = share of net output quantity allocated to input link i.

5.3.13 Form B025 — Viewing or Changing Conversion Process Data

```
ENPEP Module: BALANCE        Planning Study:          Case:          (B025)
                  Viewing or Changing Conversion Process Data

                          Process number:     (1-135)
                            Process name:
                       Sector abbreviation:

                             Input link:     (1-500)
                            Output link:     (1-500)
                 Operating & maintenance cost:     $/BOE
               Efficiency (output/input ratio):
                     Total capital investment:          1000 $
                  Capacity of a single plant:           1000 BOE/year
                           Capacity factor:     (0-1)
                     Life expectancy of plant:    years
                       Interest rate fraction:
                       Capacity of all plants:          1000 BOE/year

                          This is record     of 135.
      Press "F5" to GO BACK 25 RECORDS, "F6" to ADVANCE 25 RECORDS,
            "F7" to GO BACK  5 RECORDS, "F8" to ADVANCE  5 RECORDS,
    "F9" to GO BACK  1 RECORD, "F10" to ADVANCE  1 RECORD, "F1" for HELP,
     "Esc" to IGNORE CHANGES AND QUIT, or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

On Form B025 you are allowed to define up to 135 conversion process records. You advanced to this form by selecting option 5 on Menu B020. In this case, the conversions involve (1) transforming the quantity of the input (usually an energy form) into a quantity of output product (also usually an energy form) and (2) adding to the price of the input the additional value resulting from the process conducted. A general discussion of the conversion processes is provided under Background at the end of this section (following a list of the options available from this form and a description of the data fields displayed).

Options

- To view or change values in data fields described below on up to 135 records, use the standard cursor-control functions and the following special record-manipulation functions: press **F6** to advance 25 records, **F8** to advance 5 records, **F10** to advance 1 record, **F5** to go back 25 records, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to a 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and enter the information required on the form. The new record will be saved when you press **F4**.
- Press **F4** to save changes and return to Menu B020.
- Press **Esc** to ignore changes and return to Menu B020.
- Press **F1** to obtain on-line help.

Data Fields

Process Number: This field contains an integer of up to three digits. Valid values for this integer range from 1 to 135, but you may enter a 0 to indicate that the process record currently displayed on the screen is not to be saved. If the record is deleted by entering a 0 for the process number, all other numeric data field values should be set at 0. There is no required relationship between this process number and the current record number displayed at the bottom of the screen.

Process Name: This 12-character field can contain any name or text that will help you identify conversion nodes.

Sector Abbreviation: This field should contain a three-character abbreviation to help you identify each process.

Input Link: This field must contain an integer of up to three digits. The value must range from 1 to 500, unless the current record is marked as deleted by a 0 in the process number field at the top of the screen. If the record is marked as deleted, this link number should be 0 also.

Output Link: This field also must contain an integer of up to three digits with a value from 1 to 500. However, if the current record is marked as deleted by a 0 in the process number field at the top of the screen, this link number should be 0 also.

Operating and Maintenance Cost: This field contains the annual operating and maintenance cost ($U.S./BOE of output) associated with the conversion node. The amount entered in this field should not include the costs of fuels used in the process. If the current process is marked as deleted, this field should be set at 0.

Efficiency: This field contains the ratio of output to input flows for a conversion node. If both the input and output quantities are in energy units, this five-place value represents the thermal efficiency of the conversion

process, otherwise the value may be greater than 1. If the current process is marked as deleted, this value should be 0.

Total Capital Investment: This field contains the total capital investment (in thousands of $U.S.) of a conversion process. If the current process is marked as deleted, this value should be 0.

Capacity of a Single Plant: This field contains the nameplate annual output capacity (in thousands of BOE/year) of a representative process for the current conversion node displayed on your screen. If the current process is marked as deleted, this value should be 0.

Capacity Factor: This field contains the capacity factor of a representative process for the current conversion node. This five-place fractional value should range from 0 to 1, and should be set at 0 if the current process is marked as deleted with a 0 in the process number field.

Life Expectancy of Plant: This field contains an integer expressing the life expectancy (in years) of a representative conversion process. This two-digit integer must be greater than 0 unless the current process is marked as deleted.

Interest Rate Fraction: This field contains the annual interest rate used for amortizing the capital cost of a conversion process. It is expressed as a five-place decimal fraction. For example, a value of 0.10 represents an annual interest rate of 10%. If the process is marked as deleted, this value should be 0.

Capacity of All Plants: This field contains the total annual output capacity (in thousands of BOE/year) of all plants associated with the conversion process. A 10-place value can be entered. A value of 0 should be entered if the current process is marked as deleted.

Background

By convention, a conversion node has a single input link and a single output link. Two equations are associated with a conversion node: a quantity equation and a price equation. The quantity equation represents the transformation of the input (usually an energy form) to the output product (also usually an energy form). The price equation represents the value added to the price of the input due to the process. Examples of conversion nodes include (1) fuel oil kiln in the cement sector (input = fuel oil, output = heat); (2) gasoline automobile in the transport sector (input = gasoline, output = vehicle-miles traveled); (3) fuel oil boilers in the sugar sector (input = fuel oil, output = steam); (4) peat-fired steam turbine units in the

electric sector (input = peat, output = electricity); (5) coal port facility in the coal sector (input = coal, output = coal), and (6) ethanol distillation in the biomass sector (input = sugar juice, output = ethanol).

The following example illustrates the quantity and price equations for an ethanol distillation process that transforms sugar juice into ethanol. The quantity of ethanol output is related to the quantity of surgar juice input by the following equation:

$$Q_e = Q_j \times f \tag{5.7}$$

where:

Q_e = quantity of ethanol output,

Q_j = quantity of sugar juice input, and

f = quantity of ethanol output from a single unit of sugar juice input (efficiency).

The basic assumption in developing the price equation for the conversion node is that the annual revenue obtained from the output of the process equals the annual costs of the sugar juice and the processing operations. The equation relating annual revenue and cost is:

$$Q_e \times P_e = Q_j \times P_j + OM \times Q_e + TCI \times CRF(i,n) \tag{5.8}$$

(Revenue) = (Cost)

where:

P_e = price of ethanol.

P_j = price of sugar juice.

OM = operating and maintenance cost of distillation process. (This cost excludes the costs of the sugar juice feedstock; the sugar juice cost is accounted for in term $Q_j \times P_j$.)

TCI = total capital cost of a representative distillation process or plant.

CRF(i,n) = capital recovery factor that amortizes the capital cost over the life of the process, n, at annual interest rate i.

If both sides of Eq. 5.8 are divided by Q_e, f is substituted for Q_e/Q_j, and the process is assumed to operate near its annual rated output capacity, then the following equation is obtained relating the required ethanol price to the sugar juice price and processing costs:

$$P_e = P_j / f + OM + [TCI / (CAP \times CF)] \times CRF(i,n) \quad (5.9)$$

where:

CAP = annual maximum rated output capacity of a representative plant, and

CF = capacity factor for a representative plant (indicating the fraction of the time the plant operates over a one-year period).

Equations 5.8 and 5.9 are used to compute the output quantity and price, respectively, for a conversion node.

The capital recovery factor, CRF(i, n), for amortizing the capital cost of a process over a fixed number of discrete time intervals is computed from the following standard equation:

$$CFR(i,n) = i \times (1 + i)^n / [(1 + i)^n - 1] \quad (5.10)$$

5.3.14 Form B026 — Viewing or Changing Multiple-Input-Link Conversion Process Data

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B026)

          Viewing or Changing Multiple-Input-Link Conversion Data

                    Process number:    (1-15)
                      Process name:
                  Sector abbreviation:

                                    1     2     3     4     5
                       Input links:                              (1-500)
                 Input/output ratios:
                       Output link:    (1-500)
      Operating & maintenance cost:     $/BOE
          Total capital investment:           1000 $
        Capacity of a single plant:           1000 BOE/year
                  Capacity factor:      (0-1)
        Life expectancy of plant:     years
          Interest rate fraction:
      Maximum allowable capacity:           1000 BOE/year

                      This is record    of 15.
     Press "F7" to GO BACK  5 RECORDS, "F8" to ADVANCE  5 RECORDS,
   "F9" to GO BACK  1 RECORD, "F10" to ADVANCE  1 RECORD, "F1" for HELP,
    "Esc" to IGNORE CHANGES AND QUIT, or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

On Form B026 you are allowed to define up to 15 multiple-input-link conversion process records. You advanced to this form by selecting option 6 on Menu B020. By convention, a multiple-input-link conversion node has a single output link and two or more input links. Several equations are associated with a multiple-input conversion node: a number of quantity equations and a price equation. The quantity equations represent the transformation of the inputs (generally some form of fuel) to the output (generally a form of energy). The price equation represents the value added to the prices of the input fuels due to processing. A general discussion of multiple-input-link conversion processes is provided under the Background section following a listing of the options available from this form and a description of the data fields displayed.

Options

- To view or change values in data fields described below on up to 15 records, use the standard cursor-control functions and the following special record-manipulation functions: press **F8** to advance 5 records, **F10** to advance 1 record, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and enter the information required on the form. The new record will be saved when you press **F4**.

- Press **F4** to save changes and return to Menu B020.

- Press **Esc** to ignore changes and return to Menu B020.

- Press **F1** to obtain on-line help.

Data Fields

Process Number: This field contains an integer of up to two digits used to identify the current process. Valid values for this integer range from 1 to 15, but you may enter a 0 to indicate that the process record currently displayed on the screen is not to be saved. If the record is deleted by entering a 0 for the process number, all other numeric data field values should also be set at 0. There is no required relationship between this process number and the current record number displayed at the bottom of the screen.

Process Name: This 12-character field can contain a name or any text that will help you identify the conversion node.

Sector Abbreviation: This field should contain a three-character abbreviation that will help you identify the process.

Input Links: This field contains an integer of up to three digits and indicates the numbers of the input links to the process, as represented in the energy network. The value must range from 1 to 500, unless the current record is marked as deleted by a 0 in the process number field at the top of the screen. If the record is marked as deleted, all input link numbers should be 0. For each input link entered here, you must also enter an input/output ratio as described in the next field.

Input/Output Ratios: This field contains a set of five-place input/output ratios that indicate the input quantity per unit of output for each input link you entered in the previous field.

Output Link: This field contains an integer of up to three digits. The integer must range in value from 1 to 500, unless the current record is marked as deleted by a 0 in the process number field at the top of the screen. If the record is marked as deleted, this link number should be set at 0 also.

Operating and Maintenance Cost: This field contains a five-place value representing the annual operating and maintenance cost (in $U.S./BOE) associated with the process represented by a conversion node. The value should not include the cost of fuels used in the process. If the current process is marked as deleted, this value should be set at 0.

Total Capital Investment: This field contains a 10-place value representing the total capital investment (in thousands of $U.S.) of a multiple-input-link conversion process. If the current process is marked as deleted, this value should be set at 0.

Capacity of a Single Plant: This field contains a 10-place number representing the nameplate annual output capacity (in thousands of BOE/year) of a representative process for the current conversion node displayed on your screen. If the current process is marked as deleted, this value should be set at 0.

Capacity Factor: This field contains the capacity factor of a representative process for the current conversion node. This five-place fractional value should range from 0 to 1, and should be set to 0 if the current process is marked as deleted with a 0 in the process number field.

Life Expectancy of Plant: This field contains an integer expressing the life expectancy (in years) of a representative conversion process. This two-digit integer must be greater than 0 unless the current process is marked as deleted.

Interest Rate Fraction: This field contains the annual interest rate used for amortizing the capital cost of a conversion process. It is expressed as a five-place decimal fraction. For example, a value of 0.10 represents an annual interest rate of 10%. If the process is marked as deleted, this value should be set at 0.

Maximum Allowable Capacity: This field expresses the maximum allowable output capacity (thousands of BOE/year) of all plants associated with the multiple-input-link conversion process. A value of up to 10 places can be entered in this field. A value of 0 should be entered if the current process is marked as deleted.

Background

By convention, a multiple-input-link conversion node has a single output link and two or more input links. Several equations are associated with a multiple input conversion node -- a number of quantity equations equal to the number of input links and a price equation. The quantity equations represent the transformation of the inputs (generally forms of fuel) to the node to the

output (generally a form of energy). The price equation represents the value added to the prices of the input fuels by processing. Examples of multiple-input-link nodes include (1) a solar heater in the household sector that has LPG as a backup fuel; (2) a node that blends gasoline and ethanol to produce gasohol in the transport sector; and (3) a preprocessor in which heavy crude is spiked with lighter fractions in the oil sector.

The following example illustrates the price and quantity equations for a node with two inputs: a solar heater that transforms solar energy into heat and a backup heater fueled by LPG. The quantity of solar energy input (on an energy-content basis) required to produce a quantity of heat output is given by the following equation:

$$Q_s = Q_h \times IO_s \tag{5.11}$$

where:

Q_s = quantity of solar energy input,

Q_h = quantity of heat output, and

IO_s = quantity of solar energy input required per unit of heat output.

Similarly, the quantity of LPG required to produce a quantity of heat is given by the equation:

$$Q_1 = Q_h \times IO_1 \tag{5.12}$$

where:

Q_1 = quantity of LPG input, and

IO_1 = quantity of LPG input required per unit of heat output.

The input/output ratio, IO_s, can be thought of as the ratio of the total solar energy converted to heat during the course of a typical year in a typical application for such a process, divided by the total heat produced by the process over a typical year. The total heat produced by the process over a typical year includes the heat produced by both the solar energy and the LPG.

The basic assumption used in developing the price equation for the multiple-input-link conversion node is that the value of the output of the process equals the costs of the process and input fuels on an annual basis. The following equation relates the annual value (revenue) and cost:

$$Q_h \times P_h = Q_s \times P_s + Q_1 \times P_1 + OM \times Q_h + TCI \times CRF(i,n) \quad (5.13)$$

(Value) = (Cost)

where:

P_h = price of heat output (on an equivalent heat content basis).

P_s = price (if any) of solar energy.

P_1 = price of LPG.

OM = operating and maintenance cost of the heater for converting solar energy and LPG to heat. (This cost includes labor and material costs for operating the process, but excludes the costs of the LPG and solar energy inputs.)

TCI = total capital cost of a representative heater.

CRF(i,n) = capital recovery factor that amortizes the capital cost of the heater over its life n, at annual interest rate i as seen in Eq. 5.10.

If both sides of Eq. 5.13 are divided by Q_h, IO_s is substituted for Q_s/Q_h, IO_1 is substituted for (Q_1/Q_h), and the process is assumed to operate near its annual assumed output capacity, then the following equation is obtained relating the price of heat output to the prices of the LPG, solar energy, and the heater costs:

$$P_h = P_s \times IO_s + P_1 \times IO_1 + OM + [TCI / (CAP \times CF)] \times CRF(i,n) \quad (5.14)$$

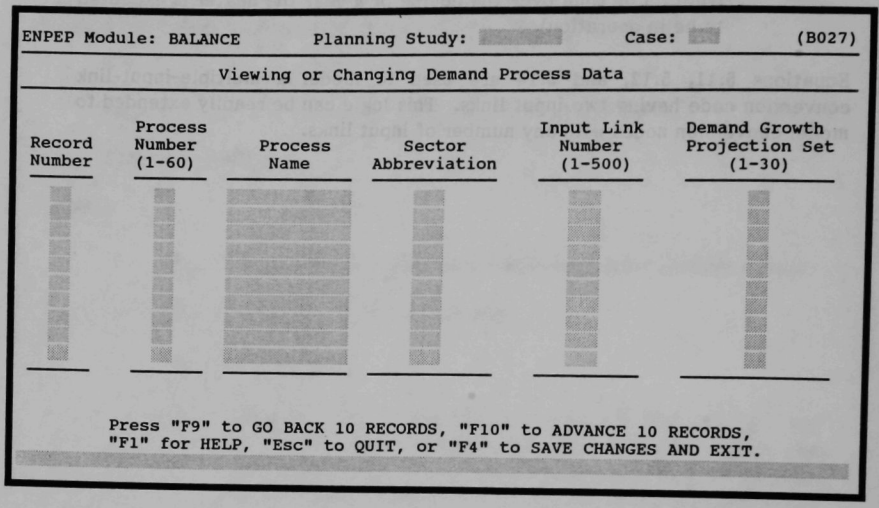
where:

CAP = annual maximum rated output capacity of a representative heater, and

CF = capacity factor for a representative heater (indicating the fraction of time over the course of a year the heater is expected to be in operation).

Equations 5.11, 5.12, and 5.14 are used to model a multiple-input-link conversion node having two input links. This logic can be readily extended to model conversion nodes with any number of input links.

5.3.15 Form B027 — Viewing or Changing Demand Process Data



Purpose

On Form B027 you are allowed to define up to 60 demand process records. You advanced to this form by selecting option 7 on Menu B020. By convention, a demand node has a single input link and no output links. Demand nodes must be positioned in the energy network to indicate the points of final demand -- that is, points that terminate energy flows throughout the network. A general discussion of demand process data is provided under Background at the end of this section (following a listing of the options available on this form and a description of the data fields displayed).

Options

- View or change values in data fields described below on up to 60 records. Ten records will be displayed simultaneously, and you can move from record to record and make any necessary changes by using the standard cursor-control keys. In addition, you can press **F10** to page forward 10 records and **F9** to page back 10 records.

- To delete an existing record, advance to that record, then change the process number to 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and enter the information required on the form. The new record will be saved when you press **F4**.

- Press **F4** to save changes and return to Menu B020. (You will be prompted to indicate whether the data being saved are complete or incomplete. If they are complete, press **F10**, otherwise press **Esc**.)

- Press **Esc** to ignore changes and return to Menu B020.

- Press **F1** to obtain on-line help.

Data Fields

Record Number: When you display a specific page of data, the record numbers for each of the 10 records on that page are shown in the first column of the screen. This is a display-only field that you cannot change. There is no defined relationship between the record numbers in the first column and the process numbers, which you can access, in the second column.

Process Number: This field contains a two-digit integer used to identify each process. Valid values for these integers range from 1 to 60, but you may enter a 0 to indicate that a specific process record is not to be saved. If the record is deleted by entering a 0 for the process number, all other numeric data field values for that record should be 0 also. There is no required relationship between these process numbers and the record numbers displayed in the first column.

Process Name: This 12-character field can contain a name or any text that will help you identify the demand nodes. It should be left blank if the associated record has been marked as deleted with a 0 process number.

Sector Abbreviation: This field contains a three-character abbreviation to help you identify each process. It should be left blank if the associated record has been marked as deleted with a 0 process number.

Input-Link Number: This field contains an integer of up to three digits representing the number of the input link to the process in the energy network. The value of the integer must range from 1 to 500, but should be set at 0 if a record has been marked as deleted.

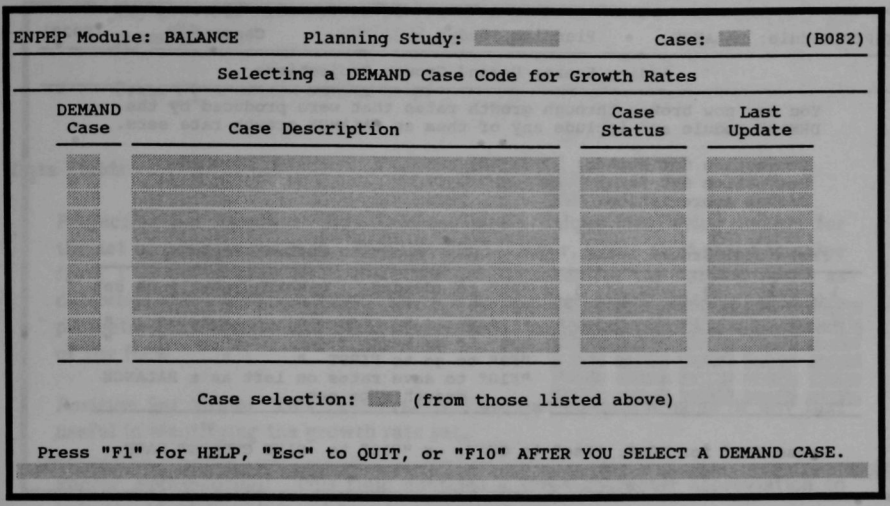
Demand Growth Projection Set: This field contains a two-digit integer that must range in value from 1 to 30, unless a record has been marked as deleted. This number uniquely identifies a set of growth rates that you must enter using Forms B028 or B088, as described below.

Background

By convention, a demand node has a single input link and no output links. No equations are associated with a demand node. Demand nodes must be positioned in the energy network to indicate the points of final demand -- that is, points that terminate energy flows throughout the network. Examples of demand nodes include (1) cement demand in the cement sector; (2) electricity demand in the commercial sector; and (3) heat demand for cooking in the household sector.

The IDES FORTRAN model associates a set of user-specified demand projections over the simulation period with each demand node. The demand node assigns the computed demand quantity in each year to the demand node input link; this quantity is then used as the required output quantity of the node at the input end of the link.

5.3.16 Form B082 — Selecting a DEMAND Case Code for Growth Rates



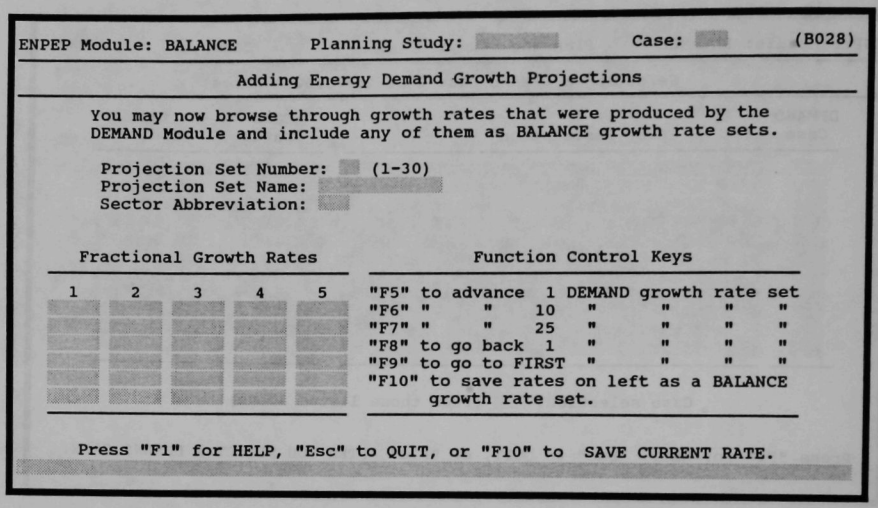
Purpose

In Form B082, you can select a DEMAND Module case from which to add energy demand growth rates to those already defined in your BALANCE case. You advanced to this form by selecting option 8 on Menu B020 and by further indicating that you wished to add growth rates generated by a DEMAND Module case of your current planning study. Four items of information are displayed for each DEMAND case associated with your previously selected planning study: a case code, a case description, a status variable indicating whether the case is complete or incomplete, and the date when the case was last modified.

Options

- To select a DEMAND case from which to obtain energy demand growth rates, enter the case code from among those displayed on the screen and press **F10**. You will advance to Form B028 to select specific growth rates.
- Press **Esc** to return to Menu B020 without selecting a DEMAND case.
- Press **F1** to obtain on-line help.

5.3.17 Form B028 — Adding Energy Demand Growth Data



Purpose

Form B028 allows you to add annual energy demand growth rates calculated by the DEMAND Module to the set of existing growth rates you may have already defined in BALANCE. You advanced to this form after selecting a DEMAND Module case code while in Form B082. Up to 30 growth rate projection sets may be defined. You must ensure that the total number of existing sets plus the number of sets you want to add does not exceed 30; otherwise, only the first 30 will be available for access in Form B088, as described below. The growth rates requested in Form B027 above correspond to the growth rates you are adding with this form (B028).

Options

- To select a DEMAND Module growth rate to add to your existing growth rate set, advance to that rate record, make any necessary changes in the data fields described below, complete the information on the form, and press **F10**. The current data will be added to those already existing for BALANCE. You can move back and forth through the available DEMAND growth rate records using the following special function keys: Press **F5** to advance 1 growth rate set, **F6** to advance 10 sets, **F7** to advance 25 sets, **F8** to go back 1 set, and **F9** to return to the first set.

- Press **Esc** to return to Menu B020 after you have completed selecting growth rates to add to you existing set. (Pressing **Esc** will not affect any previous rate record selection if you completed that selection by pressing **F10**.)

- Press **F1** to obtain on-line help.

Data Fields

Projection Set Number: This field contains a unique identifying number for the set of projection rates. This two-digit integer, which must range in value from 1 to 30, is used to identify the growth rates for the demand nodes as described above on Form B027. There is no required relationship between this projection set number and the current record number displayed at the bottom of the form.

Position Set Name: This 12-character field can contain a name or any text useful in identifying the growth rate set.

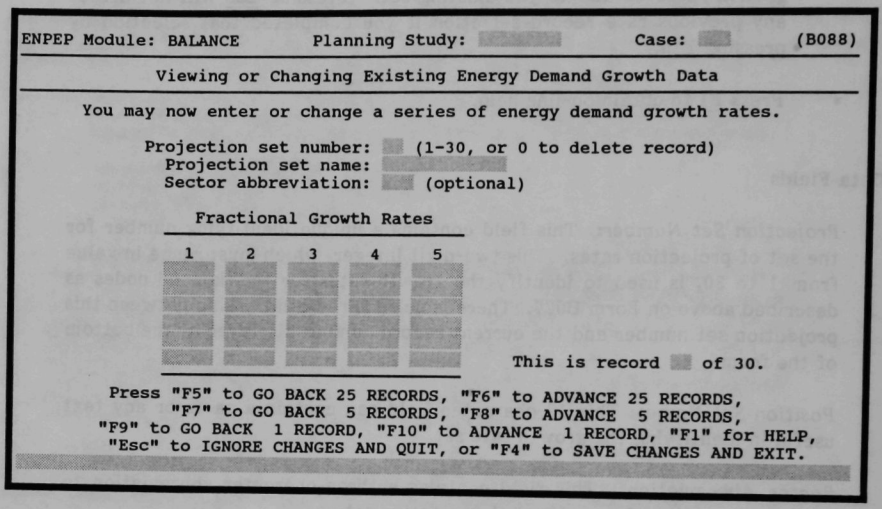
Sector Abbreviation: This field contains a three-character abbreviation to help you identify a demand growth projection set.

Fractional Growth Rates: This field contains five-place fractional values, computed by the DEMAND Module, that represent a unique growth rate in energy demand between successive years in your study period. The first growth rate represents the growth between the first and the second year. The rates are expressed as decimal fractions. For example, a value of 0.10 indicates that there is a 10% growth in the energy demand from the previous year. If there are less than 30 years in your study period, the extra fields may be left blank.

Background

Once you have finished adding DEMAND growth rates to BALANCE, you should press **Esc**. This key has no effect on the records already added to BALANCE, and it returns you to Menu B020. When you return to Menu B020, the status variable associated with the energy demand growth rate sets will be set to *Incomplete*. You should select option 8 again and access these growth rates using Form B088 in order to change this status to *Complete*.

5.3.18 Form B088 — Viewing or Changing Existing Energy Demand Growth Data



Purpose

Form B088 permits you to access (for purposes of viewing, defining, changing, adding, or deleting) the 30 available annual energy demand growth rates. If the total number of growth rate sets exceeds 30, you will be able to access only the first 30. You advanced to this form by selecting option 8 on Menu B020 and further indicating in response to a prompt that you wished to access existing growth rates already defined for the current BALANCE case.

Options

- To view or change values in data fields described below on up to 30 records, use the standard cursor-control functions and the following special record-manipulation functions: press **F6** to advance 25 records, **F8** to advance 5 records, **F10** to advance 1 record, **F5** to go back 25 records, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and enter the information required on the form. The new record will be saved when you press **F4**.
- Press **F4** to save changes and return to Menu B020.
- Press **Esc** to ignore changes and return to Menu B020.
- Press **F1** to obtain on-line help.

Data Fields

Projection Set Number: This field contains a two-digit integer that identifies the set of projection rates that is displayed. The value of this integer must range from 1 to 30. If a record is deleted by entering a 0 for the projection set number, all other numeric data fields for that record should also be set at 0. There is no required relationship between this projection set number and the current record number displayed at the bottom of the form.

Projection Set Name: This 12-character field can contain a name or other text to help you identify the projection set. This field should be left blank if a record is marked as deleted with a 0 process number.

Sector Abbreviation: This three-character field can contain an abbreviation to help you identify a demand growth projection set.

Fractional Growth Rates: This field contains five-place fractional values that represents the growth rate in energy demand between successive years in your study period. The first growth rate should represent the growth between the first and the second year. A value of 0.10 indicates there is a 10% growth in the energy demand from the previous year. If there are less than 30 years in your study period, the extra fields may be left blank.

5.3.19 Form B029 — Viewing or Changing Multiple-Output-Link Node Process Records

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B029)

     Viewing or Changing Multiple-Output-Link (Refinery) Node Process Data

Process number:    (1-10)              Process name:                Sector:
    Input link:    (1-500)     Output sizing link:     (1-500)
                                 1     2     3     4     5     6
                  Output links:
                 Output ratios:
                   Price links:
                  Price ratios:
              Stockpile numbers:
             Excess demand links:
                  Control links:
              Control multipliers:
  Operating & maintenance cost:        $/BOE input
      Total capital investment:             1000 $
    Capacity of a single unit:              1000 BOE input/year
                Capacity factor:        (0-1)
 Life expectancy:            Interest rate (fraction):
   Profit factor:              Capacity of all plants:              1000 BOE/year
                             This is record    of 10.
  Press "F9" to GO BACK 1 RECORD, "F10" to ADVANCE 1 RECORD, "F1" for HELP,
     "Esc" to IGNORE CHANGES AND QUIT, or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

Form B029 allows you to define, view, change, or delete up to 10 multiple-output-link process records. You advanced to this form by selecting option 9 in Menu B020. By convention, a multiple-output-link (typically a refinery) node has a single input link and two or more output links. Several quantity and price equations are associated with such a node. The quantity equations represent the transformation of the input (such as crude oil) to the outputs (such as petroleum products). The price equations represent the value added by the processing of the input, and allocate the processing costs to the outputs. Multiple-output-link nodes are discussed in more detail under Background at the end of this section (following a listing of the options available in this form and a description of the data fields displayed).

Options

- To view or change values in data fields described below on up to 10 records, use the standard cursor-control functions and the following special record-manipulation functions: press **F10** to advance one record and **F9** to go back one record.

- To delete an existing record, advance to that record, then change the process number to a 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and enter the information required on the form. The new record will be saved when you press **F4**.
- Press **F4** to save changes and return to Menu B020.
- Press **Esc** to ignore changes and return to Menu B020.
- Press **F1** to obtain on-line help.

Data Fields

Process Number: This field contains a unique two-digit integer used to identify the process. Valid values for this integer range from 1 to 10, but you may enter a 0 to indicate that the process record currently displayed on the screen is not to be saved. If the record is deleted by entering a 0 for the process number, all other numeric data field values should also be set at 0. There is no required relationship between this process number and the current record number displayed at the bottom of the screen.

Process Name: This 12-character field can contain any name or text that will help you identify multiple-output-link conversion nodes. If the current process is to be deleted, this field should be blank.

Sector: This three-character field contains an abbreviation to help you identify each process. It should be left blank if the current process is to be deleted.

Input Link: This field must contain an integer of up to three digits. The value must range from 1 to 500, unless the current record is marked as deleted by a 0 in the process number field at the top of the screen. If the record is marked as deleted, this link number should be set at 0.

Output Sizing Link: This field contains a value of up to three digits that determines the input requirements of a multiple-output-link process such as a refinery. The demand for a specific output product on the output sizing link is used to adjust the quantities input to the node so that the demand for the specified sizing product is met exactly. The demands for the other products may be exceeded or may not be met. If the quantity of an output product exceeds its demand, you have the option of specifying a stockpile, as described below. The integer value of a sizing link number must range from 1 to 500, except this link number should be set at 0 if the record is marked as deleted.

Output Links: This field must contain a set of integers of up to three digits. Up to six products can be produced by a multiple-output-link process, and each of these products is associated with a link number that you must specify in these fields. If there are less than six output products in a process, extra output links should be set to 0. These integers must range from 1 to 500, or must be set at 0 if a record is marked as deleted. For every output product you specify here, you must also specify output ratios and price links and ratio data in the next three fields described below.

Output Ratios: This field must contain up to five-place values for each output product you specified in the previous field. For a given process, the parameters s_i of Eq. 5.16 (see Background below) are used to relate the quantity of input to the quantity of an output product; they constitute the refinery slate. If a multiple-output-link process is marked as deleted with a 0 process number, all output ratios for that node should also be set at 0. If there are less than six output products specified above, the excess output ratio fields should be set at 0.

Price Links: This field contains a number of up to three digits that must be specified for each output link defined above. You may specify that the price for each output link of a multiple-output-link process is either a multiple of the input link's price, or a multiple of the price of the first output link of the current process. In either case, the price link number, which can range from 1 to 500, must be supplied in this field. If you do not use all six output links, you should leave extra price link fields blank, or set them to 0. The price link associated with the first output link (such as 110) must be the same as the first output link (such as 110). The price links associated with the second through the sixth output links must be equal to the first output link (such as 110) or one of the current process' input links.

Price Ratios: This field contains the price ratio (a number of up to five places) that must be specified for each output link defined above. For a multiple-output-link process, you may specify that the price of each output link is either a multiple of the input link's price, or a multiple of the price of the first output link. The price ratio for the first output link should always be 1, and the corresponding price link for the first output link should be set to the number of the first output link. If you do not use all six output links, you should leave the extra price multiplier fields blank.

Stockpile Number: This field contains integers of up to two digits representing the stockpile numbers for each output link. These numbers may range from 1 to 20, or may be left blank if the associated output link is missing. If the amount of the associated output product exceeds the demand for that product at this process, the excess supply is added to the specified stockpile for use in subsequent years. If there is no stockpile associated with an output link, these fields can be left blank, and excess output products will remain unused in the simulation.

Excess Demand Links: This field contains integers of up to three digits representing the excess demand link numbers for each output product of a multiple-output-link process. These link numbers should range from 1 to 500, or may be left blank if the node models a refinery. If the demand for the associated output product cannot be met by this process, the demand shortage is supplied by using more of the product from the link number specified in this field. Typically, output products from a multiple-output-link process are input to decision nodes. A product shortage at such a decision node should be satisfied by one of its input links on which there is no quantity limitation.

Control Links: This field contains the link numbers controlled by each of the refinery output links, if any. This and the next field are used to specify how the capacities of other links, not necessarily associated with the current process, are controlled by the computed quantity on the output links of this process. Control links are a special feature of refinery nodes and generally are not used unless the situation specifically warrants them. As an example, assume a controlled link 23 is specified in this field, that the associated output link for this process is 7, and that the multiplier specified in the following field for this controlled link is 0.5. Then the output capacity on link 23 will be adjusted by:

$$CAPL(23) = Q(7) \times 0.5 \qquad (5.15)$$

where:

CAPL(23) = output capacity on link 23, and

Q(7) = quantity of output from link 7 of this multiple-output-process.

If there are no controlled links, this field should be left blank.

Control Multipliers: This field contains the five-place multipliers for control links, as described in the above field and Eq. 5.15. If there are no controlled links, this field should be left blank.

Operating and Maintenance Cost: This field contains a 10-place number representing the operation and maintenance cost for a typical multiple-output-link process or refinery. The units of this field are $U.S./BOE input, and should exclude the costs of input fuels such as crude oil. If the current process is marked as deleted with a 0 process number, this field should be left blank.

Total Capital Investment: This field contains a 10-place number representing the total capital investment of a representative process. The units of this field are thousands of $U.S. If the current process is marked as deleted with a 0 process number, this field should be left blank.

Capacity of a Single Unit: This field contains a 10-place value representing the annual nameplate *input* capacity (in thousands of BOE/year) of a representative multiple-output-link process. If the current process is marked as deleted with a 0 process number, this field should be left blank.

Capacity Factor: This field contains a five-place fractional value expressing the capacity factor of a representative process. This value should range from 0 to 1, but if the current process is marked as deleted with a 0 process number, this field should be left blank.

Life Expectancy: This field contains a two-digit integer representing the expected life (in years) of a typical process of this type. If the current process is marked as deleted with a 0 process number, this field should be left blank.

Interest Rate: This field contains a five-place decimal fraction representing the annual interest rate used for amortizing the capital cost of a process. For example, the value in this field should be 0.10 if the annual interest rate is 10%. If the current process is marked as deleted with a 0 process number, this field should be left blank.

Profit Factor: This field contains a five-place decimal fraction expressing the profit factor for the current process. If the current process is marked as deleted with a 0 process number, this field should be left blank.

Capacity of All Plants: This field contains a 10-place value that represents the total annual *input* capacity of all processes of the current type in the base year. Values should be expressed in thousands of BOE in the initial year of your planning study. If, however, the current process is marked as deleted with a 0 process number, this field should be left blank.

Background

By convention, a multiple-output-link (typically a refinery) node has a single input link and two or more output links. Several price and quantity equations are associated with a refinery node. The quantity equations represent the transformation of the input (such as crude oil) to the outputs (such as petroleum products). The price equations represent the value added by the processing to the input, and allocate the processing costs to the outputs. A refinery node can be used to model any process that has a single input and

multiple output products. For example, besides a crude oil refinery, a refinery node can be used to model an industrial cogeneration process that produces steam and electricity. Examples of refinery nodes in the IDES model include (1) a refinery in the oil sector (input = crude oil, outputs = LPG, distillate, gasoline, and residual oil); (2) cogeneration in the sugar sector (input = bagasse, outputs = steam and electricity); and (3) sugar juice production in the renewables sector (input = sugar cane, outputs = sugar juice and bagasse).

The following example of a refinery node with two output products illustrates the price and quantity equations. The quantity of product 1 is related to the quantity of crude input by the following equation:

$$Q_1 = Q_c \times s_1 \tag{5.16}$$

where:

Q_1 = quantity of product 1 output,

Q_c = quantity of crude input, and

s_1 = ratio of product 1 output per unit of input crude.

An equation similar to Eq. 5.16 relates the quantity of product 2 produced for each unit of crude input. In the equation, Q_2 and s_2 would be defined similarly to Q_1 and s_1, respectively, for the second product. The parameters s_1 and s_2 constitute the refinery *slate*.

The basic assumption in developing the price equations for the refinery node is that the annual total revenue obtained from the outputs of the refinery is equal to the annual cost of the crude input plus the associated processing costs. The equation relating annual revenue and cost is:

$$Q_1 \times P_1 + Q_2 \times P_2 = Q_c \times P_c + OM \times Q_c + TCI \times CRF(i,n) \tag{5.17}$$

(Revenue) = (Cost)

where:

Q_1, Q_2 = quantities of product 1 and 2, respectively.

P_1, P_2 = prices of product 1 and 2, respectively.

P_c = price of crude.

OM = operating and maintenance cost of the refinery. (This cost includes the costs of labor and materials for operating the refinery but excludes the cost of the input crude.)

TCI = total capital cost of the refinery (if the refinery already exists, this value is the present value of the remaining debt).

CRF(i,n) = capital recovery factor that amortizes the capital cost of the refinery over its life n, at annual interest rate i.

PFF = profit factor.

If both sides of Eq. 5.17 are divided by Q_c, s_1 is substituted for (Q_1/Q_c) and s_2 for (Q_2/Q_c), and the refinery is assumed to operate near its expected capacity, then the following equation relates the price of product 1 to the crude input price, the price of product 2, and the processing costs:

$$P_1 = [P_c/s_1 + OM/s_1 + (TCI/(CAP \times CF \times s_1)) \times CRF(i,n)] \times (1 + PFF) - (s_2/s_1) \times P_2 \quad (5.18)$$

where:

CAP = crude input capacity of the refinery, and

CF = capacity factor (indicating the fraction of time the refinery is expected to operate).

To determine the product prices P_1 and P_2, an additional equation is required that indicates how the costs of crude and processing are to be allocated among the two products. This equation is assumed to be linear and of the form:

$$P_2 = w_2 \times P_1 \quad (5.19)$$

where:

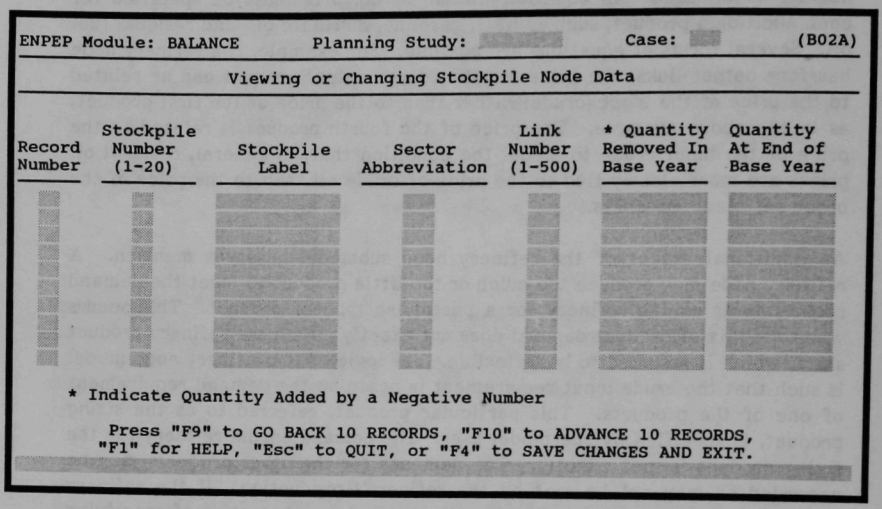
w_2 = a user-specified parameter.

The product prices P_1 and P_2 can be determined from Eqs. 5.18 and 5.19 given the price of crude, P_c, the product slate, s_1 and s_2, and the processing costs.

The procedure described above can be used to model a refinery node with any number of outputs. An equation similar to Eq. 5.19 must be specified for each additional product, such as LPG, gasoline, distillate oil, and residual fuel oil. Several forms of equations are possible. For example, if a refinery node has four output links, the price for the fourth output product can be related to the price of the input (crude) rather than to the price of the first product, as in the above example. The price of the fourth product is related to the price of the input crude to model the condition that, in general, residual oil prices are more closely tied to the price of crude oil than to the price of the other petroleum products.

An additional aspect of the refinery node submodel deserves mention. A refinery node may produce too much or too little product to meet the demand requirements on the refinery for a particular type of product. This occurs when the mix of product demand does not exactly match the refinery product slate, which is assumed to be inflexible. The logic of the refinery node model is such that the crude input requirement is based on the demand requirement of one of the products. This particular product, referred to as the *sizing* product, is specified by the model user. The demand on the refinery for the sizing product is met exactly. The demands for the other products may be exceeded or may not be met by the refinery's production. If the refinery produces an excess of a particular product, you have the option of specifying that this excess amount be placed in a stockpile (stockpile node) for possible consumption in future periods. If the refinery demand for a product cannot be met, you must specify an alternative link of the network from which the needed amount will be obtained to make up the shortage.

5.3.20 Form B02A — Viewing or Changing Stockpile Node Data



Purpose

On Form B02A you are allowed to define up to 20 stockpile process records. You advanced to this form by selecting option 10 on Menu B020. By convention, a stockpile node has a single link that functions as both an input link for filling the stockpile and an output link for reducing the stockpile. A stockpile node is used in conjunction with a multiple-output-link node (such as a refinery) and a decision node. The purpose of a stockpile node is to store the quantity of a particular type of a multiple-output-link product that exceeds the demand for that product. A general discussion of stockpile node data is provided under Background at the end of this section (following a listing of the options available from this form and a description of the data fields displayed).

Options

- View or change values in data fields described below on up to 20 records. Ten records will be displayed simultaneously and you can move from record to record and make any necessary changes by using the standard cursor-control keys. In addition, you can press **F10** to move forward 10 records and **F9** to move back 10 records.

- To delete an existing record, advance to that record, then change the process number to 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and then enter the information required on the form. The new record will be saved when you press **F4**.

- Press **F4** to save changes and return to Menu B020. (You will be prompted to indicate whether the data being saved are complete or incomplete. If they are complete, press **F10**, otherwise press **Esc**.)

- Press **Esc** to ignore changes and return to Menu B020.

- Press **F1** to obtain on-line help.

Data Fields

Record Number: When you display a specific page of data, the record numbers for each of the 10 records on that page are shown in the first column of the screen. This is a *display-only* field that you cannot change. There is no defined relationship between the record numbers in the first column and the stockpile numbers, which you can access, in the second column.

Stockpile Number: This field contains a unique integer of up to two digits identifying the stockpile. Valid values for this integer range from 1 to 20, but you may enter a 0 to indicate that a specific process record is not to be saved. If the record is deleted by entering a 0 for the process number, all other numeric input field values for that record should also be set at 0. There is no required relationship between the process numbers in this column and the record numbers displayed in the first column.

Stockpile Name: This 12-character field can contain a name or any other text that will help you identify the stockpile node. This field should be left blank if the associated record has been marked as deleted with a 0 process number.

Sector Abbreviation: This field contains a three-character abbreviation to help you identify each stockpile node. The field should be left blank if the associated record has been marked as deleted.

Link Number: This field contains a three-digit integer representing the link number associated with each stockpile record. The input link to a stockpile is also its output link. The value of this integer can range from 1 to 500, but may be 0 if a record has been marked as deleted.

Quantity Removed in Base Year: This field contains a 10-place value representing the quantity (in thousands of BOE) of a product removed in the base year. The value should be 0 if the associated process is deleted. A negative flow in the base year indicates a flow into, rather than out of, the stockpile. After this quantity is removed, the amount remaining in the stockpile at the end of the base year is entered in the next field.

Quantity at End of Base Year: This field contains a 10-place value representing the quantity (in thousands of BOE) of a product remaining in the stockpile at the end of the base year. This value must be computed after the product has been removed in the base year, as described for the previous field.

Background

By convention, a stockpile node has a single link that functions as both an input link for filling the stockpile and an output link for reducing the stockpile. A stockpile node is used in conjunction with a multiple-output-link node (such as a refinery) and a decision node. These two node types are described in Forms B029 and B024, respectively. The purpose of a stockpile node is to store the quantity of a particular type of a multiple-output-link product that exceeds the demand for that product. Examples of stockpile nodes may include (1) a stockpile for residual oil from a specific refinery in the oil sector of your network; or (2) a stockpile for bagasse in the sugar sector (since bagasse production is assumed to be driven by the demand for sugar juice).

Any excess production of each output product of a multiple-output-link node is added to the existing amount in a corresponding stockpile each year in the simulation period. The logic for computing the amount of the product to be extracted from the stockpile node is explained below.

A convention adopted in the IDES FORTRAN program is that the link of a stockpile must be an input link to some decision node of the network. The decision node inspects the amount in the stockpile each year and removes as much of the product as possible to meet the demand requirement on the multiple-output-link process. Any remaining demand requirement is considered the net demand requirement that the process then attempts to meet.

5.3.21 Form B02B — Viewing or Changing Price Regulation Process Data

```
ENPEP Module: BALANCE      Planning Study:          Case:      (B02B)
          Viewing or Changing Price Regulation Process Data

                              Process number:    (1-40)
                                Process name:
                          Sector abbreviation:

                                 Input link:    (1-500)
                                Output link:    (1-500)

                             Price multiplier:
                               Price addition:        ($/BOE)
                                Maximum price:        ($/BOE)
                                Minimum price:        ($/BOE)

                       Input price reference link:    (1-500)

                          This is record    of 40.
     Press "F5" to GO BACK 25 RECORDS, "F6" to ADVANCE 25 RECORDS,
          "F7" to GO BACK  5 RECORDS, "F8" to ADVANCE  5 RECORDS,
    "F9" to GO BACK  1 RECORD, "F10" to ADVANCE  1 RECORD, "F1" for HELP,
     "Esc" to IGNORE CHANGES AND QUIT, or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

Form B02B allows you to define up to 40 price regulation process records. You advanced to this form by selecting option 11 on Menu B020. By convention, a pricing node has a single input link and a single output link. A pricing node changes the price on the input link of the node to simulate a government tax, subsidy, price ceiling, price floor, or other government pricing policy. The resulting price is assigned to the output link of the node. A general discussion of price regulation processes is presented under Background at the end of this section (following a listing of the options available in the form and a description of the data fields displayed).

Options

- To view or change values in data fields described below on up to 40 records, use the standard cursor-control functions and the following special record-manipulation functions: press **F6** to advance 25 records, **F8** to advance 5 records, **F10** to advance 1 record, **F5** to go back 25 records, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and then enter the information required on the form. The new record will be saved when you press **F4**.
- Press **F4** to save changes and return to Menu B020.
- Press **Esc** to ignore changes and return to Menu B020.
- Press **F1** to obtain on-line help.

Data Fields

Process Number: This field contains a unique two-digit integer to identify the process. Valid values for this integer range from 1 to 40, but you may enter a 0 to indicate that the process record currently displayed on the screen is not to be saved. If the record is deleted by entering a 0 for the process number, all other numeric data field values can also be set at 0. There is no required relationship between this process number and the current record number displayed at the bottom of the screen.

Process Name: This 12-character field can contain a name or any text that will help you identify this price regulation node.

Sector Abbreviation: This three-character field contains an abbreviation to help you identify each process.

Input Link: This field contains an integer of up to three digits that identifies the input link. This integer must range from 1 to 500, unless the current record is marked as deleted by a 0 in the process number field at the top of the screen. If the record is marked as deleted, this link number should be set at 0.

Output Link: This field contains an integer of up to three digits that identifies the output link. This integer must range from 1 to 500 (except if the record is marked as deleted, this link number should be set at 0).

Price Multiplier: This field contains a value expressing the price multiplier. A value of less than 1 indicates a subsidy, and a value greater than 1 indicates a tax. This unitless five-place value is represented by the factor a of Eq. 5.20 and c of Eq. 5.21 (see Background below). If the current process is marked as deleted, this number should be set at 0.

Price Addition: This field contains a value expressing any price addition. A value of less than 0 indicates a subsidy, and a value greater than 0 indicates a tax. This five-place value is represented by the term b of Eq. 5.20, and d of

Eq. 5.21 (see Background), and is expressed in terms of $U.S./BOE. If the current process is marked as deleted, this number should be 0.

Maximum Price: This field contains a five-place value that represents the maximum price ($U.S./BOE) that the IDES program should assign to the output of the pricing node. The value should be set at 0 if the current process is deleted.

Minimum Price: This field contains a five-place value that represents the minimum price ($U.S./BOE) that IDES should assign to the output of the pricing node. The value should be 0 if the current process is deleted.

Input Price Reference Link: This field contains an integer of up to three digits identifying the input price reference link. This value, which can range from 1 to 500 (unless the current process is deleted) is seen in Eq. 5.21 below. The factor *c* and term *d* in that equation are set to the values *a* and *b*, respectively, of Eq. 5.20. In general, the associated link may be the input link to the pricing node.

Background

By convention, a pricing node has a single input link and a single output link. A pricing node changes the price on the input link of the node to simulate a government tax, subsidy, price ceiling, price floor, or other government pricing policy. The resulting price is assigned to the output link of the node. Examples of pricing nodes typically include (1) tax nodes to represent taxes on petroleum products from a refinery; and (2) a subsidy node in the transport sector that equates the price of ethanol to the price of gasoline.

The output price of a pricing node is determined from the following equation:

$$P_o = a \times P_i + b \qquad (5.20)$$

where:

P_o = price on output link of pricing node,

P_i = price on input link of pricing node,

a = price multiplier, and

b = price increment (or decrement).

A percentage subsidy is modeled using Eq. 5.20 by specifying a < 1 and b = 0. For example, to model a 10% subsidy set a = 0.90 and b = 0. A percentage tax is modeled by specifying a > 1 and b = 0. A fixed subsidy is modeled by specifying a = 1 and b < 0. For example, a $0.05/gallon gasoline subsidy is specified by setting a = 1 and b = -0.05 (assuming the input price is in the units of $U.S./gallon). A fixed tax can be modeled in a similar way. Combinations of percentage and fixed taxes and subsidies can also be modeled by specifying the appropriate values for a and b.

If a price ceiling floor is specified for a pricing node, the computed output price P_o is compared with the price ceiling or floor. If P_o is outside of the allowable price range, P_o is reset to either the price ceiling (if the price ceiling is exceeded) or the price floor (if the price is less than the price floor). That is,

$P_o \leftarrow$ Price Ceiling if $P_o >$ Price Ceiling

$P_o \leftarrow$ Price Floor if $P_o <$ Price Floor

Another option for a pricing node is to specify that the price on the output link of the pricing node is to be set equal to a multiple of the price on another user-specified link somewhere else in the network. For example, this option would be used if the price of ethanol is to be subsidized so it matches the price of gasoline. If this pricing option is selected, the output price is computed from the following equation:

$$P_o = c \times P(L) + d \qquad (5.21)$$

where:

L = user-specified link number,

P(L) = price on the user-specified link,

c = user-specified multiplier, and

d = user-specified price increment or decrement.

The quantity on the output link of a pricing node is set equal to the quantity on the input link of the node - the node does not change the quantity on the input link of the node. The quantity equation is very simple:

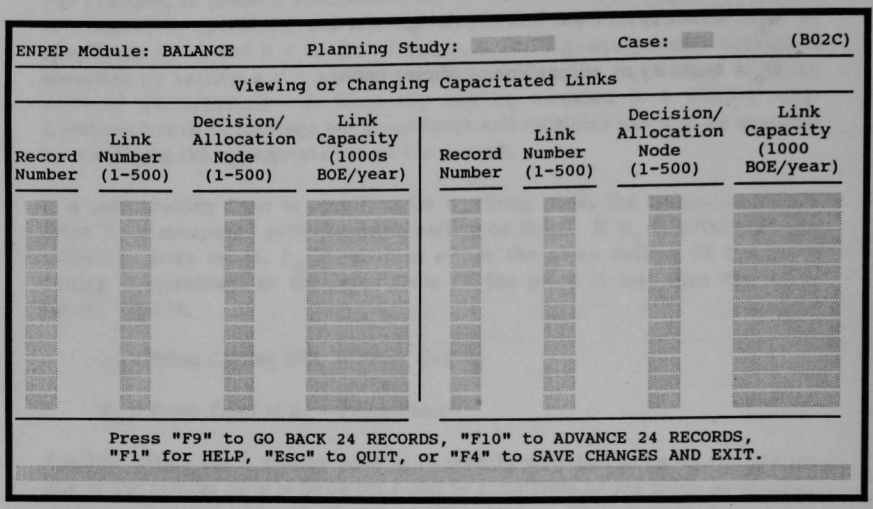
$$Q_o = Q_i \qquad (5.22)$$

where:

Q_i = quantity on input link of pricing node, and

Q_o = quantity on output link of pricing node.

5.3.22 Form B02C — Viewing or Changing Capacitated Links Data



Purpose

On Form B02C you are allowed to specify an upper limit on the flow of energy in up to 96 network links. Upper limits on the flow of energy in a link can be specified only for links that are input to decision/allocation nodes. You advanced to this form by selecting option 12 on Menu B020. This form is somewhat different from the other forms used so far in the BALANCE Module in that your screen is divided vertically into two identical halves. Twelve records are displayed in each half.

Options

- View or change values in data fields described below on up to 96 records. Twenty-four records will be displayed simultaneously (12 on each half of your screen). You can move from record to record and make any necessary changes by using the standard cursor-control keys. In addition, you can press **F10** to page forward 24 records and **F9** to page back 24 records.

- To delete an existing record, advance to that record, then change the process number to a 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and enter the information required on the form. The new record will be saved when you press **F4**.

- Press **F4** to save changes and return to Menu B020. (You will be prompted as to whether the data being saved are complete or incomplete. If they are complete, press **F10**, otherwise press **Esc**.)

- Press **Esc** to ignore changes and return to Menu B020.

- Press **F1** to obtain on-line help.

Data Fields

Record Number: When you display a specific page of data, the record numbers for each of the 12 records on each half of the screen are shown in the first column of that half screen. This is a display-only field that you cannot change. There is no defined relationship between the record numbers in the first column and the link numbers, which you can access, in the second column of each half screen.

Link Number: This field contains an integer of up to three digits specifying the capacitated link number. If a link of your network is specified here, IDES will verify that the energy flowing through that link will never exceed the value you specify on this form. Each link number you specify here should be between 1 and 500, but it may be set to 0 if you want to remove its capacity limitations. If a link number is 0, the values in the following two data fields should also be set at 0.

Decision/Allocation Node: This field contains a number identifying the decision/allocation node to which a capacitated link is an input. IDES requires that all capacitated links be input links to a decision or allocation node. Unless the link is deleted, the values of this field should range from 1 to 500. Decision and allocation nodes are described above in Form B024.

Link Capacity: This field contains a 10-place number expressing the annual capacity (in thousands of BOE/year) of the capacitated link. If a capacitated link is deleted with a 0 link number, the value of this field should also be set at 0.

5.3.23 Menu B030 — Viewing or Changing Electric Sector Network Data

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B030)

              Viewing or Changing Electric Sector Network Data

                                                          Status   Last Update
Type of Data to be Viewed or Changed
1. Electric sector output control
2. Electric sector data
3. View or modify existing thermal process data
4. Selectively add thermal data from PLANTDATA
5. View or modify existing hydroelectric process data
6. Selectively add hydroelectric data from PLANTDATA
7. Electric generating unit conversions
8. Fuel price links for ELECTRIC Module

Type of network data to be viewed, modified or added:  (1-8, from above list)

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu B030 enables you to access (for the purpose of viewing or changing) eight types of electric sector data for eventual input to the IDES FORTRAN program. You advanced to this menu after selecting option 3 on Menu B004. You gain access to the data described on this menu by selecting the appropriate option, as listed below, to advance to the desired form. Displayed on this menu for each data type are its status and the date on which the data were last changed. Information on BALANCE's electric sector submodule is provided at the end of this section under Background.

Options

1 Select this option to access electric sector output control data. These data are used to specify whether you want to include an electric sector in your network, and to allow you to control input data and quantity of output to be printed. You will advance to Form B031.

2 Select this option to access electric sector data, including network structure and basic technical characteristics. You will advance to Form B032. Information such as link numbers, base-year electric production, interest rates, and load duration curve data will be presented.

3 Select this option to access existing thermal process data. You will advance to Form B033. Information such as link numbers, capacity, capital cost, fixed and variable O&M costs, heat rate, outage rates, minimum utilization rate, and life expectancy of each thermal unit you have previously defined in BALANCE will be displayed.

4 Select this option to selectively add thermal data and unit information available from the PLANTDATA Module. You will be prompted to enter the identity (such as A, B, or C) of the disk drive on which PLANTDATA information for the current planning study is stored. After you have entered the requested information, you will advance to Form B093. The information available for each unit will be the same as that described under option 3 for existing BALANCE units.

5 Select this option to access existing hydroelectric process data. You will advance to Form B034. Information such as link number, capacity, capital cost, O&M cost, outage rates, and minimum utilization rate of each hydroelectric unit you have previously defined in BALANCE will be displayed.

6 Select this option to selectively add hydroelectric data and unit information available from the PLANTDATA Module. After you have indicated the disk drive on which the PLANTDATA information for this case study is stored, you will advance to Form B094. The information available for each unit will be the same as that described under option 5 for existing BALANCE units.

7 Select this option to access electric generating unit conversion data. You will advance to Form B035. If an oil-burning thermal unit is converted to a coal-fired facility, for example, relevant data can be accessed with this option. Data on the new facilities include a link number, capacity, incremental capital cost, O&M costs, heat rate, outage rates, minimum utilization rate, and life expectancy.

8 Select this option to access fuel price links for the ELECTRIC Module. You will advance to Form B036. These data include the link number that will be used to obtain domestic and foreign fuel prices for fuel oil, coal, gas, nuclear fuel and distillate oil. When the IDES FORTRAN simulation is complete, these prices will be placed in a data file and made available to the ELECTRIC Module.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu B004.

Background

The electricity generation sector of the IDES model is a self-contained submodule with its own computational procedures and logic that are distinct from the other parts of the module. However, the electric sector is embedded in the energy network and receives electricity demand (from the output links of the sector) and fuel prices (from the input links to the sector) over the simulation period. Given total annual electricity demand and fuel prices taken from the links that are output and input from the electric sector, respectively, the electric sector submodule makes the following calculations for each year of the simulation period:

- Develops a discrete approximation of the inverse load duration curve from a fifth-order polynomial approximation of the annual load duration curve,
- Computes peak load from the load duration curve and total electricity demand,
- Computes the derated capacity of each of the available electricity generating units,
- Computes the total variable cost (variable O&M plus fuel costs) for each available unit and orders the units on the basis of variable cost,
- Loads units in order onto the load duration curve (based on derated capacity) to meet electricity demand, peak load, and reserve margin requirements for the system, and
- Computes average total cost of electricity production and the amounts of fuel consumed by each available generating unit.

The generating units available for loading in each year of the simulation period are determined from data that you supply. For each electricity generating unit, the year that the unit first became available (or will become available if the unit does not exist in the base year) is a data item. The submodule does not produce a build schedule endogenously. Rather, the dates of availability for the units that you supply imply a prospective build schedule, and the electric sector submodule determines the units necessary for operation to meet electricity demand and reserve margin requirements. Not all available units will necessarily be used to generate electricity, however. An available unit is loaded only if its ranking in the loading order is such that the unit is required to meet the electricity demand and reserve margin requirements. If demand and reserve requirements are significantly less than the capacity of available units, some units will not be needed. In addition, the utilization rate of each unit (as determined from its prospective

position in the loading order) must be greater than a user-specified minimum level for the unit to be loaded. If an available unit is not needed, but it has been used in any previous year of the simulation period (and therefore is assumed to exist), the fixed costs of the unit (amortized capital cost and fixed operating and maintenance cost) are included in the total cost of electricity production. If an available unit is not needed and it has not been used in any previous year, the unit is assumed not to have been built, and its fixed costs are not included in the total cost of electricity generation.

Three computed variables are particularly important in the electric sector submodule, as indicated by the preceding discussion: unit derated capacity, unit variable cost, and average cost of electricity generation. Unit derated capacity is computed from the following equation:

$$DCAP = CAP \times (1 - FORC) \times (1 - DMAIN / 365) \quad (5.23)$$

where:

DCAP = derated capacity of the unit,

CAP = maximum continuous capacity of the unit,

FORC = forced outage rate of the unit (fraction of the time over the course of a year that the unit is down due to unanticipated operational problems), and

DMAIN = days per year of scheduled maintenance for the unit.

Unit variable cost is computed from the equation:

$$VC = VOM / 10 + PF \times HTRT / 53908 \quad (5.24)$$

where:

VC = total variable cost of the unit (cents/kWh),

VOM = variable operating and maintenance cost (mills/kWh) (1 mill = 0.1 cent),

PF = fuel price ($U.S./BOE), and

HTRT = heat rate (Btu/kWh) (1 BOE = 5,390,800 Btu; 1 kWh = 3413 Btu).

The total cost of electricity generation is computed from the following equation:

$$TC = \sum_{u \in U} [CAPC_u \times CRF(i,n_u) + FOM_u] \times CAP_u + VC_u \times OUT_u / 100 \quad (5.25)$$

where:

TC = total cost of electricity generation in some year ($U.S./yr),

U = set of available units that are needed to meet electricity demand, peak load, and reserve margin requirements and units not needed to meet these requirements but that have been operated in a previous year of the simulation period,

$CAPC_u$ = capital cost of unit ($U.S./kW),

$CRF(i,n_u)$ = capital recovery factor for amortizing capital cost over life of unit (n_u years) at annual interest rate i,

FOM_u = fixed operating and maintenance cost of unit ($U.S./kW-yr),

CAP_u = maximum rated capacity of unit (kW),

VC_u = variable cost of unit (cents/kWh) from Eq. 5.24, and

OUT_u = annual electricity production by unit (kWh/year).

The average cost of electricity generation ($U.S./kW) is then:

$$ATC = TDC / \sum_{u \in U} OUT_u \quad (5.26)$$

The price of electricity is taken as the average cost of electricity generation in the model.

5.3.24 Form B031 — Viewing or Changing Electric Sector Output Control Data

```
ENPEP Module: BALANCE    . Planning Study:          Case:          (B031)
          Viewing or Changing Electric Sector Output Control Data

                          Electric sector:  (0=does not exist, 1=exists)
                Echo electric sector data:  (0=YES, 1=NO)

  (2=converged iteration only, 1=output for specified iterations, 0=no output)
                     1 2 3 4 5 6 7 8 9   1 2 3 4 5 6 7 8 9   1 2 3 4 5 6 7 8 9
Electric sector code:

                     1   2   3   4   5   6   7   8   9   10  11  12  13  14  15
Beginning iteration:

                     1   2   3   4   5   6   7   8   9   10  11  12  13  14  15
   Ending iteration:

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Form B031 enables you to view or change five types of electric sector output control data. You advanced to this form after selecting option 1 in Menu B030.

Options

- View or change values in the data fields described below.
- Press **F10** to store your changes. The data will be copied to a temporary file (to be permanently saved when you make the proper selection on Menu B003). You next will be prompted to indicate if the data being saved are complete or incomplete. If they are complete, press **F10** again. If the data are incomplete, press **Esc**. In either case, you will return to Menu B030.
- Press **Esc** to return to Menu B030 without having your changes saved.
- Press **F1** to obtain on-line help.

Data Fields

Electric Sector: This serves as a switch to indicate whether the electric sector exists in your network. If it does, you should enter a 1 and continue with the rest of the form. If the electric sector does not exist, you should enter 0, press **F10** to exit this form, and press **F10** again to tag the data as complete and return to Menu B004.

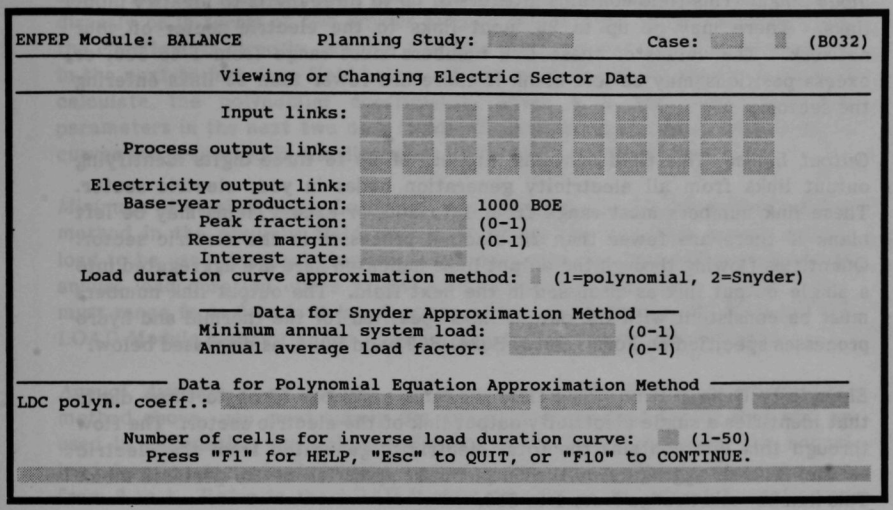
Echo Electric Sector Data: This field serves as a flag to indicate whether you want to duplicate electric sector input data in the output file ELEC.OUT. Enter a 0 in this field if you do, otherwise enter a 1.

Electric Sector Code: This field contains a set of 30 intermediate results flags, one flag for each of 30 possible years of your planning study. These values can be set to either 0, 1, or 2. (The echo switch of the previous field operates independently of these flags.) If the value in the third position in this field is set at 2, IDES will print the detailed results of electric sector calculations for the last converged simulation iteration of the third year. If that value is set at 1, detailed iteration results will be printed for both the intermediate iteration and the converged iteration. If the value is set at 0, no output will be printed. The first and last iterations for which these detailed results will be printed are controlled by values in the next two fields described below. If there are fewer than 30 years in your planning study, extra fields can be left blank.

Beginning Iteration: This field consists of 30 three-digit positions (one for each year of your study up to 30 years) that specify the initial iteration for which detailed results are to be printed. If you entered a 1 for a specific year in the previous field, you can specify in this field the first iteration for which detailed intermediate iteration results will be printed in the ELEC.OUT output file. You must specify an initial iteration number for each year for which you requested intermediate results in the previous field. If there are fewer than 30 years in you planning study, the extra fields can be left blank.

Ending Iteration: This field consists of 30 three-digit positions (one for each year of your study up to 30 years) that specify the final iteration for which detailed results are to be printed. If you enter a 1 for a specific year in the *Electric Sector* field above, you can specify in this field the last iteration for which detailed intermediate iteration results will be printed in the ELEC.OUT output file. You must specify a final iteration number for each year for which you requested intermediate results. If there are fewer than 30 years in your planning study, the extra fields can be left blank.

5.3.25 Form B032 — Viewing or Changing Electric Sector Data



Purpose

Form B032 enables you to view or change 12 types of basic electric sector data. You advanced to this form after selecting option 2 in Menu B030.

Options

- View or change values in the data fields described below.
- Press **F10** to store your changes. The data will be copied to a temporary file (to be permanently saved when you make the proper selection on Menu B003). You next will be prompted to indicate if the data being saved are complete or incomplete. If they are complete, press **F10** again. If the data are incomplete, press **Esc**. In either case, you will return to Menu B030.
- Press **Esc** to return to Menu B030 without having your changes saved.
- Press **F1** to obtain on-line help.

Data Fields

Input Links: This field contains integers of up to three digits to identify input links. There may be up to 20 input links to the electric sector of your network. The values of these link numbers must range from 1 to 500, or excess positions may be left blank if there are fewer than 20 links entering the sector.

Output Links: This field contains integers of up to three digits identifying output links from all electricity generation nodes in your electric sector. These link numbers must range from 1 to 500, or excess fields may be left blank if there are fewer than 20 electric processes in the electric sector. Quantities flowing through the output links indicated here are aggregated into a single output link as discussed in the next field. The output link numbers must be consistent with the output links specified for the thermal and hydro processes specified on Forms B033, B034, B093 and B094, as discussed below.

Electricity Output Link: This field contains a number of up to three digits that identifies a single electricity output link of the electric sector. The flow through this link contains the total electricity generated from the electric sector; it is an aggregate of the output links specified in the previous field. This number must range from 1 to 500.

Base-Year Production: This field contains a 10-place value representing the base-year electricity production expressed in thousands of BOE. This value is used for the base-year balance; before the simulation begins, the submodule uses this value as the base-year electricity production.

Peak Fraction: This field contains a 10-place value representing the fraction of electricity that the IDES simulation will try to meet with peaking units. The value of this target peak fraction must range from 0 to 1. The difference between peaking units and base-loaded units is described in Form B033 below.

Reserve Margin: This field contains a decimal fraction of up to 10 places expressing the reserve margin for the electric sector of your network. This value must be expressed in terms of a fraction of the total electrical generation capacity required above the peak load. A reserve margin of 30%, for example, should be entered as 0.30.

Interest Rate: This field contains a decimal fraction of up to 10 places representing the annual interest rate to be used for amortizing the capital costs of electric generating units, as previously seen in Eq. 5.25.

Load-Duration Curve Approximation Method: This is a one-digit number indicating the method to be used in approximating the load-duration curve. The BALANCE Module uses one annual load-duration curve, and that curve is

represented by a fifth-degree polynomial equation. You have the option of specifying the load duration curve polynomial equation coefficients either directly or in terms of two *Snyder method* parameters. If you want to enter the coefficients directly, enter a 1 in this field and complete the information in the next-to-last data field below. If you want to use the Snyder method to calculate the polynomial coefficients, enter a 2 and supply the two parameters in the next two data fields. Equations pertaining to load duration curves are presented in the discussion of ENPEP's LOAD Module.

Minimum Annual System Load: If you selected the Snyder approximation method in the previous field, you must supply the minimum annual system load to be used in calculating the polynomial equation that will represent the annual load duration curve in BALANCE's electric submodule. This value must range from 0 to 1; it is a fraction of the annual peak load. Refer to the LOAD Module description for more information on the Snyder method.

Annual Average Load Factor: If you selected the Snyder approximation method above, you must supply the annual average load factor that will be used in calculating the polynomial equation that will represent the annual load duration curve in BALANCE's electric submodule. This value must range from 0 to 1. Refer to the LOAD Module description for more information on the Snyder method.

Data for Polynomial Equation Approximation Method: If you selected to enter the polynomial equation coefficients directly, you must now enter the six coefficients for the fifth-degree polynomial equation that will form your annual load duration curve. The first coefficient must be 1.

Number of Cells for Inverse Load Duration Curve: This field contains the number of cells used to approximate the inverse load duration curve. The value in this field must range from 1 to 50.

5.3.26 Form B033 — Viewing or Changing Thermal Electric Process Data

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B033)

              Viewing or Changing Thermal Electric Process Data

  Process number:     (1-300, or 0 to delete)    Process name:
      Input link:     (1-500)                     Output link:     (1-500)
        Capacity:     MW                         Capital cost:          $/kW

          Fixed operating & maintenance cost:        $/kW-year
       Variable operating & maintenance cost:        mills/kWh
                                  Heat rate:           Btu/kWh
                          Forced outage rate:        (0-1)
                         Planned outage rate:        days/year
                               On-line date:        (year)
                             Unit total life:     years
                Minimum annual utilization rate:    (0-1)

                          This is record     of     .

        Press "F5" to GO BACK 25 RECORDS, "F6" to ADVANCE 25 RECORDS,
              "F7" to GO BACK  5 RECORDS, "F8" to ADVANCE  5 RECORDS,
              "F9" to GO BACK  1 RECORD, "F10" to ADVANCE  1 RECORD,
"F1" for HELP, "Esc" to IGNORE CHANGES AND QUIT, "F4" to SAVE CHANGES AND EXIT.
```

Purpose

Form B033 allows you to view or change thermal electric process records, each of which represents a thermal electric generating unit. Included are any units you may have already added from the PLANTDATA Module (option 4 on Menu B030). You advanced to this form by selecting option 3 on Menu B030. Up to 300 records are available to you in this form, so long as the total number of thermal and hydroelectric units combined does not exceed 300 records.

Options

- To view or change values in data fields described below on up to 300 records, use the standard cursor-control keys and the following special record-manipulation functions: press **F6** to advance 25 records, **F8** to advance 5 records, **F10** to advance 1 record, **F5** to go back 25 records, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and enter the information required on the form. The new record will be saved when you press **F4**.

- Press **F4** to save changes and return to Menu B030.
- Press **Esc** to ignore changes and return to Menu B030.
- Press **F1** to obtain on-line help.

Data Fields

Process Number: This field must contain a unique number of up to three digits to identify each thermal unit. Valid values for this integer range from 1 to 300, but you may enter 0 to indicate that the process record currently displayed is not to be kept. If the record is deleted by entering a 0 for the process number, all other numeric data fields on the current screen will be ignored. There is no required relationship between this process number and the current record number displayed near the bottom of the screen.

Process Name: This 12-character field should contain a name or any text that will help you identify each process or unit.

Input Link: This field contains an input link number of up to three digits for the current thermal generating unit. This integer should range from 1 to 500, but it may be 0 if the current record is marked as deleted.

Output Link: This field contains an integer of up to three digits identifying the output link number for the current thermal generating unit. This integer should range from 1 to 500, but it may be 0 if the current record is marked as deleted.

Capacity: This five-place field contains the generating capacity (expressed in units of megawatts electric) of the current thermal generating unit.

Capital Cost: The total capital cost (in $U.S./kilowatt) of each thermal generating unit is placed in this seven-place field.

Fixed Operating & Maintenance Cost: This five-place field contains the fixed operating and maintenance costs (in $U.S./kilowatt-year) for the thermal unit.

Variable Operating & Maintenance Cost: This field contains a five-place value expressing the variable operating and maintenance costs of the thermal unit. This value must be expressed in units of mills/kilowatt-hour and should not include the cost of fuel for the unit.

Heat Rate: This eight-place field expresses the heat rate (Btu/kilowatt-hour) for the associated thermal unit.

Unplanned Outage Rate: This five-place field contains a decimal fraction representing the unplanned outage rate for the thermal unit. The value must be between 0 and 1.

Planned Outage Rate: This field contains the planned outage rate for the thermal unit. The values in this five-place field must be expressed in units of days per year.

On-Line Date: This field indicates the earliest year in which the IDES FORTRAN program will consider the thermal unit's availability. The on-line year in this field can be earlier or later than the base year of your planning study. This value is the same year as that used by the FIXSYS submodule of the ELECTRIC Module, but the VARSYS submodule does not use the year if the unit has not been tagged as committed in the PLANTDATA Module.

Unit Total Life: This field represents the unit total life (in years) of the thermal generating unit. This information is used in conjunction with the previous field to provide the IDES FORTRAN program the last year a unit will be operational. If, for example, the specific unit is needed in the year 2001 and the unit life in this field is 25 years, the BALANCE Module will assume the unit operates from Jan. 1, 2001, through Dec. 31, 2025.

Minimum Annual Utilization Rate: This five-place field must contain a value expressing the fraction of the total hours in a year that the unit will be used. If a unit is loaded but is positioned in the loading order such that this minimum utilization rate cannot be maintained, the unit will be removed from the loading order and assumed not to operate at all. Peaking units are designated by values of 0.0 in this field.

5.3.27 Form B093 — Adding Thermal Electric Units from PLANTDATA Module

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B093)

              Adding Thermal Electric Units from PLANTDATA Module

This unit will NOT be added to your network unless you provide a process number.

  Process number:     (1-300, or 0 to omit)     Process name:
     Input link:      (1-500)                    Output link:     (1-500)
       Capacity:      MWe                       Capital cost:          $/kW

          Fixed operating & maintenance cost:          $/kW-year
       Variable operating & maintenance cost:          mills/kWh
                                   Heat rate:              Btu/kWh
                         Unplanned outage rate:          (0-1)
                           Planned outage rate:          days/year
                                 On-line date:          (year)
                               Unit total life:          years
                        Minimum utilization rate:          (0-1)

                    This is PLANTDATA record     of     .
        Press "F7" to GO BACK 5 RECORDS, "F8" to ADVANCE 5 RECORDS,
              "F9" to GO BACK 1 RECORD, "F10" to ADVANCE 1 RECORD,
               "F1" for HELP, "Esc" to IGNORE ADDITIONS AND QUIT,
              or "F4" to SAVE ALL ADDITIONS AND EXIT FROM THIS MENU.
```

Purpose

Form B093 enables you to add to your current BALANCE planning study up to 300 thermal electric units that you earlier defined in the PLANTDATA Module (provided that the total number of BALANCE thermal and hydro-electric units combined does not exceed 300 units). You advanced to this form by selecting option 4 on Menu B030. Once you access a specific PLANTDATA record on this form, you can add that record to BALANCE by completing the required information in 5 of the 14 data fields displayed (see Data Fields below). The information required includes such items as the process number and name and certain network information.

Options

- To add a specific PLANTDATA record to your BALANCE network, advance to that record and complete the missing information as indicated below in the description of data fields. To access the desired records, press **F8** to advance five records, **F10** to advance one record, **F7** to go back 5 records, and **F9** to go back 1 record. (Note: If necessary, other changes can also be made in the data fields described below, but first read the information under Background at the end of this section.)

- Press F4 to save all additions and changes and return to Menu B030. The units will be copied to a temporary file and will be permanently saved in your planning study subdirectory only when you make the proper selection on Menu B003.

- Press Esc to ignore additions and return to Menu B030.

- Press F1 to obtain on-line help.

Data Fields

Process Number: The first field of each record contains a process number of 0. You must provide a unique process number for each thermal unit you wish to add from PLANTDATA. Valid values for this integer range from 1 to 300. If you do not want to add the currently displayed thermal unit from PLANTDATA, be sure the process number field is 0 to indicate that the record on the screen is not to be added. If the PLANTDATA unit is bypassed with a 0 process number, all other numeric data fields associated with that record will be ignored. There is no required relationship between this process number and the current record number displayed near the bottom of the screen. *This field must be completed in order to add the PLANTDATA record to BALANCE.*

Process Name: You must enter a name or text of up to 12 characters to help identify each PLANTDATA process or unit you wish to add to BALANCE. *This field must be completed in order to add the PLANTDATA record to BALANCE.*

Input Link: You must enter an input link number of up to three digits in this field if you want to add the PLANTDATA unit to BALANCE. This integer should range from 1 to 500, but it may be 0 if the current record is not to be added. *This field must be completed in order to add the PLANTDATA record to BALANCE.*

Output Link: You must enter an output link number of up to three digits in this field if the PLANTDATA unit record currently displayed is to be added to BALANCE. This integer should range from 1 to 500, but it may be 0 if the current record is not to be added to BALANCE. *This field must be completed in order to add the PLANTDATA record to BALANCE.*

Capacity: This field contains a value of up to five places expressing the generating capacity (in megawatts electric) of the current thermal generating unit, as stored in PLANTDATA. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Fixed Operating & Maintenance Cost: This field contains a value of up to five places representing the fixed operating and maintenance costs (in $U.S./kilowatt-year) of the PLANTDATA thermal unit. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Capital Cost: In this field you must supply the total capital costs of the PLANTDATA thermal generating unit before you add the record to BALANCE. The units of this seven-place field are $U.S./kilowatt. *This field must be completed in order to add the PLANTDATA record to BALANCE.*

Variable Operating & Maintenance Cost: This field contains a value of up to five places representing the variable operating and maintenance cost (in mills/kilowatt-hour) of the PLANTDATA thermal unit. The cost of fuel for the unit should not be included. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Heat Rate: This eight-place field contains the heat rate (expressed in Btu/kilowatt-hour) of the PLANTDATA thermal unit. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Unplanned Outage Rate: This five-place field contains a decimal fraction (with a value between 0 and 1) expressing the unplanned outage rate for the PLANTDATA thermal unit. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Planned Outage Rate: This five-place field contains the planned outage rate (expressed in days per year) for the thermal unit. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

On-line Date: This field indicates the earliest year in which the IDES FORTRAN program will consider the thermal unit's availability. The on-line year of this field can be earlier or later than the base-year of your planning study. This value is the same year as that used by the FIXSYS submodule of the ELECTRIC Module, but the VARSYS submodule does not use the year if the unit has not been tagged as committed in the PLANTDATA Module. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Unit Total Life: This field contains an integer representing the total life (in years) of the thermal unit. This value is used in conjunction with the previous field to provide IDES with the last year the unit will be operational. If, for

example, the specific unit is needed in the year 2001 and the unit life in this field is 25 years, the BALANCE Module will assume that the unit operates from Jan. 1, 2001, through Dec. 31, 2025. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Minimum Utilization Rate: This field contains a five-place value (expressed as a fraction of the total hours in a year) representing the minimum utilization rate of the thermal unit. If the unit is loaded but is positioned in the loading order such that it cannot maintain this minimum utilization, the unit will be removed from the loading order and assumed not to operate at all. Peaking units are designated by values of 0.0 in this field. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Background

Although changes to technical characteristics of thermal plants and units should preferably be made from within the PLANTDATA Module, you are able to change the values in the data fields on this form if necessary. You should be aware, however, that any changes you make to generating unit characteristics in BALANCE will not be reflected in PLANTDATA. Once you have added a thermal unit to BALANCE, you can change it only by returning to Menu B030 and selecting option 3 to go to Form B033. You should also be aware that you can add the identical PLANTDATA thermal units several times by repeatedly accessing the same record and supplying a new process number each time. BALANCE allows you to access and optionally add all committed PLANTDATA units, but it allows you to add only 10 thermal units of a given candidate PLANTDATA plant. If you need to add more than 10 units of a candidate plant, you can repeat option 4 of Menu B030 as many times as necessary.

5.3.28 Form B034 — Viewing or Changing Hydroelectric Process Data

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B034)
                Viewing or Changing Hydroelectric Process Data

       Process number:      (1-300, or                Process name:
                            0 to delete)               Output link:      (1-500)
 Average annual energy:      MW-year                  Capital cost:        $/kW

          Fixed operating & maintenance cost:        $/kW-year

                          Unplanned outage rate:      (0-1)
                            Planned outage rate:      days/year
                                  On-line date:       (year)
                                Plant total life:     years
                    Minimum annual utilization rate:  (0-1)

                                This is record    of    .

      Press "F5" to GO BACK 25 RECORDS, "F6" to ADVANCE 25 RECORDS,
            "F7" to GO BACK  5 RECORDS, "F8" to ADVANCE  5 RECORDS,
   "F9" to GO BACK  1 RECORD, "F10" to ADVANCE  1 RECORD,"F1" for HELP,
    "Esc" to IGNORE CHANGES AND QUIT, or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

Form B033 allows you to view or change hydroelectric process records, each of which represents a hydroelectric generating unit. Included are any units you may have already added from the PLANTDATA Module (option 6 on Menu B030). You advanced to this form by selecting option 5 on Menu B030. Up to 300 records are available to you in this form, so long as the total number of thermal and hydroelectric units combined does not exceed 300 records.

Options

- To view or change values in data fields described below on up to 300 records, use the standard cursor-control keys and the following special record-manipulation functions: press **F6** to advance 25 records, **F8** to advance 5 records, **F10** to advance 1 record, **F5** to go back 25 records, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to a 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and then enter the information required on the form. The new record will be saved when you press **F4**.
- Press **F4** to save changes and return to Menu B030.
- Press **Esc** to ignore changes and return to Menu B030.
- Press **F1** to obtain on-line help.

Data Fields

Process Number: This field contains a three-digit process number. You must provide a unique process number for each hydroelectric plant. Valid values for this integer range from 1 to 300, but you may enter a 0 to indicate that the process record currently displayed on the screen is not to be kept when you save the data. If the record is deleted by entering 0 for the process number, all other numeric data fields on the record will be ignored. There is no required relationship between this process number and the current record number displayed near the bottom of the screen.

Process Name: This 12-character field contains a name or other text to help you identify each process or plant.

Output Link: This field contains an integer of up to three digits identifying the output link number. The value should range from 1 to 500, but may be 0 if the current record is marked as deleted.

Average Annual Energy: This field contains a value of up to five places representing the average annual energy (in megawatt-years) of the current hydroelectric unit. This value may have been calculated in the PLANTDATA Module.

Capital Cost: This seven-place field represents the total capital cost (in $U.S./kilowatt) of the hydroelectric unit.

Fixed Operating & Maintenance Cost: This five-place field represents the the fixed operating and maintenance cost (in $U.S./kilowatt-year) of the hydroelectric plant.

Unplanned Outage Rate: This five-place field contains a decimal fraction (value between 0 and 1) indicating the unplanned outage rate assigned to this hydroelectric unit.

Planned Outage Rate: This five-place field expresses the planned outage rate (in days/year) of the hydroelectric plant.

On-Line Date: This field contains the earliest year in which the IDES FORTRAN program will consider the hydroelectric plant's availability. The on-line year in this field can be earlier or later than the base year of your planning study. This value is the same year as that used by the FIXSYS submodule of the ELECTRIC Module, but the VARSYS submodule does not use the year if the plant has not been tagged as committed in the PLANTDATA Module.

Plant Total Life: This field indicates the total life (in years) of the hydroelectric plant. This value is used in conjunction with the previous field to provide IDES the last year a plant will be operational. If, for example, the specific plant is needed in the year 2001 and the life in this field is 25 years, the BALANCE Module will assume that the plant operates from Jan. 1, 2001, through Dec. 31, 2025.

Minimum Annual Utilization Rate: This field contains a decimal fraction of up to five places indicating the minimum utilization rate (fraction of the total hours in a year). If the plant is loaded but is positioned in the loading order such that it cannot maintain this minimum utilization, the plant will be removed from the loading order and assumed not to operate at all.

5.3.29 Form B094 — Adding Hydroelectric Units from PLANTDATA Module

```
ENPEP Module: BALANCE        Planning Study:          Case:      (B094)
                Adding Hydroelectric Units from PLANTDATA Module
This unit will NOT be added to your network unless you provide a process number.

       Process number:     (1-300, or                Process name:
                           0 to delete)               Output link:     (1-500)
Average annual energy:     MW                        Capital cost:          $/kW

          Fixed operating & maintenance cost:        $/kW-year

                        Unplanned outage rate:       (0-1)
                          Planned outage rate:       days/year
                               On-line date:         (year)
                             Plant total life:       years
                      Minimum utilization rate:      (0-1)

                    This is PLANTDATA record    of    .
        Press "F7" to GO BACK 5 RECORDS, "F8" to ADVANCE 5 RECORDS,
              "F9" to GO BACK 1 RECORD, "F10" to ADVANCE 1 RECORD,
              "F1" for HELP, "Esc" to IGNORE ADDITIONS AND QUIT, or
              "F4" to SAVE ALL ADDITIONS AND EXIT FROM THIS MENU.
```

Purpose

Form B094 enables you to add to your current BALANCE planning study up to 300 hydroelectric plants that you earlier defined in the PLANTDATA Module (provided that the total number of BALANCE thermal and hydroelectric units combined does not exceed 300 units). You advanced to this form by selecting option 6 on Menu B030. Once you access a specific PLANTDATA record on this form, you can add that record to BALANCE by completing the required information in 4 of the 11 data fields displayed (see Data Fields section below). The information required includes such items as the process number and name and certain network information.

Options

- To add a specific PLANTDATA hydroelectric plant record to your BALANCE network, advance to that record and complete the necessary information as indicated below in the description of data fields. To access the desired records, press **F8** to advance five records, **F10** to advance one record, **F7** to go back 5 records, and **F9** to go back 1 record. (Note: If necessary, other changes can also be made in the data fields described below, but first read the information under Background at the end of this section.)

- Press **F4** to save all additions and changes and return to Menu B030. The units will be copied to a temporary file and will be permanently saved in your planning study subdirectory only when you make the proper selection on Menu B003.

- Press **Esc** to ignore additions and return to Menu B030.

- Press **F1** to obtain on-line help.

Data Fields

Process Number: In this field, you must provide a unit process number of up to three digits for each PLANTDATA hydroelectric unit you wish to add to BALANCE. Valid values for this integer range from 1 to 300. If you do not want to add the currently displayed plant from PLANTDATA, be sure that the process number field is set at 0. If the PLANTDATA plant is bypassed with a 0 process number, all other numeric data fields associated with that record will be ignored. There is no relationship between this process number and the current record number displayed near the bottom of the screen. *This is one of the fields that must be completed before you can add this PLANTDATA hydroelectric unit to your BALANCE planning study.*

Process Name: You must enter a name or other text in this 12-character field to help you identify each process or plant. *This is one of the fields that must be completed before you can add this PLANTDATA hydroelectric unit to your BALANCE planning study.*

Output Link: You must enter the output link number (an integer of up to three digits) in this field if the currently displayed hydroelectric unit is to be added to BALANCE. The value of this integer should be from 1 to 500, but it may be 0 if the current record is not being added to BALANCE. *This is one of the fields that must be completed before you can add this PLANTDATA hydroelectric unit to your BALANCE planning study.*

Average Annual Energy: This field contains a five-place value expressing the expected annual electricity output (in megawatt-years) of the current hydroelectric unit as computed by PLANTDATA and described in the PLANTDATA Module documentation. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Capital Cost: You must enter the total capital cost (in $U.S./kilowatt) in this seven-place field for each unit you want to add to BALANCE. *This is one of the fields that must be completed before you can add this PLANTDATA hydroelectric unit to your BALANCE planning study.*

Fixed Operating & Maintenance Cost: This field contains a value of up to five places representing the fixed operating and maintenance costs (in $U.S./kilowatt-year) of the PLANTDATA hydroelectric unit. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Unplanned Outage Rate: This five-place field contains a decimal fraction (with a value of between 0 and 1) expressing the unplanned outage rate for the PLANTDATA hydroelectric unit. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Planned Outage Rate: This five-place field contains the planned outage rate (expressed in days per year) for the hydroelectric unit. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

On-line Date: This field indicates the earliest year in which the IDES FORTRAN program will consider the hydroelectric unit's availability. The on-line year of this field can be earlier or later than the base year of your planning study. This value is the same year as that used by the FIXSYS submodule of the ELECTRIC Module, but the VARSYS submodule does not use the year if the unit has not been tagged as committed in the PLANTDATA Module. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Plant Total Life: This field contains an integer representing the total life (in years) of the hydroelectric plant. This value is used in conjunction with the previous field to provide IDES the last year the unit will be operational. If, for example, the specific plant is needed in the year 2001 and the plant life in this field is 25 years, the BALANCE Module will assume that the plant operates from Jan. 1, 2001, through Dec. 31, 2025. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Minimum Utilization Rate: This field contains a five-place value (expressed as a fraction of the total hours in a year) representing the minimum utilization rate of the hydroelectric plant. If the unit is loaded but is positioned in the loading order such that it cannot maintain this minimum utilization, the unit will be removed from the loading order and assumed not to operate at all. *If necessary, you may change this value before you add the record to BALANCE, but the change will not be made in PLANTDATA.*

Background

Although changes to technical characteristics of hydroelectric units should preferably be made from within the PLANTDATA Module, you are able to change values (as described above) on this form if necessary. You should be aware, however, that any changes you make to generating unit characteristics in BALANCE will not be reflected in PLANTDATA. Once you have added a hydroelectric unit to BALANCE, you can change it only by returning to Menu B030 and selecting option 5 to go to Form B034. You should also be aware that you can add the identical PLANTDATA hydroelectric units multiple times by repeatedly accessing the same record and supplying a new process number each time. BALANCE allows you to access and optionally add all committed PLANTDATA units, but if you need to add more than 10 candidate plants of a specific type, you can repeat option 6 of Menu B030 as many times as necessary.

5.3.30 Form B035 — Viewing or Changing Data for Electric Generating Unit Conversions

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B035)

      Viewing or Changing Data for Electric Generating Unit Conversions

                  Conversion process number:     (1-300)
                    Conversion process name:
                             New input link:     (1-500)
                            New output link:     (1-500)
                              New capacity:          MW
                 Incremental capital cost:          $/kW
  New fixed operating & maintenance cost:          $/kW-year
New variable operating & maintenance cost:          mills/kWh, excluding fuel
                            New heat rate:             Btu/kWh
                 New unplanned outage rate:       (0-1)
                   New planned outage rate:     days/year
                          Conversion date:      (year)
    Expected unit life after conversion:     years
           New minimum utilization rate:       (0-1)

                        This is record     of 135.
     Press "F5" to GO BACK 25 RECORDS, "F6" to ADVANCE 25 RECORDS,
           "F7" to GO BACK  5 RECORDS, "F8" to ADVANCE  5 RECORDS,
    "F9" to GO BACK  1 RECORD, "F10" to ADVANCE  1 RECORD,"F1" for HELP,
    "Esc" to IGNORE CHANGES AND QUIT , or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

Form B035 enables you to define, change, add, or delete up to 135 records that will be used to indicate that thermal electric generating units will be converted from one type of fuel to another during your planning study simulation period. Only 135 of the 300 possible thermal units can be converted during your planning period. You advanced to this form by selecting option 7 on Menu B030.

Options

- To view or change values in data fields described below on up to 135 conversions records, use the standard cursor-control keys and the following special record-manipulation functions: press **F6** to advance 25 records, **F8** to advance 5 records, **F10** to advance 1 record, **F5** to go back 25 records, **F7** to go back 5 records, and **F9** to go back 1 record.

- To delete an existing record, advance to that record, then change the process number to 0. The records so designated will not be saved when you press **F4**.

- To add a new record, advance to an empty record and then enter the information required on the form. The new record will be saved when you press **F4**.
- Press **F4** to save changes and return to Menu B030.
- Press **Esc** to ignore changes and return to Menu B030.
- Press **F1** to obtain on-line help.

Data Fields

Number of Converted Process: This field contains a unique thermal electric unit process number of up to three digits that was previously defined on Form B033. Valid values for this integer range from 1 to 300, but you may enter a 0 to indicate that the process record currently displayed is not to be kept when you save the data. If the record is deleted by entering a 0 for the process number, all other numeric data fields on the current record will be ignored. There is no relationship between this process number and the current record number displayed near the bottom of the screen.

Name of Converted Process: A name or other identifying text of up to 12 characters should be entered for each electricity process to be converted in BALANCE.

New Input Link: This three-digit field contains a new input link number for the generating unit after it is converted. This integer should range in value from 1 to 500, but it may be 0 if the current record is marked as deleted.

New Output Link: This field contains a new output link number for the generating unit after it is converted. This integer should range from 1 to 500, but it may be 0 if the current record is marked as deleted with a 0 process number.

New Capacity: This five-place field represents the new capacity (in megawatts electric) of the generating unit after it is converted.

Incremental Capital Cost: This seven-place field contains the incremental capital cost (in $U.S./kilowatt) of the thermal generating unit after it is converted.

New Fixed Operating & Maintenance Cost: This five-place field contains the new fixed operating and maintenance cost (in $U.S./kilowatt-year) of the thermal unit after it is converted.

New Variable Operating & Maintenance Cost: This five-place field contains the new variable operating and maintenance cost (in mills/kilowatt-hour) of the thermal unit after it is converted. The value should not include the cost of fuel for the converted unit.

New Heat Rate: This eight-place field expresses the new heat rate (in Btu/kilowatt-hour) of the thermal unit after it has been converted.

New Unplanned Outage Rate: This field contains a decimal fraction of up to five places (value of between 0 and 1) expressing the new unplanned outage rate for the converted thermal unit.

New Planned Outage Rate: This five-place field contains the new planned outage rate (expressed in units of days per year) for the converted thermal unit.

Conversion Date: This field contains the year in which the IDES FORTRAN program will convert the thermal electric generating process of the current unit. The conversion year should be later than the base year of your planning study.

Expected Unit Life after Conversion: This field contains the expected life (in number of years) of the thermal unit following conversion. This number is used in conjunction with the previous field to provide IDES the last year the unit will be operational. If, for example, the specific unit is converted in the year 2001, and the unit life in this field is 25 years, the BALANCE Module will assume that the converted unit operates from Jan. 1, 2001, through Dec. 31, 2025.

New Minimum Utilization Rate: This five-place field expresses the new minimum utilization rate of the converted thermal unit. This is expressed as a fraction of the total hours in a year. If a unit is loaded but is positioned in the loading order such that the unit cannot maintain this minimum utilization, the unit will be removed from the loading order and assumed not to operate at all. Peaking units are designated by values of 0.0 in this field.

5.3.31 Form B036 — Setting Fuel-Price Links for ELECTRIC Module

```
ENPEP Module: BALANCE        Planning Study:             Case:          (B036)
              Setting Fuel Price Links For ELECTRIC Module

          You may now indicate which network links are to be
          used to supply data to the ELECTRIC Module of ENPEP.

                                                  Network
                           Electric Fuel           Link
                   ______________________________ ______
                   Fuel oil          (domestic)
                                      (foreign)
                   Coal              (domestic)
                                      (foreign)
                   Gas               (domestic)
                                      (foreign)
                   Nuclear fuel      (domestic)
                                      (foreign)
                   Distillate oil    (domestic)
                                      (foreign)
                   ______________________________ ______

      Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Form B036 enables you to pass on to the ELECTRIC Module the computed prices for both foreign and domestic supplies of five types of fuel for every year of your planning study. You advanced to this form by selecting option 8 on Menu B030. This form contains 10 data fields for insertion of link numbers -- domestic and foreign links for each of the following: fuel oil, coal, gas, nuclear fuel, and distillate oil.

Options

- To pass on to ELECTRIC the computed price of a specific supply of fuel, advance to the appropriate field and enter a link number of 1 to 300 (corresponding to a specific foreign or domestic fuel link in your network). Enter 0 to indicate that no link with ELECTRIC is desired for a particular fuel supply.

- Press <u>F10</u> (after you have entered link numbers or a 0 in all ten fields) to save the information in a temporary file and return to Menu B030. The temporary file will be permanently saved into your planning subdirectory when you select the proper options in Menu B003 and Menu B500.

- Press **Esc** to ignore all changes and return to Menu B030.
- Press **F1** to obtain on-line help.

5.3.32 Form B040 — Defining Output-Writer Options

```
ENPEP Module: BALANCE      Planning Study:          Case:      (B040)
                    Defining Output-Writer Options

   You are allowed to specify the number of sections to be produced by
   the BALANCE Output Writer. For EACH of these sections you are also
   allowed to define the structure (rows and columns) and content by
   specifying information in the following forms (B041, B042 and B043).

      How many sections do you want in the output report?    (1-12)

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Form B040 is the first in a series of forms that enable you to design an output report to be printed by the IDES FORTRAN program. You advanced to this form by selecting option 4 on Menu B004. The most important information on energy flows and prices throughout the energy network should be summarized in the output report. The report can contain up to 12 sections, each with up to 12 rows of computed data. For each report section, you can specify one of four types of mathematical operations to be performed on the data in any links of your network. In this form, you specify the number of sections your report should contain.

Options

- To view or change the design of your output report, be sure that the data field on this form contains the correct number of sections in your report. After you press **F10**, you will advance to Form B041.

- Press **Esc** to return to Menu B004 if you do not want to define or change the design of the output report.

Background

If you increase the number of sections in your report, you will have to supply additional specifications for these additional sections, but the specifications for the old sections will remain unchanged until you explicitly modify them. If you decrease the number of sections in your report by changing the value in the field on Form B040, the specifications for the deleted sections of your output report will be lost unless you press **Esc** to quit and return to Menu B004.

By pressing **F10** in all the forms in the report writer hierarchy, you are able to access all the forms that contain all the specifications for your output report.

5.3.33 Form B041 — Defining Output-Writer Row Contents

```
ENPEP Module: BALANCE        Planning Study:          Case:      (B041)
                    Defining Output-Writer Row Contents

      You are now allowed to specify the number of rows, the content of
      these rows, and a title for Section   (of   ) of the Output Report.

        Number of rows in this section:   (1-12, or 0 to delete section)

    Aggregation code for all rows of this section:   (1-4, as described below)

          1: Sum QUANTITIES of links specified on next Form (B042).
          2: Sum PRICE x QUANTITY of links specified on Form B042.
          3: Use QUANTITY-WEIGHTED-AVERAGE PRICE of links on Form B042.
          4: Sum (PRICE x QUANTITY)i - (PRICE x QUANTITY)j of links
             i and j on Form B043.

        Section title:

    You may view or modify other sections of the report by pressing F7 or F8.
     Press "F7" to GO BACK 1 SECTION, "F8" to GO TO NEXT SECTION, "F4" to EXIT,
Press "F1" for HELP, "Esc" to QUIT OUTPUT WRITER, or "F10" to VIEW SECTION ROWS.
```

Purpose

Form B041 permits you to define the row contents for your output-writer report. You advanced to this form by pressing **F10** while in Form B040. This form can be displayed for each of the sections of your output report that you defined on Form B040.

Options

- View or change values in three data fields (as described below) for each section as needed. When you are done making changes, press **F10** to continue defining row specifications. You will advance to Form B042 if you specify aggregation codes 1-3 (see below) or to Form B043 if you specify aggregation code 4.

- Press **F7** to go to the previous section of the report specifications.

- Press **F8** to go to the next section of the report specifications.

- Press **F4** to save all changes made in report specifications. You will return to Menu B004, and the report-writer data will be copied to a temporary file that will be permanently saved into your planning study subdirectory when you select the proper option in Menu B500.

- Press **Esc** to ignore all changes to any part of the report-writer specifications and return to Menu B004.

- Change the number of sections in the report by exiting from this form and returning to Menu B004 to select option 4 again.

- Press **F1** to obtain on-line help.

Data Fields

Number of Rows in This Section: This field contains an integer of up to two digits specifying the number of rows in the current report section. The integer must range from 1 to 12. If you increase the number of rows in a section, you will have to supply additional specifications for these additional rows, but the specifications for the old rows will remain unchanged until you explicitly modify them. If you decrease the number of rows in your report by changing the value in this field, the specifications for the deleted rows of the current report section will be lost unless you press **Esc** to quit and return to Menu B004. Note, however, that if you press **Esc**, all changes to your report specifications will be lost.

Aggregation Code: This field contains a one-digit number from 1 to 4 that identifies the aggregation code, or the type of mathematical operations you want to perform on the prices and quantities of the links in the current report section. The actual links involved with these operations are specified later on Forms B042 and B043, but the operations must be specified on this form. The available operations are as follows:

- Aggregation Code 1 instructs the report writer to sum the quantity of each of the links you specify on Form B042.

- Aggregation Code 2 instructs the report writer to sum the product of the unit price and quantity of each link you specify on Form B042 in order to generate the total cost through those links. The results of these calculations will be multiplied by 1000 before they are printed.

- Aggregation Code 3 instructs the report writer to compute the quantity-weighted-average price of each link you specify on Form B042.

- Aggregation Code 4 instructs the report writer to aggregate the differences between the total costs of matched pairs of links by summing the differences of the product of the unit price and quantity of two sets of links you specify on from B043. The

results of these calculations will be multiplied by 1000 before they are printed.

Section Title: This field contains a section title of up to 52 characters that will be printed above the table rows in the current section of your report.

5.3.34 Form B042 — Defining Output-Writer Row Labels and Links (Options 1-3)

```
ENPEP Module: BALANCE      Planning Study:          Case:        (B042)
          Defining Output-Writer Row Labels and Links (Options 1-3)

      You are now allowed to specify the labels and required links
      for row    (of    ) of Section    (of    ) in the Output REPORT.

   For this Section, you specified that row entries be calculated by


 Label for this row:
     ———————— Links to be used in above aggregation equation ————————
                                                          (1-500)
  You may view or modify other parts of the report by pressing F7 or F8.
  Press "F7" to GO BACK 1 ROW, "F8" to GO TO NEXT SECTION, "F4" to EXIT,
Press "F1" for HELP, "Esc" to QUIT VIEWING ROW, or "F10" to VIEW NEXT ROW.
```

Purpose

Form B042 enables you to define the row labels and links for your current output-writer report when you select aggregation code 1, 2, or 3 in Form B041. This form can be displayed for each row that was defined on Form B041.

Options

- View or change the values in the two data fields (as described below) in the currently displayed row. (The use of the standard **Del** and **F3** cut-and-paste keys may be appropriate if you wish to move one section or row to another location.)
- Press **F7** to return to the previous row of the current section.
- Press **F10** to go to the next row of the current section.
- Press **F8** to advance to the next section of the output report.
- Press **F4** to save all changes made in report specifications. You will return to Menu B004, and the report-writer data will be copied to a temporary file that will be permanently saved into your planning study subdirectory when you select the proper option in Menu B500.

- Change the number of sections in the report by exiting from this form and returning to Menu B004 to select option 4 again.
- Change the number of rows in the current section by exiting from this form and returning to Form B041.
- Press Esc to ignore all changes to any part of the report-writer specifications and return to Menu B004.
- Press F1 to obtain on-line help.

Data Fields

Label for This Row: This field contains a title of up to 52 characters for the current row of the current section. This label will be printed with the current row table in the current section of your report.

Links to Be Used in Above Aggregation Equation: This field contains the link numbers whose energy prices and quantities will be aggregated to generate a row in the current section of your report. The numbers can be up to three digits with values from 1 to 500. The method of aggregation depends on the aggregation code you selected for the current row on Form B041 and is explained by the equations presented in that form.

5.3.35 Form B043 — Defining Output-Writer Row Labels and Links (Option 4)

```
ENPEP Module: BALANCE        Planning Study:          Case:          (B043)
              Defining Output-Writer Row Labels and Links (Option 4)

      You are now allowed to specify the labels and required links
      for row    (of   ) of Section    (of   ) in the Output Report.

   For this Section, you specified that row entries be calculated by
   summing values of links i and j according to the aggregation equation:

                  (PRICE x QUANTITY)i - (PRICE x QUANTITY)j

  Label for this row:
          Links "i" and "j" to be used in above aggregation equation
"i" links:                                                        (1-500)
"j" links:                                                        (1-500)
    You may view or modify other parts of the report by pressing F7 or F8.
    Press "F7" to GO BACK 1 ROW, "F8" to GO TO NEXT SECTION, "F4" to EXIT,
  Press "F1" for HELP, "Esc" to QUIT VIEWING ROW, or "F10" to VIEW NEXT ROW.
```

Purpose

Form B043 enables you to define the row labels and links for your current output writer report when you select aggregation code 4 in Form B041. This form can be displayed for each of the rows that were defined on Form B041.

Options

- View or change the values in the three data fields (as described below) in the currently displayed row. (The use of the standard **Del** and **F3** cut-and-paste keys may be appropriate if you want to move one section or row to another.)
- Press **F7** to return to the previous row of the current section.
- Press **F10** to go to the next row of the current section.
- Press **F8** to advance to the next section of the output report.
- Press **F4** to save all changes made in report specifications. You will return to Menu B004, and the report-writer data will be copied to a temporary file that will be permanently saved into your planning study subdirectory when you select the proper option in Menu B500.

- Change the number of sections in the report by exiting from this form and returning to Menu B004 to select option 4 again.
- Change the number of rows in the current section by exiting from this form and returning to Form B041.
- Press **Esc** to ignore all changes to any part of the report-writer specifications and return to Menu B004.
- Press **F1** to obtain on-line help.

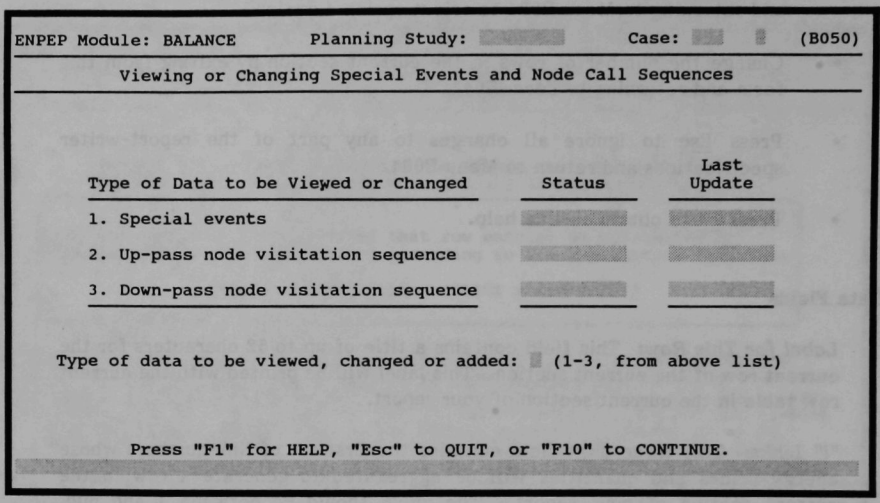
Data Fields

Label for This Row: This field contains a title of up to 52 characters for the current row of the current section. This label will be printed with the current row table in the current section of your report.

"i" Links: This three-digit field contains the first set of link numbers whose energy prices and quantities will be aggregated to generate a row in the current section of your report. The value should be between 1 and 500. These links are used in conjunction with the second set of links below, as described by the equation presented with Form B041.

"j" Links: This three-digit field contains the second set of link numbers whose energy prices and quantities will be aggregated to generate a row in the current section of your report. These links are used in conjunction with the first set of links above, as described by the equation presented with Form B041.

5.3.36 Menu B050 — Viewing or Changing Special Events and Node Call Sequences



Purpose

From Menu B050 you are able to access the special events form and the up-pass and down-pass (node call sequence) forms of BALANCE. You advanced to this menu by selecting option 5 on Menu B004. In the special events form you can specify that certain events will occur that change some aspects of your network as the years in your simulation period progress. In the node call sequence forms you can establish the order of subroutine calls that determine how IDES processes your energy network.

Options

1 Select this option to access the special events menu. You will advance to Form B051.

2 Select this option to access the up-pass node visitation sequence form. You will advance to Form B052.

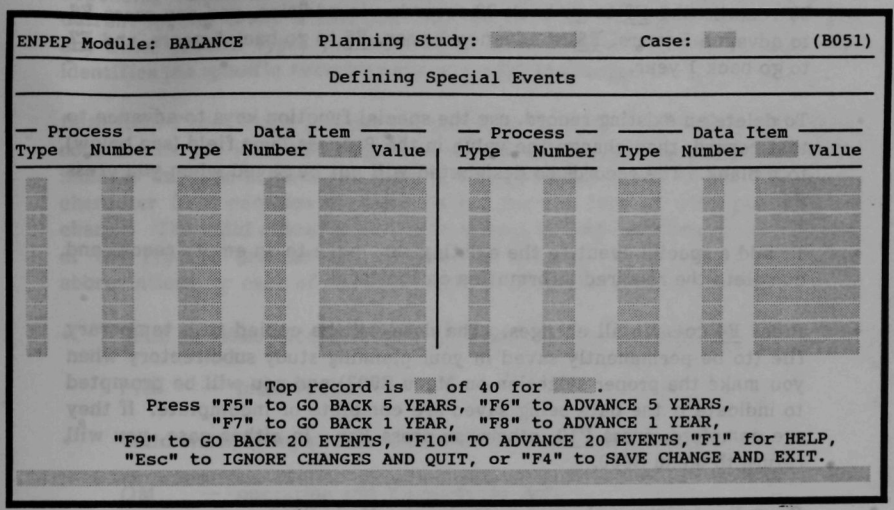
3 Select this option to access the down-pass node visitation sequence form. You will advance to Form B053.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu B004.

5.3.37 Form B051 — Defining Special Events



Purpose

On Form B051 you are able to define special event records that will change certain characteristics of some types of nodes in your energy network in any year of your planning study simulation period. You are allowed to define up to 40 such events for each year (starting with the second year). While the IDES FORTRAN program is progressing from year to year, it modifies the network according to the specifications you enter using this form. You advanced to this form by selecting option 1 on Menu B050. This form is somewhat different from most of the forms used in the BALANCE Module in that your screen is divided vertically into two identical halves. When you first enter this form, you are presented with the first 20 events (10 on each side of the screen) for the second year of your study. Near the bottom of the form are two fields that display the top record and the current year. The special functions used to page through the special event records and to make any changes, additions, or deletions are described below.

Options

- View or change values in the five data fields described below in up to 40 special event records for each year of your planning study (beginning in the second year). Twenty records will be displayed simultaneously (10 on each half of your screen). You can move from record to record and

from field to field within a record by using the standard cursor-control keys. Within each year's set of records, you can press **F10** to advance 20 records and **F9** to go back 20 records. In addition, you can press **F6** to advance 5 years, **F8** to advance 1 year, **F5** to go back 5 years, and **F7** to go back 1 year.

- To delete an existing record, use the special function keys to advance to that record, then change the value in the *Process Type* field (see below) to a blank. The records so designated will not be saved when you press **F4**.

- To add a special event to the existing set, move to an empty record and complete the required information on the form.

- Press **F4** to save all changes. The data will be copied to a temporary file (to be permanently saved in your planning study subdirectory when you make the proper selection on Menu B003) and you will be prompted to indicate if the data being saved are complete or incomplete. If they are complete, press **F10**, otherwise press **Esc**. In either case, you will return to Menu B050.

- Press **Esc** to ignore changes and return to Menu B050.

- Press **F1** to obtain on-line help.

Data Fields

Process Type: This field contains a two-character abbreviation for the process type. It must contain a specific abbreviation based on the type of node (or link) you want to change during your simulation period. Valid abbreviations and the types of processes to which they refer are:

AL -- decision/allocation node
MI -- multiple-input-link conversion node
RE -- multiple-output-link/refinery node
PP -- pricing node
RS -- depletable resource/import node
RN -- renewable resource node
PR -- conversion process node
CA -- capacity on a link.

If you specify a process type of *CA*, you must enter the appropriate special event link number in the next field. Otherwise you must enter the appropriate process number in the next field.

Process Number: This field contains a process number or link number, depending on the content of the previous field. If the process type for the current special event is *CA*, you must enter a link number in this field. For any other process type, you must enter an appropriate process number that identifies the specific network node you want to change.

Data Item Type: Once you use the previous two fields to identify the unique node or link you want to change in a special event, you must use this field to indicate the type of data you want to change for that node or link. This four-character field contains an abbreviation for the type of data you want to change. The valid abbreviations, which must be left justified, are a function of the type of process you specified in the first field. Valid data type abbreviations for each of the eight types of processes are listed below.

- Valid decision/allocation node (AL) data type abbreviations:

  PRI -- priority link

- Valid multiple-input-link node (MI) data type abbreviations:

  OM -- operation and maintenance cost
  IO -- input-output coefficient
  TCI -- total capital investment
  CAPM -- capacity of a representative unit
  CF -- capacity factor
  LIFE -- process lifetime
  IR -- interest rate for amortizing capital
  CAPL -- capacity on output link

- Valid multiple-output-link node (RE) data type abbreviations:

  SIZE -- sizing link number
  SLAT -- output slate parameter
  PRAT -- output pricing ratio
  STOC -- stockpile for production excess
  EXCS -- supply links for production shortage
  CNTL -- control link
  REMU -- multipliers for control link
  OM -- operation and maintenance cost
  TCI -- total capital investment
  CAPM -- capacity of a representative unit
  CF -- capacity factor
  LIFE -- process lifetime
  IR -- interest rate for amortizing capital
  CAPL -- total capacity of all such processes (only valid if the output link of the process is an input link to a decision/allocation node)

- Valid pricing node (PP) data type abbreviations:

  ALPH -- price multiplier
  DELT -- price increment
  PMAX -- price ceiling
  PMIN -- price floor
  LINP -- specified price link

- Valid depletable resource/import node (RS) data type abbreviations:

  CAPL -- capacity on output link (only valid if the output link of the process is an input link to a decision/allocation node)

- Valid renewable resource node (RN) data type abbreviations:

  CAPL -- capacity on output link (only valid if the output link of the process is an input link to a decision/allocation node)

- Valid conversion process node (PR) data type abbreviations:

  OM -- operation and maintenance cost
  EFF -- efficiency
  TCI -- total capital investment
  CAPM -- capacity of a representative unit
  CF -- capacity factor
  LIFE -- process lifetime
  IR -- interest rate for amortizing capital
  CAPL -- total capacity of all such processes (only valid if the output link of the process is an input link to a decision/allocation node)

- Valid capacitated link (CA) data type abbreviations:

  CAPL -- capacity on link

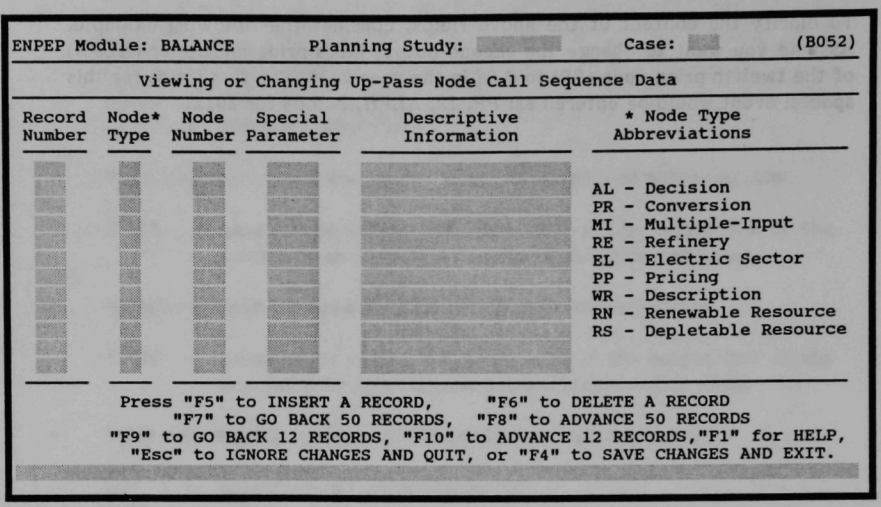
Data Item Number: This field contains a number of up to two digits identifying the data item to be changed by the current special event. This value is needed only for those data types that have more than one entry. For example, if you want to change the price multiplier on the second output link, a value of 2 should be entered in this field.

Data Item Value: This field contains a 10-place value that will become the new value for the specified data item to be changed by the current special event.

Background

To clarify the content of the above fields, consider the following example. Assume you want to change the second output link's price multiplier *(ALPH)* of the twelfth price node *(PP)* to *0.98* in the year *2012*. The five fields for this special event would be entered as: *PP*, *12*, *ALPH*, *2*, *0.98* for 2012.

5.3.38 Form B052 — Viewing or Changing Up-Pass Node Call Sequence Data



Purpose

Form B052 enables you to specify the up-pass node call sequence. You advanced to this form by selecting option 2 on Menu B050. You are allowed to define up to 500 up-pass records, including one for each of your network nodes and several additional comment records. This sequence signifies the order in which submodels that process the various types of nodes in the energy network are called. Additional information on the up-pass node call sequence is provided under Background at the end of this section (following a listing of the options available in this form and a description of the data fields displayed).

Options

- View or change values in the data fields described below in up to 500 up-pass node call sequence records. Twelve records will be displayed simultaneously. You can move from record to record and from field to field within a record by using the standard cursor-control keys. In addition, you can press **F10** to advance 12 records, **F9** to go back 12 records, **F8** to advance 50 records, and **F7** to go back 50 records.

- To delete an existing record, advance to that record and press **F6**.

- To insert a new record in front of the current record, press **F5** and enter the required information.

- Press **F4** to save all changes. The data will be copied to a temporary file (to be permanently saved in your planning study subdirectory when you make the proper selection on Menu B003) and you will be prompted to indicate if the data being saved are complete or incomplete. If they are complete, press **F10**, otherwise press **Esc**. In either case, you will return to Menu B050.

- Press **Esc** to ignore changes and return to Menu B050.

- Press **F1** to obtain on-line help.

Data Fields

Record Number: This is a view-only field that shows the numbers of the records displayed on your screen. You cannot access or make changes in this field.

Node Type: This field contains a submodel abbreviation that signifies the type of data that will follow in the remaining fields of the record. These abbreviations are limited to two-character codes. The codes and the types of nodes or other information they designate are as follows:

AL -- decision or allocation node
MI -- multiple-input-link conversion node
RE -- multiple-output-link or refinery node
EL -- electric sector submodel
PP -- pricing node
RS -- depletable resource or import node
RN -- renewable resource node
PR -- conversion process node
WR -- comment

For all submodels except *EL* and *WR*, you must supply a node number in the following field.

Node Number: This three-digit field represents the node that will be processed by the IDES submodel designated by the abbreviation in the *Node Type* field above. Unless the submodel in the above field is *EL* or *WR*, you must supply a value of from 1 to 500 in this field.

Special Parameters: This field is not currently used for the up-pass processing within IDES.

Descriptive Information: This optional field can contain up to 20 characters of text providing additional descriptive information for each up-pass record. This field, which may be left blank unless *WR* is coded in the *Node Type* field described above, is written to output files during up-pass calculations.

Background

The up-pass node call sequence designates the order in which submodels that process the various types of nodes in the energy network are called. These submodels perform price calculations on the up-pass of the iterative simulation process. All nodes other than the demand nodes must be included in this sequence. The order of the sequence is very important. All depletable and renewable resources nodes must be listed first; the order of these is not important. The remaining nodes must be sequenced such that a given node *N* is not called until all nodes whose output links are input links to node *N* have been called.

5.3.39 Form B053 — Viewing or Changing Down-Pass Node Call Sequence Data

```
ENPEP Module: BALANCE        Planning Study:          Case:        (B053)

          Viewing or Changing Down-Pass Node Call Sequence Data

Record   Node*   Node     Special      Descriptive      * Node Type
Number   Type    Number   Parameter    Information      Abbreviations

                                                       DE - Demand
                                                       AL - Decision
                                                       PR - Conversion
                                                       MI - Multiple-Input
                                                       RE - Refinery
                                                       EL - Electric Sector
                                                       PP - Pricing
                                                       WR - Description

     Press "F5" to INSERT A RECORD,     "F6" to DELETE A RECORD
          "F7" to GO BACK 50 RECORDS,  "F8" to ADVANCE 50 RECORDS
    "F9" to GO BACK 12 RECORDS, "F10" to ADVANCE 12 RECORDS,"F1" for HELP,
      "Esc" to IGNORE CHANGES AND QUIT, or "F4" to SAVE CHANGES AND EXIT.
```

Purpose

Form B053 enables you to specify the down-pass node call sequence. You advanced to this form by selecting option 3 on Menu B050. You are allowed to define up to 500 down-pass records, including one for each of your network nodes and several additional comment records. Additional information on the down-pass node call sequence is provided under Background at the end of this section (following a listing of the options available in this form and a description of the data fields displayed).

Options

- View or change values in the data fields described below in up to 500 down-pass node call sequence records. Twelve records will be displayed simultaneously. You can move from record to record and from field to field within a record by using the standard cursor-control keys. In addition, you can press **F10** to advance 12 records, **F9** to go back 12 records, **F8** to advance 50 records, and **F7** to go back 50 records.

- To delete an existing record, advance to that record and press **F6**.

- To insert a new record in front of the current record, press **F5** and enter the required information.

- Press **F4** to save all changes. The data will be copied to a temporary file (to be permanently saved in your planning study subdirectory when you make the proper selection on Menu B003), and you will be prompted to indicate if the data being saved are complete or incomplete. If they are complete, press **F10**, otherwise press **Esc**. In either case, you will return to Menu B050.

- Press **Esc** to ignore changes and return to Menu B050.

- Press **F1** to obtain on-line help.

Data Fields

Record Number: This is a *view-only* field that shows the numbers of the records displayed on your screen. You cannot access or make changes in this field.

Node Type: This field contains a submodel abbreviation that indicates the type of data that will follow in the remaining fields of the record. These abbreviations are limited to two characters. The abbreviations and the types of nodes or other information they designate are as follows:

AL -- decision or allocation node
MI -- multiple-input-link conversion node
RE -- multiple-output-link or refinery node
DE -- demand node
EL -- electric sector submodel
PP -- pricing node
PR -- conversion process node
WR -- comment.

For all submodels except *EL* and *WR*, you must supply a node number in the following field.

Node Number: This three-digit field indicates the node that will be processed by the IDES submodel designated by the abbreviation in the *Node Type* field above. Unless the submodel in the above field is *EL* or *WR*, you must supply a value in this field.

Special Parameters: This field is used only for refinery nodes (designated by *RE* in the *Node Type* field above) for the down-pass processing within IDES. For refinery nodes, a default value of 0 (or a blank) can be used except in the following case. If a call to a refinery node is only for the purpose of controlling the capacity on another link in your network, this field value should be set at 1.

Descriptive Information: This optional field can contain up to 20 characters of text providing additional descriptive information for each down-pass record. This field, which may be left blank unless *WR* is coded in the *Node Type* field described above, is written to output files during down-pass calculations.

Background

The down-pass node call sequence designates the order in which submodels that process the various types of nodes in the energy network are called. These submodels perform quantity calculations on the down-pass of the iterative simulation process. The order in which nodes are processed during down-pass processing is very important. Nodes must be sequenced such that a given node *N* is not called until all nodes whose input links are output links from node *N* have been called.

5.3.40 Form B060 — Passing Process Data to the IMPACTS Module

ENPEP Module: BALANCE Planning Study: Case: (B060)

Passing Process Data to the IMPACTS Module

You are able to specify BALANCE processes (represented as network nodes and identified by process types and numbers) to be passed to IMPACTS. You must specify, for existing and candidate units of each process, a name, process type and number, an IMPACTS plant type, and a capacity and lifetime.

Facility	BALANCE Process Name	Type	Number	IMPACTS Type (1-13)	Capacity of Unit (1000 BOE)	Retirement or Lifetime
Existing						(ret. year)
Candidate						(lifetime)

This is record of 29.

Press "F7" to GO BACK 5 RECORDS, "F8" to ADVANCE 5 RECORDS,
"F9" to GO BACK 1 RECORD, "F10" to ADVANCE 1 RECORD,
"F1" for HELP, "Esc" to IGNORE CHANGES AND QUIT IMPACTS INTERFACE,
or "F4" to SAVE CHANGES AND PROCEED TO SECOND PART OF INTERFACE.

Purpose

Form B060 allows you to interface the BALANCE Module and the IMPACTS Module and pass on to IMPACTS certain process data generated by BALANCE. You advanced to this form by selecting option 6 on Menu B004. The energy quantities projected by the IDES simulation in BALANCE imply facility and facility expansion requirements, which are transferred to the IMPACTS Module according to the specifications you enter on this form. Once the expansion requirements are determined, the IMPACTS Module is able to calculate resource requirements. Each facility corresponds to a node in the BALANCE energy network and is identified uniquely by a process abbreviation and number. The three process abbreviations are *PR*, *RE*, and *MI*, for conversion, refinery, and multiple-input link processes, respectively. The IMPACTS Module organizes plants by one of 13 types. One of the purposes of this form is to label relevant BALANCE processes with IMPACTS plant types. You are allowed to define up to 29 processes whose build schedule will be passed to the IMPACTS Module.

Options

- To view or change information in the data fields described below for up to 29 process records, use the standard cursor-control keys and the following special record-manipulation functions: press **F10** to advance

1 record, press **F8** to advance 5 records, press **F9** to go back 1 record, and press **F7** to go back 5 records.

- To delete an existing record, advance to that record and change the values in all of its fields to blank or 0; that record will not be saved when you press **F4**.
- To add a new record, advance to an empty record and complete the required information.
- Press **F4** to save all changes and advance to Form B061. The data will be copied to a temporary file (to be permanently saved in your planning study subdirectory when you make the proper selection on Menu B003).
- Press **Esc** to ignore all changes and return to Menu B004.
- Press **F1** to obtain on-line help.

Data Fields

Name of Existing Facility: This field contains the name of the existing facility represented by the process displayed on the form. If no facility of this type currently exists, the name in this field should be the name of the *candidate facility* (as described below), and a capacity of 0.0 should be entered in the *Capacity* field (below) to indicate that the facility does not exist.

BALANCE Process Type: This two-character field is limited to the following three abbreviations to indicate the process type:

PR -- for a conversion process
MI -- for a multiple-input-link conversion process
RE -- for a multiple-output-link process or refinery.

BALANCE Process Number: This field contains a three-digit process number corresponding to the process type specified above. For example, if the second and third fields of this form contained the values *PR* and *7*, the current process number displayed on the form would refer to the seventh conversion process in your network. The limitations within BALANCE allow you to access up to 135 conversion processes, 10 multiple-output-link processes or refineries, and 15 multiple-input-link processes.

IMPACTS Type: This field contains an integer of up to two digits representing the IMPACTS Module type of facility represented by the current record. The IMPACTS Module can work with 13 types of nonelectric

facilities or activities, and this field must contain the code for the appropriate type. The codes are as follows:

1 -- offshore crude oil import facility
2 -- onshore oil import facility
3 -- offshore oil production facility
4 -- onshore oil production facility
5 -- high gasoline yield refinery
6 -- low gasoline yield refinery
7 -- onshore gas extraction facility
8 -- LNG import facility
9 -- coal import facility
10 -- underground coal mining facility
11 -- surface coal mining facility
12 -- other - to be labeled in IMPACTS
13 -- other - to be labeled in IMPACTS

Capacity of Existing Unit: This five-place field contains the capacity (in thousands of BOE/year) of the existing plant represented by the current process displayed on the screen. If no such facility exists, this value should be 0.0.

Retirement Year: This field contains the retirement year of the existing facility.

Name of Candidate Facility: This field contains the name of the candidate facility represented by the process displayed on the form. If no facility of this type currently exists, the name in this field should be the name of the facility in the first field above, and a capacity of 0.0 should be entered in the *Capacity* field above to indicate that the facility does not exist.

Capacity of Candidate Unit: This field expresses the capacity (in thousands of BOE/year) of a typical candidate facility.

Lifetime of Candidate Facility: This two-digit field contains the expected lifetime (in years) of a typical candidate facility.

Background

After you complete the information requested on Form B060 and press F4 to save your changes, you immediately will be presented with Form B061 and allowed to access the second half of the BALANCE/IMPACTS interface. Unless the proper switch for creating the IMPACTS interface data is specified on Form B300 after you choose to execute the IDES model from Menu B003, the information on Forms B060 and B061 will not be used by the FORTRAN program.

5.3.41 Form B061 — Passing Fuel Expenditures to the IMPACTS Module

```
ENPEP Module: BALANCE      Planning Study:          Case:      (B061)
                Passing Fuel Expenditures to the IMPACTS Module

You are able to provide the IMPACTS Module with expenditures
for all domestically and foreign produced fuels. To do this,
you must specify BALANCE network link numbers of these fuels.

          Link Numbers of Domestically Produced Fuels

                    (link numbers between 1 and 500)

          Link Numbers of Foreign (Imported) Fuels

                    (link numbers between 1 and 500)

     Press "F1" for HELP, "Esc" to QUIT IMPACTS INTERFACE,
          or "F10" to SAVE CHANGES AND EXIT INTERFACE.
```

Purpose

Form B061 allows you to pass on to the IMPACTS Module expenditures for all domestic and foreign (imported) fuels. To do this, you must specify the network link numbers of up to 20 domestic and 20 imported fuels. You advanced to this form after pressing F4 to save data in Form B060.

Options

- To specify the network link numbers for fuels in the data fields described below, advance to the appropriate field and enter a link number.
- Press **F4** to save all changes and entries you have made. The data will be copied to a temporary file (to be permanently saved in your planning study subdirectory when you make the proper selection on Menu B003). You will be prompted to indicate if the data being saved are complete or incomplete. If they are complete, press **F10**, otherwise press **Esc**. In either case, you will return to Menu B004.
- Press **Esc** to ignore all changes and return to Menu B004.
- Press **F1** to obtain on-line help.

Data Fields

There are two sets of 20 input fields on this form. The first set contains a list of numbers that correspond to your network links for domestically produced fuels. The second set of 20 numbers refer to links for foreign or imported fuels. Each of these link numbers must range from 0 (if no link is to be specified) to 500.

5.3.42 Form B300 — Setting Mode Control and Output Options

```
ENPEP Module: BALANCE        Planning Study:          Case:      (B300)
                  Setting Mode Control and Output Options

          You are now able to specify four options that
          control execution of the BALANCE FORTRAN model.

     1. Year in which computations will assume fixed shares
        from previous years and be unresponsive to prices:
        (enter: a year from      to      ,
             or LEAVE BLANK to run model in price/equilibrium
               mode for all years)

     2. Create data for the LOAD Module?      (Y or N)

     3. Create data for the ELECTRIC Module?  (Y or N)

     4. Create data for the IMPACTS Module?   (Y or N)


          Press "F1" for HELP, "Esc" to QUIT, or "F10" to RUN MODEL.
```

Purpose

Form B300 enables you to set the last options that are needed before the IDES FORTRAN simulation program can be executed. You advanced to this form by selecting option 2 on Menu B003.

Options

- Set the desired options in the four fields described below by using the standard cursor-control keys. After making your selections, press **F10** to have the IDES program executed (see Background below). You will return to Menu B003.
- Press **Esc** to return to Menu B003 without executing the IDES program.
- Press **F1** to obtain on-line help.

Data Fields

Year in Which Computations Will Assume Fixed Shares...: This field contains the starting year for which the model is to operate in the Reference Energy System (RES) mode. In this RES mode, constant market shares are

maintained at all allocation and decision nodes, and market shares are not responsive to prices. If you do not want to operate in RES mode and all market shares are to be based on relative prices, the year in this field should be left blank. Otherwise the year specified in this input field should be between the first and last years of your study period, as displayed on the form.

Create Data for the LOAD Module?: This field should contain a Y or a N to indicate whether the output file for the LOAD Module should be generated by the IDES FORTRAN program when BALANCE completes the simulation. If you enter Y, the LAGLF.DAT output file will be passed to LOAD with annual load factor and minimum annual load data.

Create Data for the ELECTRIC Module?: This field should contain a Y or a N to indicate whether the output file for the ELECTRIC Module should be generated by the IDES FORTRAN program when BALANCE completes the simulation. If you enter Y, the TOELEC.DAT output file will be passed to ELECTRIC with data on fuel prices for the electric sector.

Create DATA for the IMPACTS Module: This field should contain a Y or N to indicate whether the output file for the IMPACTS Module should be generated by the IDES FORTRAN program when BALANCE completes the simulation. If you enter Y, the BALIM.DAT output file will be passed to IMPACTS with domestic and foreign fuel links and facility information.

Background

After you press **F10** to record you option selections, the IDES FORTRAN simulation program will execute. As the program is executing, iteration and convergence error summary data (duplicated in the file TIME.OUT as described in Form B400) are displayed on your screen. This allows you to observe the progress of the model as it is goes from iteration to iteration and from year to year.

5.3.43 Menu B400 — Viewing or Printing Output from the BALANCE Module

```
ENPEP Module: BALANCE        Planning Study:          Case:      (B400)
                Viewing or Printing Output from the BALANCE Module

      You are now able to view and/or print the reports that were
      generated by the BALANCE Module's FORTRAN program for this case.

There are up to 4 reports that were generated, depending on your responses to
previous input forms.  Within each of these reports are sections that were
printed only if you requested them in previous input forms.

  Report                          Contents
    1.   Echo of nonelectric input data if requested in BALANCE Form B011.
    2.   Echo of electric sector input data if requested in Form B031, and
         detailed electric sector calculations.
    3.   Detailed iteration calculations if requested in Form B012.
    4.   Main model results, iteration summary and convergence error summary,
         and final price and quantity summary if requested in Form B011.

      Report number to be viewed or printed:    (1-4, from above list)

        Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu B400 enables you to selectively view the four output files generated during execution of the BALANCE Module's IDES FORTRAN program. You advanced to this form by selecting option 3 on Menu B003. While viewing an output file, you can use the standard ENPEP Paging Routine to examine its various components. When you exit a file, you will return to this menu. The contents of each of the four output files are described at the end of this section under *Output Files* following a listing of the options available in this form.

Options

1 Select this option to view the *DATA.DAT* file.

2 Select this option to view the *ELEC.OUT* file.

3 Select this option to view the *SUM.OUT* file.

4 Select this option to view the *TIME.OUT* file.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu B003.

F1 Press this key to obtain on-line help.

Output Files

DATA.DAT File: This file contains duplicates of input data for all but the electric sector if you set the value of the echo field in Form B011 at 0.

ELEC.OUT File: This file contains duplicates of electric sector input data (if you set the echo flag on Form B031 at 0) and results of the electric-sector simulation. It also contains load-duration-curve data and results from the loading of electrical generating units for the converged iteration in each year for which you specified an electric sector code of 2 on Form B031. Additional optional loading results will be present in this report for all years tagged with an electric sector code of 1 on Form B031, within the iterations also specified on Form B031. The loading order section of ELEC.OUT also includes information on the fuel input and electricity output of each generating unit, the cost of electricity production for each unit, total electricity demand, peak load, available generating capacity, computed reserve margin, and average total cost of electricity generation. This last value is taken as the price of electricity in the model.

SUM.OUT File: This file contains detailed results of price and quantity calculations for each node in your network, for every iteration, for every year in the simulation period. SUM.OUT may also contain execution error messages. Because of its large size, this file should be generated only while developing or changing your network, or for debugging purposes. These details will be included in the report for each year with a calculation flag of 1 or 2 as specified in the second part of Form B012, for the iteration range specified in the third part of Form B012. By modifying these parameters, you can limit the size of SUM.OUT.

TIME.OUT File: This is the main model results file for the IDES FORTRAN program. It contains an iteration and convergence error summary that duplicates the information that was displayed on your screen as the IDES model was executing. This summary indicates the number of iterations required and the resulting convergence errors for the model operation in each year of the simulation. TIME.OUT also contains reports generated by the output writer. These reports constitute the main output of the model. The most important information on energy flows and prices throughout the energy network should be summarized in the output-writer tables you requested on Forms B040 through B043. Finally, if the final price and quantity flag on Form B011 is set at 0, TIME.OUT contains the energy flow quantities and energy prices on all network links for the years specified in the first section of Form B012. Typically these data are more detailed than the output-writer reports.

5.3.44 Menu B500 — Saving Data Back to the Planning Subdirectory

```
ENPEP Module: BALANCE      Planning Study:          Case:      (B500)

                Saving Data Back to the Planning Subdirectory

          You are now allowed to save any of the following data sets.
                              Run Control
1. Basic param's                                2. Output Codes
                            Energy Network
3. Depletables                                  9. Demands
4. Price proj's                                 10. Demand growth
5. Renewables                                   11. Multi-outputs
6. Decisions                                    12. Stockpiles
7. Conversions                                  13. Price reg's
8. Multi-inputs                                 14. Capac'd links
                         Electric Sector Network
15. Out. control                                18. Hydro data
16. Sector data                                 19. Conversions
17. Thermal data                                20. ELECTRIC links
                    Special Events and Node Call Sequences
21. Spec. events                                23. Down-sequence
22. Up-sequence
24. Output Writer                               25. IMPACTS links
     Temporary work file to be saved in planning subdirectory:    (1-25)
 Press "F10" TO ENTER SELECTION, "Esc" to QUIT, or "F4" TO SAVE SELECTED DATASET
```

Purpose

You must go to Menu B500 to save any changes you may have made in data sets in the BALANCE Module. You advance to this form by selecting option 4 on Menu B003. The data in the BALANCE Module were originally copied from your planning subdirectory to the BALANCE subdirectory when you selected a case on Form B002. As you progressed through the BALANCE Module, you most likely changed some of the data. Those changes will be copied back to the planning subdirectory only if you follow the procedures outlined below before you exit from Menu B003. You can use the options available in Menu B500 to save changes in any of the 25 data sets identified on your screen.

Options

- To select a data set to be saved, enter the number of that set (from 1 to 25) and press **F10** to register your selection. *Repeat this step for each of the 25 data sets you wish to save.*

- When you have selected all the data sets you want to save, press **F4**. Only after you complete this step will the changes that you have made be saved. You will return to Menu B003.

- Press F1 to obtain on-line help.
- Press Esc to return to Menu B003 without saving any of the changes that you may have made as you progressed through the BALANCE Module.

CHAPTER 6

LOAD MODULE

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6.1 Introduction

This section introduces the LOAD Module that you use to transform data and perform calculations pertaining to the electric load. You can use the data that results from executing the LOAD Module to execute the ELECTRIC Module.

6.1.1 Objective

The LOAD module is designed so you can enter, project, and format electric load information to prepare input data for the ELECTRIC Module. LOAD does not "forecast" future electric demands. (For information about forecasting electric load, see Ref. 1.) Instead, it uses data that you enter, data from the BALANCE Module, or a combination of both to calculate and specify the character of the electric demand, that is, annual electricity demand, annual peak load, period demands (up to 12 periods per year), period peak loads, period load duration curves (LDCs), and annual LDCs.

LOAD provides a convenient structure for modifying historical data, such as period LDCs. See Figs. 6.2 and 6.3 in the appendix (Sec. 6.5) for an example LDC. The area under a normalized period LDC is the load factor* for that period. In some regions and countries, it is possible to predict with some confidence that the load factor for particular periods will rise or fall in the future. For example, when a large new industry is expected to develop, the load factor may be expected to increase to reflect the more or less continuous use of electricity that is the nature of some heavy industries. LOAD is designed to allow you to easily modify historical LDCs over time to match predicted changes in the character of the load.

6.1.2 Approach

The first step in determining the electric load is to supply annual electricity generation for the planning study; you can supply this information in one of three ways. You can use output from the BALANCE Module of ENPEP to supply the LOAD Module with expected electricity generation (measured in kWh) for each year of the planning study. In addition, you can either enter the annual generation directly or enter annual electrical consumption and transmission and distribution (T&D) losses to calculate annual generation from Eq. 6.1:

$$AG_i = \frac{AS_i}{1 - AT_i} \qquad (6.1)$$

where:

AG_i = annual generation (kWh) in year i,

AS_i = annual electrical consumption of electricity (kWh) in year i, and

AT_i = T&D losses expressed as a fraction of generation in year i (can change over time).

*Therefore, the load factor is the average load for a period of time divided by the maximum load in that same period.

The next step in the LOAD Module is to supply the annual load factor. The load factor can be specified from BALANCE output, from values that you directly enter, or from a base value for the initial year and a specified rate of change over time.

Given the annual generation and the annual load factor, the annual peak load can be determined from Eq. 6.2:

$$AP_i = \frac{AG_i}{AL_i \times 8.76 \times 10^6} \tag{6.2}$$

where:

AL_i = annual load factor (fraction) in year i,

AP_i = annual peak load (MW), and

8.76×10^6 = hours in a year times 1,000 kW/MW.

Now the annual information has been collected for all years of the study. At this point LOAD advances you to the period calculations. Normally for electric system planning, it is important to account for the period variation in loads, the expected variation in hydroelectric electric supply, and other important period considerations, such as scheduling maintenance at times of relatively low loads. Therefore, most studies using ELECTRIC are expected to have from 4 to 12 periods per year.

To calculate period loads, you need to supply period generation fractions, that is, the fraction of total generation that is expected in each period. These fractions may change over time to account for shifts in the demand structure. Equation 6.3 specifies the obvious condition on the period generation fractions.

$$\sum_{t=1}^{NS} g_{ti} = 1 \tag{6.3}$$

where:

g_{ti} = fraction of total generation year i that occurs in period t, and

NS = number of periods per year.

The generation in each period (G_{ti}) is therefore given by:

$$G_{ti} = g_{ti} \times AG_i \tag{6.4}$$

The next set of information needed is the ratio of period peak load to the annual peak. These ratios must be specified for each period and can change year by year. However, at least one of the ratios must be exactly 1.0 for each year and none of the ratios can ever exceed 1.0.

$$P_{ti} = f_{ti} \times AP_i \tag{6.5}$$

where:

P_{ti} = period peak load (MW) for period t in year i, and

f_{ti} = ratio of peak load in period t to annual peak in year i.

Convenient spreadsheets for LOAD allow you to change the peak-load ratios (fractions) and period generation fractions over time.

Now it is possible for LOAD to determine the period load factors for each period and each year of the study.

$$L_{ti} = \frac{G_{ti} \times NS}{P_{ti} \times 8.76 \times 10^6} \tag{6.6}$$

where L_{ti} = period load factor. (See the appendix in Sec. 6.5 for more information about the calculations that the LOAD Module uses and the constraints on input for LOAD.)

The next stage of LOAD is to compute the period LDCs for every period and year of the study. It is expected that period LDCs for a base year would normally be available; however, if these historical data are not available, LOAD will prepare LDCs to match the given load factors.

You are offered three basic options for computing the period load duration curves:

1. Enter the period LDCs directly (as a fifth order polynomial or as coordinates),

2. Enter a minimum load and use the Snyder method,[2] or

3. Use base-year LDCs and compute future period LDCs using the POLIN computer program[3] (which is included in LOAD).

You should use the first method when detailed load analyses have been performed outside ENPEP. The second method can be used if no historical period LDCs can be obtained. The third method is preferred when historical period LDCs are available and period load factors are expected to change over time. The POLIN program performs a

least squares fit on the historical data while precisely matching the specified load factor to maintain some of the character of the LDC shape. Thus, LOAD provides you with a number of options on the form of the input for determining period LDCs.

One important point is that LOAD will accommodate you when you have no data concerning LDCs. In such cases, all you have to do is specify load factors and minimum loads by period (LOAD provides a default value if you have no information). On the other hand, when you have extensive data on LDCs, you will be able to use that information in LOAD.

A number of backup calculations that are built into LOAD will be used if inconsistencies arise when you use the POLIN method. As an example, when a period load factor for a future year is drastically different than the historical data for that period, it is possible that POLIN will determine a LDC that at some point has a positive derivative. Since this is an impossibility according to the LDC definition, LOAD automatically checks for such a condition and, when it occurs, reverts to a backup procedure using the Snyder method. If the Snyder method also fails for this reason, a LDC consisting of two straight line segments is prepared (the two-segment method). Whenever these backup routines are used, you will be given a warning message.

At this point, all the load data needed to execute the ELECTRIC Module have been prepared. LOAD can also compute an annual LDC from the period LDCs and the period peak-load fractions. This annual LDC can be useful for preparing graphs for reports or general interest, but is not used by ELECTRIC except when each year consists of only one period. The period LDCs can also be plotted. These plots should be made for a few years of the study so you can compare the period curves and the changes that occur over time.

You can use LOAD as part of the ENPEP series of models following BALANCE, in conjunction with ELECTRIC, or by itself to organize and examine load and generation data over time.

6.1.3 Functions

LOAD uses automated spreadsheets for data entry and tabular computations. You can store all changes and output from each case. After you select a case, the ENPEP forms package guides you through a hierarchy of menus so you can use the functions listed below:

- Determine annual generation using electrical consumption and loss factors, values that you enter, or data from the BALANCE Module.
- Determine annual load factors using growth rates and a base value, values that you enter, or data from the BALANCE Module.
- Compute annual peak load.

- Determine period generation, peak-load fractions, and load factors.
- Determine period LDCs using polynomial coefficients or coordinates that you enter, the Snyder method, the POLIN method, or the two-segment method.
- Compute annual LDCs.

After you complete each function or task, LOAD gives you the opportunity to graph the results with GrafTalk.

6.1.4 References

1. *Expansion Planning for Electrical Generating Systems: A Guidebook*, International Atomic Energy Agency Report STI/DOC/10/241, Vienna (1984).

2. Snyder, A.J., *Load Duration Curves*, letter, Nuclear Technology, *24*:260 (1979). [Reproduced in Sec. 6.5.5.]

3. Molina, P., *Description of the Computer Programmes to Prepare the LOAD Duration Curve Input Data as Required by the WASP Code*, Division of Nuclear Power and Reactors, International Atomic Energy Agency, Vienna (1979).

6.2 Structure

Figure 6.1 illustrates the relationships among the various menus and forms used in the LOAD Module. A number outside of a box indicates the keystroke that you enter to advance to a particular form or carry out a specific function when more than one option is available. The boxes that contain the abbreviation *FW* indicate the points in the hierarchy where you enter Framework II, the program used to generate spreadsheets; the boxes that contain the abbreviation *GT* indicate where you enter GrafTalk, the program used to generate graphics.

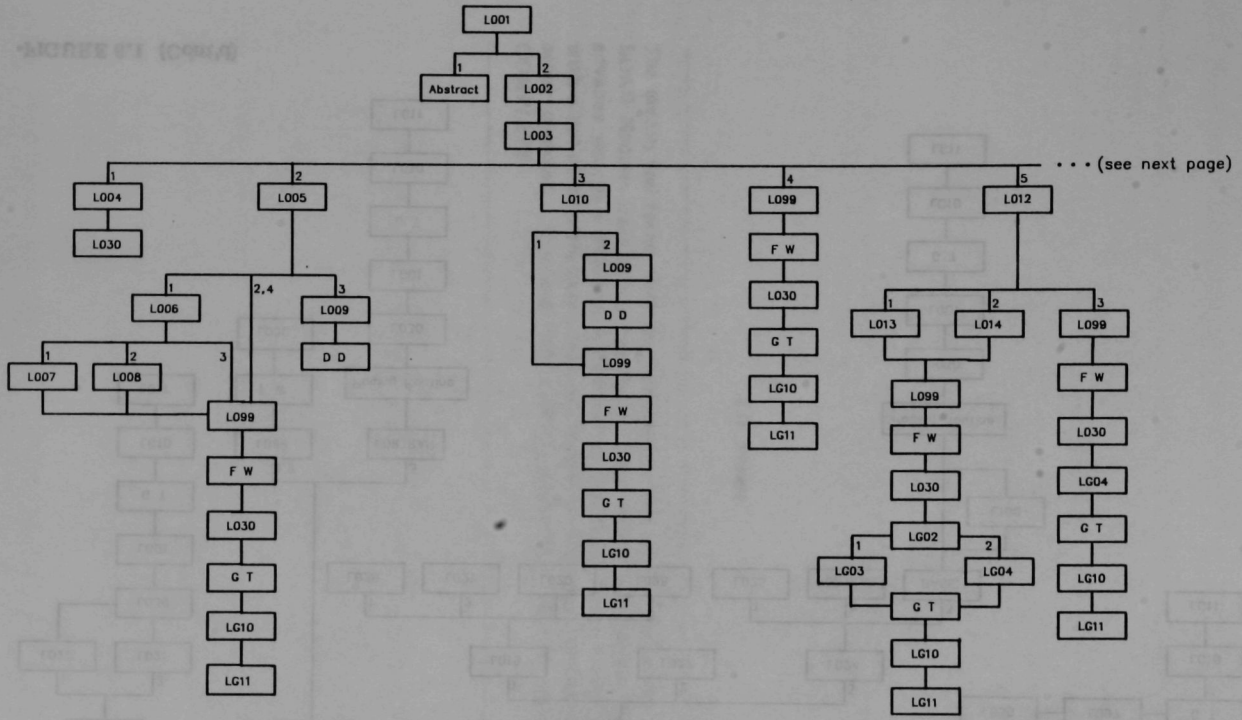


FIGURE 6.1 LOAD Module Hierarchy

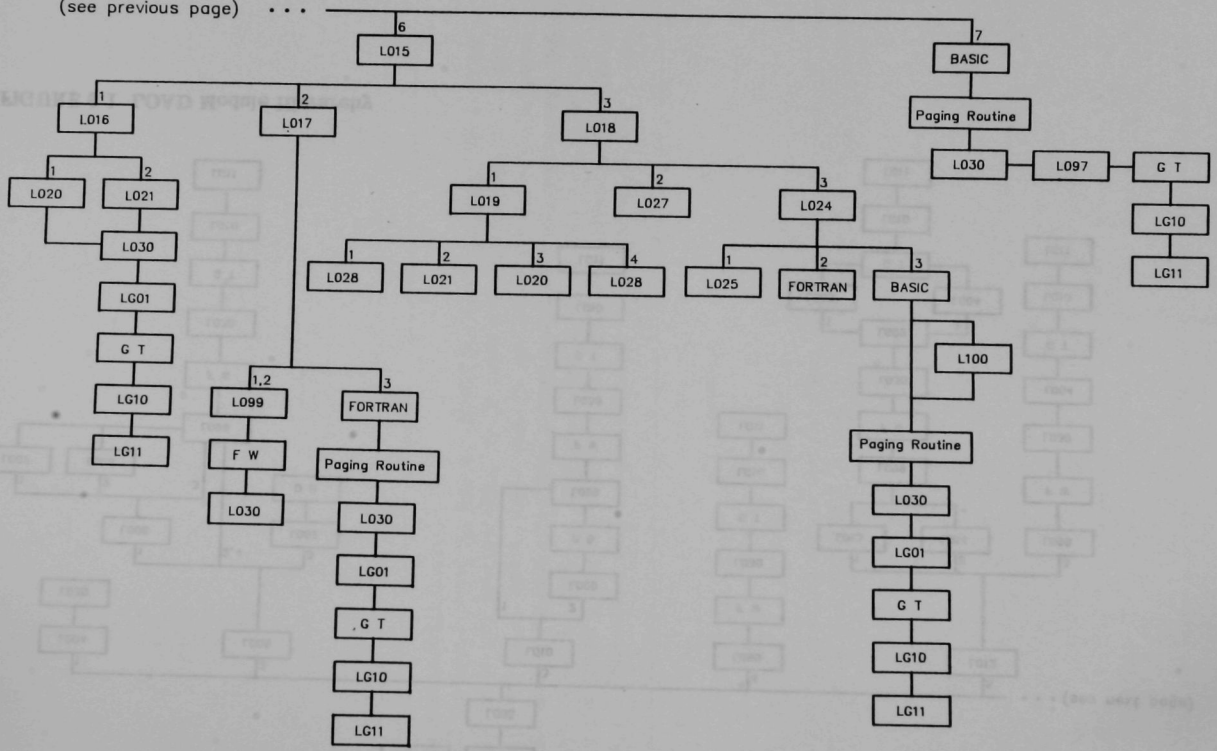
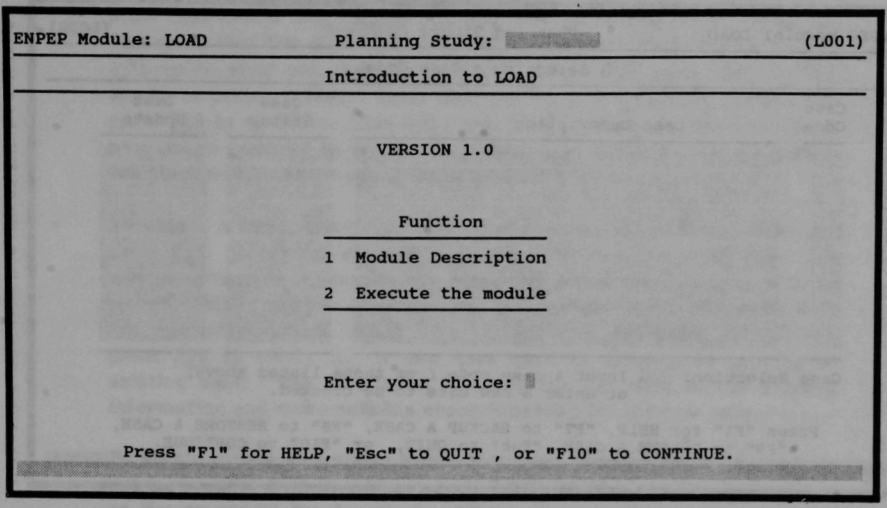


FIGURE 6.1 (Cont'd)

6.3 Forms

The menus and forms that are described in this section guide you through the LOAD Module. Usually you can choose from two to six options, and each will advance you to a different submodule or function. Some forms present you with a list of possible cases that you must choose from to provide links to the other modules. You can link only to cases that have a case status of *COMPLETE*.

6.3.1 Menu L001 — Introduction to LOAD



Purpose

Menu L001 is an introduction to the LOAD module. It allows you to view information about the module or to execute LOAD. You advanced to this menu by selecting option 5 on Menu X003 in the EXECUTIVE Module.

Options

1 Select this option to view an on-line abstract that describes the LOAD Module. You will advance to the ENPEP Paging Routine; after you finish viewing the abstract, press **Esc** to return to this menu. (See the Introduction at the beginning of this volume for more information about the Paging Routine.)

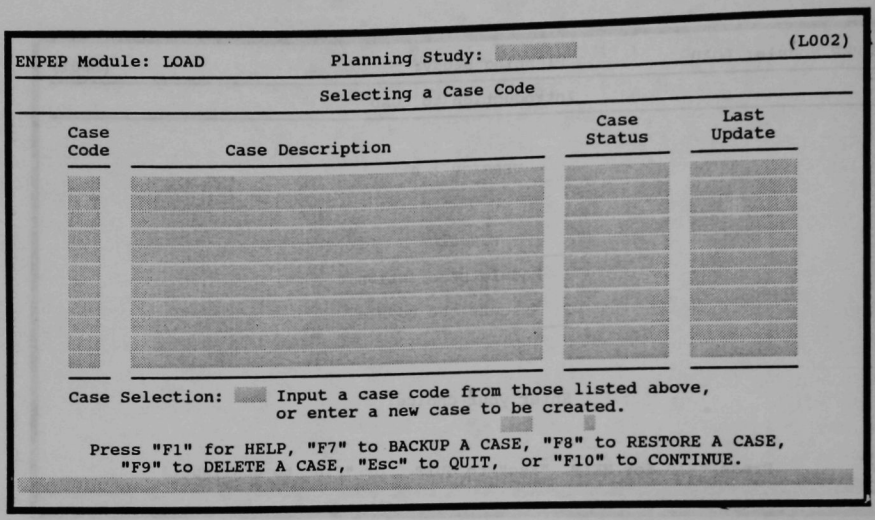
2 Select this option to enter the module and advance to Form L002.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help. (See the Introduction at the beginning of this volume for more information on the on-line help available in ENPEP.)

Esc Press this key to return to Menu X003 in the EXECUTIVE Module.

6.3.2 Form L002 — Selecting a Case



Purpose

Form L002 allows you to select a case to execute in the LOAD Module. You can select a case to execute, back up (archive) a case, restore a case, create a case, or delete a case. You advanced to this form by selecting option 2 on Menu L001.

Options

- To choose a case to execute, enter the number of an existing case and press **F10**. You will be prompted to identify the disk drive on which the data are stored. Press **F10** again to continue. The program will automatically store the case and disk-drive designation in the Data Dictionary and advance you to Menu L003.

- To back up a case, enter the number of an existing case and press **F7**. The program will prompt you to identify the disk drive where the data for that case are stored and the disk drive on which you want to back up the data. Each time you enter a disk-drive designation, press **F10** to verify it. The program will write the Data Dictionary variables to a file. This file and all files associated with the case will be backed up onto separate disks for archiving purposes.

- To restore a case, enter the number of a case that you previously backed up and press **F8**. (If an existing case has the same number, you must first delete that case.) You will then be prompted to identify the disk drive that the data are to be restored onto (that is, where the data will reside when you execute the case) and the disk drive that the data are to be restored from. Each time you enter a disk-drive designation, press **F10** to verify it. This will cause all data files associated with the case to be restored to the working directory, and the Data Dictionary variables will be written into the Data Dictionary.

- To create a case, enter the number of a case that does not exist and press **F10**. After you enter a description for the case, press **F10**. You will be prompted to identify the disk drive where the new case is to be stored, which case you want to copy, and the disk drive where the data are currently stored. Each time you enter a disk-drive designation, press **F10** to verify it. A new case must be created by copying an existing case. This is done so that you can use most of the existing information and make only the changes needed for the new case.

- To delete a case, press **F9**. You will be prompted to ensure that you do not lose a case that you do not want deleted (press any key to continue or **Esc** to cancel the function). After you enter the case number and verify the function by pressing **F10**, you will be prompted to identify the disk drive where the case is stored. All files for this case and all Data Dictionary variables for the case will then be deleted.

- Press **F1** to obtain on-line help.

- Press **Esc** to return to Menu L001.

6.3.3 Menu L003 — Selecting a LOAD Submodule

```
ENPEP Module: LOAD        Planning Study:          Case:        (L003)

                    Selecting a Function for Load

                                                  Status    Last Update
Description of Function
1. Enter base year, end year and number of periods

2. Determine Annual Generation
3. Determine Annual Load Factors
4. Compute Annual Peak-Load

5. Determine Period Generation, Load Factors and
   Peak-Load Fractions
6. Determine Period Load Duration Curves

7. Compute Annual Load Duration Curve

Function Selection:    (1-7, from above list)

To complete the Load module, functions 1-7 must be completed in order.

        Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This is the menu from which you select a LOAD submodule to execute. You must complete the submodules sequentially (in other words, complete option 1 before selecting option 2, complete option 2 before selecting option 3, and so forth). You advanced to Menu L003 by selecting a case on Form L002.

Options

1 Select this option to view or change the beginning and end years and number of periods of the case. You will advance to Form L004.

2 Select this option to determine annual generation. You will advance to Menu L005.

3 Select this option to determine annual load factors. You will advance to Menu L010.

4 Select this option to compute annual peak loads from the annual generation and annual load factor values. You will advance first to Form L099 to enter Framework II and then to Spreadsheet LANPE.

5 Select this option to determine period generation, peak-load fractions, and load factors. You will advance to Menu L012.

6 Select this option to determine period LDCs. You will advance to Menu L015.

7 Select this option to compute annual LDCs. You will advance to a BASIC program that aggregates the period LDCs determined in option **6**. After you finish viewing the results (with the ENPEP Paging Routine), press **Esc** to advance to Form L097 to select the years that you want to graph.

F10 Press this key to continue after you select option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Form L002.

6.3.4 Form L004 — Changing Case Parameters

```
ENPEP Module: LOAD        Planning Study:          Case:      (L004)
                          Enter General Data

                          Base Year:
                          End Year:
                          Number of Periods:    (1-12)

                  Options:
                     1 - No changes in current years and number of periods.
                         Press "F10" to CONTINUE.

                     2 - Modify the years and/or the number of periods -
                         Change the base year, end year, and/or the number
                         of periods, and press "F7".
                     Note: A change in any of the fields will require
                           the user to re-execute all submodules.

          Press "F1" for HELP, or "Esc" to QUIT, "F10" to CONTINUE.
```

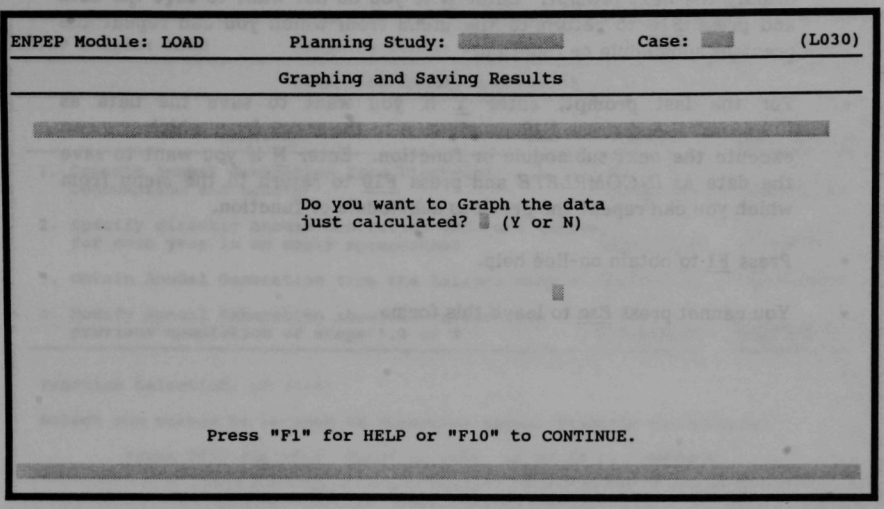
Purpose

Use Form L004 to view or change the beginning and end years and number of periods of the case. You advanced to this form by selecting option 1 on Menu L003.

Options

- To use the existing data, press **F10**. You will advance to Form L030.
- Change the base and end years and number of periods. Then press **F7** to save the displayed values and press **F10** to advance to Form L030.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu L003.

6.3.5 Form L030 — Saving Submodule Results



Purpose

Form L030 allows you to graph and save the results from executing a LOAD submodule or function by responding to one to three prompts. First, you will be prompted to decide whether you want to graph the data, unless you advanced from Form L004 or the previous step was interrupted. Then you will be prompted to decide whether you want to save the data. Finally, you will be prompted to decide whether the data should be saved as *COMPLETE* or *INCOMPLETE*. You advanced to this form after viewing or changing case parameters on Form L004, exiting from Framework II, completing option 6 or 7 on Menu L003, or exiting from GrafTalk (and completing Forms LG10 and LG11).

Options

- For the graphics prompt, enter **Y** if you want to graph the data and press **F10** to advance to GrafTalk or to Form LG02, LG01, or L097 if you have just completed option 5, 6, or 7, respectively, on Menu L003. Enter **N** if you do not want to graph the data and press **F10** to display the next prompt. (Note: If you advanced from Form L004 or the previous step was interrupted, this prompt will not be displayed.)

- For the prompt to save data, enter **Y** to save the data and press **F10** to display the next prompt. Enter **N** if you do not want to save the data and press **F10** to return to the menu from which you can repeat the previous submodule or function.

- For the last prompt, enter **Y** if you want to save the data as *COMPLETE* and press **F10** to advance to the menu from which you can execute the next submodule or function. Enter **N** if you want to save the data as *INCOMPLETE* and press **F10** to return to the menu from which you can repeat the previous submodule or function.

- Press **F1** to obtain on-line help.

- You cannot press **Esc** to leave this form.

6.3.6 Menu L005 — Determining Annual Generation

```
ENPEP Module: LOAD        Planning Study:             Case:        (L005)

                    Determine Annual Generation

                     Function                          Status    Last Update

 1. Compute Annual Generation from Electrical
    consumption and Losses

 2. Specify directly Annual Generation absolute values
    for each year in an empty spreadsheet

 3. Obtain Annual Generation from the Balance Module

 4. Modify Annual Generation absolute values from
    previous completion of steps 1,2 or 3

 Function Selection:    (1-4)

 Select one method to be used to determine Annual Electric Generation.

       Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This menu allows you to select a method for determining annual generation. You advanced to Menu L005 by selecting option 2 on Menu L003.

Options

1 Select this option to compute annual generation using annual electrical consumption and loss data. You will advance to Menu L006.

2 Select this option to directly enter annual generation values into an empty spreadsheet (LANGE). You will advance to Form L099 to enter Framework II.

3 Select this option to obtain annual generation values from a previously completed case in the BALANCE Module. You will advance to Form L009 to select the appropriate BALANCE case.

4 Select this option to change existing annual generation values from a previous use of option 1, 2, or 3. You will advance first to Form L099 to enter Framework II and then to Spreadsheet LANGE.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L003.

6.3.7 Menu L006 — Calculating Annual Generation from Electrical Consumption and Losses

```
ENPEP Module: LOAD        Planning Study:          Case:      (L006)

        Compute Annual Generation From Electrical Consumption and Losses

                                                  Status     Last Update
  Function
  1. Enter Annual Electrical Consumption
  2. Enter Transmission and Distribution Losses
  3. Compute Annual Generation

  Function Selection:    (1-3)

  To complete the calculations for annual generation, Electrical consumption
  and loss factor data must first be supplied.

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This is the menu from which you calculate annual generation from electrical consumption and losses. You must complete options 1 and 2 before selecting option 3. You advanced to Menu L006 by selecting option 1 on Menu L005.

Options

1 Select this option to enter annual electrical consumption or calculate it using growth rates and a base value. You will advance to Menu L007.

2 Select this option to enter annual T&D loss fractions or calculate them using growth rates and a base value. You will advance to Menu L008.

3 Select this option to calculate annual generation using the previously entered data (options 1 and 2). You will advance first to Form L099 to enter Framework II and then to Spreadsheet LANGE.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L005.

6.3.8 Menu L007 — Entering Electrical Consumption Data to Calculate Annual Generation

```
ENPEP Module: LOAD        Planning Study:          Case:      (L007)

     Enter Electrical Consumption Data for Electric Generation Calculation

      You may specify electrical consumption by:
        1. Entering new annual growth rates and a base
           consumption value
        2. Modifying existing annual growth rates and base
           consumption value
        3. Entering directly consumption values for all years on
           empty spreadsheet
        4. Modifying consumption values from previous completion
           of steps 1, 2, or 3

Function Selection:    (1-4)

Select one method to be used in calculating electric generation.
The results will be used with loss factors to calculate annual electric
generation.

        Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu L007 allows you to select a method for determining annual electrical consumption. You advanced to this by selecting option 1 on Menu L006.

Options

1 Select this option to enter annual growth rates for electrical consumption into an empty spreadsheet. You will advance to Spreadsheet LSAGR.

2 Select this option to change the growth rates from a previous use of option **1**. You will advance to Spreadsheet LSAGR.

3 Select this option to enter annual electrical consumption directly into an empty spreadsheet. You will advance to Spreadsheet LSABA.

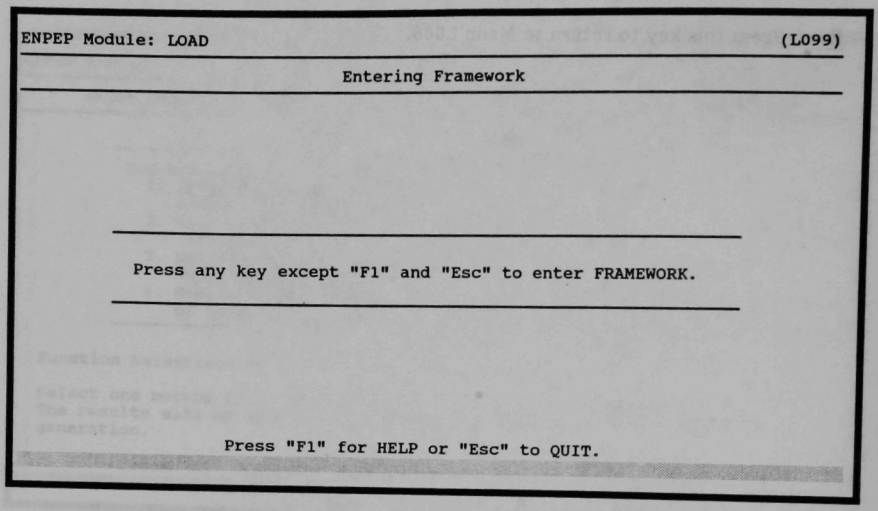
4 Select this option to change the data from a previous use of option **1**, **2**, or **3**. You will advance to Spreadsheet LSABA.

F10 Press this key to continue after you select an option. You will advance to Form L099 to enter Framework II.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L006.

6.3.9 Form L099 — Entering Framework II



Purpose

This form allows you to decide whether you want to enter Framework II. You advanced to Form L099 by selecting an option that calculates or displays data on a spreadsheet.

Options

- Press any key (except **F1** or **Esc**) to enter Framework II.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to the form or menu from which you advanced.

6.3.10 Form LG10 — Printing Graphics

```
ENPEP Module:          Planning Study:          Case:        (LG10)
                    Obtaining Graphics Hard Copy

The previously created graph may now be plotted on an HP-7475A pen-plotter

                Do you want a hard copy of the graph?  (Y or N)

            (Make sure the plotter is properly connected and turned on.)

                        Press "F1" for HELP or "F10" to CONTINUE.
```

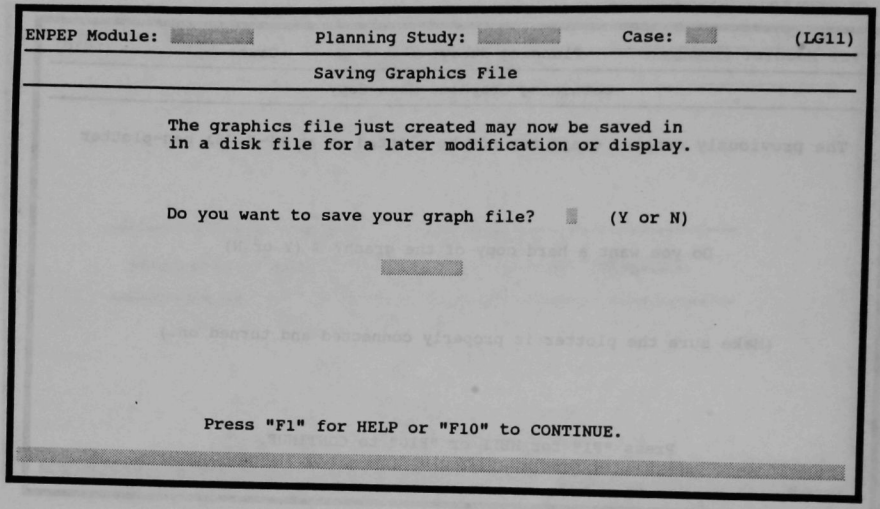
Purpose

Form LG10 allows you to decide whether you want to plot on a graphics device the results of the data that you just calculated. You advanced to this form after using GrafTalk to graph data. (Note: After GrafTalk displays a graph, press any key to advance to Form LG03.)

Options

- Enter **Y** if you want a hard copy of the graph (make sure that the plotter is on line).
- Enter **N** if you do not want a hard copy.
- Press **F10** to verify your choice; you will advance to Form LG11.
- Press **F1** to obtain on-line help.
- You cannot press **Esc** to leave this form.

6.3.11 Form LG11 — Saving Graphics Files



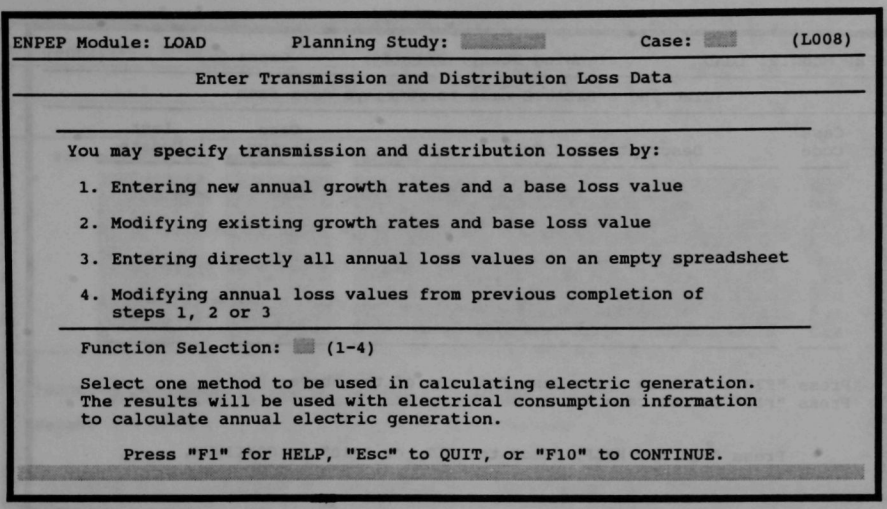
Purpose

Form LG11 allows you to save graphics files. You advanced to this form after deciding whether to plot a graph on Form LG03.

Options

- Enter **Y** if you want to save the graphics file, and enter **N** if you do not want to save the file.
- Press **F10** to return to Form L030.
- Press **F1** to obtain on-line help.
- You cannot press **Esc** to leave this form.

6.3.12 Menu L008 — Entering Transmission and Distribution Loss Data



Purpose

Menu L008 allows you to select a method for determining annual T&D fractions. You advanced to this menu by selecting option 2 on Menu L006.

Options

1 Select this option to enter annual growth rates into an empty spreadsheet. You will advance to Spreadsheet LLOGR.

2 Select this option to change the growth rates from a previous use of option **1**. You will advance to Spreadsheet LLOGR.

3 Select this option to enter annual loss fractions directly into an empty spreadsheet. You will advance to Spreadsheet LLOBA.

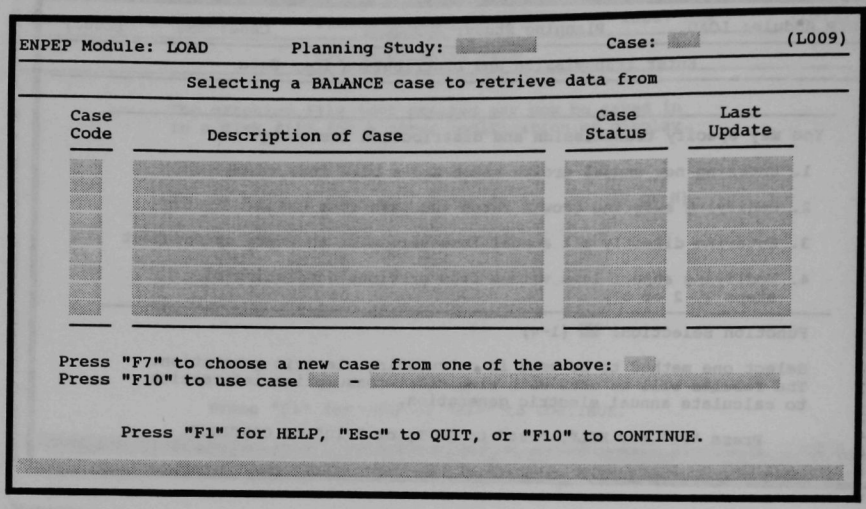
4 Select this option to change the data from a previous use of options **1**, **2**, or **3**. You will advance to Spreadsheet LLOBA.

F10 Press this key to continue after you select an option. You will advance to Form L099 to enter Framework II.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L006.

6.3.13 Form L009 — Selecting a BALANCE Case to Obtain Annual Generation or Load Factors



Purpose

This form allows you to choose a reference BALANCE case from which to retrieve data about annual generation or load factors. You advanced to Form L009 by selecting option 3 on Menu L005 (to obtain annual generation) or option 5 on Menu L010 (to obtain load factors).

Options

- To use data from the current BALANCE case, press **F10**.
- To select a new BALANCE reference case, enter the number of the case and press **F7**. You will be prompted to verify your choice by pressing **F10**. You can use only cases that are *COMPLETE*.
- After you complete one of the above options, you will advance to Form L099 to enter Framework II. If you are obtaining annual generation data, the values will be displayed on Spreadsheet LANGE. If you are obtaining load factors, the values will be displayed on LLFBA.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu L005 or L010.

6.3.14 Menu L010 — Entering Annual Load Factors

```
ENPEP Module: LOAD        Planning Study:          Case:      (L010)
                        Enter Annual Load Factors

  You may specify annual load factors by:

      1. Entering new annual growth rates and a base load factor value

      2. Modifiying existing annual growth rates and base load factor value

      3. Entering directly all annual load factor values

      4. Modifying annual load factor values from previous completion of
         steps 1, 2, 3 or 5
      5. Using output from the Balance Module

  Function Selection:    (1-5)

  Select one method of specifying annual load factors.

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This is the menu from which you select a method for determining annual load factors. You advanced to Menu L010 by selecting option 3 on Menu L003.

Options

1 Select this option to enter annual load factor growth rates into an empty spreadsheet (LLFGR). You will advance to Form L099 to enter Framework II.

2 Select this option to change the growth rates from a previous use of option 1. You will advance first to Form L099 to enter Framework II and then to Spreadsheet LLFGR.

3 Select this option to enter annual load factors directly into an empty spreadsheet (LLFBA). You will advance to Form L099 to enter Framework II.

4 Select this option to change annual load factors from a previous use of option 1, 2, 3, or 5. You will advance first to Form L099 to enter Framework II and then to Spreadsheet LLFBA.

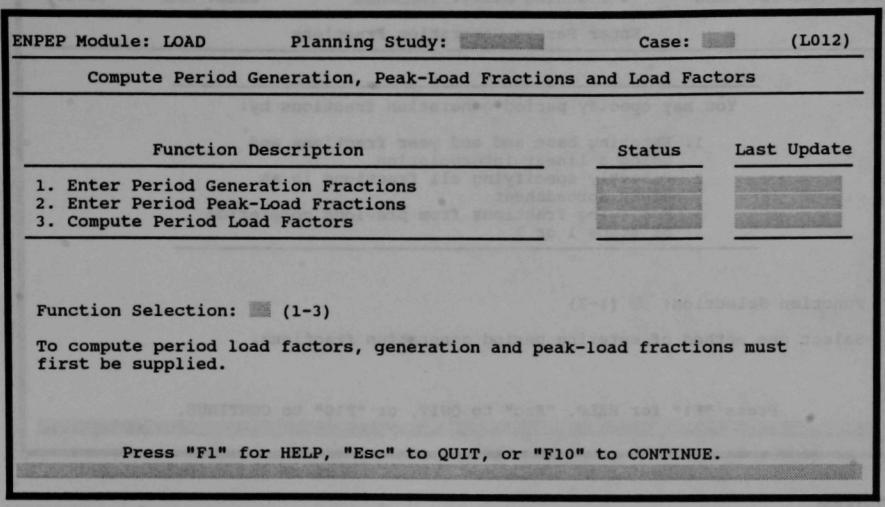
5 Select this option to obtain annual load factors from a previously completed case in the BALANCE Module. You will advance to Form L009 to identify the appropriate BALANCE case.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L003.

6.3.15 Menu L012 — Calculating Period Generation, Peak-Load Fractions, and Load Factors



Purpose

Menu L012 allows you to select a method to enter period generation fractions and period peak-load fractions to calculate period load factors. You must complete options 1 and 2 before selecting option 3. You advanced to this menu by selecting option 5 on Menu L003.

Options

1 Select this option to enter or calculate period generation fractions. You will advance to Menu L013.

2 Select this option to enter or calculate period peak-load fractions. You will advance to Menu L014.

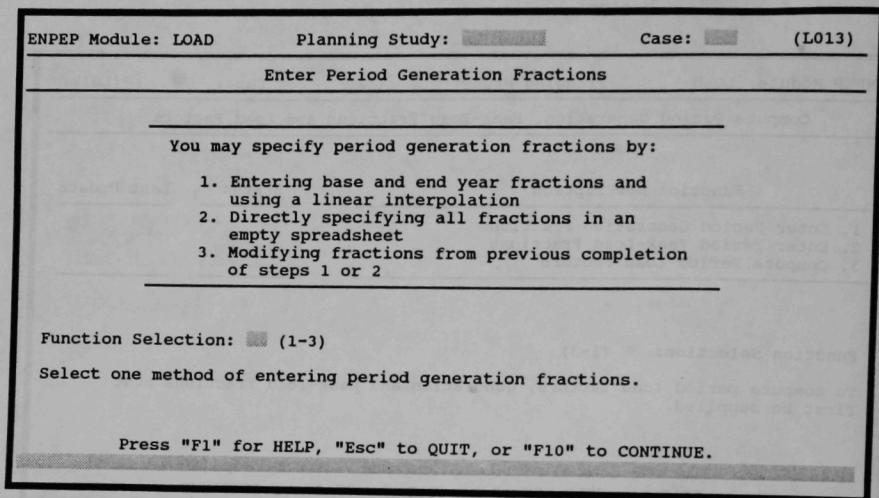
3 Select this option to calculate period load factors using period generation and peak-load fractions (options 1 and 2). You will advance first to Form L099 to enter Framework II and then to Spreadsheet LSELF.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L003.

6.3.16 Menu L013 — Entering Period Generation Fractions



Purpose

This is the menu from which you select a method for determining period generation fractions. You must complete options 1 and 2 before selecting option 3. You advanced to Menu L013 by selecting option 1 on Menu L012.

Options

1 Select this option to enter base- and end-year period generation fractions. These fractions will be used in a linear interpolation to compute the period generation fractions for all remaining years. You will advance to Spreadsheet LSEG1.

2 Select this option to enter period generation fractions for all years into an empty spreadsheet. You will advance to Spreadsheet LSEG2.

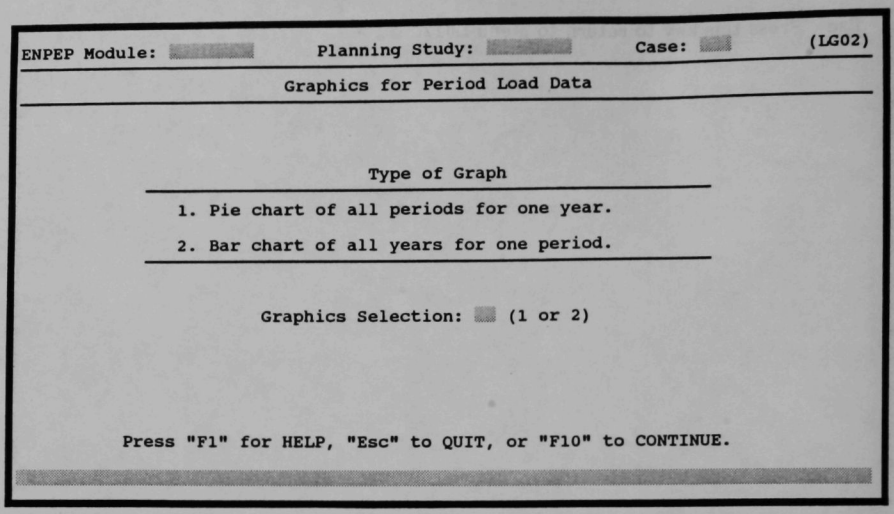
3 Select this option to change period generation fractions from a previous use of option 1 or 2. You will advance to Spreadsheet LSEG2.

F10 Press this key to continue after you select an option. You will advance to Form L099 to enter Framework II.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L012.

6.3.17 Menu LG02 — Selecting a Type of Graph



Purpose

Menu LG02 allows you to select a type of graph to represent the calculated period generation and load data. You advanced to this menu after completing option 1 or 2 on Menu L012 and deciding to graph the data on Form L030.

Options

1 Select this option to generate a pie chart of all periods for one year. You will advance to Form LG03 to select a year.

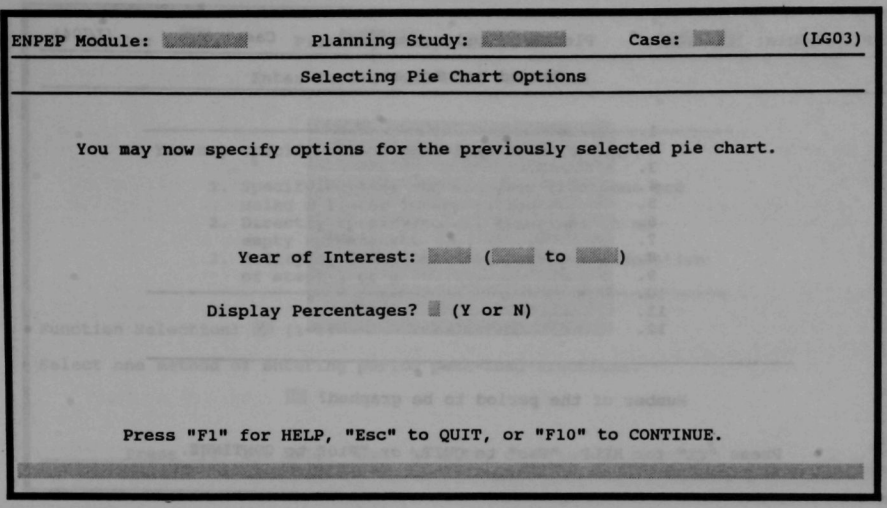
2 Select this option to generate a bar chart of all years for one period. You will advance to Form LG04 to select a period.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Form L030.

6.3.18 Form LG03 — Selecting Pie-Chart Options



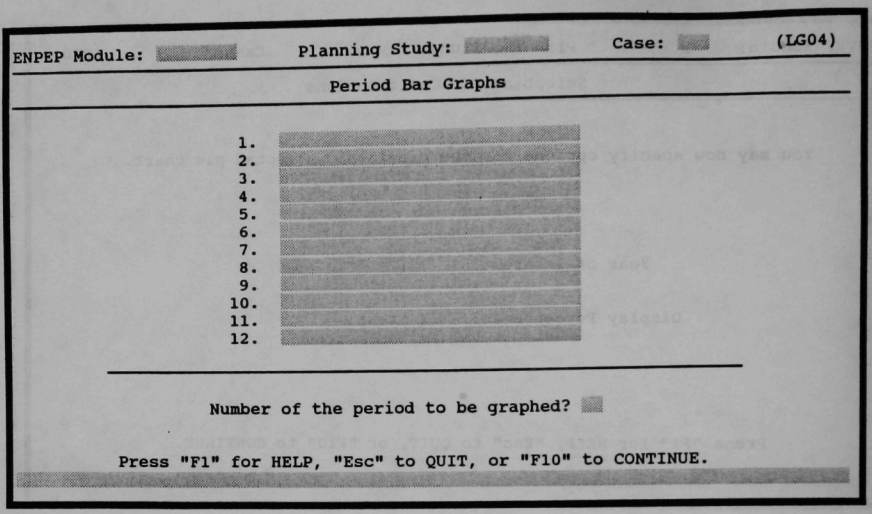
Purpose

Form LG03 allows you to identify the year for which you want to graph period generation or peak-load factions and decide whether to have GrafTalk display the percentages on the graph. You advanced to this form by selecting option 1 on Menu LG02.

Options

- Enter the year that you want to graph.
- Enter **Y** if you want GrafTalk to display the percentages; enter **N** if you do not.
- Press **F10** after you respond to both prompts. You will advance to GrafTalk.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu LG02.

6.3.19 Form LG04 — Selecting a Period for a Bar Chart



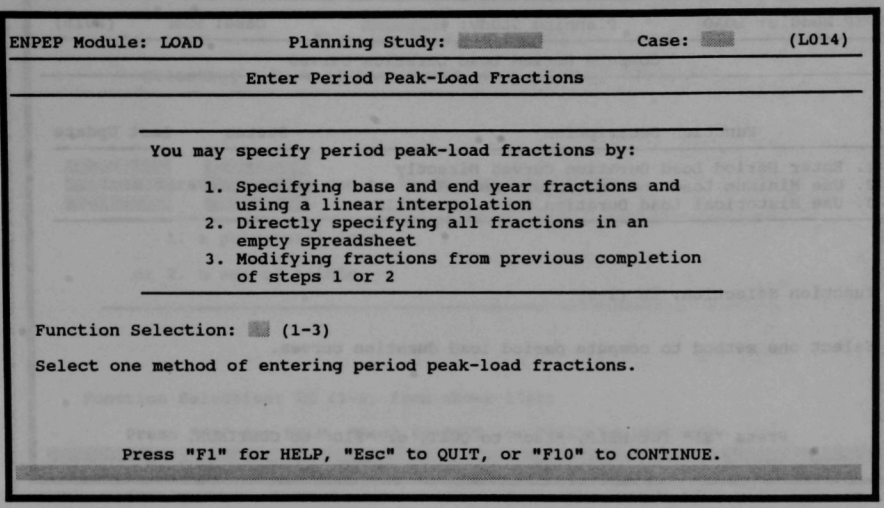
Purpose

Form LG04 allows you to identify the period for which you want to graph period generation, peak-load fractions, or peak loads. You advanced to this form by selecting option 2 on Menu LG02 or completing option 3 on Menu L012 and deciding to plot a graph on Form L030.

Options

- Enter the period number for which you want to generate a bar chart.
- Press **F10** to advance to GrafTalk.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu LG02 or Form L030.

6.3.20 Menu L014 — Entering Period Peak-Load Fractions



Purpose

Menu L014 allows you to select a method for determining period peak-load fractions. You must complete option 1 or 2 before selecting option 3. You advanced to this menu by selecting option 2 on Menu L012.

Options

1 Select this option to enter base- and end-year period peak-load fractions. These fractions will be used in a linear interpolation to compute the period peak-load fractions for all remaining years. You will advance to Spreadsheet LSEP1.

2 Select this option to enter period peak-load fractions for all years into an empty spreadsheet. You will advance to Spreadsheet LSEP2.

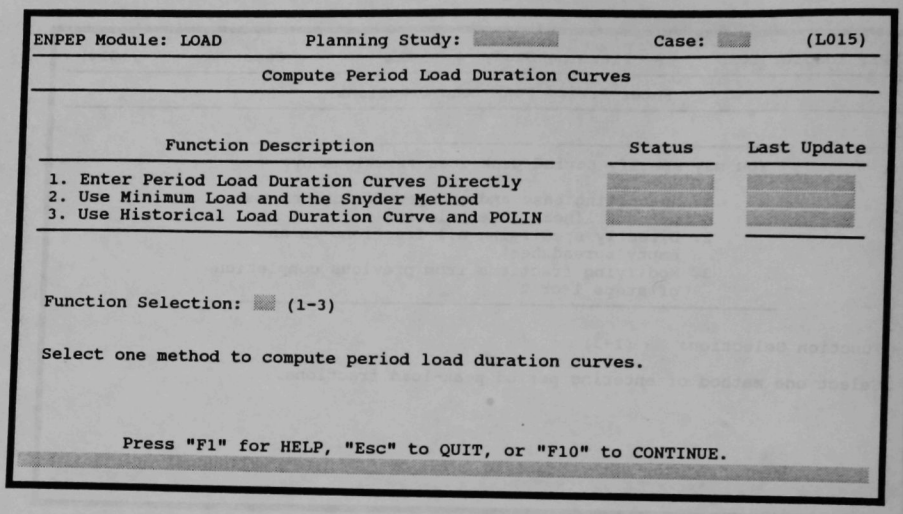
3 Select this option to change period peak-load fractions from a previous use of option 1 or 2. You will advance to Spreadsheet LSEP2.

F10 Press this key to continue after you select an option. You will advance to Form L099 to enter Framework II.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L012.

6.3.21 Menu L015 — Selecting a Method to Calculate Period LDCs



Purpose

Use Menu L015 to select a method for determining period LDCs. You advanced to this menu by selecting option 6 on Menu L003.

Options

1 Select this option to enter period LDCs directly by specifying coordinates or a polynomial. You will advance to Menu L016.

2 Select this option to calculate period LDCs using minimum load factors and the Snyder method. You will advance to Menu L017.

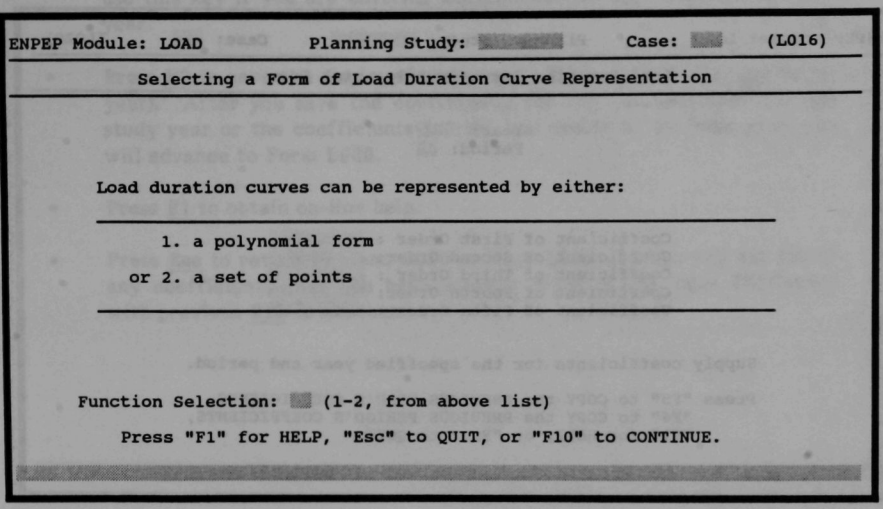
3 Select this option to calculate period LDCs using a base-year LDC and the POLIN method. You will advance to Menu L018.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L003.

6.3.22 Menu L016 — Selecting LDC Representation



Purpose

This is the menu from which you select a method to directly enter period LDCs. You advanced to Menu L016 by selecting option 1 on Menu L015.

Options

1 Select this option to directly enter period LDCs in polynomial form. You will advance to Form L020 to enter five coefficients for each period.

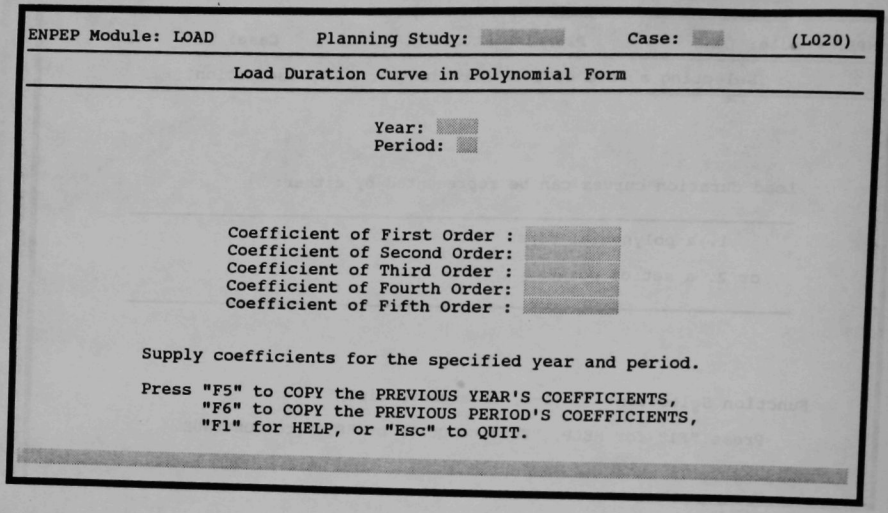
2 Select this option to directly enter period LDCs as coordinates. You will advance to Form L021 to enter the points for each period.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L015.

6.3.23 Form L020 — Entering LDC Polynomial Coefficients



Purpose

Use Form L020 to enter five polynomial coefficients for each period (of each year). You advanced to this form by selecting option 1 on Menu L016 or option 3 on Menu L019. If there are no coefficients in the Data Dictionary, the data fields will be blank. If the Data Dictionary contains coordinates when you advance to this form, the data fields will be blank and an error message will tell you that the Data Dictionary contains coordinates for the load duration curve. If the Data Dictionary contains coefficients, the data fields will contain the appropriate coefficient values for each period in each year.

Options

- Enter, view, or change the coefficients for the displayed period and year.
- Press **F5** to copy the coefficients from the corresponding period of the previous year. You cannot use this key if you are entering coefficients for the first study year or if you are entering only the base-year coefficients (Menu L019).

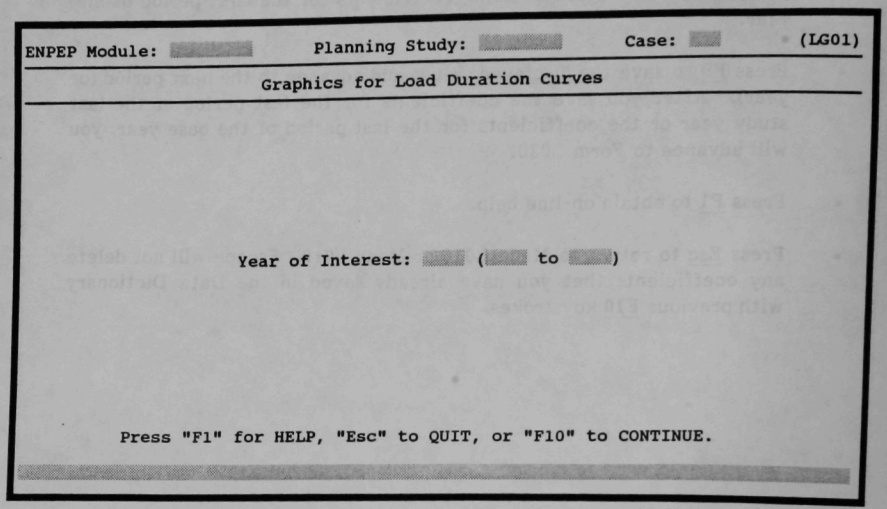
- Press **F6** to copy the coefficients from the previous period. You cannot use this key if you are entering coefficients for the first period of any year.

- Press **F9** to save the displayed values and advance to the next period (or year). After you save the coefficients for the last period of the last study year or the coefficients for the last period of the base year, you will advance to Form L030.

- Press **F1** to obtain on-line help.

- Press **Esc** to return to Menu L016 or Menu L019. Escape will not delete any coefficients that you have already saved in the Data Dictionary with previous **F10** keystrokes.

6.3.24 Form LG01 — Selecting a Year for Graphing Period LDCs



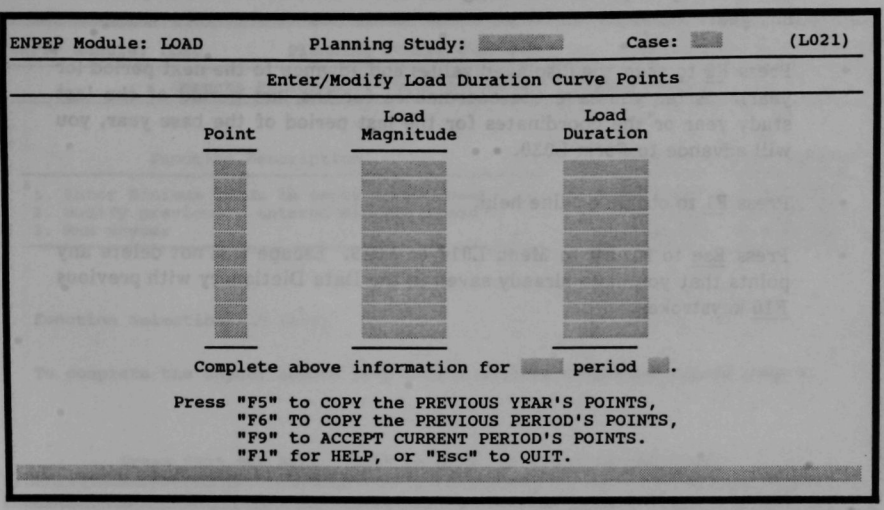
Purpose

Form LG01 allows you to identify the year for which you want to plot period LDCs. You advanced to this form after completing option 6 on Menu L003 and deciding to graph the data on Form L030.

Options

- Enter the year for which you want to plot the period LDCs.
- Press **F10** to advance to GrafTalk.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form L030.

6.3.25 Form L021 — Entering LDC Coordinates



Purpose

Use Form L021 to enter period LDCs as coordinates for each period (of each year). You advanced to this form by selecting option 2 on Menu L016 or L019. If there are no coordinates in the Data Dictionary, the data fields will be blank. If the Data Dictionary contains coefficients when you advance to this form, the data fields will be blank and an error message will tell you that the Data Dictionary contains coefficients for the LDC. If the Data Dictionary contains coordinates, the data fields will contain the appropriate coordinate values for each period in each year.

Options

- Enter, view, or change the coordinates for the displayed period and year. Note that the highest value for the *load magnitude* should correspond to the lowest value for the *load duration* and that the lowest value for the *load magnitude* should correspond to the highest value for the *load duration*.

- Press **F5** to copy the coordinates from the corresponding period of the previous year. You cannot use this key if you are entering coordinates for the first study year or if you are entering only the base-year coordinates (Menu L019).

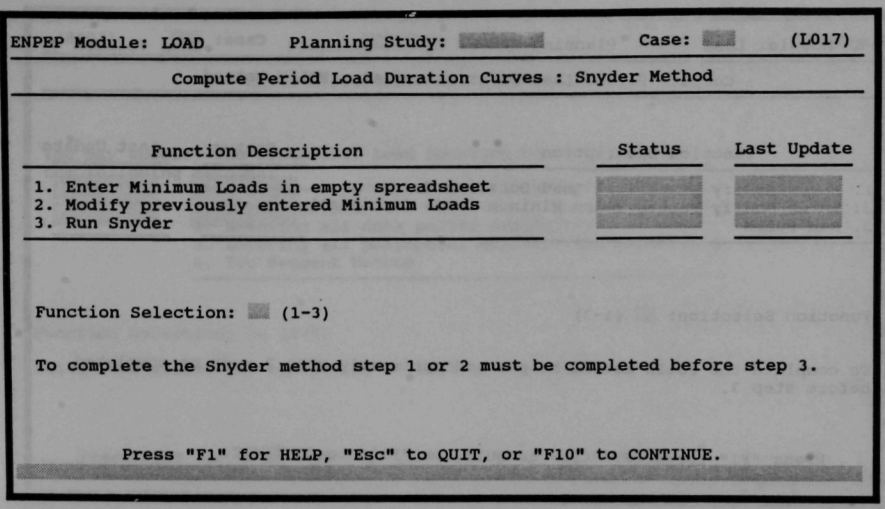
- Press **F6** to copy the coordinates from the previous period. You cannot use this key if you are entering the coordinates for the first period of any year.

- Press **F9** to save the displayed values and advance to the next period (or year). After you save the coordinates for the last period of the last study year or the coordinates for the last period of the base year, you will advance to Form L030.

- Press **F1** to obtain on-line help.

- Press **Esc** to return to Menu L016 or L019. Escape will not delete any points that you have already saved in the Data Dictionary with previous **F10** keystrokes.

6.3.26 Menu L017 — Calculating Period LDCs with the Snyder Method



Purpose

Menu L017 allows you to calculate period LDCs using the Snyder method, which estimates period LDCs with period load factors and minimum loads. You must complete option 1 or 2 before selecting option 3. You advanced to this menu by selecting option 2 on Menu L015.

Options

1 Select this option to enter period minimum load factors for each year into an empty spreadsheet (LSEML). You will advance to Form L099 to enter Framework II.

2 Select this option to change the data from a previous use of option 1. You will advance first to Form L099 to enter Framework II and then to Spreadsheet LSEML.

3 Select this option to calculate period LDCs using the Snyder method. You will advance to Form L030 after the Snyder program executes.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L015.

6.3.27 Menu L018 — Calculating Period LDCs with the POLIN Method

```
ENPEP Module: LOAD        Planning Study:          Case:      (L018)
              Compute Period Load Duration Curves : POLIN Method

                                                  Status    Last Update
        Function Description                      ------    -----------
1. Enter/Modify Historical Load Duration Curve
2. Enter/Modify Future Years Minimum Loads (optional)
3. Run POLIN

Function Selection:    (1-3)

To complete the POLIN method step 1 and optionally step 2 must be completed
before step 3.

     Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This menu allows you to complete the various steps needed to calculate period LDCs using the POLIN program, which fits a fifth-order polynomial to LDC coordinates. You must complete option 1 before selecting option 3. If you select option 2, you must also complete it before selecting option 3. You advanced to Menu L018 by selecting option 3 on Menu L016.

Options

1 Select this option to enter, change, or calculate base-year period LDC coefficients or coordinates. You will advance to Menu L019.

2 Select this option to enter or change period minimum load factors for each year in the case. This is an optional step for the POLIN method. You will advance to Form L027.

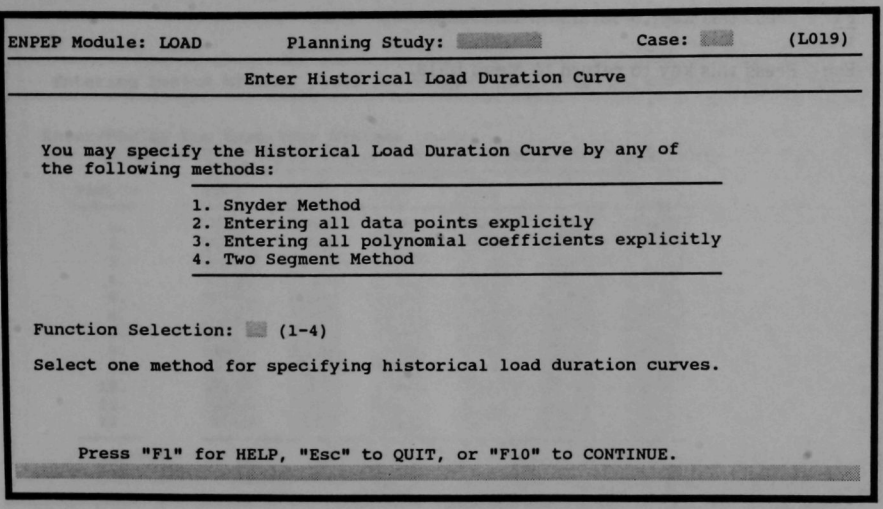
3 Select this option to calculate period LDCs using the POLIN method. You will advance to Menu L024.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L015.

6.3.28 Menu L019 — Entering Historical LDCs



Purpose

This is the menu from which you may select a method for determining the base-year (historical) LDCs. You can use options 1 and 4 if you have no data other than load factors and minimum loads. You advanced to Menu L019 by selecting option 1 on Menu L018.

Options

1 Select this option to calculate base-year period LDCs using minimum load factors and the Snyder method. You will advance to Form L028 to enter the minimum loads.

2 Select this option to enter base-year period LDCs directly by specifying coordinates. You will advance to Form L021.

3 Select this option to enter base-year period LDCs directly by specifying polynomial coefficients. You will advance to Form L020.

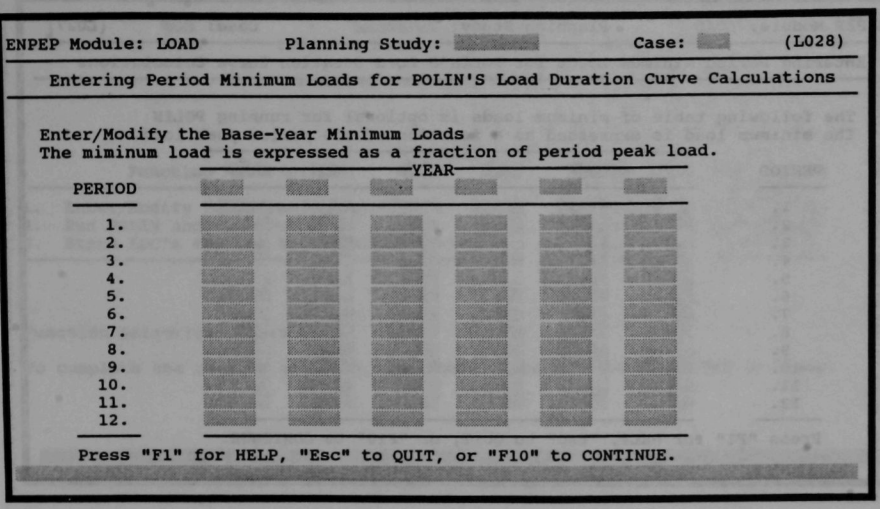
4 Select this option to calculate base-year period LDCs using minimum load factors and the two-segment method. You will advance to Form L028 to enter the minimum loads.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L018.

6.3.29 Form L028 — Entering Base-Year Period Minimum Loads



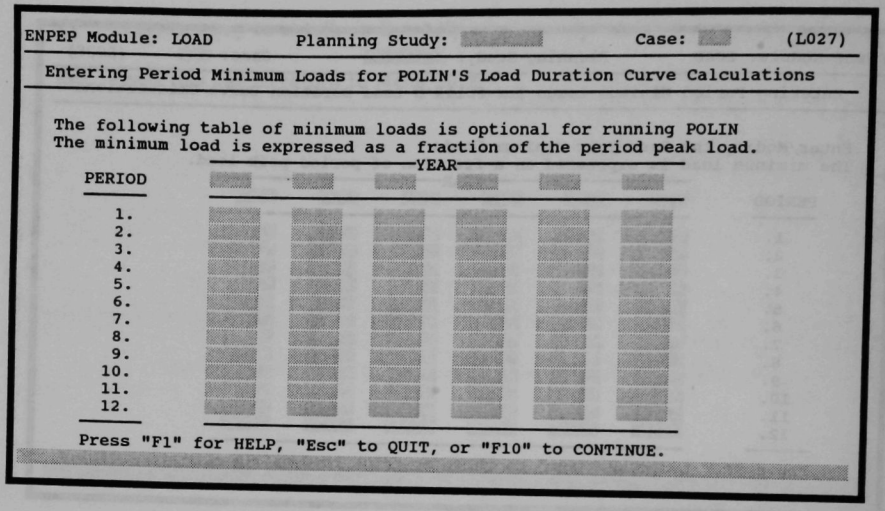
Purpose

Use Form L028 to enter, view, or change period minimum loads for the base year. These data will be used by the POLIN program. You advanced to this form by selection option 1 or 4 on Menu L019. If there are no period minimum loads in the Data Dictionary, the data fields will be blank. If the Data Dictionary contains period minimum loads when you advance to this form, the data fields contain the appropriate values for each period in each year. Although this form displays all periods for the first six years, you can change only the period minimum loads for the base year.

Options

- Enter, view, or change the minimum loads for any periods in the base year. Then press **F10** to save the displayed values and return to Menu L018.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu L019.

6.3.30 Form L027 — Entering Period Minimum Loads



Purpose

Use Form L027 to enter, view, or change period minimum loads; this is an optional step that you may specify when calculating period LDCs with the POLIN method. You advanced to this form by selecting option 2 on Menu L018. If there are no period minimum loads in the Data Dictionary, the data fields will be blank. If the Data Dictionary contains period minimum loads, the data fields will contain the appropriate values. This form displays all periods for six years at a time. Once you have completed the first six years, you can advance six years at a time until you complete all years.

Options

- Enter, view, or change the period minimum loads for each period of the displayed years and press **F10** to save the displayed values and advance to the next six years.
- After you enter the minimum loads for the last period of the last year, press **F10** to return to Menu L018.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu L018. Escape will not delete any period minimum loads already saved with previous **F10** keystrokes.

6.3.31 Menu L024 — Completing the POLIN Method

```
ENPEP Module: LOAD        Planning Study:          Case:        (L024)
                        POLIN Method: Run POLIN

        Function Description                    Status    Last Update
1.  Enter/Modify POLIN run options
2.  Run POLIN and view output
3.  Store LDC's for use by Electric Module

Function Selection:    (1-3)
To complete the running of POLIN, the above steps must be completed in order.

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This menu allows you to complete the final steps needed to calculate period LDCs using the POLIN method. You advanced to Menu L024 by selecting option 3 on Menu L018. You must complete the options sequentially.

Options

1 Select this option to enter the order of the polynomial used in POLIN and to select a print option. You will advance to Form L025.

2 Select this option to execute the POLIN FORTRAN program. You will then return to Menu L024 to select option 3.

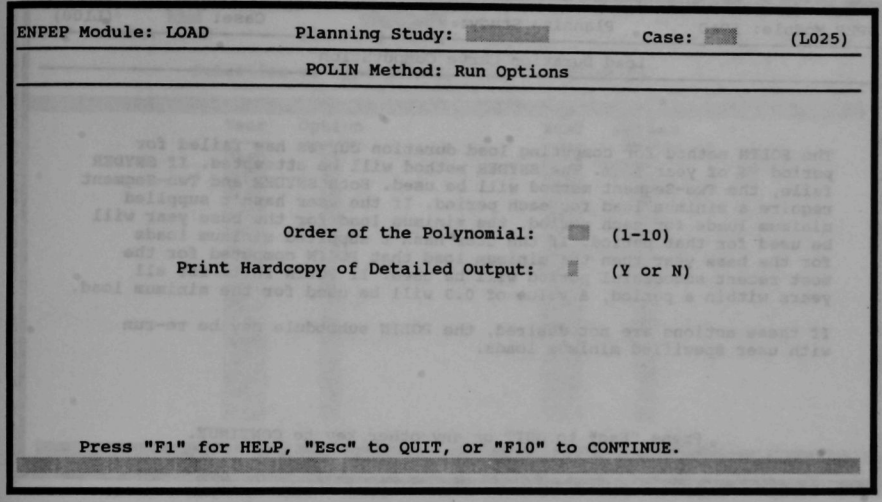
3 Select this option to store the computed period LDCs in the Data Dictionary. If the POLIN program is unable to compute a period LDC using the given data, you will advance to Form L100 to decide whether you want to use alternate methods. If POLIN computes the period LDCs successfully, the ENPEP Paging Routine will display a summary of the results. After you finish viewing these results, press Esc to advance to Form L030.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu L018.

6.3.32 Form L025 — Choosing POLIN Run Options



Purpose

Use this form to enter the order of the polynomial and to specify whether you want a printed copy of the output from the POLIN program. If you will use the results from LOAD for input to the ELECTRIC Module, it is recommended that you specify a fifth-order polynomial. You advanced to Form L025 by selecting option 1 on Menu L024.

Options

- Enter an integer (1-10) to specify the desired order of the polynomial.
- Enter **Y** if you want printed output and **N** if you do not.
- After you enter data in both data fields, press **F10** to return to Menu L024 to execute the POLIN program.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu L024.

6.3.33 Form L100 — Restarting Period LDC Calculations

```
ENPEP Module: LOAD        Planning Study:          Case:      (L100)
                    Load Duration Curve Computation

The POLIN method for computing load duration curves has failed for
period   of year    . The SNYDER method will be attempted. If SNYDER
fails, the Two-Segment method will be used. Both SNYDER and Two-Segment
require a minimum load for each period. If the user hasn't supplied
minimum loads for each period, the minimum load for the base year will
be used for that period. If the user hasn't supplied minimum loads
for the base year then the minimum load that POLIN computed for the
most recent successful period will be used. If POLIN fails for all
years within a period, a value of 0.3 will be used for the minimum load.

If these actions are not desired, the POLIN submodule may be re-run
with user specified minimum loads.

          Press "Esc" to QUIT or any other key to CONTINUE.
```

Purpose

Form L100 allows you to decide whether you want to use the backup methods for calculating period LDCs if the POLIN method fails for the displayed period and study year. If you decide to use the backup methods, then the Snyder method will be automatically used with existing period minimum loads. If there are no existing period minimum loads, then base-year period minimum loads will be used. If there are no base-year period minimum loads, then a value of 0.3 will be used for all period minimum loads. If the Snyder method fails, then the two-segment method will automatically be used to compute period LDCs. The two-segment method cannot fail. You started executing the POLIN program by selecting option 3 on Menu L024.

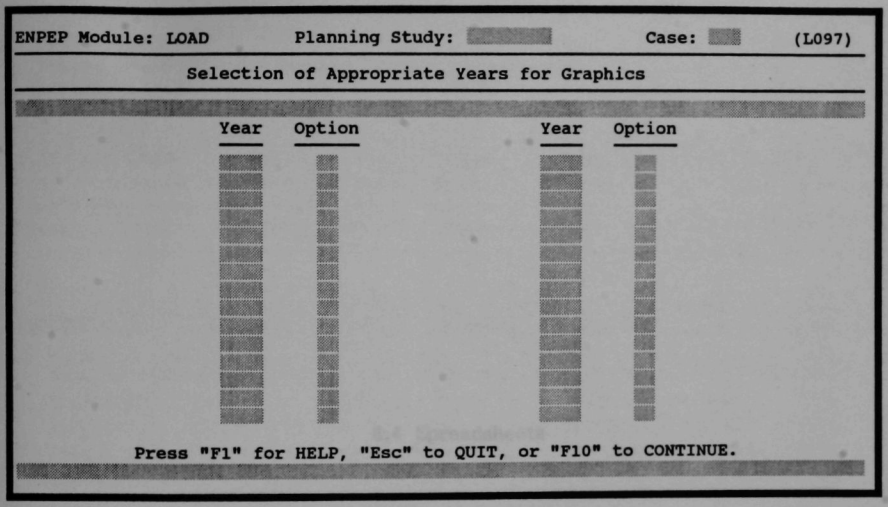
Options

- Press any key (except F1 or Esc) to use the backup methods as described above. As the period LDCs are calculated, a summary of the results will be displayed. After you finish viewing these results, press Esc to advance to Form L030.

- If you do not want to use the backup methods, press Esc to return to Menu L024.

- Press F1 to obtain on-line help.

6.3.34 Form L097 — Selecting Years to Graph

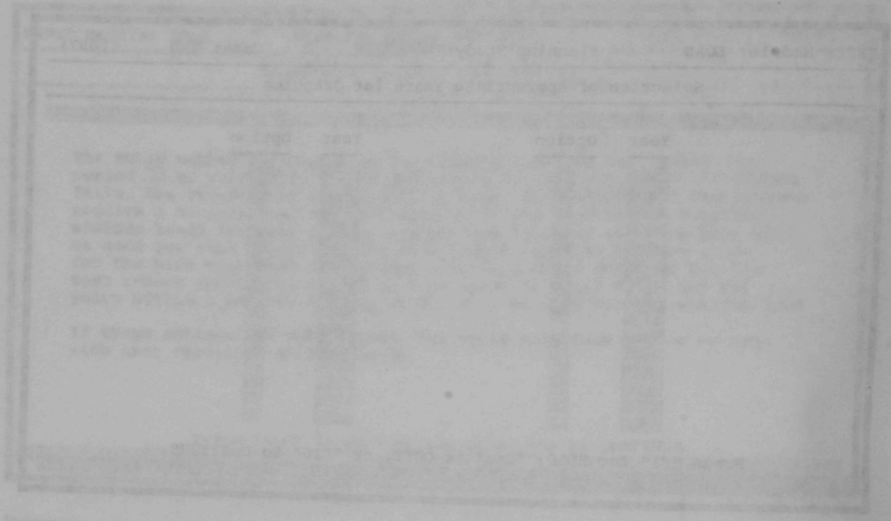


Purpose

Form L097 allows you to select the years for which you want to graph the annual LDCs. It is recommended that you do not graph more than five years at a time. You advanced to this form after completing option 7 on Menu L003 and deciding to graph the results on Form L030.

Options

- Enter **Y** in the field(s) to the right of the year(s) for which you want to graph the annual LDCs.
- Press **F10** to advance to GrafTalk.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form L030.



6.4 Spreadsheets

This section describes and provides examples of the Framework II spreadsheets used in the LOAD Module. These spreadsheets are designed so you can easily enter, view, or change the data needed to calculate period LDCs. It is recommended that you review the Framework II documentation before using these spreadsheets.

6.4.1 LSAGR — Electric Consumption Annual Growth Rates

```
:-------------------------------------------------------------------------:
:   Name: LSAGR                                                           :
:  Title: Electric consumption annual growth rates                        :
: Source: User input                                                      :
:  Units: Fraction per year                                               :
:                                                                         :
:         1992     1993     1994     1995     1996   ---> likewise for all :
:        Growth   Growth   Growth   Growth   Growth         study years    :
:-------------------------------------------------------                  :
: Rate    .0100    .0100    .0300    .0400   -.0100                        :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet allows you to enter annual growth rates for electric consumption (which is often considered as equivalent to sales). This spreadsheet can provide the data used by Spreadsheet LSABA to compute annual consumption for all years given a base-year value. You advanced to this spreadsheet by selecting option 1 or 2 on Menu L007. If you selected option 1, this spreadsheet will be empty.

Options

- Enter the annual growth rates for all years in the study.
- View or change the annual growth rates for any or all years in the study.
- Press the gray **-** key, **+**, and **F9** to advance to Spreadsheet LSABA to enter a base-year value and compute the values for all years.
- Press **Ctrl-D Q** to escape to Form L030.

Background

You can use this spreadsheet, which leads to computation of electric generation (consumption plus losses), if you have access to consumption data or if you are interested in studying changes in the percentage losses. The growth rates that you provide in LSAGR should reflect changes in consumption only; changes in transmission loss growth rates are specified in Spreadsheet LLOGR.

6.4.2 LSABA — Annual Electric Consumption

```
:-------------------------------------------------------------------------:
:   Name: LSABA                                                           :
:  Title: Annual consumption absolute values                              :
: Source: User input or LSAGR and LSABA                                   :
:  Units: kWh                                                             :
:                                                                         :
:               1991     1992     1993     1994     ---> likewise for all :
:                kWh      kWh      kWh      kWh           study years     :
: ---------------------------------------------                           :
: Consumption  4.00E+3  4.04E+3  4.08E+3  4.20E+3                          :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet allows you to enter or calculate annual electric consumption. If you advanced from Spreadsheet LSAGR, enter a base-year annual consumption value to compute the values for subsequent years. If you advanced by selecting option 3 on Menu L007, this spreadsheet will be empty and you can directly enter the annual consumption values for each year in the study. If you advanced by selecting option 4 on Menu L007, you can change the values on this spreadsheet.

Options

- Enter the base-year annual consumption value in the first data column (1991 above) and press Alt-C to compute the values for all subsequent years and the average, maximum, and minimum values (which will be displayed in the last data columns). The calculations will be based on the growth rates from Spreadsheet LSAGR.

- Enter the annual consumption values for each year of the study and press Alt-C to compute the average, maximum, and minimum values.

- Change any or all of the annual consumption, values and press Alt-C to compute the average, maximum, and minimum values.

- Press Ctrl-D Q to advance to Form L030. If you press Ctrl-D Q before you press Alt-C, any changes will not be saved.

Background

This spreadsheet allows you to calculate and view annual electric consumption (kWh) for all years in the study. You can use LSABA in conjunction with Spreadsheets LLOGR and LLOBA to determine annual generation (Spreadsheet LANGE).

6.4.3 LLOGR — Transmission and Distribution Loss Annual Growth Rates

```
:-------------------------------------------------------------------------:
:   Name: LLOGR                                                           :
:  Title: Transmission and distribution losses annual growth rates        :
: Source: User input                                                      :
:  Units: Fraction per year                                               :
:                                                                         :
:          1992     1993     1994     1995     1996   ---> likewise for all :
:         Growth   Growth   Growth   Growth   Growth          study years  :
: ----------------------------------------------------                    :
: Rate     .0000    .0000    .0000    .0000    .0000                       :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet allows you to enter, view, or change the annual growth rates for T&D losses. This spreadsheet provides the data used by Spreadsheet LLOBA to compute annual T&D losses for all years from a base-year value. If you advanced to LLOGR by selecting option 1 on Menu L008, this spreadsheet will be empty. If you advanced by selecting option 2 on Menu L008, you can view or change the data.

Options

- Enter the annual growth rates for all years in the study.
- View or change the annual growth rates for any or all years in the study.
- Press the gray **-** key, **+**, and **F9** to advance to Spreadsheet LLOBA to enter a base-year value and compute the values for all years.
- Press **Ctrl-D Q** to escape to Form L030.

Background

LOAD allows you to specify the T&D loss growth rates in this spreadsheet so you can easily study the effects of reducing such losses. Note that if the T&D losses in the base year are 20% and the growth rate in this spreadsheet for the next year is 20%, the T&D losses for the next year (determined in Spreadsheet LLOBA) will be 22%.

6.4.4 LLOBA — Annual Transmission and Distribution Losses

```
:-------------------------------------------------------------------------:
:  Name: LLOBA                                                            :
:  Title: Annual transmission and distribution loss absolute values       :
: Source: User input or LLOGR and LLOBA                                    :
:  Units: Annual transmission and distribution loss fractions             :
:                                                                         :
:          1992     1993     1994     1995     1996  ---> likewise for all :
:         Fract.   Fract.   Fract.   Fract.   Fract.         study years   :
: ---------------------------------------------------                     :
: Losses   .0000    .0000    .0000    .0000    .0000                       :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet allows you to enter, view, or change annual T&D losses. If you advanced from Spreadsheet LLOGR, enter a base-year annual T&D loss fraction to compute the values of subsequent years. If you advanced by selecting option 3 on Menu L008, LLOBA will be empty, and you can directly enter the fractions for each year in the study. If you advanced by selecting option 4 on Menu L008, you can view or change the displayed values.

Options

- Enter the base-year annual T&D loss fraction in the first data column and press Alt-C to compute the values for all subsequent years and the average, maximum, and minimum values. The calculations will be based on the growth rates from Spreadsheet LLOGR.
- Enter the annual T&D loss fractions for each year of the study and press Alt-C to compute the average, maximum, and minimum values.
- Change any or all of the fractions and press Alt-C to compute average, maximum, and minimum values.
- Press Ctrl-D Q to return to Form L030. If you press Ctrl-D Q before pressing Alt-C, any changes will not be saved.

Background

This spreadsheet displays the T&D losses (%) over time. You should use LLOBA for studies where T&D losses are an important factor.

6.4.5 LANGE — Annual Electric Generation

```
:-------------------------------------------------------------------------:
:   Name: LANGE                                                           :
:  Title: Annual generation absolute values                               :
: Source: User input, LSABA and LLOBA, or Balance Module                  :
:  Units: kWh                                                             :
:                                                                         :
:                      1991      1992      1993      1994     ---> likewise :
:                       kWh       kWh       kWh       kWh         for all  :
: ----------------------------------------------------------      study years :
: Annual Generation  2.38E+10 2.63E+10 2.90E+10 3.18E+10                   :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet allows you to enter, view, or change annual generation values. If you advanced by selecting option 2 on Menu L005, LANGE will be empty and you can enter annual generation values for each year in the study. If you advanced by selecting option 3 on Menu L006, the annual generation will be automatically computed using data from Spreadsheets LSABA and LLOBA. If you advanced by selecting a BALANCE case on Form L009, LANGE will display the data from that case. If you advanced by selecting option 4 on Menu L005, you can view or change the previously computed values.

Options

- Enter the annual generation for each year of the study.
- View or change the annual generation for any year of the study.
- Press Alt-C to compute the average, maximum, and minimum values. The values will be computed using the formula shown below.
- Press Ctrl-D Q to advance to Form L030. If you press Ctrl-D Q before pressing Alt-C, any changes will not be saved.

Background

If the annual generation is computed using annual consumption and annual T&D losses (from Spreadsheets LSABA and LLOBA), the following formula is used:

$$\text{annual generation} = \frac{\text{annual consumption}}{1 - \text{annual T\&D losses}}$$

The annual generation (kWh), annual consumption (kWh), and annual T&D losses (fraction) are for the same year. This calculation is performed for each year of the study.

6.4.6 LLFGR — Load Factor Annual Growth Rates

```
:-------------------------------------------------------------------------:
:   Name: LLFGR                                                           :
:  Title: Load factor annual growth rates                                 :
: Source: User input                                                      :
:  Units: Fraction per year                                               :
:                                                                         :
:          1992     1993     1994     1995       ---> likewise           :
:        Growth   Growth   Growth   Growth          for all              :
: ---------------------------------------          study years           :
: Rate   -.0056   -.0059   -.0060   -.0060                                 :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet allows you to enter, view, or change annual growth rates for electric load factors. This spreadsheet can provide the data used by Spreadsheet LLFBA to compute annual load factors for all years from a base-year value. If you advanced by selecting option 1 on Menu L010, LLFGR will be empty, and you can directly enter the fractional percentages. If you advanced by selecting option 2 on Menu L010, you can view or change the displayed values.

Options

- Enter the annual growth rates for all years in the study.
- View or change the annual growth rates for any or all years in the study.
- Press the gray **-** key, **+**, and **F9** to advance to Spreadsheet LLFBA to enter a base-year value and compute the values for all years.
- Press **Ctrl-D Q** to escape to Form L030.

Background

The capability to change load factors over time is necessary in planning studies. You can specify the changes in this spreadsheet or enter the load factors directly in Spreadsheet LLFBA.

6.4.7 LLFBA — Annual Electric Load Factors

```
:-------------------------------------------------------------------------:
:   Name: LLFBA                                                           :
:  Title: Annual load factor absolute values                              :
: Source: User input, LLFGR and LLFBA, or Balance Module                  :
:  Units: Load Factor Fractions                                           :
:                                                                         :
:                      1991     1992     1993     1994      ---> likewise :
:                     Fract.   Fract.   Fract.   Fract.         for all   :
: ---------------------------------------------------          study years :
: Annual Load Factor  .6798    .6760    .6720    .6680                     :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet allows you to enter or change annual load factors. If you advanced from spreadsheet LLFGR, enter a base-year annual load factor to compute the values of subsequent years. If you advanced by selecting option 3 on Menu L010, LLFBA will be empty and you can enter the annual load factors for each year in the study. If you advanced by selecting a BALANCE case on Form L009, LLFBA will display the data from that case. If you advanced by selecting option 4 on Menu L010, you can view or change the previously computed values.

Options

- Enter the base-year annual load factor fraction and press **Alt-C** to compute the values for all subsequent years, which will be based on the growth rates in LLFGR, and the average, maximum, and minimum values.

- Enter, view, or change the annual load factor fractions for any year of the study and press **Alt-C** to compute the average, maximum, and minimum values.

- Press **Ctrl-D Q** to advance to Form L030. If you press **Ctrl-D Q** before pressing **Alt-C**, any changes will not be saved.

Background

You should carefully examine the data in this spreadsheet because period load factors are necessary for all subsequent analyses with the LOAD and ELECTRIC Modules.

6.4.8 LANPE — Annual Peak Loads

```
:-------------------------------------------------------------------------:
:   Name: LANPE                                                           :
:  Title: Annual peak load absolute values                                :
: Source: LANGE and LLFBA                                                 :
:  Units: MW                                                              :
:                                                                         :
:                      1991      1992      1993      1994     --->  likewise :
:                       MW        MW        MW        MW             for all :
: ---------------------------------------------------------            study years :
: Annual Peak Load  4.00E+3   4.44E+3   4.92E+3   5.44E+2                 :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet LANPE displays the annual peak load for each year in the study. These values were computed using data from Spreadsheets LANGE and LLFBA and the equation shown below. You advanced to LANPE by selecting option 4 on Menu L003.

Options

- View the values for each year of the study.
- Press Ctrl-D Q to advance to Form L030.

Background

The values in LANPE are calculated from the values in Spreadsheets LANGE and LLFBA using the following formula:

$$\text{annual peak load} = \frac{\text{annual generation}}{\text{annual load factor} \times 8.76 \times 10^6}$$

The annual peak load (MW), annual generation (kWh), and annual load factor are for the same year. This calculation is performed for each year of the study.

6.4.9 LSEG1 — Base- and End-Year Period Generation Fractions

```
:-------------------------------------------------------------------------:
:   Name: LSEG1                                                           :
:  Title: Period generation fractions of annual generation                :
:         for base and end years of study                                 :
: Source: User input                                                      :
:  Units: Fraction of annual generation for each period                   :
:                                                                         :
:                  1991     2010                                         :
:    Period       Fract.   Fract.                                        :
: ------------------------------                                         :
: Period1          .2749    .2749                                       :
: Period2          .2339    .2339                                       :
: Period3          .2573    .2573                                       :
: Period4          .2339    .2339                                       :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet LSEG1 allows you to enter base- and end-year period generation fractions (fraction of annual generation in each period) that can be used by Spreadsheet LSEG2 to compute period generation fractions for all years by using a linear interpolation. You advanced to LSEG1 by selecting option 1 on Menu L013.

Options

- Enter period generation fractions for each period in the base and end years. The fractions for each year must sum to exactly 1.0.
- When finished, press Alt-C to validate the fractions and advance to Spreadsheet LSEG2 to compute the period generation fractions for all years in the study.
- Press Ctrl-D Q to escape to Form L030.

Background

This spreadsheet provides a convenient way to analyze an increasing importance of generation at a particular time of year. The linear interpolation allows you to determine the values for all years by entering data for only the first and last years. If you do not want to use linear interpolation or have more-specific data, you can enter the period generation factors for all years on Spreadsheet LSEG2.

6.4.10 LSEG2 — Period Generation Fractions

Name: LSEG2
Title: Period generation fraction of annual generation for each year of the study
Source: User input or LSEG1
Units: Fraction of annual generation for each period

Period	1991 Fract.	1992 Fract.	1993 Fract.	1994 Fract.	1995 Fract.	---> likewise for all study years
Period1	.2749	.2749	.2749	.2749	.2749	
Period2	.2339	.2339	.2339	.2339	.2339	
Period3	.2573	.2573	.2573	.2573	.2573	
Period4	.2339	.2339	.2339	.2339	.2339	

Purpose

This spreadsheet allows you to enter, view, or change period generation fractions. If you advanced to this spreadsheet by selecting option 2 on Menu L013, LSEG2 will be empty and you can directly enter period generation fractions for each period of each year in the study. If you advanced to LSEG2 by selecting option 3 on Menu L013, you can view or change the displayed values. If you advanced from Spreadsheet LSEG1, the values will have already been computed using a linear interpolation; LSEG2 will be displayed only briefly and you will automatically advance to Spreadsheet LSEGE.

Options

- Enter or change the period generation fractions for each period of each year in the study. The fractions for each year must sum to exactly 1.0.
- Press Alt-C to validate the fractions and advance to Spreadsheet LSEGE.
- Press Ctrl-D Q to escape to Form L030.

Background

This spreadsheet allows you to specify changes in period generation over time, such as for seasonal demand or growth of heavy industry.

6.4.11 LSEGE — Period Generation

```
:-------------------------------------------------------------------------:
:   Name: LSEGE                                                           :
:  Title: Period generation absolute values                               :
: Source: LANGE and LSEG2                                                 :
:  Units: kWh                                                             :
:                                                                         :
:              1991      1992      1993      1994      1995  ---> likewise :
:  Period       kWh       kWh       kWh       kWh       kWh       for all :
: ----------------------------------------------------------   study years :
: Period1   6.55E+9   7.23E+9   7.96E+9   8.74E+9   9.57E+9               :
: Period2   5.57E+9   6.15E+9   6.77E+9   7.44E+9   8.14E+9               :
: Period3   6.12E+9   6.76E+9   7.45E+9   8.17E+9   8.95E+9               :
: Period4   5.57E+9   6.15E+9   6.77E+9   7.44E+9   8.14E+9               :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet LSEGE displays the period generation for each year in the study. These values were calculated from the values in Spreadsheets LANGE and LSEG2 with the equation below. You advanced to LSEGE from Spreadsheet LSEG1 or LSEG2.

Options

- View the period generation absolute values.
- Press Ctrl-D Q to advance to Form L030.

Background

The values in LSEGE are calculated from the values in Spreadsheets LANGE and LSEG2 by the equation:

$$\text{period generation} = \begin{matrix}\text{annual} \\ \text{generation}\end{matrix} \times \begin{matrix}\text{period generation} \\ \text{fraction}\end{matrix}$$

The annual generation (kWh), period generation fraction, and period generation (kWh) are for the same year; the period generation and period generation fraction are for the same period. This calculation is performed for each period of each study year.

6.4.12 LSEP1 — Base- and End-Year Period Peak-Load Fractions

```
:-------------------------------------------------------------------------:
:   Name: LSEP1                                                           :
:  Title: Period Peak-Load fractions for base and end years of study      :
: Source: User input                                                      :
:  Units: Period Peak-Load fractions                                      :
:                                                                         :
:                  1991     2010                                         :
: Period          Fract.   Fract.                                         :
: -------------------------------                                         :
: Period1         .9500    .9500                                        :
: Period2         .8500    .8500                                        :
: Period3        1.0000   1.0000                                        :
: Period4         .8500    .8500                                        :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet LSEP1 allows you to enter base- and end-year period peak-load fractions. Note that the values in LSEP1 are ratios (of period peak load to annual peak load), as opposed to the period generation fractions (of annual generation) in Spreadsheets LSEG1 and LSEG2. These fractions can be used in Spreadsheet LSEP2 to compute period peak-load fractions for all years using a linear interpolation. You advanced to LSEP1 by selecting option 1 on Menu L014.

Options

- Enter period peak-load fractions for the base and end years. At least one of the fractions for each year must be equal to 1.0.
- Press Alt-C to validate the fractions and advance to Spreadsheet LSEP2 to compute the period peak-load fractions for all years of the study.
- Press Ctrl-D Q to escape to Form L030.

Background

As in the case of period generation fractions (Spreadsheet LSEG1), this spreadsheet allows you to prepare a study for which you know the period peak-load fractions for the base year and expect a trend during the years for which you have no data. When you do have detailed data, you can enter the values for every year on Spreadsheet LSEP2. At least one period must have a value of 1.0 and that the corresponding period in the end year must also have a value of 1.0. If the annual peak load shifts from one period to another during the study period, do not use this spreadsheet; use LSEP2 instead.

6.4.13 LSEP2 — Period Peak-Load Fractions

Name: LSEP2
Title: Period peak-load fraction absolute values
Source: User input or LSEP1
Units: Period peak-load fraction

Period	1991 Fract.	1992 Fract.	1993 Fract.	1994 Fract.	1995 Fract.	---> likewise for all study years
Period1	.9500	.9500	.9500	.9500	.9500	
Period2	.8230	.8230	.8230	.8230	.8230	
Period3	1	1	1	1	1	
Period4	.8230	.8230	.8230	.8230	.8230	

Purpose

Spreadsheet LSEP2 allows you to enter, view, or change period peak loads expressed as fractions of annual peak loads. If you advanced to LSEP2 by selecting option 2 on Menu L014, it will be empty and you can directly enter period peak-load fractions for each period and study year. If you advanced to LSEP2 by selecting option 3 on Menu L014, you can change the displayed values. If you advanced from Spreadsheet LSEP1, LSEP2 will be displayed only briefly and you will automatically advance to Spreadsheet LSEPE.

Options

- Enter, view, or change the period peak-load fractions for each period of each study year. At least one of the fractions for each year must be equal to 1.0.
- Press **Alt-C** to validate the fractions and advance to Spreadsheet LSEPE.
- Press **Ctrl-D Q** to escape to Form L030.

Background

This spreadsheet allows you to change period peak-load fractions over time to reflect changes in the electric system demand. For example, a shift of these fractions toward 1.0 over time would imply an increasing load factor, perhaps as a result of increasing demand from heavy industry or a tariff system that encourages off-peak use. Such effects are easier to observe in terms of fractions than in period peak-load absolute values (Spreadsheet LSEPE).

6.4.14 LSEPE — Period Peak Loads

```
:-------------------------------------------------------------------------:
:   Name: LSEPE                                                           :
:  Title: Period peak load absolute values                                :
: Source: LSEP2 and LANPE                                                 :
:  Units: MW                                                              :
:                                                                         :
:                 1991      1992      1993      1994  ---> likewise for all :
:   Period         MW        MW        MW        MW          study years  :
: ----------------------------------------------                          :
: Period1       3.80E+3   4.22E+3   4.67E+3   5.16E+3                     :
: Period2       3.29E+3   3.66E+3   4.05E+3   4.47E+3                     :
: Period3       4.00E+3   4.44E+3   4.92E+3   5.43E+3                     :
: Period4       3.29E+3   3.66E+3   4.05E+3   4.47E+3                     :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet displays the period peak loads for each year in the study. These values were calculated from the values in Spreadsheets LSEP2 and LANPE with the equation below. You advanced to LSEPE from Spreadsheet LSEP1 or LSEP2.

Options

- View the period peak loads.
- Press Ctrl-D Q to advance to Form L030.

Background

The values in LSEPE are calculated from the values in Spreadsheets LANPE and LSEP2 by the equation:

$$\text{period peak load} = \begin{matrix}\text{annual}\\ \text{peak load}\end{matrix} \times \begin{matrix}\text{period peak-load}\\ \text{fraction}\end{matrix}$$

The annual peak load (MW), period peak-load fraction, and period peak load (MW) are for the same year; the period peak load and period peak-load fraction are for the same period. This calculation is performed for each period of each year in the study.

6.4.15 LSELF — Period Load Factors

```
:-------------------------------------------------------------------------:
:   Name: LSELF                                                           :
:  Title: Period load factors absolute values                             :
: Source: LSEGE and LSEPE                                                 :
:  Units: Period load factor fraction                                     :
:                                                                         :
:            1991     1992     1993     1994     1995  ---> likewise     :
:           Fract.   Fract.   Fract.   Fract.   Fract.      for all      :
: ------------------------------------------------------    study years  :
: Period1    .7869    .7825    .7778    .7732    .7686                    :
: Period2    .7728    .7685    .7639    .7594    .7548                    :
: Period3    .6991    .6952    .6911    .6870    .6829                    :
: Period4    .7728    .7685    .7639    .7594    .7548                    :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet LSELF displays the period load factors for each year in the study. The values are calculated from the data in Spreadsheets LSEGE and LSEPE with the equation below. You advanced to LSELF by selecting option 3 on Menu L012.

Options

- View the period load factors.
- Press Ctrl-D Q to advance to Form L030.

Background

The values in LSELF are calculated from the values in Spreadsheets LSEGE and LSEPE by the equation:

$$\text{period load factor} = \frac{\text{period generation} \times \text{periods per year}}{\text{period peak load} \times 8.76 \times 10^{6}}$$

The period load factor, period generation, and period peak load are for the same period of the same year. This calculation is performed for each period of all years in the study.

6.4.16 LSEML — Period Minimum Loads

```
:-------------------------------------------------------------------------:
:   Name: LSEML                                                           :
:  Title: Period minimum load absolute values                             :
: Source: User input                                                      :
:  Units: Period minimum load fractions                                   :
:                                                                         :
:             1990     1991     1992     1993     1994 ---> likewise     :
: Period     Fract.   Fract.   Fract.   Fract.   Fract.      for all      :
: ---------------------------------------------------      study years    :
: Period1    .3000    .3000    .3000    .3000    .3000                     :
: Period2    .4000    .4000    .4000    .4000    .4000                     :
: Period3    .2000    .2000    .2000    .2000    .2000                     :
: Period4    .3000    .3000    .3000    .3000    .3000                     :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet LSEML allows you to enter, view, or change period minimum loads for all periods of all years of the study. You need to provide these values if you are using the Snyder method to determine period LDCs. You advanced to LSEML by selecting option 1 or 2 on Menu L017. If you selected option 1, this spreadsheet will be empty.

Options

- Enter the period minimum loads for each period of each study year.
- View or change the displayed period minimum loads.
- Press Alt-C to compute the average, maximum, and minimum values.
- Press Ctrl-D Q to advance to form L030. If you press Ctrl-D Q before pressing Alt-C, any changes will not be saved.

Background

You need to specify these minimum loads if you are using the Snyder method to calculate period LDCs. See the appendix in Sec. 6.5 for more information about these calculations.

6.5 Appendix: LOAD Module Equations

This appendix outlines the critical mathematical relationships in LOAD calculations so that you can be aware of the constraints on the data set. There are a limited number of degrees of freedom, and the LOAD Module cannot proceed if certain values are out of bounds (for example, if a period load factor is greater than 1.0).

6.5.1 Variable Definitions

AG_i = annual generation in year i (kWh)

AP_i = annual peak load in year i (MW)

AL_i = annual load factor in year i (fraction)

AS_i = annual electric consumption in year i (kWh)

AT_i = annual transmission and distribution losses in year i (fraction)

NS = number of periods in a year

P_{ti} = period peak load for period t year i (MW)

L_{ti} = period load factor for period t year i (fraction)

G_{ti} = period generation for period t year i (kWh)

f_{ti} = ratio of period peak in period t to annual peak in year i

g_{ti} = fraction of period generation in period t to annual generation in year i

t = period index

i = year index

6.5.2 Equations that Are True by Definition

- $\sum_{t=1}^{NS} g_{ti} = 1$ for every year i

- $f_{ti} \leq 1.0$ for every period t and year i
- $f_{ti} = 1.0$ exactly for <u>at least</u> one period t in each year i
- $L_{ti} \leq 1.0$ for every period t and year i
- $AL_i \leq 1.0$ for every year i
- $P_{ti} = f_{ti} \times AP_i$
- $G_{ti} = g_{ti} \times AG_i$

6.5.3 Additional Load Equations

$$1a.\quad AL_i = \frac{AG_i}{AP_i \times 8.76 \times 10^6}$$

$$1b.\quad AL_i = \frac{1}{NS} \times \frac{1}{AP_i} \times \sum_{t=1}^{NS} P_{ti} \times L_{ti}$$

$$2.\quad L_{ti} = \frac{G_{ti} \times NS}{P_{ti} \times 8.76 \times 10^6}$$

$$3a.\quad AG_i = \frac{AS_i}{1 - AT_i}$$

$$3b.\quad AG_i = \sum_{t=1}^{NS} G_{ti}$$

6.5.4 Fifth-Degree Polynomial LDC Equations

In the following equations, y = load (fraction of peak) and x = time (fraction of total time in the period). A point (x,y) is interpreted as the fraction of time (x) that the load is greater than or equal to y (see Figs. 6.2 and 6.3). The equations for load factor are written as if the period under consideration is 1 year. The same equations hold for any normalized time period.

$$4a.\quad y = 1 + \sum_{k=1}^{5} a_k x^k$$

$$4b.\quad y = 1 + a_1x + a_2x^2 + a_3x^3 + a_4x^4 + a_5x^5$$

$$5.\quad \frac{dy}{dx} = 1 + a_1 + 2a_2x + 3a_3x^2 + 4a_4x^3 + 5a_5x^4$$

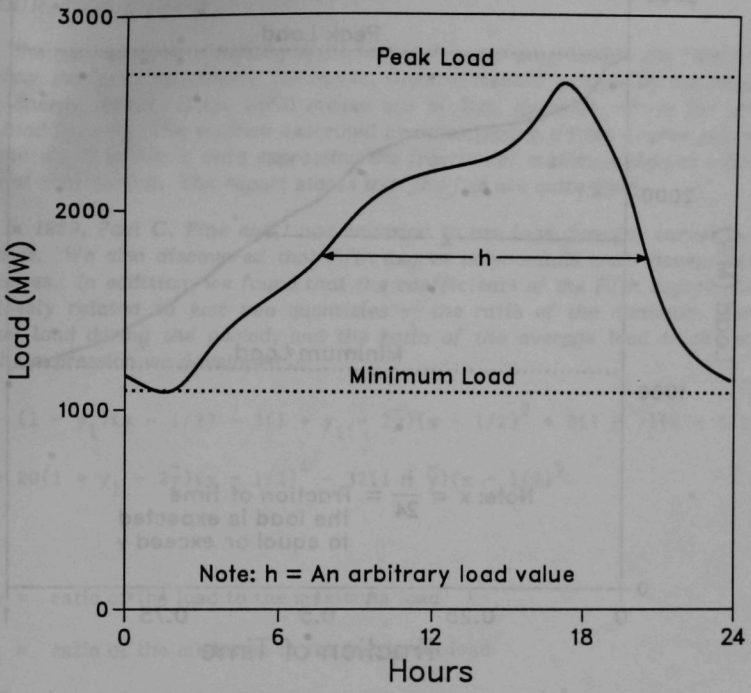


FIGURE 6.2 Daily Load Curve

6. $\frac{dy}{dx} \leq 1$ for all x between 0 and 1

7. $$\frac{\text{minimum load}}{\text{peak load}} = y\Big|_{x=1} = 1 + a_1 + a_2 + a_3 + a_4 + a_5$$

8a. $$AL = \int_0^1 y\,dx = x + \frac{a_1x^2}{2} + \frac{a_2x^3}{3} + \frac{a_3x^4}{4} + \frac{a_4x^5}{5} + \frac{a_5x^6}{6}\Big|_{x=1}$$

8b. $$AL = 1 + \frac{a_1}{2} + \frac{a_2}{3} + \frac{a_3}{4} + \frac{a_4}{5} + \frac{a_5}{6}$$

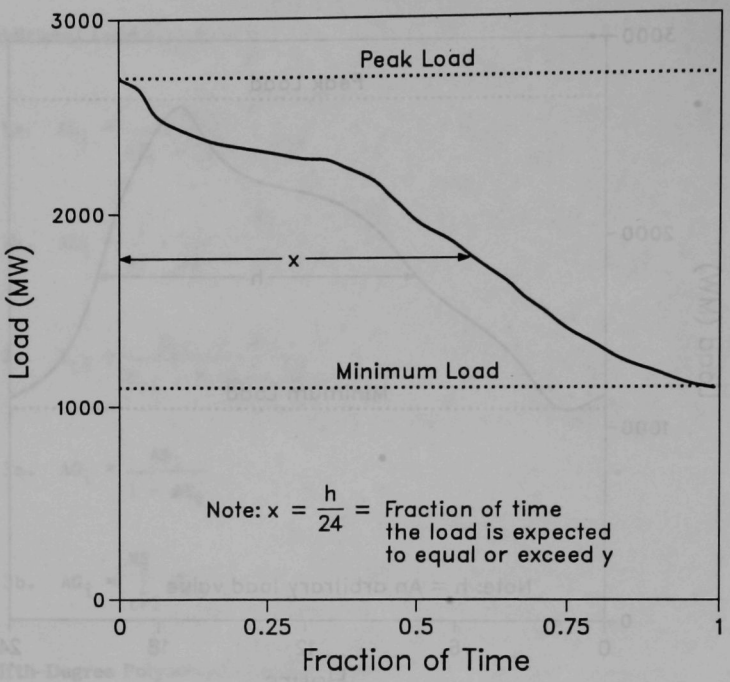


FIGURE 6.3 Load Duration Curve

6.5.5 Notes on the Snyder Method for Polynomial LDC Approximations

The letter presented in this section briefly discusses a procedure introduced by A.J. Snyder, who explains that a fifth degree polynomial equation can be generated to represent an LDC based on only two numeric values.

In the following letter, it is important to note that *average load* means the load when time = 0.5; it is the "50th percentile load." Note also that by integrating the equation provided in the letter to obtain the load factor for the LDC, it can be seen that $\bar{y}$ is also the load factor for the curve. Therefore, the Snyder method applies to a unique set of curves for which the load factor is equal to the 50th percentile load. If this method is used, it is suggested that the load factor be used for $\bar{y}$ rather than the 50th percentile load. This will preserve energy consumption.

LOAD DURATION CURVES

The method used in making electricity forecasts described in the "Market Survey for Nuclear Power in Developing Countries, General Report" printed by the International Atomic Energy Agency (Sep. 1973) makes use of load duration curves for arriving at system load factors. The method described involves fitting a fifth degree polynomial to approximately 40 points of data expressing the fraction of maximum load as a function of fraction of time period. The report states that the fits are quite good.

In 1969, Paul C. Fine and I had occasion to use load duration curves in some of our studies. We also discovered that fifth degree polynomials made acceptable fits to these curves. In addition, we found that the coefficients of the fifth degree polynomial were closely related to just two quantities — the ratio of the minimum load to the maximum load during the period, and the ratio of the average load to the maximum load. The expression we developed is

$$y = \bar{y} - (1 - y_1)(x - 1/2) - 3(1 + y_1 - 2\bar{y})(x - 1/2)^2 + 8(1 - \bar{y})(x - 1/2)^3$$

$$+ 20(1 + y_1 - 2\bar{y})(x - 1/2)^4 - 32(1 - \bar{y})(x - 1/2)^5$$

where:

y = ratio of the load to the maximum load

y_1 = ratio of the minimum to the maximum load

$\bar{y}$ = ratio of the average to the maximum load

x = fraction of the total hours in the period that the ratio of the load to the maximum load exceeds y.

This expression gives $y = 1$ when $x = 0$, $y = y_1$ when $x = 1$, and $y = \bar{y}$ when $x = 1/2$. The expression has proven to be useful since, in many instances, values for y_1 and $\bar{y}$ are available when no further information can be obtained. Furthermore, the equation can be obtained without the use of sophisticated computers. This equation was checked on actual annual data from large U.S. utility systems and overall foreign country systems. In nearly every case, the values calculated from the equation fell within ±6%.

Perhaps this information will be useful to some of your readers.

Artha Jean Snyder

U.S. Atomic Energy Commission
Energy Systems Analysis Branch
Office of Planning and Analysis
Washington, DC 20545

July 30, 1974

It is possible to derive the following equation based on the one in the letter above:

$$y = 1 + 6(3\bar{y} - y_1 - 2)\,x + (-82\bar{y} + 27y_1 + 55)x^2 + 4(38\bar{y} - 10y_1 - 28)x^3 + 20(-6\bar{y} - y_1 + 5)x^4 + 32(\bar{y} - 1)x^5$$

Therefore, the coefficients for the polynomial equation are:

$$a_0 = 1$$

$$a_1 = 6(3\bar{y} - y_1 - 2)$$

$$a_2 = -82\bar{y} + 27y_1 + 55$$

$$a_3 = 4(38\bar{y} - 10y_1 - 28)$$

$$a_4 = 20(-6\bar{y} + y_1 + 5)$$

$$a_5 = 32(\bar{y} - 1)$$

where:

$\bar{y}$ = load factor = 50th percentile load, and

y_1 = minimum load as a fraction of the peak load.

CHAPTER 7

ELECTRIC MODULE

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E026	7.3-22	E098	7.3.118
E028	7.3-32	E099	7.3-112
E029	7.3-34	E100	7.3-114
E030	7.3-30	E101	7.3-116
E031	7.3-31	E102	7.3-120
E032	7.3-36	E103	7.3-122
E033	7.3-29	E104	7.3-124
E034	7.3-37	E105	7.3-131
E035	7.3-38	E106	7.3-126
E036	7.3-40	E107	7.3-128
E037	7.3-41	E108	7.3-129
E038	7.3-42	E130	7.3-53
E039	7.3-44	E131	7.3-54
E040	7.3-45	E132	7.3-55
E049	7.3-59	E134	7.3-56
E050	7.3-60	E138	7.3-57
E051	7.3-61	E175	7.3-133
E052	7.3-74	E176	7.3-134
E053	7.3-76	E187	7.3-135
E054	7.3-67	E188	7.3-136
E055	7.3-69	E189	7.3-137
E056	7.3-71	E190	7.3-150
E057	7.3-73	E191	7.3-139
E058	7.3-65	E192	7.3-141
E059	7.3-62	E193	7.3-143
E061	7.3-64	E194	7.3-145
E070	7.3-80	E195	7.3-146
E071	7.3-82	E237	7.3-49
E072	7.3-89	E238	7.3-47
E074	7.3-83	E239	7.3-51
E075	7.3-78	E400	7.3-8
E076	7.3-79	E500	7.3-10

7.1 Introduction

This section introduces the ELECTRIC Module that you use to determine the most cost-effective strategy for expanding the generation system. The input for ELECTRIC can be obtained from the PLANTDATA, BALANCE, and LOAD Modules. The output from ELECTRIC can be used to execute the IMPACTS Module.

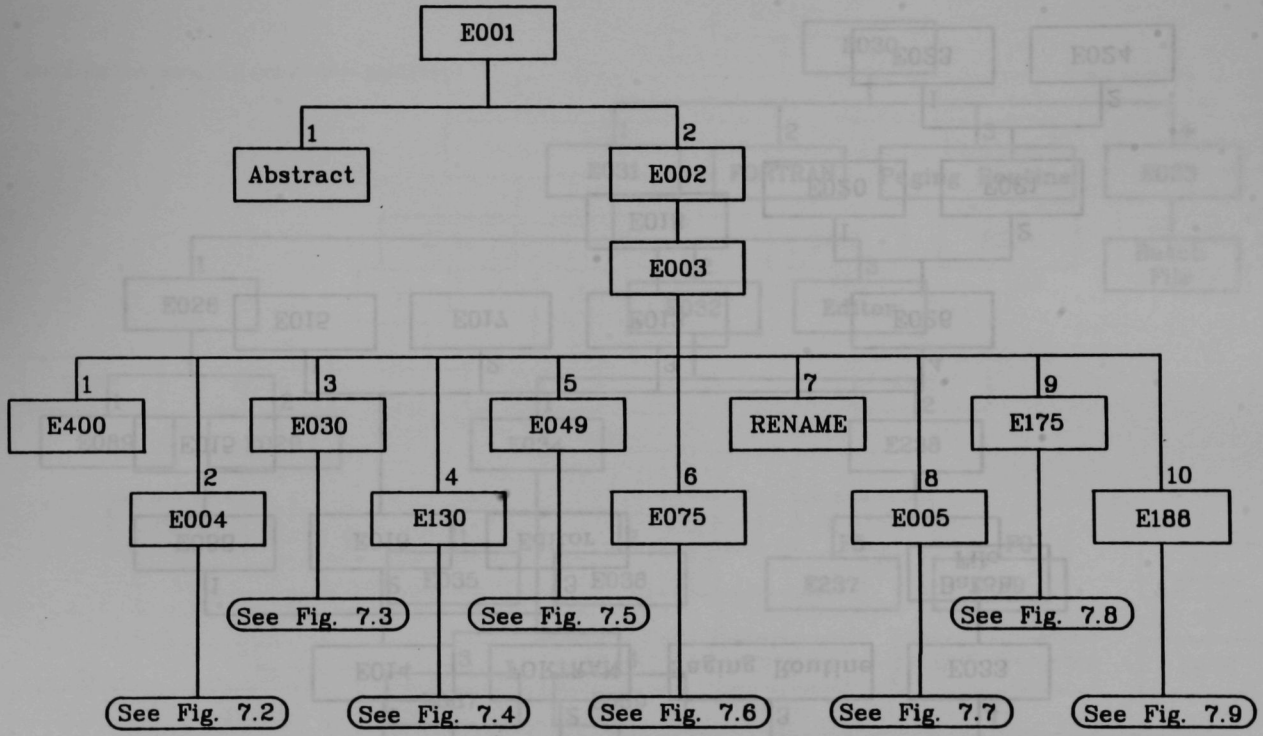


FIGURE 7.1 ELECTRIC Module Hierarchy

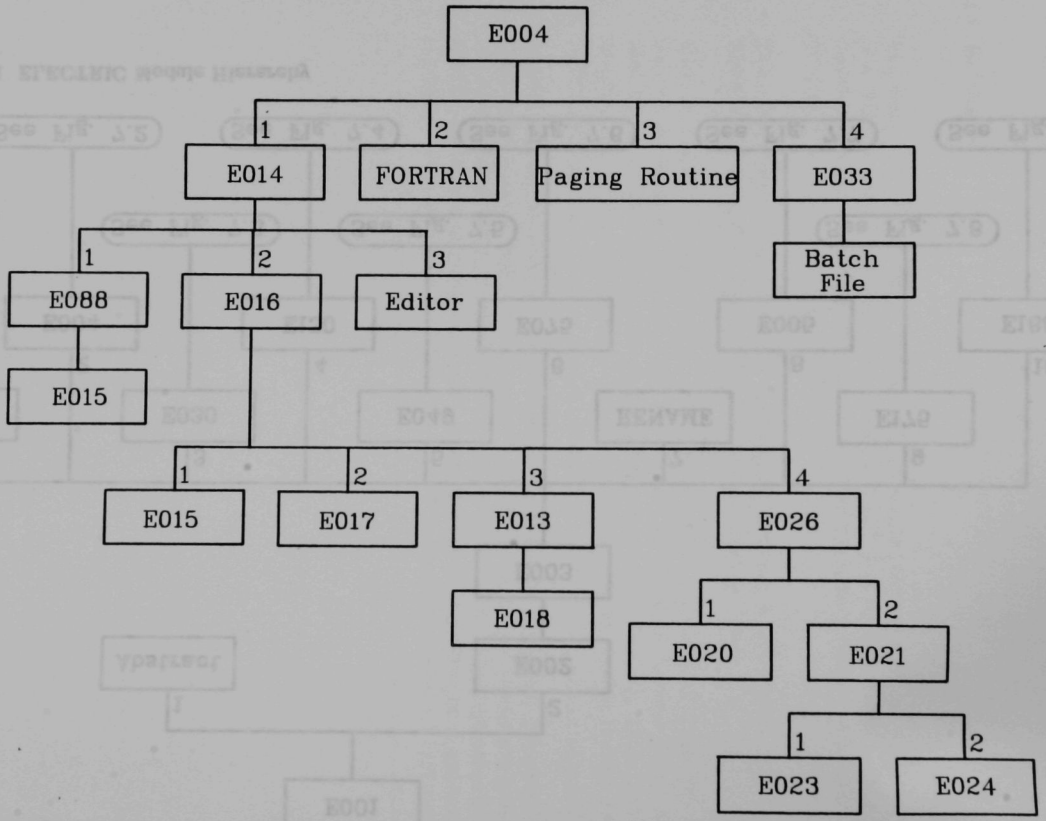


FIGURE 7.2 LOADSY Submodule Hierarchy

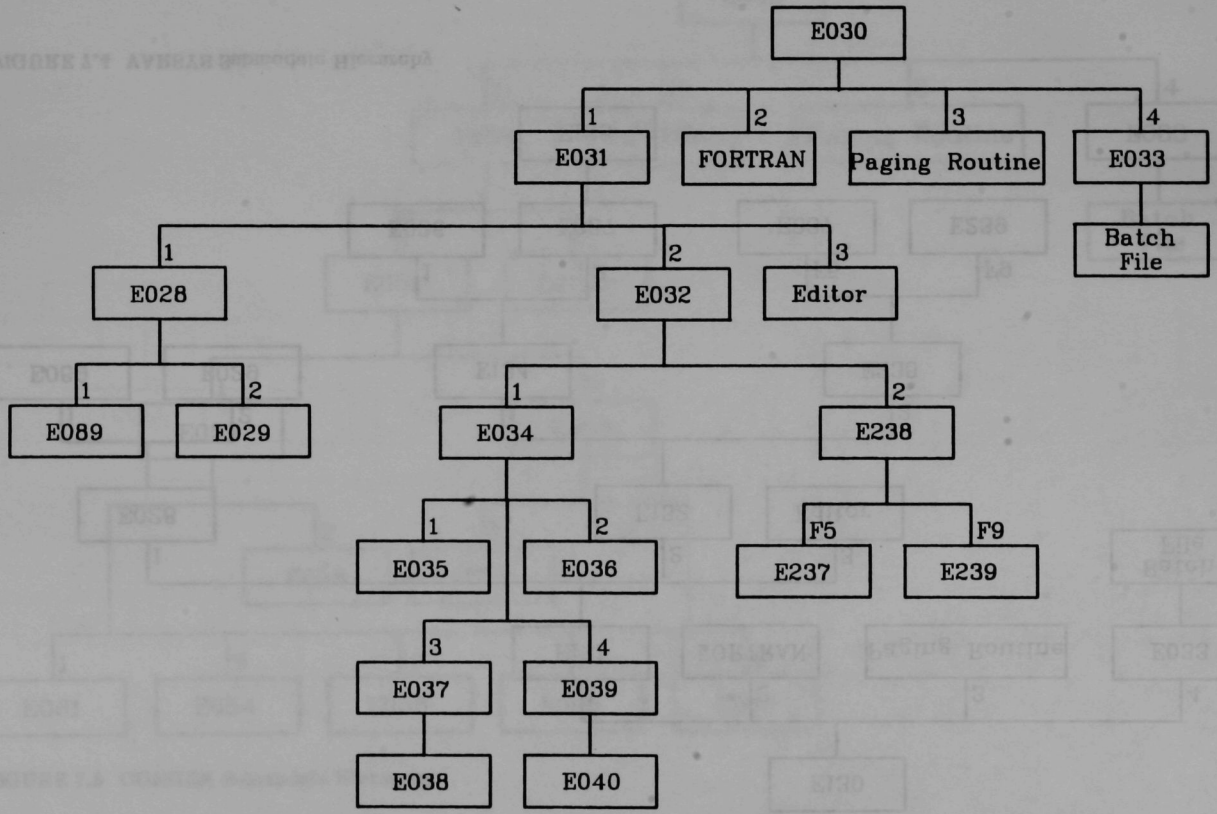


FIGURE 7.3 FIXSYS Submodule Hierarchy

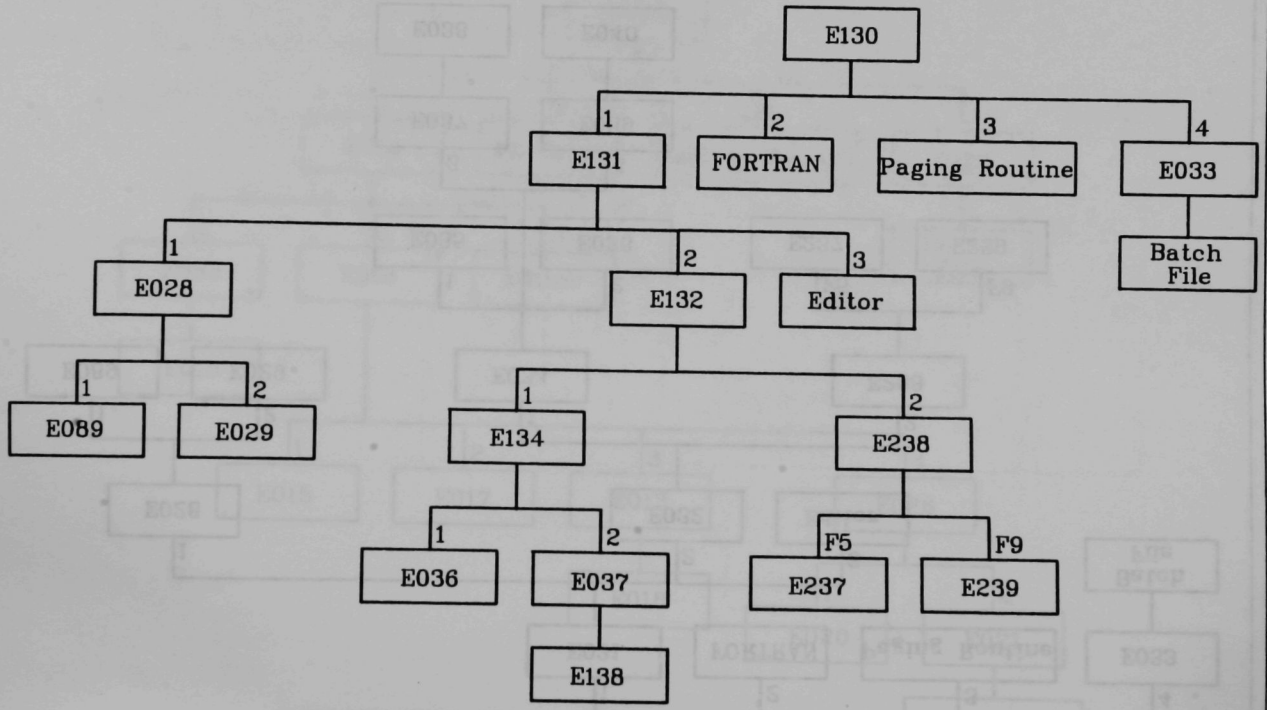


FIGURE 7.4 VARSYS Submodule Hierarchy

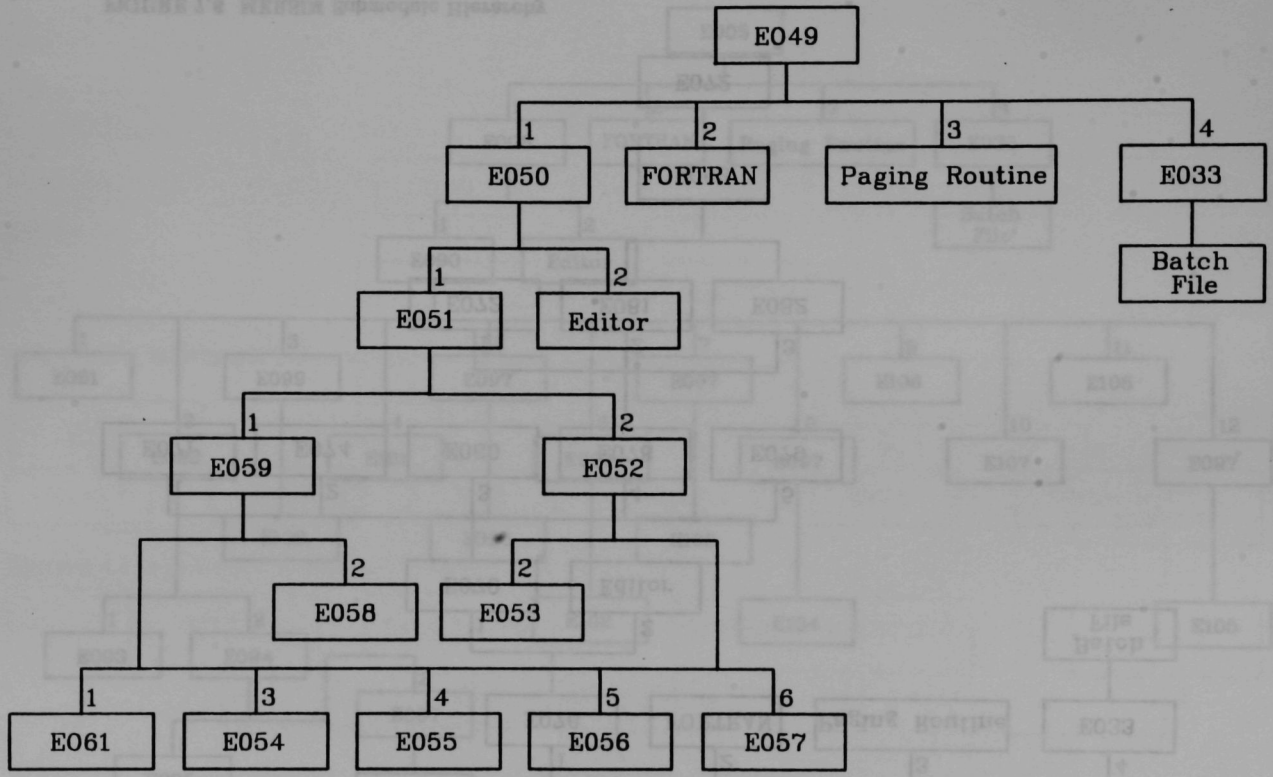


FIGURE 7.5 CONGEN Submodule Hierarchy

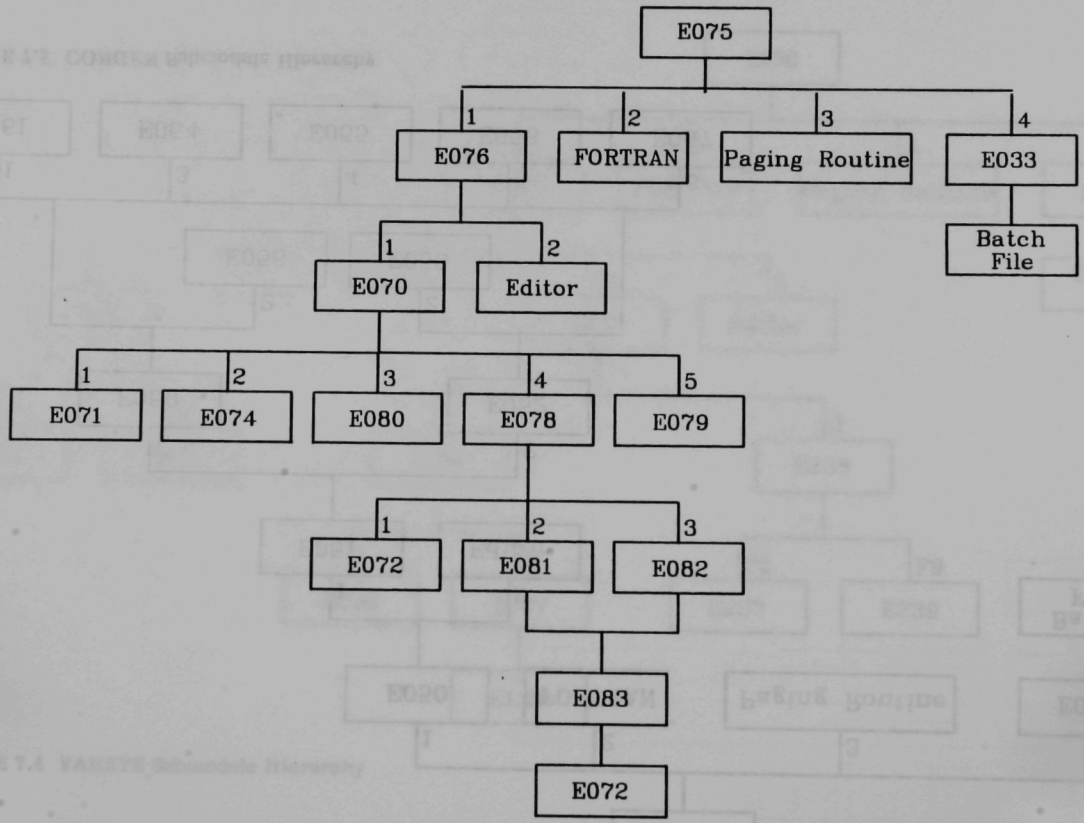


FIGURE 7.6 MERSIM Submodule Hierarchy

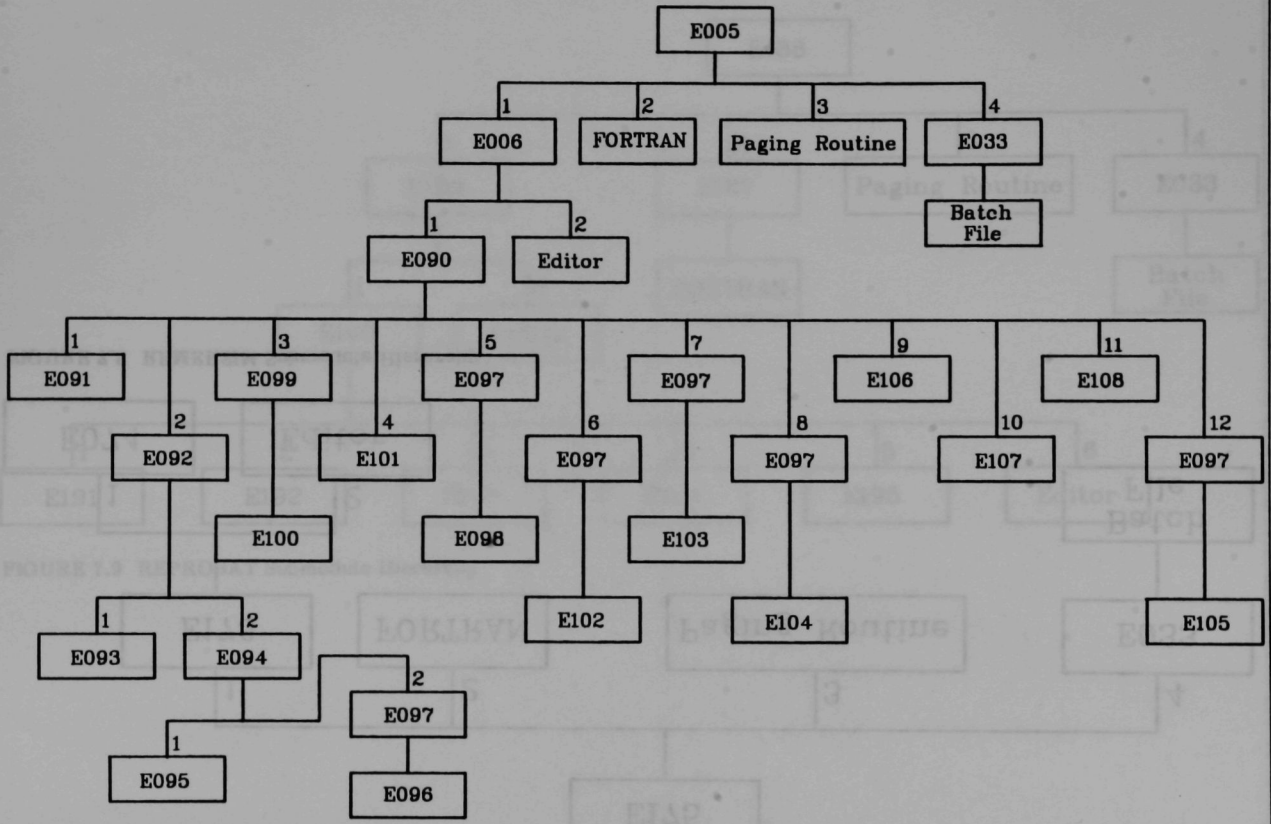


FIGURE 7.7 DYNPRO Submodule Hierarchy

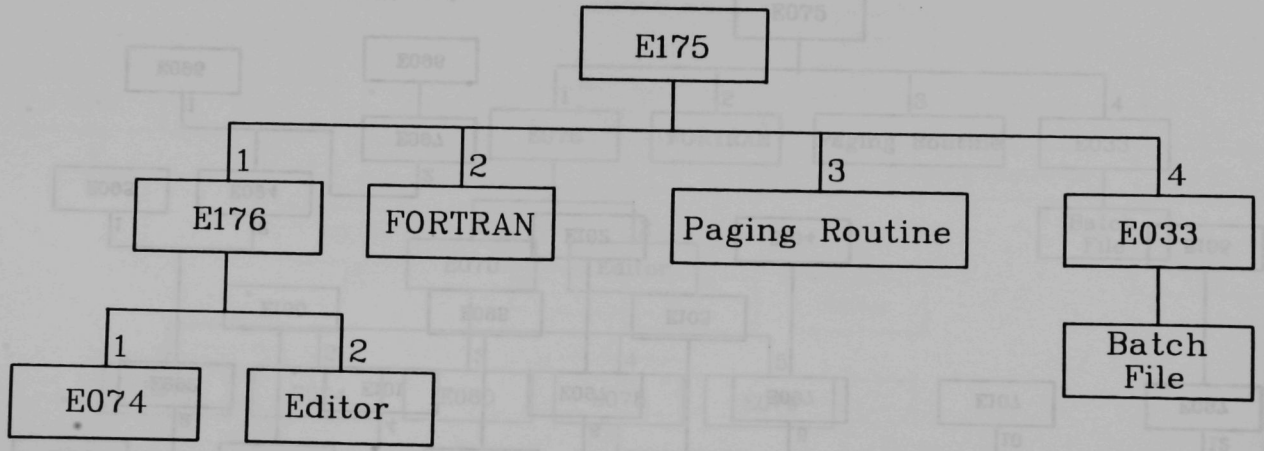


FIGURE 7.8 REMERSIM Submodule Hierarchy

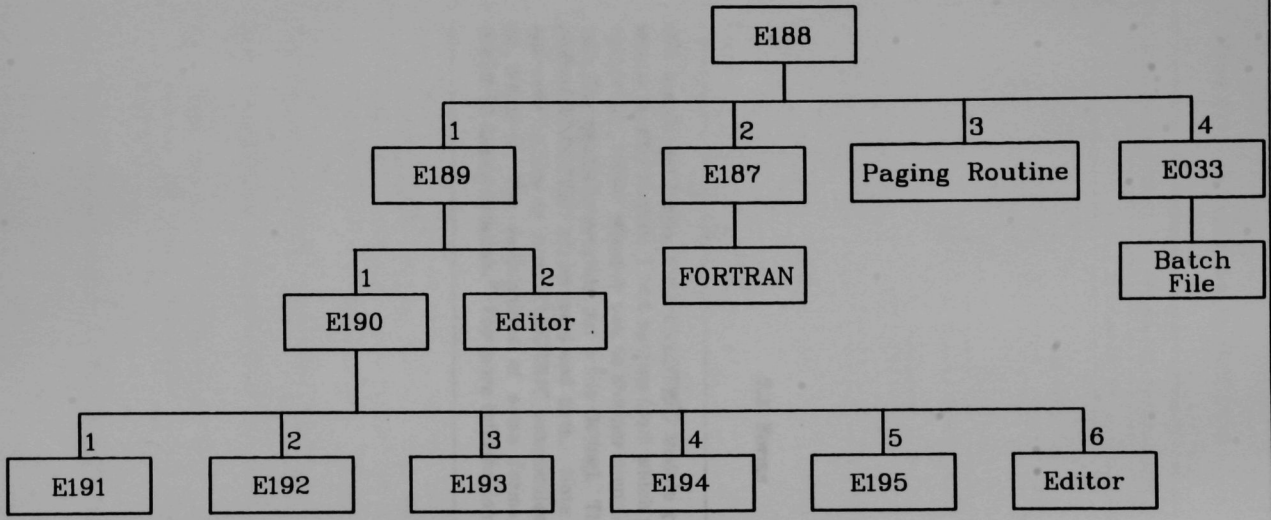
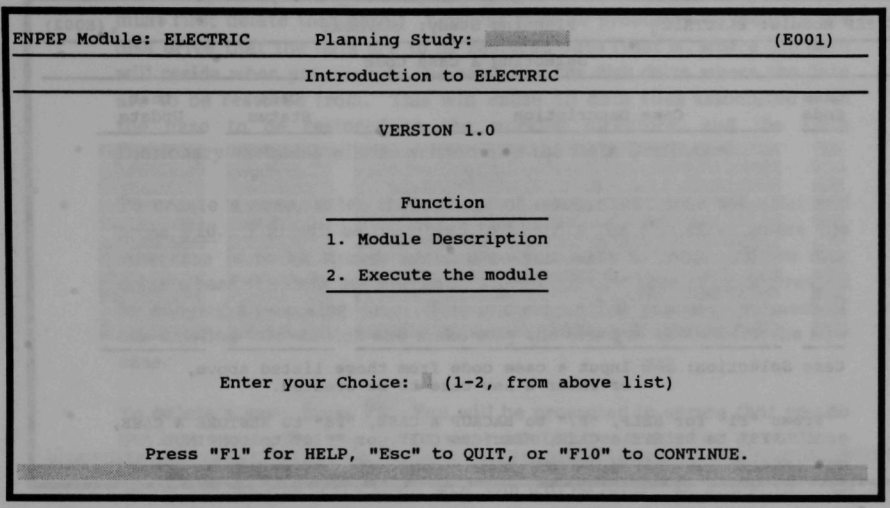


FIGURE 7.9 REPROBAT Submodule Hierarchy

7.3 Forms

The menus and forms in the ELECTRIC Module guide you through the module. Menus usually contain 2 to 6 options from which you can choose. Selecting an option will either advance you to another menu or form or execute a desired task (for example, printing out a file listing). The forms allow you to view or change ELECTRIC parameters and data. Note that some forms and menus are used by two or more ELECTRIC submodules. Since ELECTRIC is based on WASP-III, the descriptions of some forms contain references to the WASP-III documentation.[3] For more information about WASP-III, see Ref. 4.

7.3.1 Menu E001 — Introduction to ELECTRIC



Purpose

Menu E001 is an introduction to the ELECTRIC Module. You advanced to this menu by selecting option 6 on Menu X003 in the EXECUTIVE Module.

Options

1 Select this option to view an abstract describing the ELECTRIC Module with the ENPEP Paging Routine. After you finish viewing the abstract, press **Esc** to return to this menu (see the Introduction to this volume for more information about the ENPEP Paging Routine).

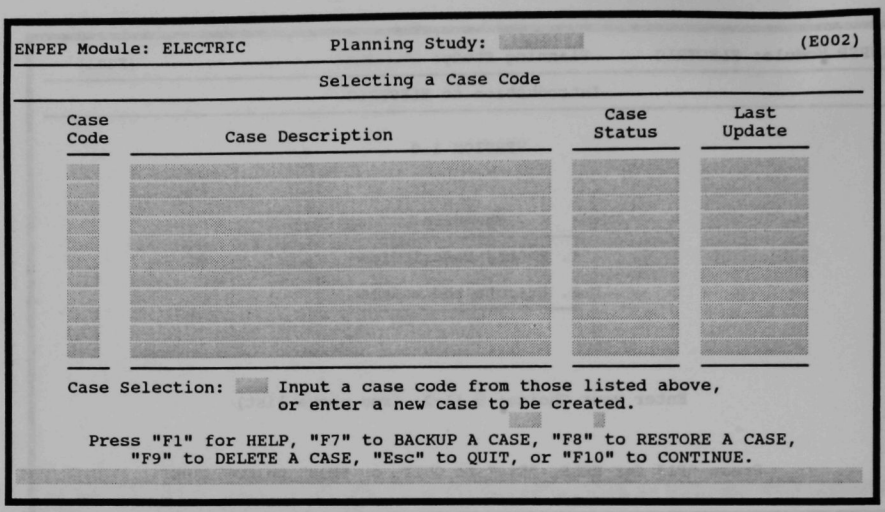
2 Select this option to enter the ELECTRIC Module.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help. (See the Introduction to this volume for more information about the on-line help available in ENPEP.)

Esc Press this key to return to Menu X003 in the EXECUTIVE Module.

7.3.2 Form E002 — Selecting a Case



Purpose

This form displays the different cases that you can execute in the ELECTRIC Module. This form also displays the status of each case (*COMPLETE* or *INCOMPLETE*) and the date on which each case was last revised. You can use Form E002 to select a case to execute, back up (archive) a case, restore a case, create a case, or delete a case. You advanced to this form by selecting option 2 on Menu E001.

Options

- To choose a case to execute, enter the number of an existing case and press **F10**. You will be prompted to identify the disk drive on which the data are stored. The program will automatically store the case and disk drive in the Data Dictionary and advance you to Form E003.

- To back up a case, enter the number of an existing case and press **F7**. After you verify the function by pressing **F10**, the program will prompt you to identify the disk drive where the data for that case are stored and the disk drive on which you want to back up the data. The program will write the Data Dictionary variables to a file. This file and all files associated with the case will be backed up onto separate disks for archiving purposes.

- To restore a case, enter the number of a case that you previously backed up and press **F8**. (If an existing case has the same number, you must first delete that case.) You will then be prompted to identify the disk drive that the data are to be restored onto (that is, where the data will reside when you execute the case) and the disk drive where the data are to be restored from. This will cause all data files associated with the case to be restored to the working directory, and the Data Dictionary variables will be written into the Data Dictionary.

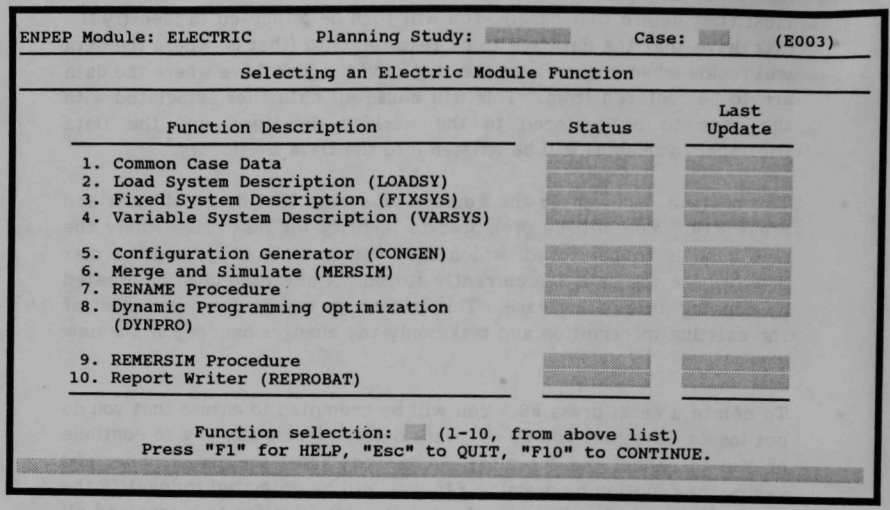
- To create a case, enter the number of a case that does not exist and press **F10**. You will be prompted to identify the disk drive where the new case is to be stored, which case you want to copy, and the disk drive where the data are currently stored. A new case must be created by copying an existing case. This is done so that you can use most of the existing information and make only the changes needed for the new case.

- To delete a case, press **F9**. You will be prompted to ensure that you do not lose a case that you do not want deleted (press any key to continue or **Esc** to cancel the function). After you enter the case number and verify the function by pressing **F10**, you will be prompted to identify the disk drive on which the case is stored. All files for this case and all Data Dictionary variables for the case will then be deleted.

- Press **F1** to obtain on-line help.

- Press **Esc** to return to Menu E001.

7.3.3 Menu E003 — Selecting an ELECTRIC Submodule



Purpose

Menu E003 allows you to select an ELECTRIC submodule to execute. You must complete the CONGEN, MERSIM, RENAME, and DYNPRO submodules sequentially (that is, complete CONGEN before attempting MERSIM, complete MERSIM before attempting RENAME, and so forth). You advanced to this menu by selecting a case on Form E002 or deciding whether or not to save the results from an ELECTRIC submodule or function on Form E500.

Options

1 Select this option to view or change the base year, end year, number of periods, and number of hydro conditions for the case that you selected on Form E002. You will advance to Form E400.

2 Select this option to enter the load system description (LOADSY) submodule. You will advance to Menu E004.

3 Select this option to enter the fixed system description (FIXSYS) submodule. You will advance to Menu E030.

4 Select this option to enter the variable system description (VARSYS) submodule. You will advance to Menu E130.

5 Select this option to enter the configuration generator (CONGEN) submodule. You will advance to Menu E049.

6 Select this option to enter the merge and simulate (MERSIM) submodule. You will advance to Menu E075.

7 Select this option to execute the RENAME procedure (see Sec. 7.1.3). After the procedure executes, you will advance to Form E500.

8 Select this option to enter the dynamic programming optimization (DYNPRO) submodule. You will advance to Menu E005.

9 Select this option to enter the repeat MERSIM (REMERSIM) submodule. You should select this option only after the optimal solution has been generated. You will advance to Menu E175.

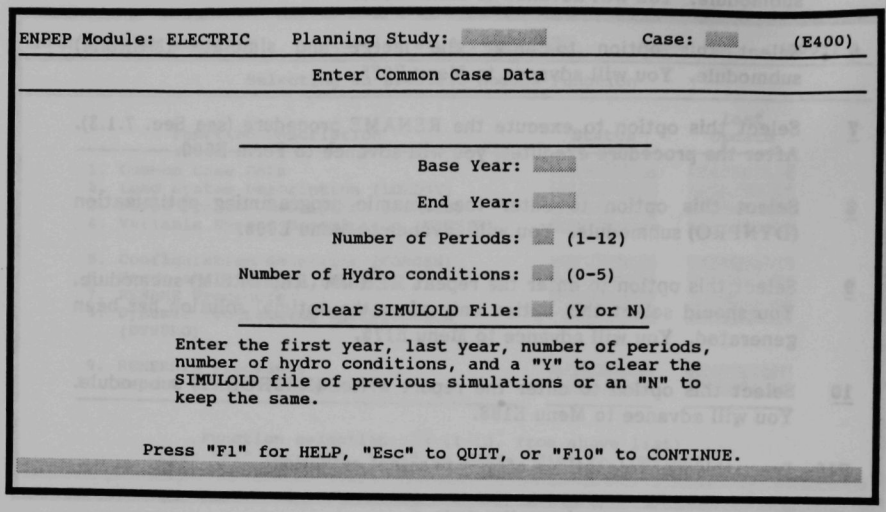
10 Select this option to enter the report writer (REPROBAT) submodule. You will advance to Menu E188.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Form E002.

7.3.4 Form E400 — Changing Case Parameters



Purpose

Form E400 allows you to view or change the base year, end year, number of periods, and number of hydro conditions for the displayed case. These parameters must remain constant throughout a particular case study in the ELECTRIC Module. You advanced to this form by selecting option 1 on Menu E003.

Options

- View or change the values in the data fields described below.
- Press **F10** to advance to Form E500 to save the displayed values in the Data Dictionary.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E003.

Data Fields

- *Base Year*: This field contains an integer that represents the first year of the displayed case.

- *End Year*: This field contains an integer that represents the last year of the displayed case.

- *Number of Periods*: This field contains an integer from 1 to 12 that represents the number of periods that will be used in the displayed case.

- *Number of Hydro Conditions*: This field contains an integer from 0 to 5 that represents the number of hydro conditions that will be used in the displayed case.

- *Clear SIMULOLD File*: This field is necessary for discarding MERSIM results the first time you execute ELECTRIC for a new case study. Enter Y to clear the SIMULOLD file that was copied along with the rest of the existing case when you created the new case (see Form E002). MERSIM output from a previous case would, in general, not be relevant to the new case; you may also want to clear the SIMULOLD file if you find serious errors in the input data for MERSIM. Enter N to save the SIMULOLD file for the second and subsequent iterations of the case study.

7.3.5 Form E500 — Saving Data

```
ENPEP Module: ELECTRIC    Planning Study:          Case:      (E500)
                              Saving Data

                  Determine if data is to be kept

              Do you want to save this data?    (Y or N)

                  Press "F1" for HELP or "F10" to CONTINUE.
```

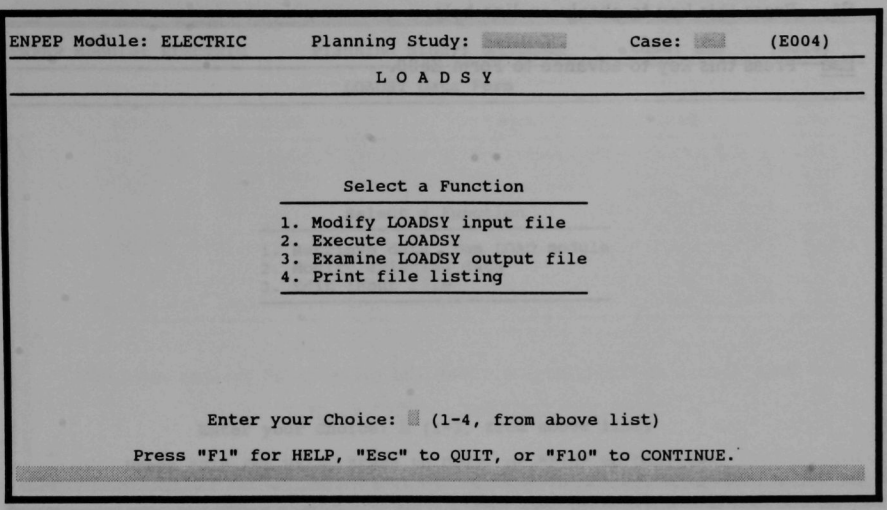
Purpose

Form E500 allows you to save the data completed during the previous step by responding to two prompts. You will first be prompted as to whether or not you want to save the data and then you will be prompted as to whether the case status should be *COMPLETE* or *INCOMPLETE*. In the ELECTRIC Module, the case status is displayed for your convenience; a status of *INCOMPLETE* does not prevent you from executing any of the submodules. You advanced to this form after changing case parameters, exiting from an ELECTRIC submodule, or executing the RENAME procedure.

Options

- For the first prompt, enter **Y** if you want to save the data and press **F10** to advance to the second prompt. If you do not want to save the data, enter **N** and press **F10** to return to Menu E003.
- For the second prompt, enter **Y** if you want the case data saved as *COMPLETE* and enter **N** if you want the case saved as *INCOMPLETE*. Then press **F10** to return to Menu E003.
- Press **F1** to obtain on-line help.
- You cannot press **Esc** to leave this form.

7.3.6 Menu E004 — LOADSY Submodule Introduction



Purpose

Menu E004 allows you to view or change the LOADSY input and output and to execute the LOADSY submodule. You advanced to this menu by selecting option 2 on Menu E003.

Options

1 Select this option to view or change the LOADSY input file. You will advance to Menu E014.

2 Select this option to execute the LOADSY submodule. After LOADSY (or any of the other ELECTRIC submodules) executes, three messages will be displayed on the screen: (1) *Files are Closed*, (2) *Stop - Program Terminated*, and (3) *Strike a key when ready ...* Press any key to return to Menu E004.

3 Select this option to view the LOADSY output file. You will advance to the ENPEP Paging Routine; when you finish viewing the output, press **Esc** to return to this menu.

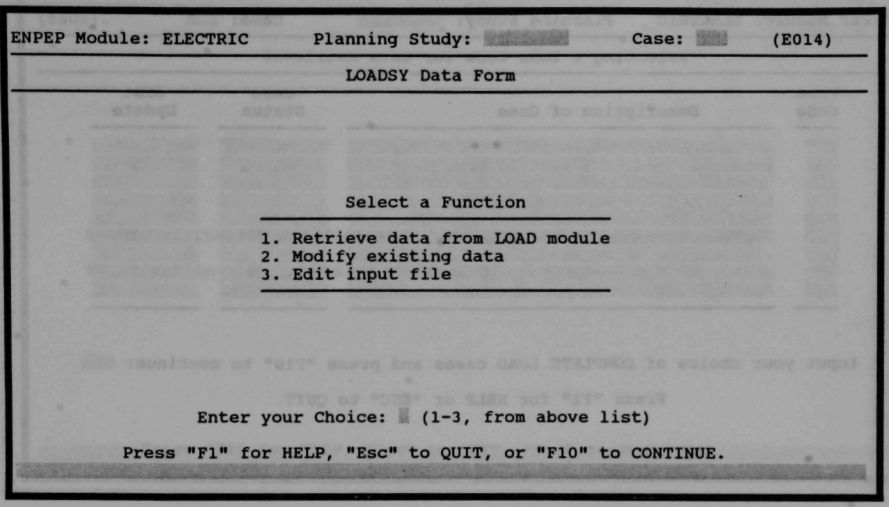
4 Select this option to obtain a listing of the LOADSY input or output files. You will advance to Menu E033.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to advance to Form E500.

7.3.7 Menu E014 — Changing LOADSY Input Data



Purpose

You can use Menu E014 to select a method for viewing or changing the LOADSY input file. You can also create a new input file from LOAD Module data. You advanced to this menu by selecting option 1 on Menu E004.

Options

1 Select this option to create a new LOADSY input file from the data calculated in the LOAD Module. You will advance to Form E088 to select a LOAD case.

2 Select this option to view or change the LOADSY input data by using forms. You will advance to Menu E016.

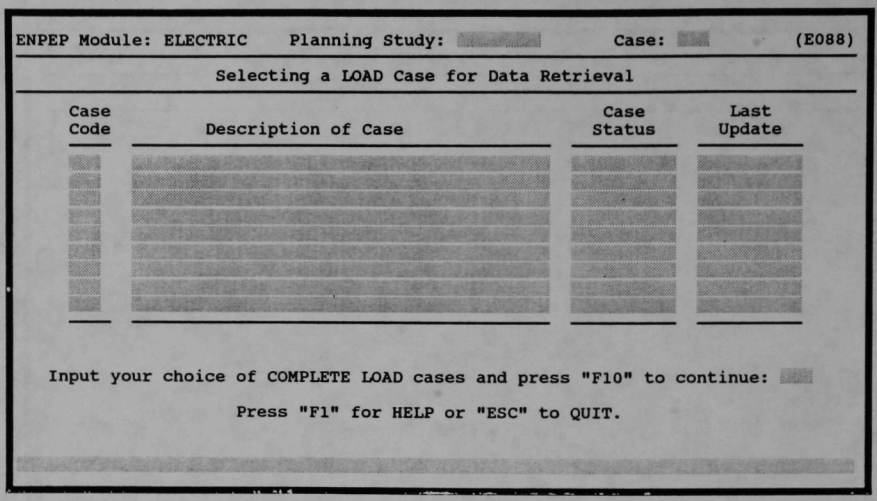
3 Select this option to view or change the LOADSY input file as an actual card image. You will advance to the IBM Professional Editor and return to this menu when you finish viewing or changing the file.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E004.

7.3.8 Form E088 — Selecting a LOAD Case



Purpose

Form E088 allows you to select a LOAD Module case from which to retrieve data. You may select only those cases that are *COMPLETE*. You advanced to this form by selecting option 1 on Menu E014.

Options

- Enter the number of the LOAD case that you want to use and press **F10**. After you identify the disk drive on which the case is stored, you will advance to Form E015.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E014.

7.3.9 Form E015 — Changing LOADSY Input File Parameters

```
ENPEP Module: ELECTRIC      Planning Study:          Case:      (E015)
                              LOADSY Data Form

     Number of fourier coefficients : 50  (maximum=100,50 recommended)
     Print option : 0  (Normal=0,Extended=1)

          Press "F1" for HELP, "Esc" to QUIT, "F10" to CONTINUE.
```

Purpose

Form E015 allows you to view or change the number of Fourier coefficients and the print option that are used to build the LOADSY input file. These necessary parameters are not defined within the LOAD Module. You advanced to this form after selecting a LOAD case on Form E088 or option 1 on Menu E016.

Options

- Enter, view, or change the values in the data fields described below.
- If you advanced from Form E088, press **F10** to build the new LOADSY input file data from LOAD Module output using the displayed values. After the file has been built, you will return to Menu E014. If you advanced from Menu E016, press **F10** to save the displayed values and return to Menu E016.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E088 or Menu E016.

Data Fields

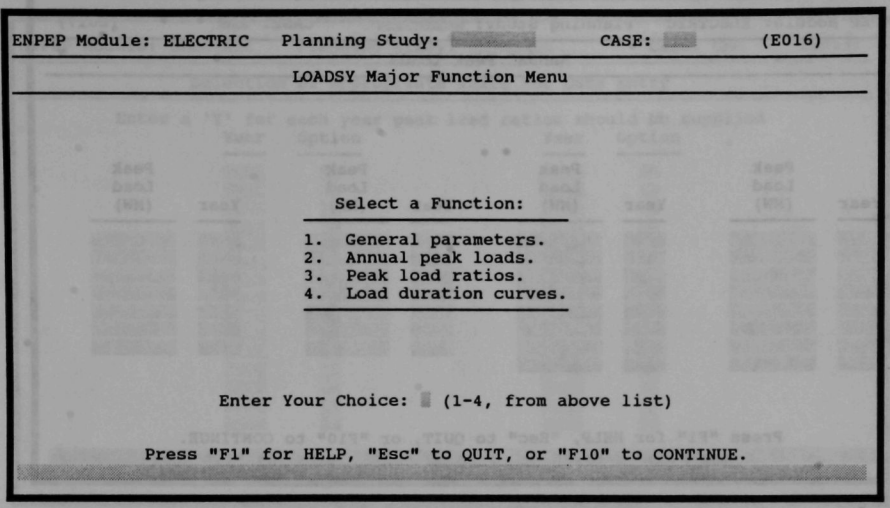
Number of Fourier Coefficients: This field contains an integer from 1 to 100 that represents the number of Fourier coefficients that will be used for the displayed case.

Print Option: This field contains either **0** for normal output or **1** for a listing of the Fourier coefficients for each LDC in addition to the normal output.

Reference

WASP-III Users' Manual, card-type A, p. 25.

7.3.10 Menu E016 — Selecting a LOADSY Function



Purpose

This is the menu from which you select a type of LOADSY input data to view or change. You advanced to Menu E016 by selecting option 2 on Menu E014.

Options

1 Select this option to view or change LOADSY parameters. You will advance to Form E015.

2 Select this option to view or change the annual peak loads. You will advance to Form E017.

3 Select this option to view or change the peak load ratios. You will advance to Form E013.

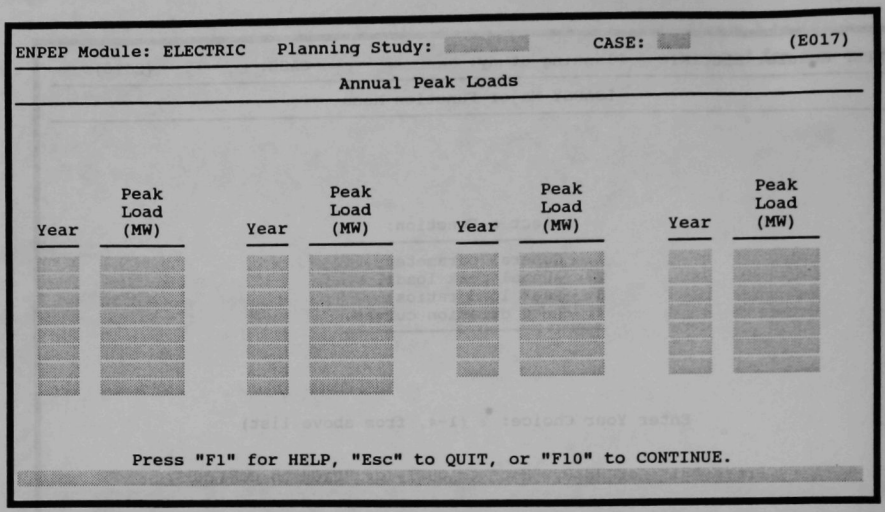
4 Select this option to view or change the LDC data. You will advance to Form E026.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E014.

7.3.11 Form E017 — Changing Annual Peak Loads



Purpose

Form E017 allows you to enter, view, or change the annual peak loads for each year in the case. You advanced to this form by selecting option 2 on Menu E016.

Options

- Enter, view, or change the values in the data fields described below; then press **F10** to save the displayed values and return to Menu E016.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E016.

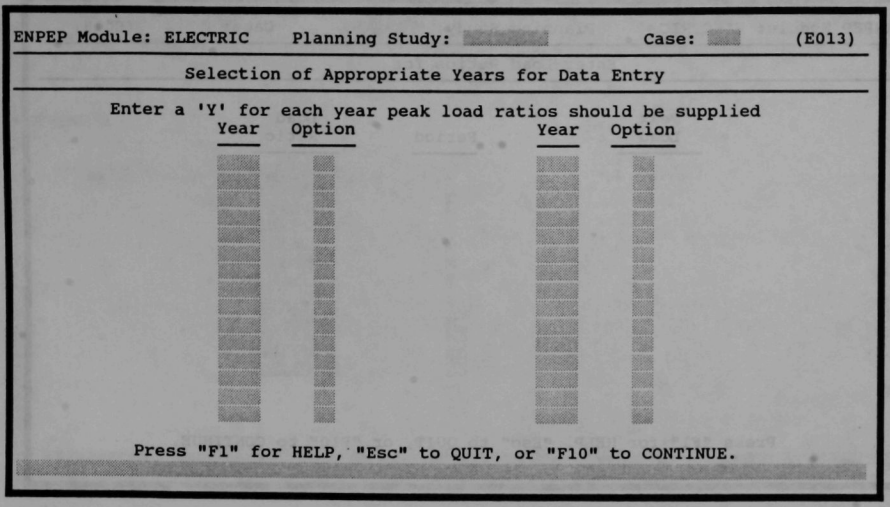
Data Fields

Peak Load: Each field contains a floating-point number that represents the annual peak load (MW).

Reference

WASP-III Users' Manual, card-type B, p. 25.

7.3.12 Form E013 — Selecting Years for Period Peak Load Ratios



Purpose

Form E013 allows you select the years for which you want to view or change peak load ratio data. You advanced to this form by selecting option 3 on Menu E016.

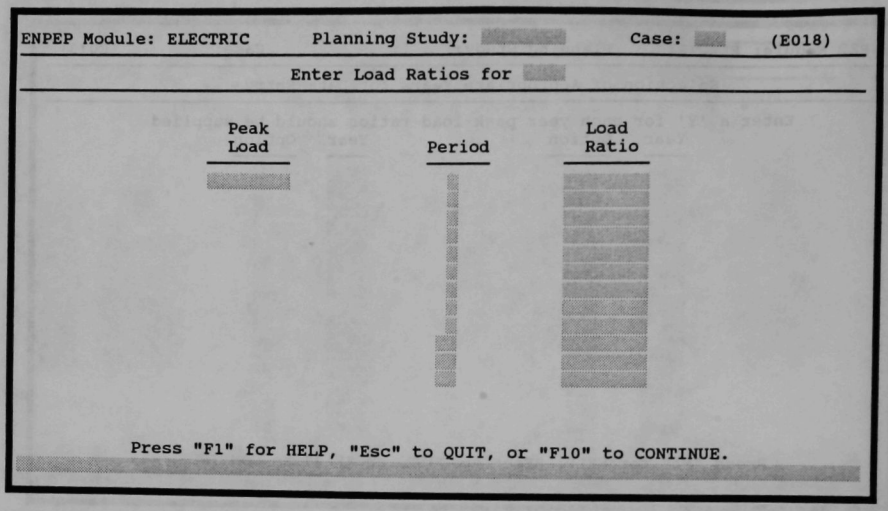
Options

- Select years to view or change as described in the data fields below.
- Press **F10** to advance to Form E018 to view or change the period peak load ratios.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E016.

Data Fields

Option: Enter **Y** in the field to the right of each year for which you want to view or change the peak load ratios.

7.3.13 Form E018 — Changing Period Peak Load Ratios



Purpose

Form E018 allows you to view or change the period peak load ratios for the displayed year. You advanced to this form by selecting one or more years on Form E013. Note that if you change the value for a particular year, years that immediately follow that year and are not selected for viewing will have the same value by default.

Options

- View or change the ratios in the data fields described below.
- Press **F10** to save the displayed values and advance to the next year. When you have viewed or changed the values for the last year (that you selected on Form E013), press **F10** to return to Form E013.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E013.

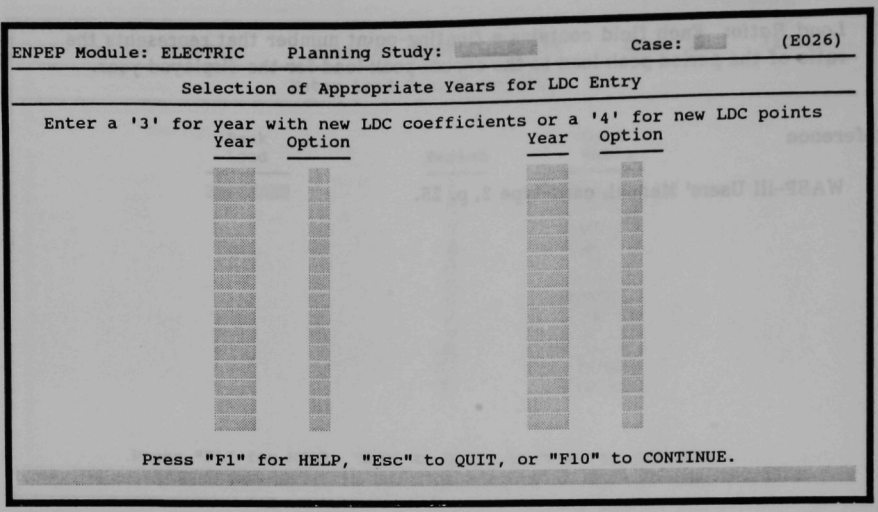
Data Fields

Load Ratio: Each field contains a floating-point number that represents the ratio of the period peak load to the annual peak load for the displayed year.

Reference

WASP-III Users' Manual, card-type 2, p. 25.

7.3.14 Form E026 — Selecting Years for Changing LDC Data



Purpose

Form E026 allows you to select the years for which you want to view or change LDC data. This form also allows you to specify whether you want to represent the curve with coefficients or coordinates (points). You advanced to this form by selecting option 4 on Menu E016.

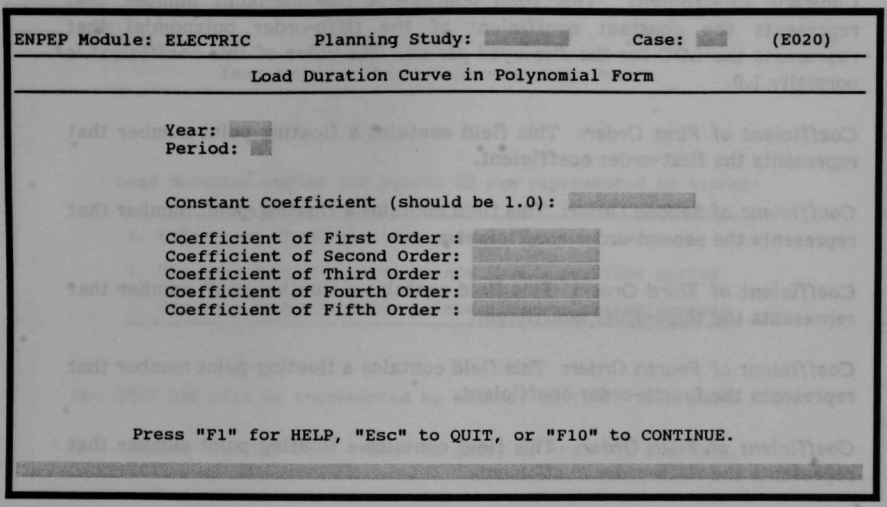
Options

- Select years to view or change as described in the data fields below; then press **F10** to advance to Form E020 to view or change LDC coefficients or to Form E021 to view or change LDC coordinates.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E016.

Data Fields

Option: Enter **3** or **4** in the field to the right of each year for which you want to view or change the LDCs. Enter **3** to represent the curves with polynomial coefficients, and enter **4** to specify the curves as coordinates. It is recommended that you do not use both methods of LDC representation for the same case.

7.3.15 Form E020 — Changing LDC Polynomial Coefficients



Purpose

This form allows you to view or change the coefficients that represent the LDC for the displayed period and year. You advanced to this form by selecting years on Form E026 with a 3.

Options

- View or change the coefficients in the data fields described below.
- Press **F10** to save the displayed values and advance to the next period or year. When you have viewed or changed the values for the last period of the last year (that you selected on Form E026), press **F10** to return to Form E026.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E026.

Data Fields

Constant Coefficient: This field contains a floating-point number that represents the constant coefficient of the fifth-order polynomial that represents the LDC for the displayed period. The value of this coefficient is normally 1.0.

Coefficient of First Order: This field contains a floating-point number that represents the first-order coefficient.

Coefficient of Second Order: This field contains a floating-point number that represents the second-order coefficient.

Coefficient of Third Order: This field contains a floating-point number that represents the third-order coefficient.

Coefficient of Fourth Order: This field contains a floating-point number that represents the fourth-order coefficient.

Coefficient of Fifth Order: This field contains a floating-point number that represents the fifth-order coefficient.

Reference

WASP-III Users' Manual, card-type 3, p. 26.

7.3.16 Menu E021 — Selecting LDC Coordinate Options

```
ENPEP Module: ELECTRIC      Planning Study:          Case:      (E021)
                Load Duration Curve Represented by Points

        Load duration curves for period   can represented by either:

          1. Enter load duration curve points
          2. Use load duration curve points from a previous period
          3. Use load duration curve points from the preceding year

     The        LDC will be represented by method:   (1-3, from above list)

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu E021 allows you to select one of three options for viewing or changing the LDC coordinates for the displayed case. You can either enter coordinates or use the coordinates from a previous period or year. You advanced to this menu by selecting years on Form E026 with a 4.

Options

1 Select this option to view or change the LDC coordinates. You will advance to Form E023.

2 Select this option to use the LDC coordinates from a previous period. You will advance to Form E024 to identify the period. You cannot use this option for period 1.

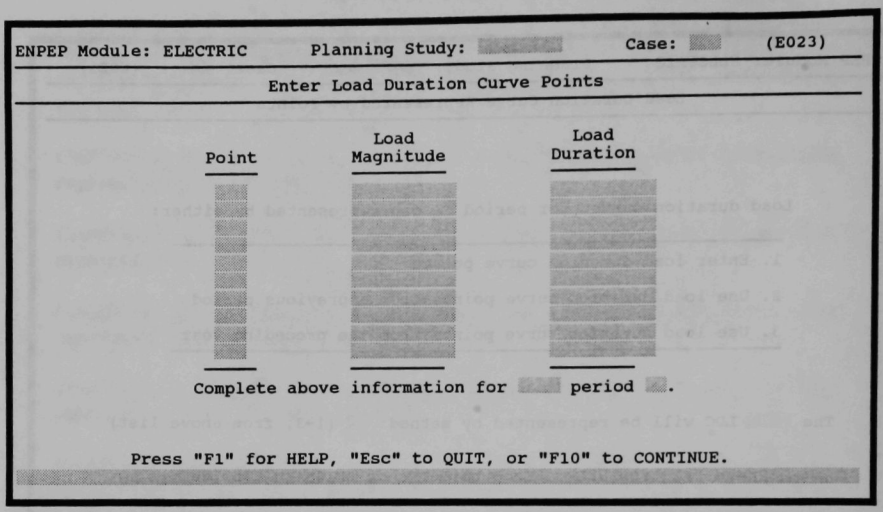
3 Select this option to use the LDC coordinates from the preceding year. You will remain at this menu. You cannot use this option for the first year of the study.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Form E026.

7.3.17 Form E023 — Changing LDC Coordinates



Purpose

Form E023 allows you to view or change the LDC coordinates for the displayed period. You must enter the coordinates in descending load magnitudes (normalized to the period peak load) and make sure that the first and last coordinates correspond to the peak and minimum loads of the period, respectively. You advanced to this form by selecting option 1 on Menu E021.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and return to Menu E021.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E021.

Data Fields

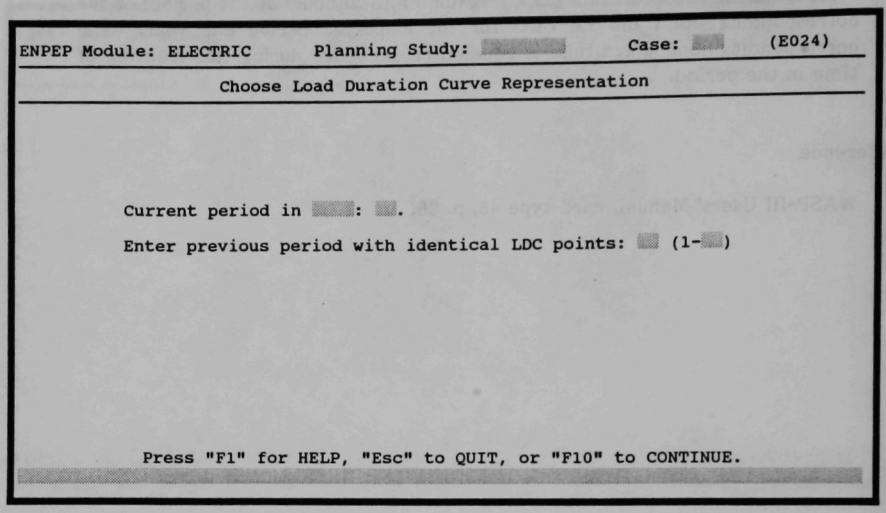
Load Magnitude: Each of these fields contains a floating-point number that represents the load magnitude (as a fraction of period peak load) of the corresponding point on the LDC for the displayed period and year.

Load Duration: Each of these fields contains a floating-point number that represents the load duration (as a fraction of total hours of the period) of the corresponding point on the LDC for the displayed period and year. The corresponding load magnitude is equaled or exceeded during this fraction of time in the period.

Reference

WASP-III Users' Manual, card-type 46, p. 26.

7.3.18 Form E024 — Entering LDC Coordinates from a Previous Period



Purpose

Form E024 allows you to use the LDC coordinates from a previous period for the displayed period. You cannot use this form for the first period of a year. You advanced to this form by selecting option 2 on Menu E021.

Options

- View or change the period number in the data field described below; then press **F10** to save the displayed value and return to Menu E021.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E021.

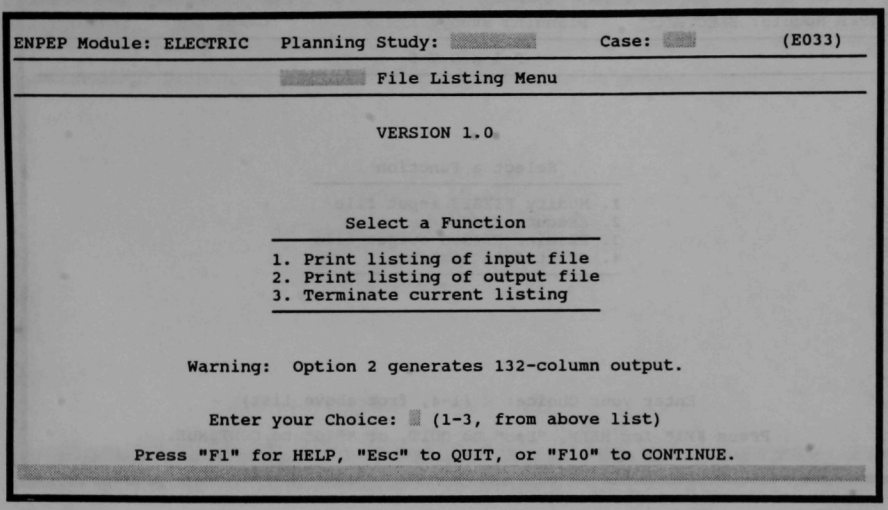
Data Field

Enter Previous Period: This field contains an integer that represents the number of the previous period with the LDC values that you want to use.

Reference

WASP-III Users' Manual, card-type 4a, p. 26.

7.3.19 Menu E033 — Listing Submodule Input and Output Files



Purpose

Menu E033 allows you to obtain a listing of the displayed submodule input or output file or terminate the listing that is currently in progress. You advanced to this menu by selecting option 4 on Menu E004, E030, E130, E049, E075, E005, E175, or E188.

Options

1 Select this option to begin a listing of the submodule input file.

2 Select this option to begin a listing of the submodule output file.

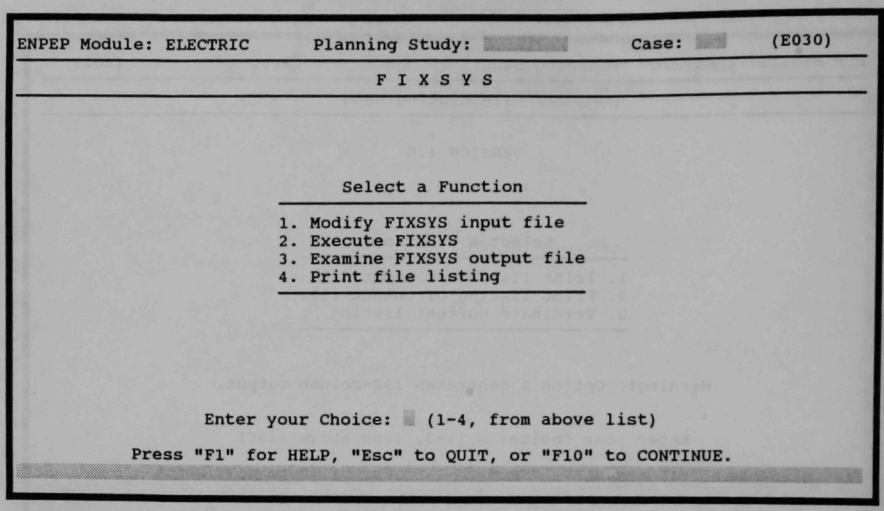
3 Select this option to terminate the file listing that is currently in progress.

F10 Press this key to continue after you select an option. You will remain at Menu E033.

F1 Press this key to obtain on-line help.

Esc Press this key to return to the submodule introductory menu (E004, E030, E130, E049, E075, E005, E175, or E188) that you advanced from.

7.3.20 Menu E030 — FIXSYS Submodule Introduction



Purpose

Menu E030 allows you to view or change the FIXSYS input and output and to execute the FIXSYS submodule. You advanced to this menu by selecting option 3 on Menu E003.

Options

1 Select this option to view or change the FIXSYS input file. You will advance to Menu E031.

2 Select this option to execute the FIXSYS submodule. You will return to Menu E030 after FIXSYS executes (see Menu E004).

3 Select this option to view the FIXSYS output file with the Paging Routine; after you view the output, press **Esc** to return to this menu.

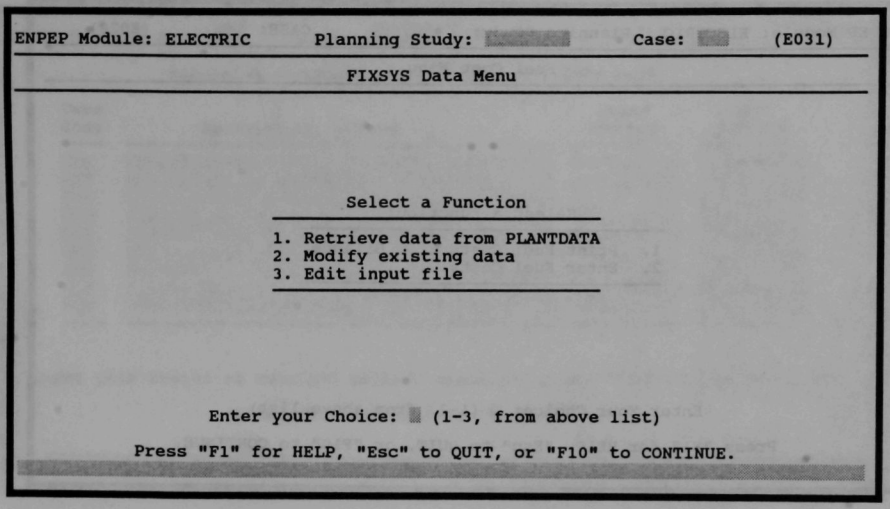
4 Select this option to obtain a listing of the FIXSYS input or output files. You will advance to Menu E033.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to advance to Form E500.

7.3.21 Menu E031 — Changing FIXSYS Input Data



Purpose

You can use Menu E031 to select a method for viewing or changing the FIXSYS input file. You can also create a new FIXSYS input file from PLANTDATA Module output. You advanced to this menu by selecting option 1 on Menu E030.

Options

1 Select this option to create a new FIXSYS input file. You will advance to Menu E028 to select a method for specifying fuel costs.

2 Select this option to view or change the FIXSYS input data by using forms. You will advance to Menu E032.

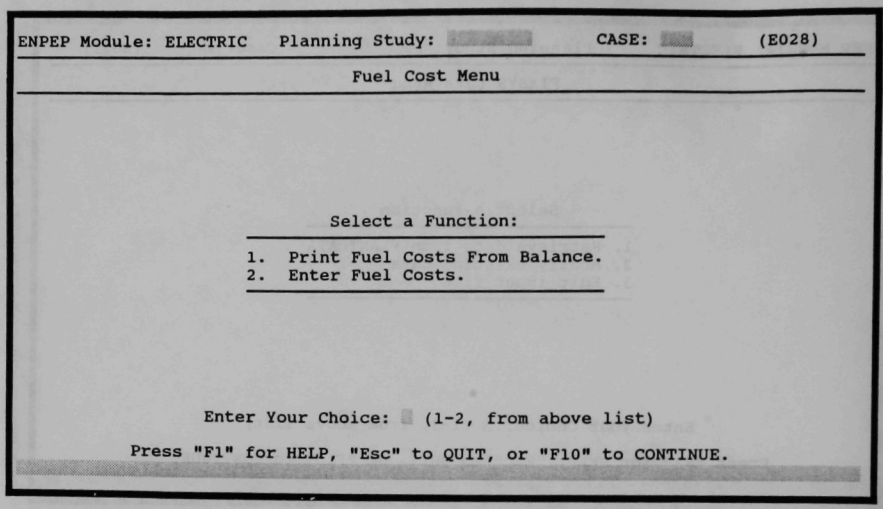
3 Select this option to view or change the FIXSYS input file as an actual card image. You will advance to the IBM Professional Editor and return to Menu E031 when you finish viewing or changing the file.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E030.

7.3.22 Menu E028 — Fuel Cost Menu



Purpose

Menu E028 allows you to determine fuel costs in one of two ways. You can use data from the BALANCE Module or enter fuel costs directly. You advanced to this menu by selecting option 1 on Menu E031.

Options

1 Select this option to obtain fuel costs from BALANCE output. You will advance to Form E089 to select a case.

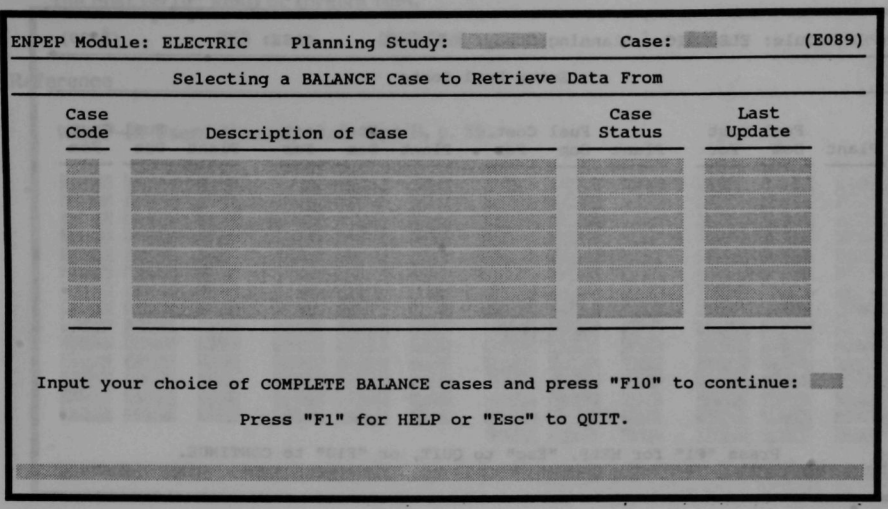
2 Select this option to view or change existing fuel cost data. You will advance to Form E029.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E031.

7.3.23 Form E089 — Selecting a BALANCE Case



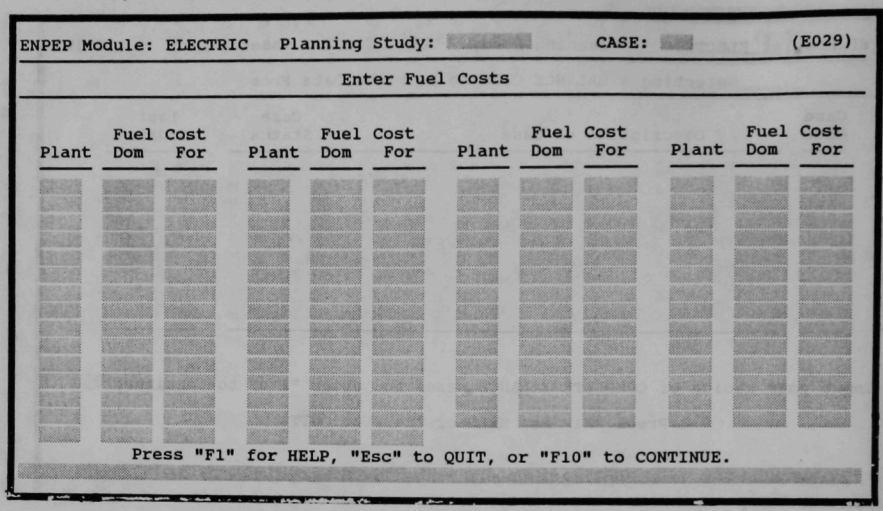
Purpose

Form E089 allows you to select a BALANCE case from which to retrieve fuel costs for the FIXSYS input file. You may use only cases that have a case status of *COMPLETE*. You advanced to this form by selecting option 1 on Menu E028.

Options

- Enter the number of the BALANCE case that you want to use and press **F10** to build the FIXSYS input file. You will remain at Form E089.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E028.

7.3.24 Form E029 — Changing Fuel Costs



Purpose

Form E029 allows you to view or change the foreign and domestic fuel costs for each thermal plant in the PLANTDATA data set. You advanced to this form by selecting option 2 on Menu E028.

Options

- View or change the values in the data fields described below.
- Press **F10** to save the displayed values and build the FIXSYS input file. You will return to this form after the file is built.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E028.

Data Fields

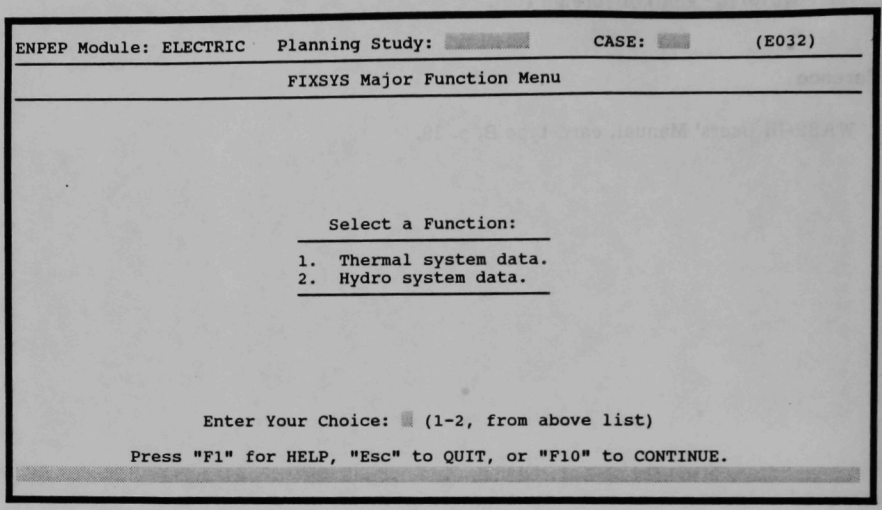
Domestic Fuel Cost: Each of these fields contains a number that represents the cost of domestic fuel. The cost is expressed in cents ($0.01) per million kcal (¢/10^6 kcal).

Foreign Fuel Cost: Each of these fields contains a number that represents the cost ($¢/10^6$ kcal) of foreign fuel.

Reference

WASP-III Users' Manual, card-type B, p. 39.

7.3.25 Menu E032 — Selecting a FIXSYS Function



Purpose

Menu E032 allows you to select a type of FIXSYS data to view or change. You advanced to this menu by selecting option 2 on Menu E031.

Options

1 Select this option to view or change the thermal system data. You will advance to Menu E034.

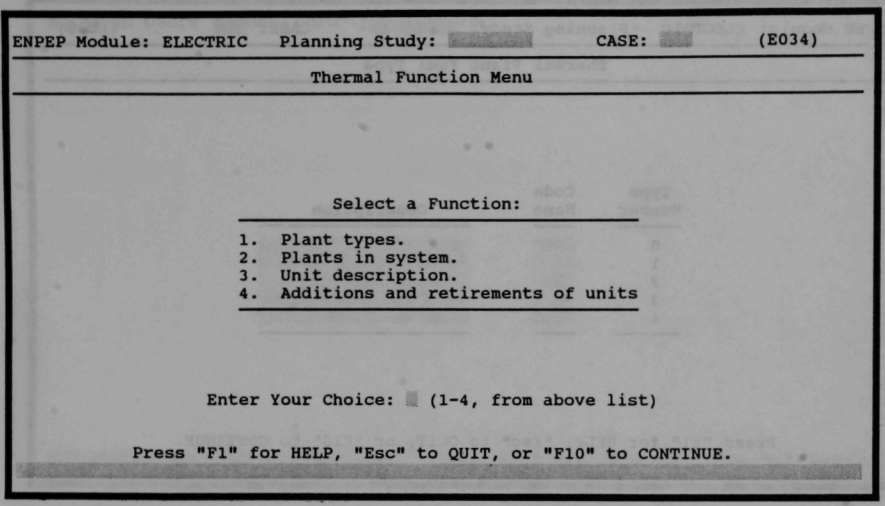
2 Select this option to view or change the hydro system data. You will advance to Form E238.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E031.

7.3.26 Menu E034 — Changing Thermal System Data



Purpose

Menu E034 allows you to select a type of thermal system data to view or change. You advanced to this menu by selecting option 1 on Menu E032.

Options

1 Select this option to view or change the thermal-plant fuel types. You will advance to Form E035.

2 Select this option to identify the thermal plants that you want to include in the fixed system. You will advance to Form E036.

3 Select this option to view or change the unit descriptions for the thermal plants in the fixed system. You will advance to Form E037.

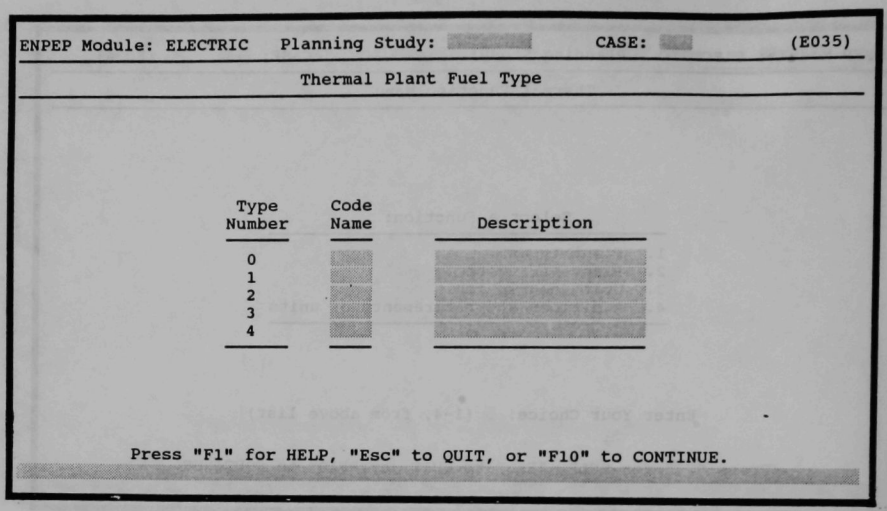
4 Select this option to view or change the number of unit additions and retirements for each plant. You will advance to Form E039.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E032.

7.3.27 Form E035 — Changing Thermal Plant Fuel Types



Purpose

This form allows you to view or change the thermal plant fuel-type information for the displayed case. You may define up to five fuel types. You advanced to Form E035 by selecting option 1 on Menu E034.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and return to Menu E034.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E034.

Data Fields

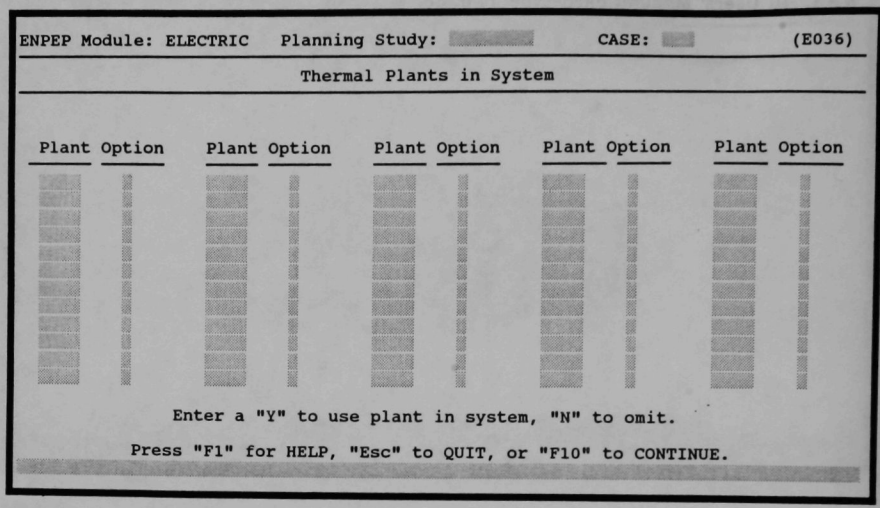
Code Name: Each of these fields contains a four-character code name for the thermal plant fuel type.

Description: Each of these fields contains a description (up to 20 characters) of the thermal plant fuel type.

Reference

WASP-III Users' Manual, card-type Y, p. 38.

7.3.28 Form E036 — Selecting Thermal Plants for the Electrical Generating System



Purpose

Form E036 allows you to identify those thermal plants that you want to include in the electrical generating system for the displayed case. You advanced to this form by selecting option 2 on Menu E034 or option 1 on Menu E134.

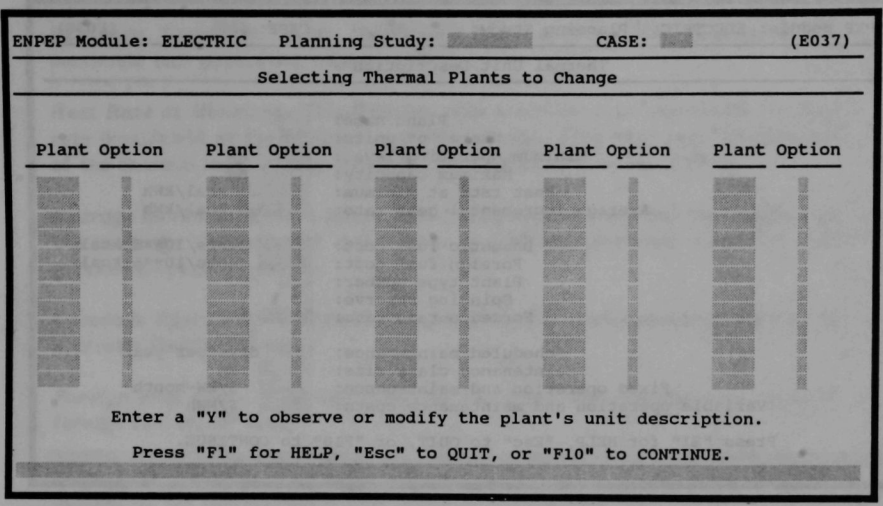
Options

- Select thermal plants to include in FIXSYS or VARSYS as described in the data fields below; then press **F10** to save your selections and return to Menu E034 or E134.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E034 or E134.

Data Fields

Option: Enter **Y** in the field to the right of each thermal plant that you want to include in the electrical generating system.

7.3.29 Form E037 — Selecting Thermal Plants to Change



Purpose

You can use this form to select thermal plant unit descriptions to view or change for the displayed case. You advanced to Form E037 by selecting option 3 on Menu E034 or option 2 on Menu E134.

Options

- Select descriptions to view or change as described in the data fields below.
- Press **F10** to advance to Form E038 for FIXSYS data or Form E138 for VARSYS data.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E034 or E134.

Data Fields

Option: Enter **Y** in the field to the right of each thermal plant for which you want to view or change the description.

7.3.30 Form E038 — Changing FIXSYS Thermal Plant Descriptions

```
ENPEP Module: ELECTRIC   Planning Study:          CASE:        (E038)
                        Thermal Unit Description

                                    Plant name:
                                 Number of units:
                        Minimum operating level:          MW
                                Maximum capacity:         MW
                              Heat rate at minimum:             kcal/kWh
                  Average incremental heat rate:                kcal/kWh

                               Domestic fuel cost:          cents/10**6 kcal
                                Foreign fuel cost:          cents/10**6 kcal
                                Plant type number:
                                  Spinning reserve:      %
                                Forced outage rate:          %

                             Scheduled maintenance:       days per year
                            Maintenance class size:         MW
                  Fixed operation and maintenance:          $/kW-month
          Variable operation and maintenance costs:         $/MWh

        Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Form E038 allows you to view or change the unit description for the displayed thermal plant. You advanced to this form by selecting plant descriptions to view or change on Form E037.

Options

- View or change the descriptions in the data fields described below.
- Press **F10** to save the displayed values and advance to the next plant that you selected on Form E037. After you view or change the description for the last thermal plant, press **F10** to return to Form E037.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E037.

Data Fields

Number of Units: This field contains an integer that represents the number of identical units in place during the base year of the case.

Minimum Operating Level: This field contains a number that represents the minimum operating level (MW) of each unit.

Maximum Capacity: This field contains a number that represents the maximum unit generating capacity (MW).

Heat Rate at Minimum: This field contains a number that represents the heat rate (kcal/kWh) at the minimum operating level. (The heat rate is a measure of the thermal input energy [kcal] of fuel needed to produce 1 kWh.)

Average Incremental Heat Rate: This field contains a number that represents the average incremental heat rate (kcal/kWh) between minimum and maximum operating levels.

Domestic Fuel Cost: This field contains a number that represents the cost of domestic fuel (¢/10^6 kcal).

Foreign Fuel Cost: This field contains a number that represents the cost of foreign fuel (¢/10^6 kcal).

Plant Type Number: This field contains an integer that represents the code number of the thermal-plant fuel type (see Form E035).

Spinning Reserve: This field contains an integer that represents the unit spinning reserve, expressed as a percentage of the maximum unit generating capacity, that is available at the minimum operating level.

Forced Outage Rate: This field contains a number that represents the equivalent full forced outage rate (%).

Scheduled Maintenance: This field contains an integer that represents the number of days per year required for scheduled maintenance of each unit.

Maintenance Class Size: This field contains a number that represents the maintenance class size (MW).

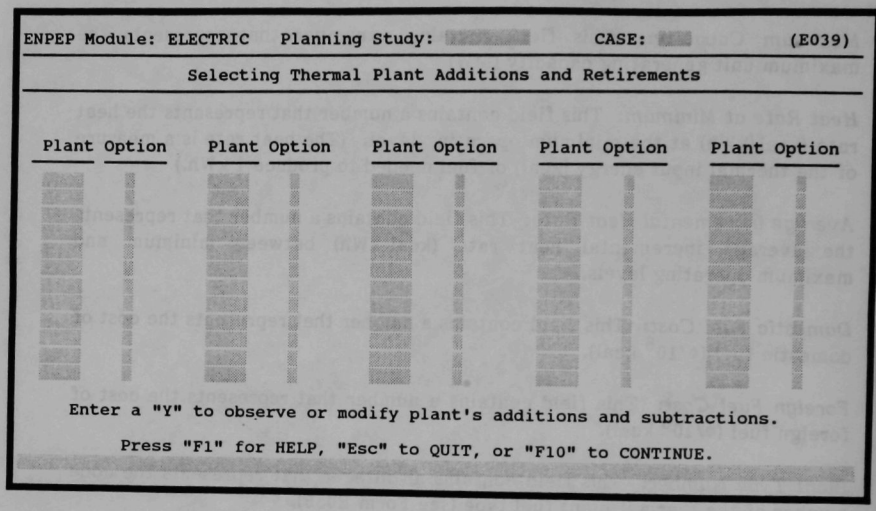
Fixed Operation and Maintenance: This field contains a number that represents the fixed component of nonfuel operation and maintenance costs ($/kW per month) of each unit; it is assumed to be a domestic cost.

Variable Operation and Maintenance: This field contains a number that represents the variable component of nonfuel operation and maintenance cost ($/MWh) of each unit; it is assumed to be a domestic cost.

Reference

WASP-III Users' Manual, card-type B, p. 39.

7.3.31 Form E039 — Selecting Thermal Plant Additions and Retirements to Change



Purpose

Form E039 allows you to select thermal plants for which you want to view or change additions and retirements for the displayed case. You advanced to this form by selecting option 4 on Menu E034.

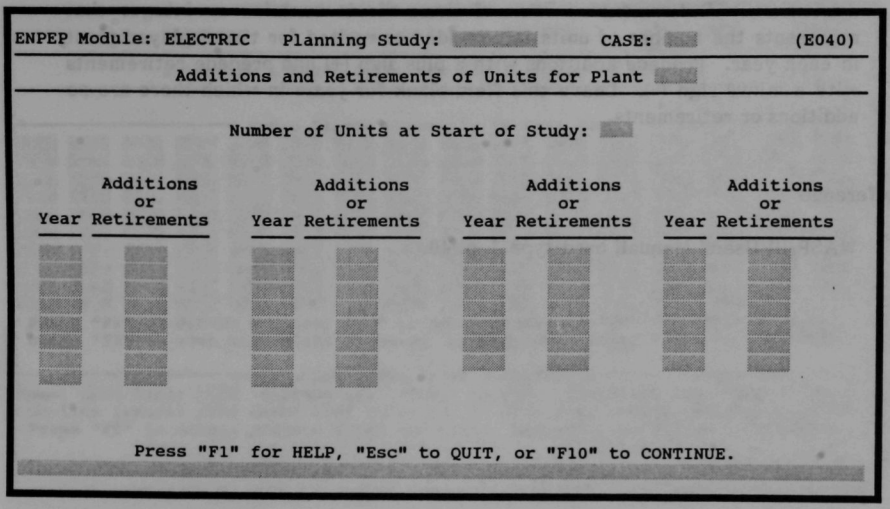
Options

- Select thermal plants as described in the data fields below; then press **F10** to advance to Form E040.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E034.

Data Fields

Option: Enter **Y** in the field to the right of each thermal plant for which you want to view or change the unit additions and retirements.

7.3.32 Form E040 — Changing Thermal Plant Unit Additions and Retirements



Purpose

This form allows you to view or change the number of unit additions and retirements for the displayed plant. You advanced to Form E040 by selecting plants to view or change on Form E039.

Options

- View or change the number of units as described in the data fields below.
- Press **F10** to save the displayed values and advance to the next plant that you selected on Form E039. After you view or change the values for the last plant, press **F10** to return to Form E039.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E039.

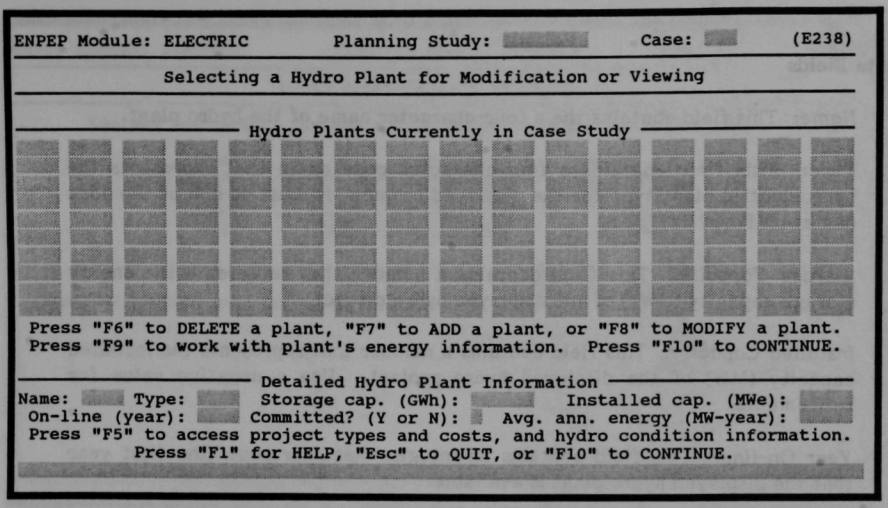
Data Fields

Additions or Retirements: Each of these fields contains an integer that represents the number of units to be added or retired for the displayed plant in each year. Precede additions with a plus sign (+) and precede retirements with a minus sign (-). Leave this field blank for years in which there are no additions or retirements.

Reference

WASP-III Users' Manual, card-type 3, p. 40.

7.3.33 Form E238 — Changing FIXSYS Hydro Plant Data



Purpose

Form E238 allows you to view or change the hydro system data for the FIXSYS and VARSYS submodules. You advanced to this form by selecting option 2 on Menu E032 or E132.

Options

- To view or change basic hydroelectric parameters, press **F5**. You will advance to Form E237.
- To delete a hydro plant from the system, move the cursor to the plant name and press **F6**.
- To add a hydro plant to the system, press **F7**.
- To change a plant description, move the cursor to the plant name and press **F8**. You can then change any of the values in the data fields described below. To save the changes, press **F10**.
- To view or change the energy data for a hydro plant, move the cursor to the plant name and press **F9**. You will advance to Form E239.
- Press **F1** to obtain on-line help.

- Press Esc to cancel any of the functions described above or return to Menu E032 or E132.

Data Fields

Name: This field contains the a four-character name of the hydro plant.

Type: This field contains a four-character code name that represents the hydroelectric plant type for the displayed project. It must be one of the code names on Form E237.

Storage Capacity: This field contains a number that represents the energy storage capacity (GWh) of the displayed hydro project.

Installed Capacity: This field contains a number that represents the installed capacity (MW) of the displayed hydro project. Use a negative value for retirements.

Year On-line: This field contains an integer that represents the first year that the displayed hydro plant is available.

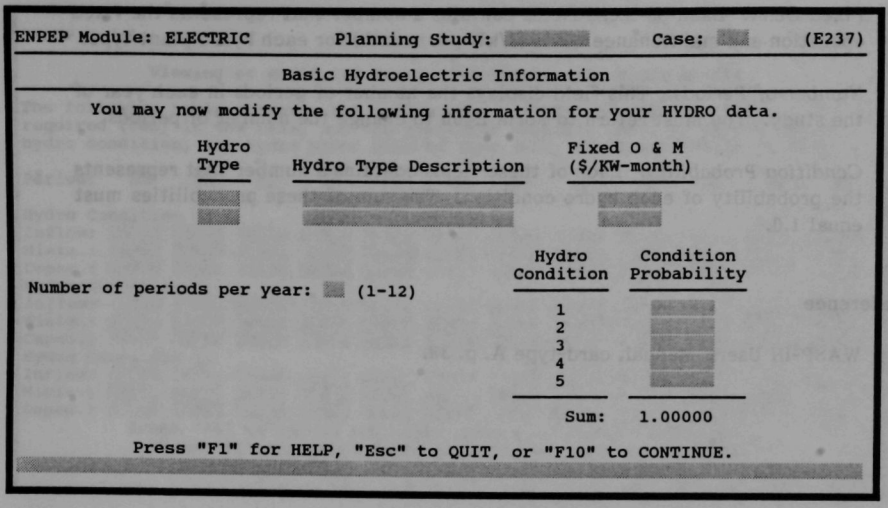
Committed?: Enter **Y** to include the displayed hydro plant in the FIXSYS input file as existing or firmly committed. Enter **N** to include the plant in the VARSYS input file as an uncommitted candidate for expansion.

Average Annual Energy: This field contains a number that represents the annual energy (MW-yr/yr) generated by the displayed hydro plant.

Reference

WASP-III Users' Manual, card-type 2a, p. 40.

7.3.34 Form E237 — Changing Basic Hydroelectric Parameters



Purpose

Form E237 allows you to view or change basic hydroelectric parameters for the FIXSYS and VARSYS submodules. You can define two types of hydro plants. You advanced to this form by pressing **F5** on Form E238.

Options

- View or change the values in the data fields described below.
- Press **F10** to save the displayed values and return to Form E238.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E238.

Data Fields

Hydro Type: This field contains a four-character hydroelectric plant-type code name.

Hydro Type Description: This field contains a description (up to 20 characters) of the hydroelectric plant type.

Fixed O&M: Each of these fields contains a number that represents the fixed operation and maintenance costs ($/kW per month) for each hydro plant type.

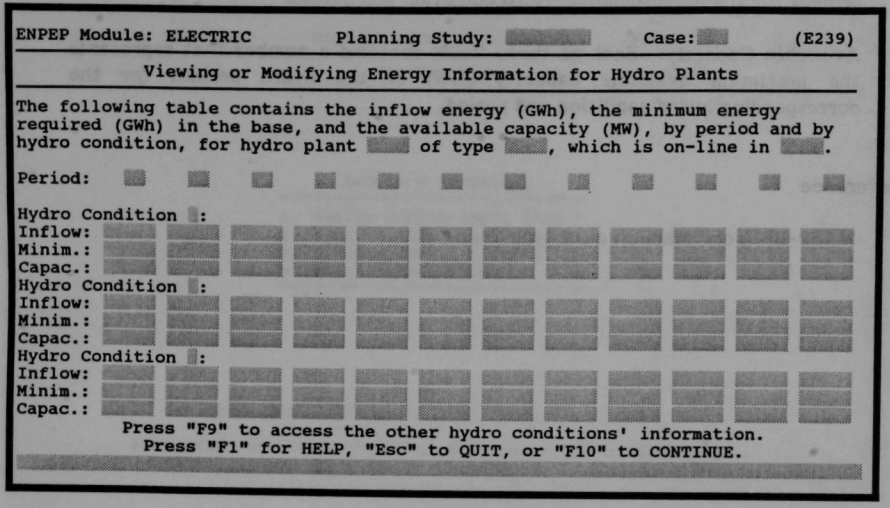
Number of Periods: This field displays the number of periods in each year of the study. You must return to Form E400 to change the number of periods.

Condition Probability: Each of these fields contains a number that represents the probability of each hydro condition. The sum of these probabilities must equal 1.0.

Reference

WASP-III Users' Manual, card-type A, p. 38.

7.3.35 Form E239 — Changing Hydro Plant Energy Data



Purpose

Form E239 allows you to view or change the energy data for any hydro plant in the fixed or variable system. You advanced to this form by pressing **F9** on Form E238.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and return to Form E238.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E238.

Data Fields

Inflow Energy: Each of these fields contains a number that represents the inflow energy (GWh) of the hydro project for the corresponding hydro condition and period.

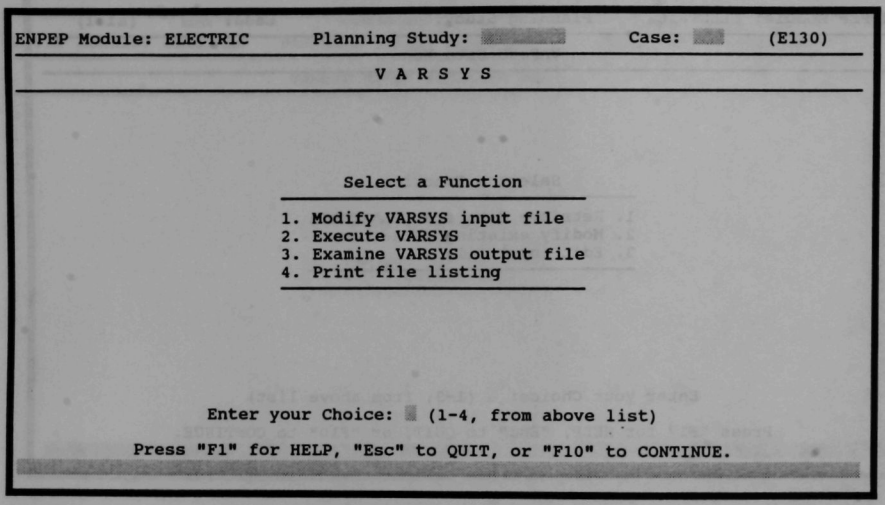
Minimum Energy in Base: Each of these fields contains a number that represents the minimum energy (GWh) required in the base of the hydro project for the corresponding hydro condition and period.

Available Capacity: Each of these fields contains a number that represents the maximum available capacity (MW) of the hydro project for the corresponding hydro condition and period.

Reference

WASP-III Users' Manual, card-type 2b, p. 40.

7.3.36 Menu E130 — VARSYS Submodule Introduction



Purpose

Menu E130 allows you to view or change the VARSYS input and output and to execute the VARSYS submodule. You advanced to this menu by selecting option 4 on Menu E003.

Options

1 Select this option to view or change the VARSYS input file. You will advance to Menu E131.

2 Select this option to execute the VARSYS submodule. You will return to Menu E130 after VARSYS executes (see Menu E004).

3 Select this option to view the VARSYS output file with the ENPEP Paging Routine; after you view the file, press **Esc** to return to this menu.

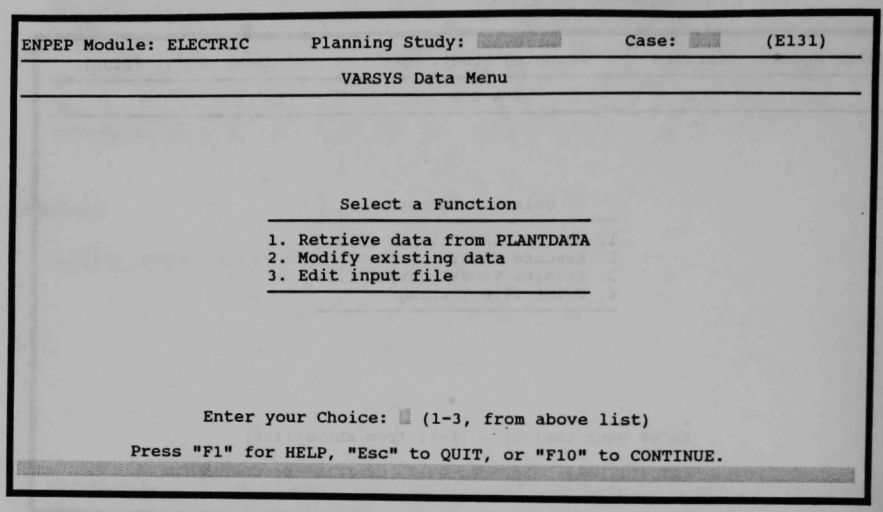
4 Select this option to obtain a listing of the VARSYS input or output files. You will advance to Menu E033.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to advance to Form E500.

7.3.37 Menu E131 — Changing VARSYS Input Data



Purpose

Menu E131 allows you to select a method for viewing or changing the VARSYS input file. You can also create a new VARSYS input file from PLANTDATA Module output. You advanced to this menu by selecting option 1 on Menu E130.

Options

1 Select this option to create a new VARSYS input file. You will advance to Menu E028.

2 Select this option to view or change the VARSYS input data by using forms. You will advance to Menu E132.

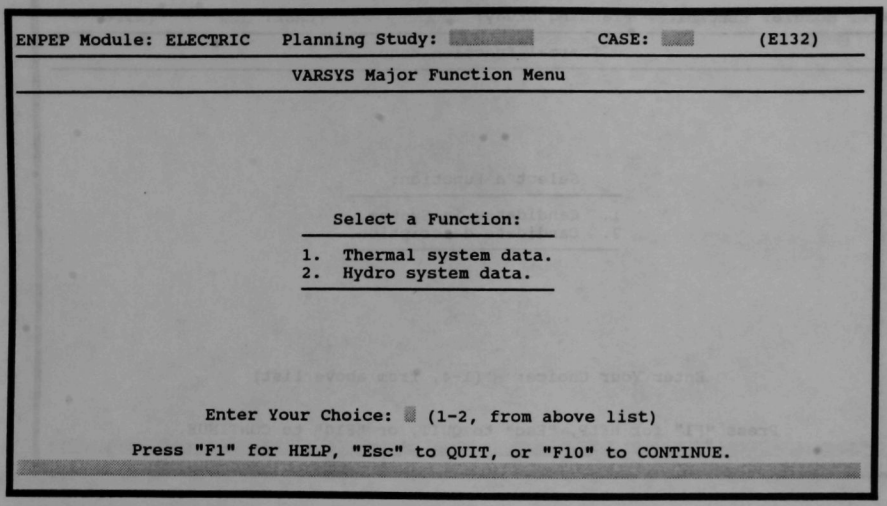
3 Select this option to view or change the VARSYS input file as an actual card image. You will advance to the the IBM Professional Editor and return to this menu when you finish viewing or changing the file.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E130.

7.3.38 Menu E132 — Selecting a VARSYS Function



Purpose

Menu E132 allows you to select a type of VARSYS data to view or change. You advanced to this menu by selecting option 2 on Menu 131.

Options

1 Select this option to view or change the thermal system data. You will advance to Menu E134.

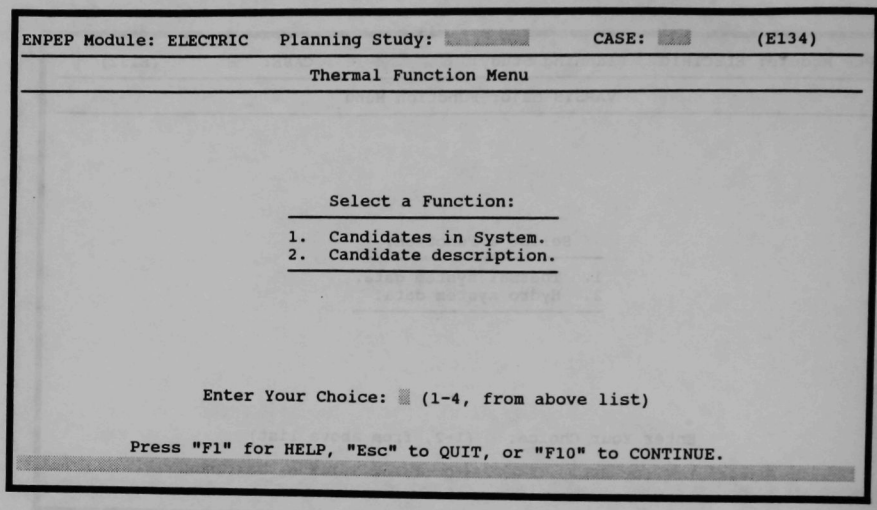
2 Select this option to view or change the hydro system data. You will advance to Form E238.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E131.

7.3.39 Menu E134 — Changing Thermal System Data



Purpose

This is the menu from which you select a type of thermal system data to view or change. You advanced to Menu E134 by selecting option 1 on Menu 132.

Options

1 Select this option to identify the thermal plants that you want to include in VARSYS as expansion candidates for the displayed case. You will advance to Form E036.

2 Select this option to view or change the thermal plant unit descriptions for the displayed case. You will advance to Form E037.

F10 Press this key to continue after you selection an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E132.

7.3.40 Form E138 — Changing VARSYS Expansion Candidate Descriptions

```
ENPEP Module: ELECTRIC   Planning Study:          CASE:          (E138)

                    Thermal Unit Description

                                  Plant name:
                  Minimum operating level:          MW
                          Maximum capacity:         MW
                       Heat rate at minimum:          kcal/kWh
                Average incremental heat rate:        kcal/kWh

                        Domestic fuel cost:       cents/10**6 kcal
                        Foreign fuel cost:        cents/10**6 kcal
                             Plant type number:
                              Spinning reserve:    %
                             Forced outage rate:   %

                       Scheduled maintenance:     days per year
                       Maintenance class size:    MW
                 Fixed operation and maintenance: $/kW-month
          Variable operation and maintenance costs: $/MWh

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Form E138 allows you to view or change the unit description for the displayed thermal expansion candidate. You advanced to this form by selecting candidates to view or change on Form E037.

Options

- View or change the values in the data fields described below.
- Press **F10** to save the displayed unit description and advance to the next expansion candidate that you selected on Form E037. After you view or change the last description, press **F10** to return to Form E037.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E037.

Data Fields

Minimum Operating Level: This field contains a number that represents the minimum operating level (MW) of each unit.

Maximum Capacity: This field contains a number that represents the maximum unit generating capacity (MW).

Heat Rate at Minimum: This field contains a number that represents the heat rate (kcal/kWh) at the minimum operating level.

Average Incremental Heat Rate: This field contains a number that represents the average incremental heat rate (kcal/kWh) between minimum and maximum operating levels.

Domestic Fuel Cost: This field contains a number that represents the cost of domestic fuel (¢/10^6 kcal).

Foreign Fuel Cost: This field contains a number that represents the cost of foreign fuel (¢/10^6 kcal).

Plant Type Number: This field contains an integer that represents the code number of the thermal-plant fuel type (see Form E035).

Spinning Reserve: This field contains an integer that represents the unit spinning reserve expressed as a percentage of the maximum unit generating capacity, that is available at the minimum operating level.

Forced Outage Rate: This field contains a number that represents the equivalent full forced outage rate (%).

Scheduled Maintenance: This field contains an integer that represents the number of days per year that are required for scheduled maintenance of each unit.

Maintenance Class Size: This field contains a number that represents the maintenance class size (MW).

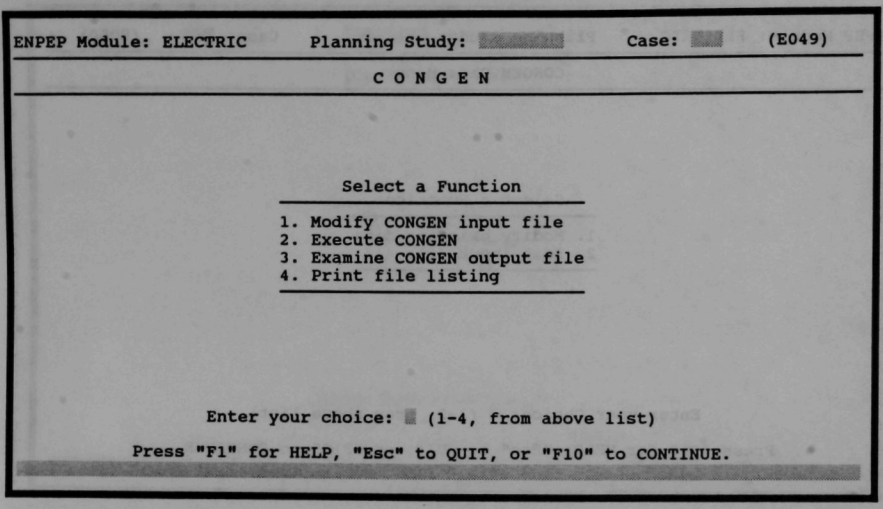
Fixed Operation and Maintenance: This field contains a number that represents the fixed component of nonfuel operation and maintenance costs ($/kW per month) of each unit; it is assumed to be a domestic cost.

Variable Operation and Maintenance: This field contains a number that represents the variable component of nonfuel operation and maintenance cost ($/MWh) of each unit; it is assumed to be a domestic cost.

Reference

WASP-III Users' Manual, card-type B, p. 62.

7.3.41 Menu E049 — CONGEN Submodule Introduction



Purpose

Menu E049 allows you to view or change the CONGEN input and output and execute the CONGEN submodule. You advanced to this menu by selecting option 5 on Menu E003.

Options

1 Select this option to view or modify the CONGEN input file. You will advance to Menu E050.

2 Select this option to execute the CONGEN submodule. After CONGEN executes, you will return to Menu E049 (see Menu E004).

3 Select this option to view the CONGEN output file with the Paging Routine; after you view the file, press **Esc** to return to this menu.

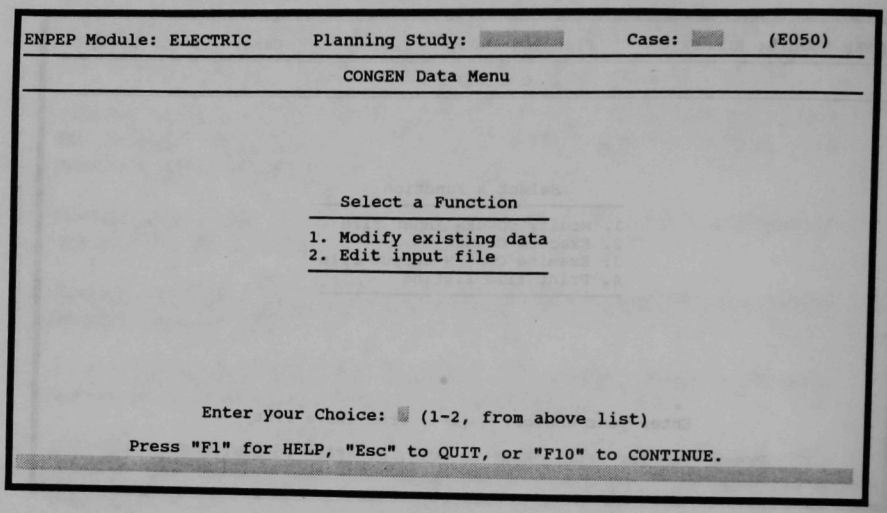
4 Select this option to obtain a listing of the CONGEN input or output files. You will advance to Menu E033.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to advance to Form E500.

7.3.42 Menu E050 — Changing CONGEN Input Data



Purpose

Menu E050 allows you to select a method for viewing or changing the CONGEN input file. You advanced to this menu by selecting option 1 on Menu E049.

Options

1 Select this option to view or change the CONGEN input data by using forms. You will advance to Menu E051.

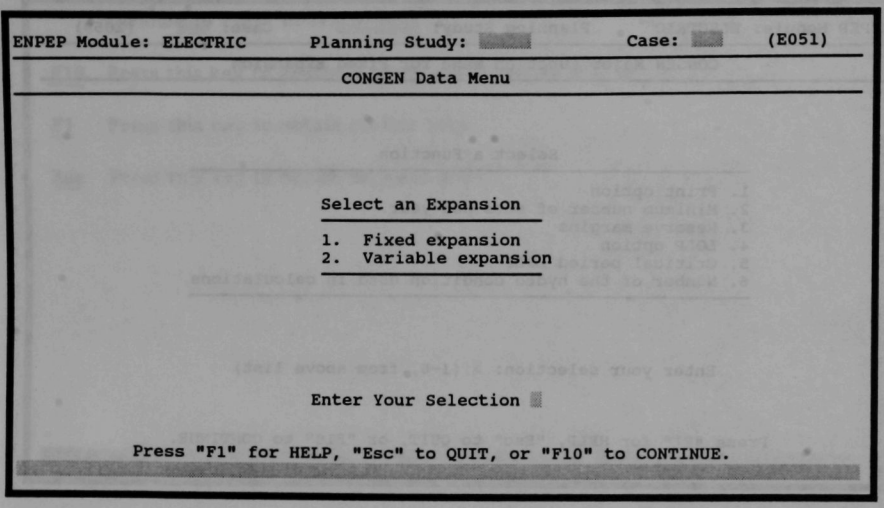
2 Select this option to view or change the CONGEN input file as an actual card image. You will advance to the IBM Professional Editor and return to this menu after you finish viewing or changing the file.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E049.

7.3.43 Menu E051 — Selecting an Expansion Method



Purpose

Use this menu to select one of two types of expansion methods (fixed or variable). It is recommended that you always complete a fixed expansion first to detect any errors or inconsistencies in the data and, thus, reduce computing time. You advanced to Menu E051 by selecting option 1 on Menu E050.

Options

1 Select this option to view or change the data for a fixed expansion. The maximum number of additional units (tunnel widths) are set to zero when you select a fixed expansion; in other words, you are simulating the operation of a predetermined expansion plan. You will advance to Menu E059.

2 Select this option to view or change the data for a variable expansion. You will advance to Menu E052.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E050.

7.3.44 Menu E059 — Selecting a CONGEN Function for Fixed Expansion

```
ENPEP Module: ELECTRIC      Planning Study:          Case:      (E059)
              CONGEN Major Function Menu for Fixed Expansion

                          Select a Function
                1. Print option
                2. Minimum number of sets per year
                3. Reserve margins
                4. LOLP option
                5. Critical period LOLP
                6. Number of the hydro condition used in calculations

                Enter your selection:  (1-6, from above list)

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu E059 allows you to select which type of fixed expansion data to view or change. You advanced to this menu by selecting option 1 on Menu E051.

Options

1 Select this option to view or change the print option. You will advance to Form E061.

2 Select this option to view or change the minimum number of units required to be in service for each expansion candidate in each year of the displayed case. You will advance to Form E058.

3 Select this option to view or change the minimum and maximum reserve margins for the displayed case. You will advance to Form E054.

4 Select this option to view or change the LOLP calculation in CONGEN. You will advance to Form E055.

5 Select this option to view or change the values of the critical period LOLP and annual average LOLP for the displayed case. You will advance to Form E056.

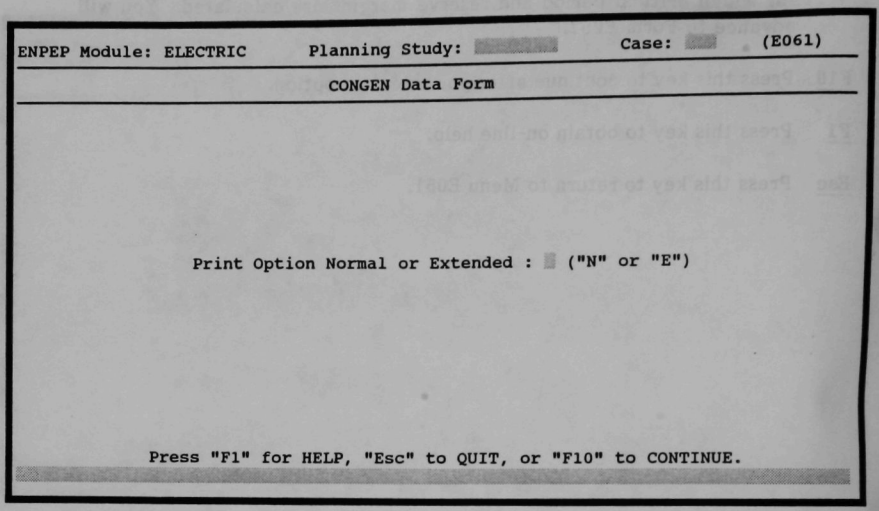
6 Select this option to view or change the number of the hydro condition for which critical period and reserve margins are calculated. You will advance to Form E057.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E051.

7.3.45 Form E061 — Selecting the CONGEN Print Option



Purpose

Form E061 allows you to view or change the option for printing a normal or extended data set. You advanced to this form by selecting option 1 on Menu E059 or E052.

Options

- Select the print option as described in the data field below; then press **F10** to save your selection and return to Menu E059 or E052.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E059 or E052.

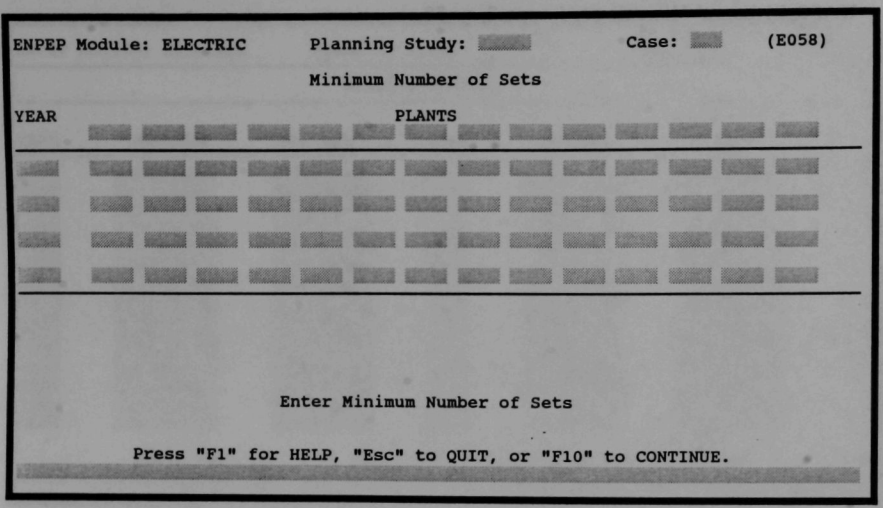
Data Field

Print Option: Enter **N** for normal output or **E** for FIXSYS and VARSYS output in addition to the normal output.

Reference

WASP-III Users' Manual, card-type X, p. 78.

7.3.46 Form E058 — Changing the Number of Units for Fixed Expansion Candidates



Purpose

Form E058 allows you to view or change the minimum number of units in service for each expansion candidate in each year of the displayed case. You advanced to this form by selecting option 2 on Menu E059.

Options

- View or change the number of units in the data fields described below; then press **F10** to save the displayed values and return to Menu E059.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E059.

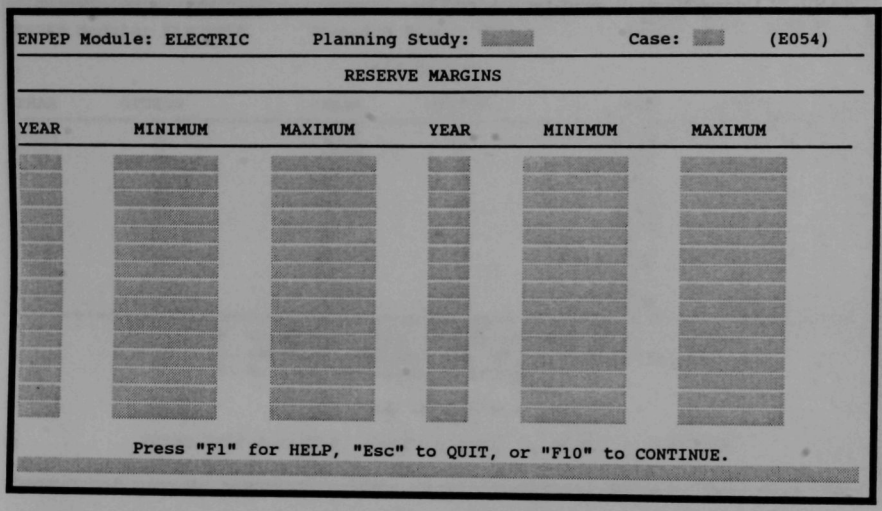
Data Fields

Minimum Number of Units: Each of these fields contains an integer that represents the minimum number of units required to be in service for the displayed expansion candidate in the corresponding year.

Reference

WASP-III Users' Manual, card-type 2, p. 78.

7.3.47 Form E054 — Changing Reserve Margins for the Generating System



Purpose

Form E054 allows you to view or change the reserve margins for each year. You advanced to this form by selecting option 3 on Menu E059 or E052.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and return to Menu E059 or E052.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E059 or E052.

Data Fields

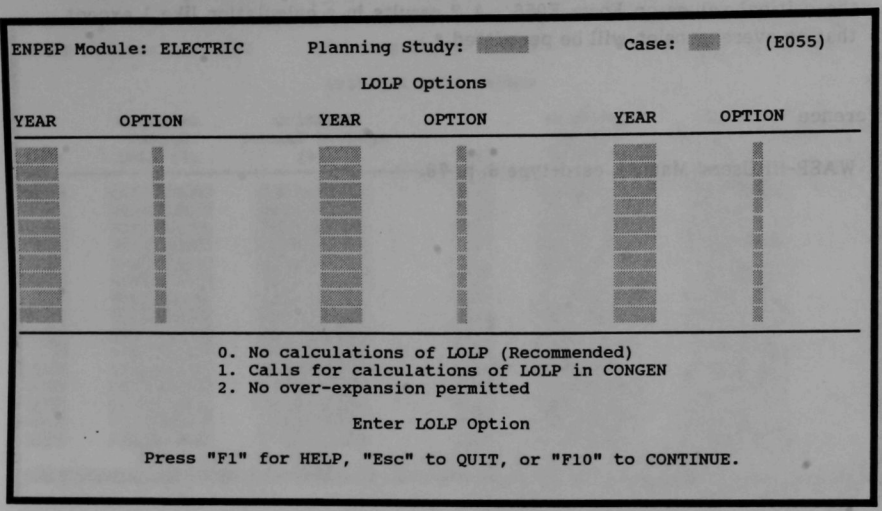
Minimum: Each of these fields contains a number that represents the minimum permissible reserve margin (% of peak load) in the critical period.

Maximum: Each of these fields contains a number that represents the maximum permissible reserve margin (% of peak load) in the critical period.

Reference

WASP-III Users' Manual, card-type 4, p. 78.

7.3.48 Form E055 — Changing the LOLP Calculation



Purpose

This form allows you to view or change the LOLP calculation in CONGEN. You advanced to Form E055 by selecting option 4 on Menu E059 or E052.

Options

- View or change the method as described in the data fields below.
- Press **F10** to save the displayed values and return to Menu E059 or E052.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E059 or E052.

Data Fields

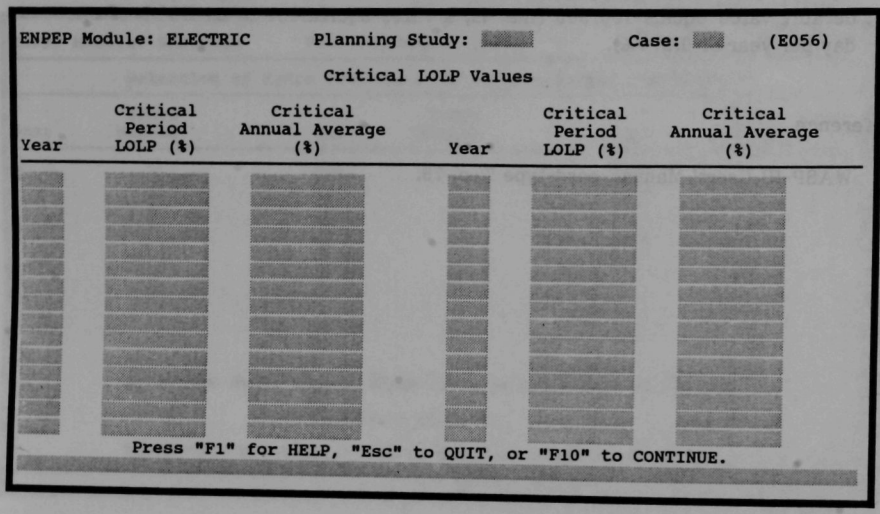
Option: Each of these fields contains a blank or an integer from 0 to 2. A blank results in the use of the method from the previous year. A 0 prevents CONGEN from calculating LOLP; once you enter 0, you must enter a 0 for the remaining years of the case. (Because the LOLP calculation is not accurate and increases computer time by a large factor, it is recommended

that you enter 0.) A 1 causes CONGEN to ignore maintenance when it calculates LOLP and reject configurations for which LOLP exceeds either of the critical values on Form E056. A 2 results in a calculation like 1 except that no overexpansion will be permitted.

Reference

WASP-III Users' Manual, card-type 6, p. 78.

7.3.49 Form E056 — Changing Critical LOLP Values



Purpose

Form E056 allows you to view or change the values of the critical period LOLP and critical annual average LOLP for the displayed case. You advanced to this form by selecting option 5 on Menu E059 or E052.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and return to Menu E059 or E052.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E059 or E052.

Data Fields

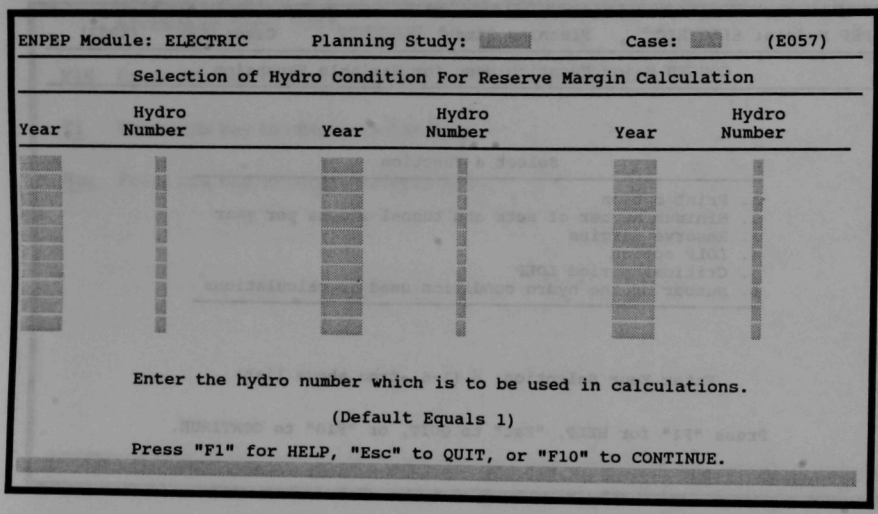
Critical Period LOLP: This field contains a number that represents the critical (maximum acceptable) value (%) of period LOLP. The default value equals 100 times the number of periods divided by 365 (for a study with four periods per year, the default value is 1.096%).

Critical Annual Average: This field contains a number that represents the critical (maximum acceptable) value (%) of annual average LOLP. The default value equals 100/365 (that is, a value equivalent to an LOLP of one day per year or 0.274%).

Reference

WASP-III Users' Manual, card-type 7, p. 79.

7.3.50 Form E057 — Changing CONGEN Hydro Conditions



Purpose

Form E057 allows you to view or change the number of the hydro condition. You advanced to this form by selecting option 6 on Menu E059 or E052.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and return to Menu E059 or E052.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E059 or E052.

Data Fields

Hydro Number: Each of these fields contains an integer that represents the number of the hydro condition for which critical period and reserve margins are calculated. The default hydro-condition number is 1.

Reference

WASP-III Users' Manual, card-type 8, p. 79.

7.3.51 Menu E052 — Selecting a CONGEN Function for Variable Expansion

```
ENPEP Module: ELECTRIC      Planning Study:          Case:      (E052)
          CONGEN Major Fucntion Menu for Variable Expansion

                      Select a Function

          1. Print option
          2. Minimum number of sets and tunnel widths per year
          3. Reserve margins
          4. LOLP option
          5. Critical period LOLP
          6. Number of the hydro condition used in calculations

                Enter Your Selection:  (1-6, from above list)

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Use this menu to select which type of variable expansion data to view or change. You advanced to Menu E052 by selecting option 2 on Menu E051.

Options

1 Select this option to view or change the print option. You will advance to Form E061.

2 Select this option to view or change the minimum number of units required to be in service and the maximum tunnel widths for each expansion candidate in each year of the displayed case. You will advance to Form E053.

3 Select this option to view or change the minimum and maximum reserve margins for the displayed case. You will advance to Form E054.

4 Select this option to view or change the calculation of LOLP in CONGEN. You will advance to Form E055.

5 Select this option to view or change the values of the critical period LOLP and annual average LOLP for the displayed case. You will advance to Form E056.

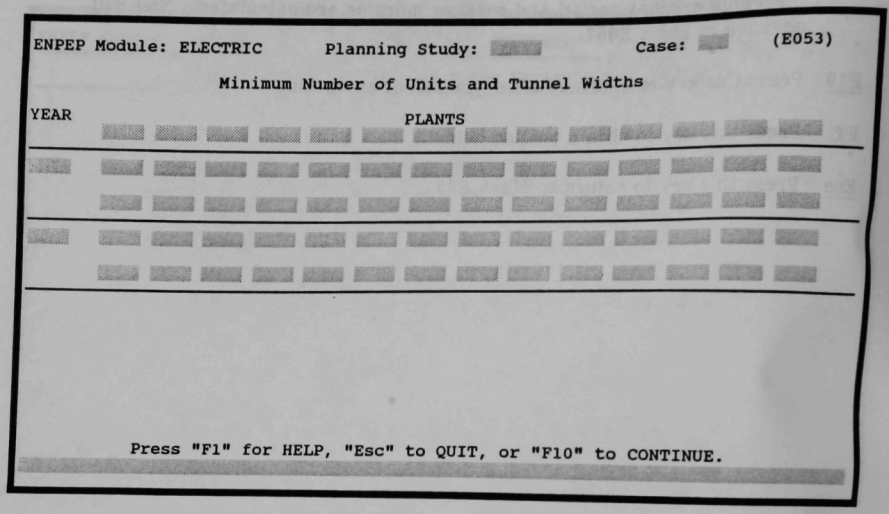
6 Select this option to view or change the number of the hydro condition for which critical period and reserve margins are calculated. You will advance to Form E057.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E051.

7.3.52 Form E053 — Changing Minimum and Maximum Number of Expansion Candidat



Purpose

Form E053 allows you to view or change the minimum number of units required and tunnel widths (maximum number of additional units) for each expansion candidate in each year of the displayed case. You advanced to this form by selecting option 2 on Menu E052.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and return to Menu E052.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E052.

Data Fields

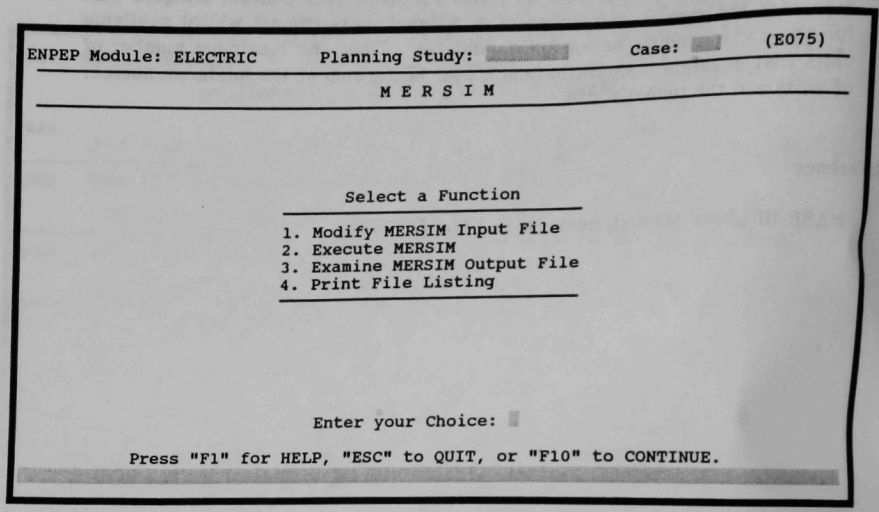
Minimum Number of Units: The upper row of fields for each year contain integers that represent the minimum number of units required to be in service for the corresponding expansion candidates.

Tunnel Width: The lower row of fields for each year contain integers that represent the maximum number of additional units (tunnel width) available for the corresponding expansion candidates. Thus, the maximum number of units that could be in operation each year is the sum of the minimum number of units and the tunnel width.

Reference

WASP-III Users' Manual, card-types 2 and 3, p. 78.

7.3.53 Menu E075 — MERSIM Submodule Introduction



Purpose

Menu E075 allows you to view or change the MERSIM input and output and execute the MERSIM submodule. You advanced to this menu by selecting option 6 on Menu E003.

Options

1 Select this option to view or change the MERSIM input file. You will advance to Menu E076.

2 Select this option to execute the MERSIM submodule. After MERSIM executes, you will return to Menu E075 (see Menu E004).

3 Select this option to view the MERSIM output file with the Paging Routine; after you view the file, press **Esc** to return to this menu.

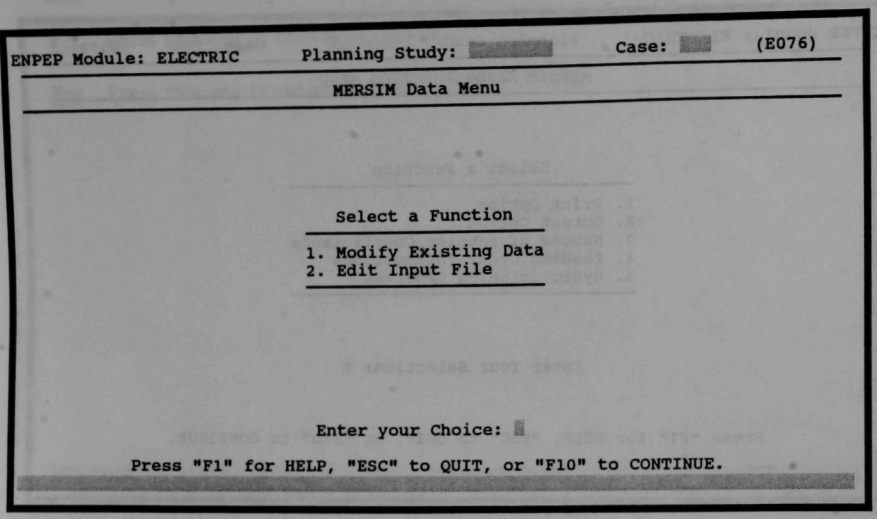
4 Select this option to obtain a listing of the MERSIM input or output files. You will advance to Menu E033.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to advance to Form E500.

7.3.54 Menu E076 — Changing MERSIM Input Data



Purpose

Menu E076 allows you to select a method for viewing or changing the MERSIM input file. You advanced to this menu by selecting option 1 on Menu E075.

Options

1 Select this option to view or change the MERSIM input data by using forms. You will advance to Menu E070.

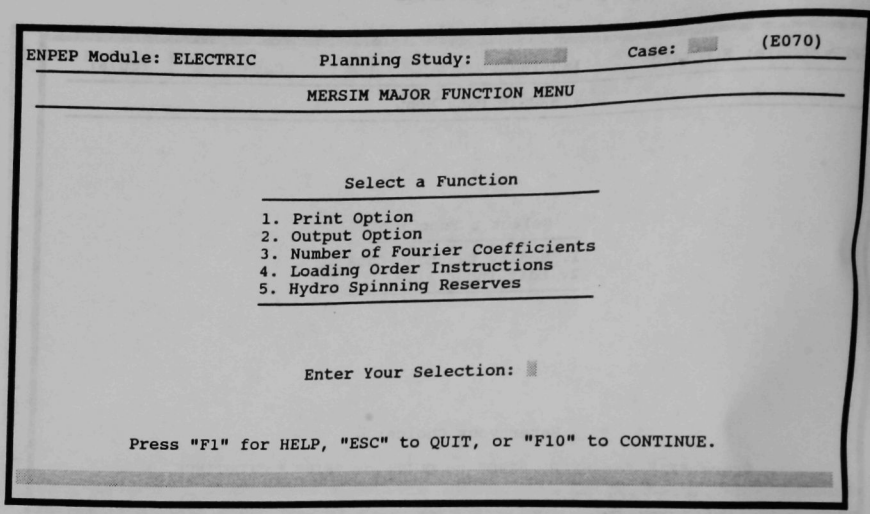
2 Select this option to view or change the MERSIM input file as an actual card image. You will advance to the IBM Professional Editor and return to this menu after you finish viewing or changing the file.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E075.

7.3.55 Menu E070 — Selecting a MERSIM Function



Purpose

Use this menu to select a type of MERSIM data to view or change. You advanced to Menu E070 by selecting option 1 on Menu E076.

Options

1 Select this option to view or change the print option. You will advance to Form E071.

2 Select this option to view or change the MERSIM output option. You will advance to Form E074.

3 Select this option to view or change the number of Fourier coefficients used in the simulation of equivalent LDCs. You will advance to Form E080.

4 Select this option to view or change the method of representing the loading order. You will advance to Form E078.

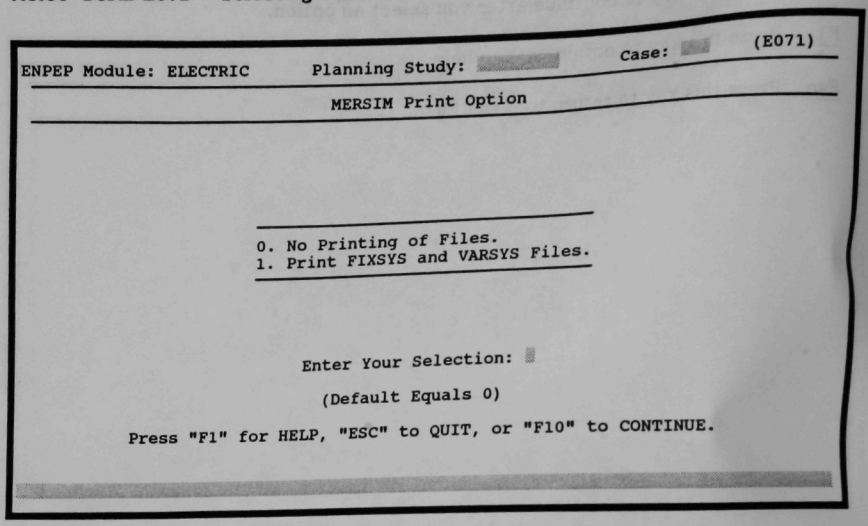
5 Select this option to view or change the hydro plant type spinning reserves. You will advance to Form E079.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E076.

7.3.56 Form E071 — Selecting the MERSIM Print Option



Purpose

Form E071 allows you to view or change the option for printing a normal or extended data set. You advanced to this form by selecting option 1 on Menu E070.

Options

- Select the print option as described in the data field below; then press **F10** to save the displayed option and return to Menu E070.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E070.

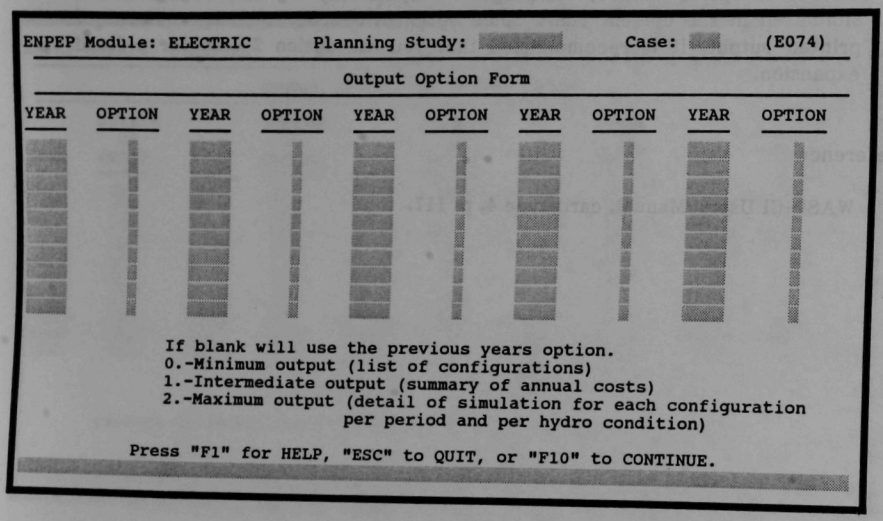
Data Field

Print Option: Enter **N** (normal output) to print only the MERSIM output file. Enter **E** (extended output) to also print the FIXSYS and VARSYS output files.

Reference

WASP-III Users' Manual, card-type X, p. 116.

7.3.57 Form E074 — Changing the MERSIM and REMERSIM Output Options



Purpose

Form E074 allows you to view or change the output option for any year in the displayed case. It is used by both the MERSIM and REMERSIM submodules. You advanced to this form by selecting option 2 on Menu E070 or option 1 on Menu E176.

Options

- View or change the values as described in the data fields below; then press **F10** to save your selections and return to Menu E070 or E176.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E070 or E176.

Data Fields

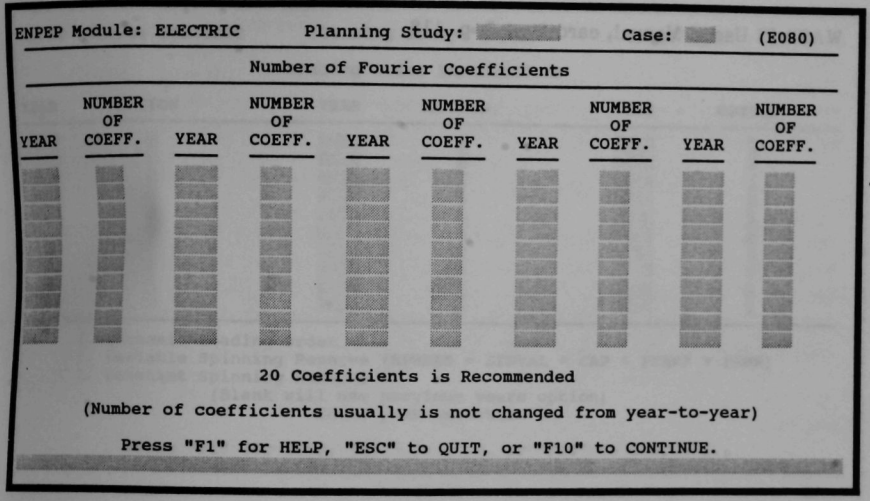
Option: Each of these fields contains a blank or an integer from 0 to 2. A blank results in output as specified in the previous year. A 0 results in a list of the configurations (minimum output). A 1 results in a summary of annual costs for each year (intermediate output). A 2 results in a detailed simulation

for each configuration, period, and hydro condition (maximum output). Whichever option is used, the program outputs only the new configurations simulated in the current run. Since option 2 results in a large amount of printed output, it is recommended that you use option 2 only for a fixed expansion.

Reference

WASP-III Users' Manual, card-type 4, p. 117.

7.3.58 Form E080 — Changing the Number of Fourier Coefficients



Purpose

Form E080 allows you to view or change the number of Fourier coefficients used in MERSIM to represent the equivalent LDC. Use this form if you want to use fewer coefficients than in LOADSY (Form E015 contains the default values). You advanced to this form by selecting option 3 on Menu E070.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and return to Menu E070.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E070.

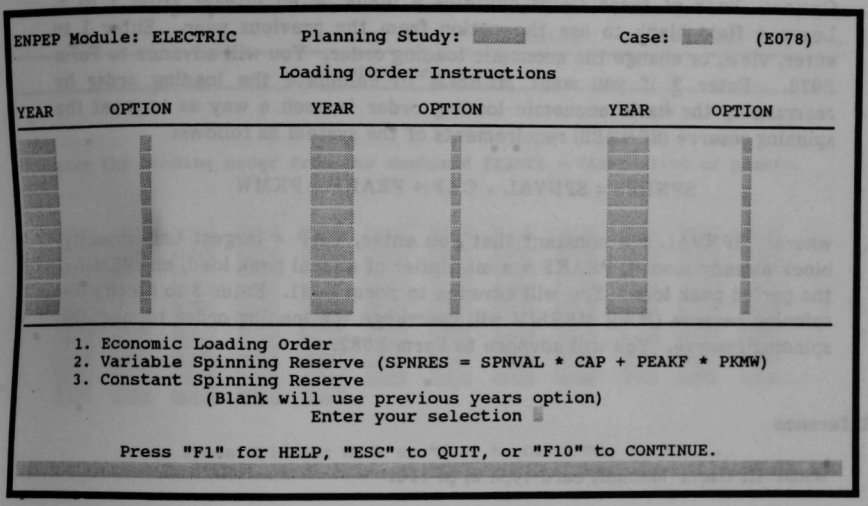
Data Fields

Number of Coeff.: Each of these fields contains an integer that represents the number of Fourier coefficients that MERSIM will use to represent the equivalent LDC. MERSIM computation time will increase in proportion to the number of coefficients.

Reference

WASP-III Users' Manual, card-type 5, p. 118.

7.3.59 Form E078 — Changing Loading Order Representation



Purpose

Form E078 allows you to view or change the method that MERSIM will use to represent the loading order for each year of the case. If you want to use more than one method, it is recommended that you view or change the loading order one year at a time. You advanced to this form by selecting option 4 on Menu E070.

Options

- View or change the method as described in the data fields below.
- Press **F10** to advance to Form E072, E081, or E082 to view or change loading order data for the year indicated by the current cursor position.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E070.

Data Fields

Option: Each of these fields contains a blank or an integer from 1 to 3. Leave a field blank to use the option from the previous year. Enter 1 to enter, view, or change the economic loading order. You will advance to Form E072. Enter 2 if you want MERSIM to calculate the loading order by rearranging the basic economic loading order in such a way as to meet the spinning reserve (SPNRES) requirements of the system as follows:

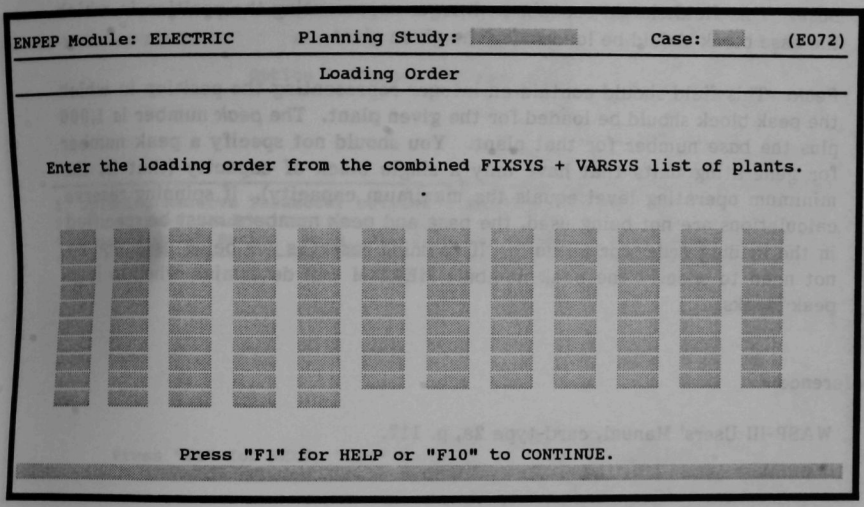
$$SPNRES = SPNVAL \times CAP + PEAKF \times PKMW$$

where: SPNVAL = a constant that you enter, CAP = largest unit capacity block already loaded, PEAKF = a multiplier of annual peak load, and PKMW = the period peak load. You will advance to Form E081. Enter 3 to specify the spinning reserve (MW); MERSIM will rearrange the loading order to meet the spinning reserve. You will advance to Form E082.

Reference

WASP-III Users' Manual, card-type 2, p. 116.

7.3.60 Form E072 — Changing the Economic Loading Order of Thermal Plants



Purpose

Form E072 allows you to view or change the economic loading order of the thermal plants in the displayed year. You cannot omit the code name of any thermal plant from the economic loading order, even if the plant is not operating. These thermal plants are obtained from a combined list of FIXSYS and VARSYS plants that begin with 3 in FIXSYS (code names that begin with 1 or 2 are reserved for hydro plants). The program will automatically load (dispatch) base and peak blocks of thermal plants in order to meet the spinning reserve requirements. You advanced to this form by selecting option 1 on Form E078 or choosing to change the loading order on Form E083.

Options

- View or change the loading order described in the data fields below; then press **F10** to save the displayed values and return to Form E078.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E078.

Data Fields

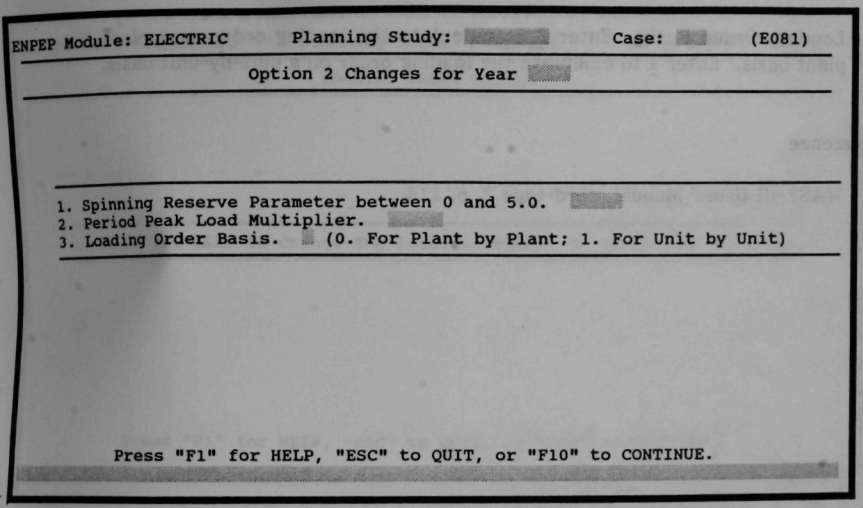
Base: This field should contain an integer representing the position in which the base block should be loaded for the given plant.

Peak: This field should contain an integer representing the position in which the peak block should be loaded for the given plant. The *peak* number is 1,000 plus the *base* number for that plant. You should not specify a peak number for generating units that have only a single block of capacity (that is, the minimum operating level equals the maximum capacity). If spinning reserve calculations are not being used, the base and peak numbers must be specified in the loading order for all units. If spinning reserves are being used, you do not need to specify the peak number; MERSIM will determine when to load peak blocks.

Reference

WASP-III Users' Manual, card-type 2a, p. 117.

7.3.61 Form E081 — Changing Spinning Reserve Parameters



Purpose

Form E081 allows you to view or change the spinning reserve parameter, period peak load multiplier, and the basis for calculating the loading order (unit by unit or plant by plant). You advanced to this form by selecting option 2 on Form E078.

Options

- Examine or modify the values in the data fields described below.
- Press **F10** to save the displayed values and advance to Form E083.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E078.

Data Fields

Spinning Reserve Parameter: This field contains a number between 0.0 and 5.0 that represents the value of the spinning reserve parameter (SPNVAL) in the equation SPNRES = SPNVAL × CAP + PEAKF × PKMW (see Form E078).

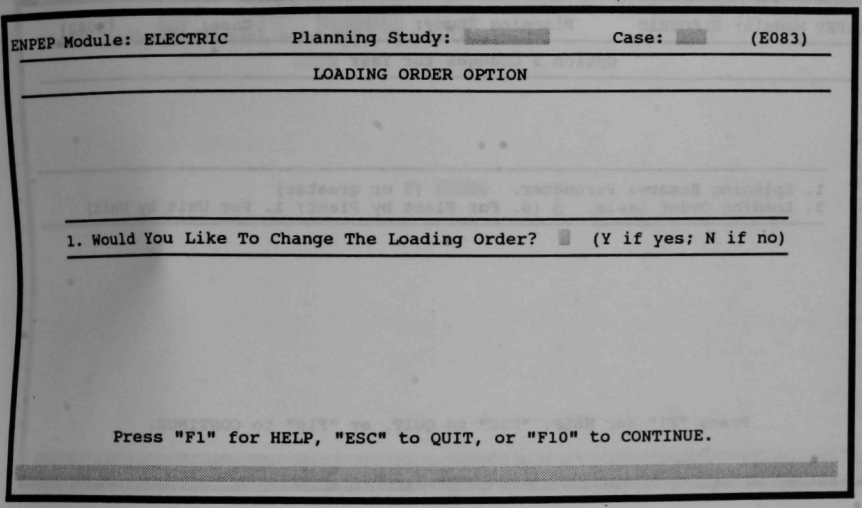
Period Peak Load Multiplier: This field contains a number that represents the value of the period peak load multiplier (PKMW) in the above equation.

Loading Order Basis: Enter **0** to calculate the loading order on a plant-by-plant basis. Enter **1** to calculate the loading order on a unit-by-unit basis.

Reference

WASP-III Users' Manual, card-type 2, p. 116.

7.3.62 Form E083 — Changing the Loading Order for Spinning Reserve



Purpose

Form E083 will prompt you as to whether or not you want to view or change the existing loading order. You advanced to this form after viewing or changing spinning reserve data on Form E081 or E082.

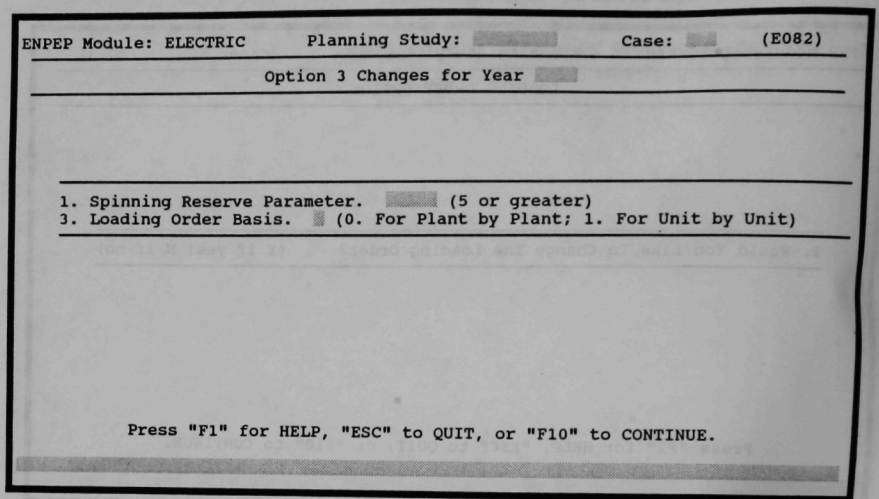
Options

- Enter **Y** to view or change the economic loading order; enter **N** if you do not want to view or change the loading order.
- Press **F10** to advance to Form E072 if you entered **Y** or to return to Form E078 if you entered **N**.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E081 or E082.

Reference

WASP-III Users' Manual, card-type I, p. 116.

7.3.63 Form E082 — Changing Spinning Reserve



Purpose

Form E082 allows you to view or change the spinning reserve and the basis for calculating the loading order (unit by unit or plant by plant). You advanced to this form by using option 3 on Form E078.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and advance to Form E083.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E078.

Data Fields

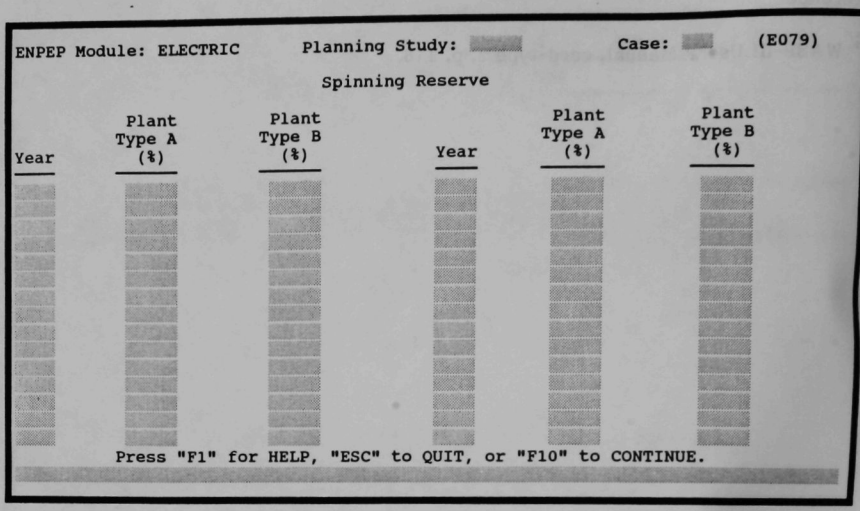
Spinning Reserve: This field contains a number greater than 5.0 that represents the value of the spinning reserve (MW).

Loading Order Basis: Enter **0** to calculate the loading order on a plant-by-plant basis. Enter **1** to calculate the loading order on a unit-by-unit basis.

Reference

WASP-III Users' Manual, card-type 2, p. 116.

7.3.64 Form E079 — Changing Hydro Capacity for Spinning Reserve



Purpose

Form E079 allows you to view or change the total available hydro capacity of plant types A and B (from Form E237) that MERSIM will consider as spinning reserve for each year of the case. You advanced to this form by selecting option 5 on Menu E070.

Options

- View or change the percentages in the data fields described below. The default for all fields is 0.
- Press **F10** to save the displayed values and return to Menu E070.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E070.

Data Fields

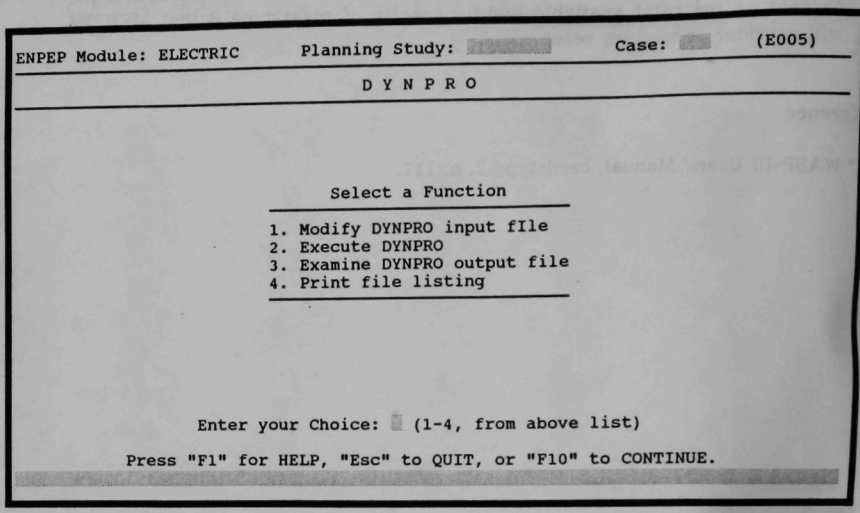
Plant Type A: Each of these fields contains an integer that represents the percent of the total available hydro capacity of plant type A that MERSIM will consider as spinning reserve.

Plant Type B: Each of these fields contains an integer that represents the percent of the total available hydro capacity of plant type B that MERSIM will consider as spinning reserve.

Reference

WASP-III Users' Manual, card-type 2, p. 117.

7.3.65 Menu E005 — DYNPRO Submodule Introduction



Purpose

Menu E005 allows you to view or change DYNPRO input and output. You advanced to this menu by selecting option 8 on Menu E003.

Options

1 Select this option to view or change the DYNPRO input file. You will advance to Menu E006.

2 Select this option to execute the DYNPRO submodule. After DYNPRO executes, you will return to Menu E005 (see Menu E004).

3 Select this option to view the DYNPRO output file with the Paging Routine; after you view the file, press **Esc** to return to this menu.

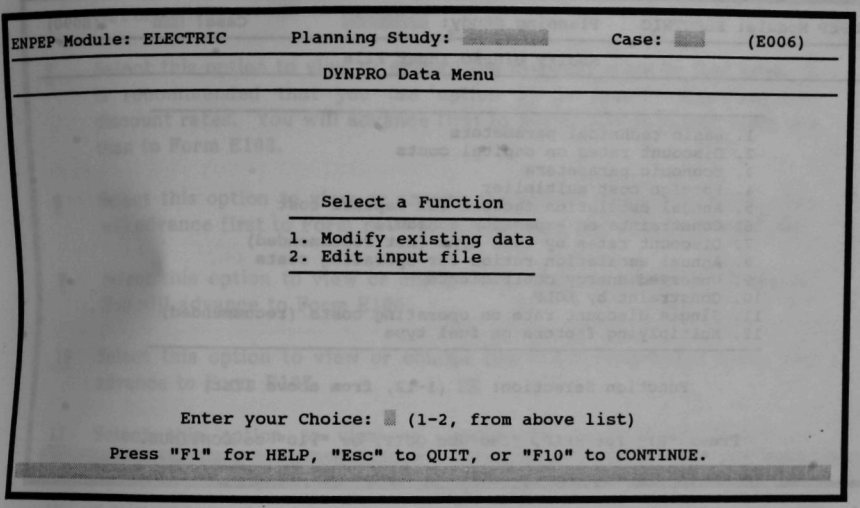
4 Select this option to obtain a listing of the DYNPRO input or output files. You will advance to Menu E033.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to advance to Form E500.

7.3.66 Menu E006 — Changing DYNPRO Input Data



Purpose

Menu E006 allows you to select a method for viewing or changing the DYNPRO input file. You advanced to this menu by selecting option 1 on Menu E005.

Options

1 Select this option to view or change the DYNPRO input data by using forms. You will advance to Menu E090.

2 Select this option to view or change the DYNPRO input file as an actual card image. You will advance to the IBM Professional Editor and return to this menu after you finish viewing or changing the file.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E005.

7.3.67 Menu E090 — Selecting a DYNPRO Function

```
ENPEP Module: ELECTRIC    Planning Study:          Case:      (E090)

                    Modify DYNPRO Input File

        1. Basic technical parameters
        2. Discount rates on capital costs
        3. Economic parameters
        4. Foreign cost multiplier
        5. Annual escalation factors for capital cost
        6. Constraints on expansion schedule
        7. Discount rates by fuel type (not recommended)
        8. Annual escalation ratios for operating costs
        9. Unserved energy coefficients
       10. Constraint by LOLP
       11. Single discount rate on operating costs (recommended)
       12. Multiplying factors on fuel type

            Function Selection:    (1-12, from above list)

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This menu allows you to select a type of DYNPRO input data to view or change. You advanced to Menu E090 by selecting option 1 on Menu E006.

Options

1 Select this option to view or change basic DYNPRO parameters. You will advance to Form E091.

2 Select this option to view or change the discount rates on capital costs (both domestic and foreign). You will advance to Menu E092.

3 Select this option to view or change the economic data of expansion candidates. You will advance to Form E099.

4 Select this option to view or change the foreign cost multiplier. You will advance to Form E101.

5 Select this option to view or change the escalation factors for capital costs. You will advance first to Form E097 to select years and then to Form E098.

6 Select this option to view or change the constraints on the expansion schedule. You will advance first to Form E097 to select years and then to Form E102.

7 Select this option to view or change the discount rates by fuel type. It is recommended that you use option 11 to specify operating-cost discount rates. You will advance first to Form E097 to select years and then to Form E103.

8 Select this option to view or change the annual escalation ratios. You will advance first to Form E097 to select years and then to Form E104.

9 Select this option to view or change the unserved energy coefficients. You will advance to Form E106.

10 Select this option to view or change the LOLP constraints. You will advance to Form E107.

11 Select this option to view or change the single discount rate on operating costs. You will advance to Form E108.

12 Select this option to view or change the escalation factors on fuel types. You will advance first to Form E097 to select years and then to Form E105.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E006.

7.3.68 Form E091 — Changing DYNPRO Basic Parameters

```
ENPEP Module: ELECTRIC    Planning Study:          Case:      (E091)
                    Modify Basic Technical Parameters

File printing option:  (0 or 1, 0 recommended)
States printing option:  (0 or 1, 0 recommended)

Base year for cost discounting calculation:
Base year for cost escalation calculation:
First year of study:
Number of years to be considered for the economic comparison:

Number of best solutions:  (1-10)
Salvage value option:  (0 for linear or 1 for sinking fund, 1 recommended)

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This form allows you to view or change the basic DYNPRO parameters. You advanced to Form E091 by selecting option 1 on Menu E090.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and return to Menu E090.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E090.

Data Fields

Print Option: Enter **0** to print no files. Enter **1** to print both FIXSYS and VARSYS files (this option is useful for debugging).

States Printing Option: Enter 0 if you do not want a listing of the states that DYNPRO considers. Enter 1 to print a listing of the states. This option will produce a listing of the lowest cumulative object function that is associated with every possible configuration (state) in each year.

Discounting Base Year: This field contains an integer that represents the base year for the DYNPRO cost discounting calculation.

Escalation Base Year: This field contains an integer that represents the base year for the DYNPRO cost escalation calculation.

First Year of Study: This field contains an integer that represents the first year of the study.

Number of Years: This field contains the number of years that DYNPRO will consider for economic comparison.

Number of Best Solutions: This field contains the number of best solutions that you want DYNPRO to list in the output. One to three solutions is recommended. Note that the next best solution is defined as the solution having the next lowest value of the objective function and a different configuration in the last study year.

Salvage Value Option: Enter 0 for sinking fund depreciation. Enter 1 for linear depreciation. The default value is 0, which is recommended.

Reference

WASP-III Users' Manual, card-type A, p. 38.

7.3.69 Menu E092 — Selecting Discount Rates for Capital Costs

```
ENPEP Module: ELECTRIC    Planning Study:          Case:      (E092)
                          Discount Rate Menu

          1. Single discount rate for case (recommended option)
          2. Discount rates by year or candidate

                Enter Your Selection:  (1-2, from above list)

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This menu allows you to specify the discount rates for capital costs. It is recommended that you use one rate for the entire case (option 1). You advanced to Menu E092 by selecting option 2 on Menu E090.

Options

1 Select this option to use a single discount rate for the entire case. You will advance to Form E093.

2 Select this option to specify discount rates by year or candidates. You will advance to Menu E094.

F10 Press this key to continue after you select an option.

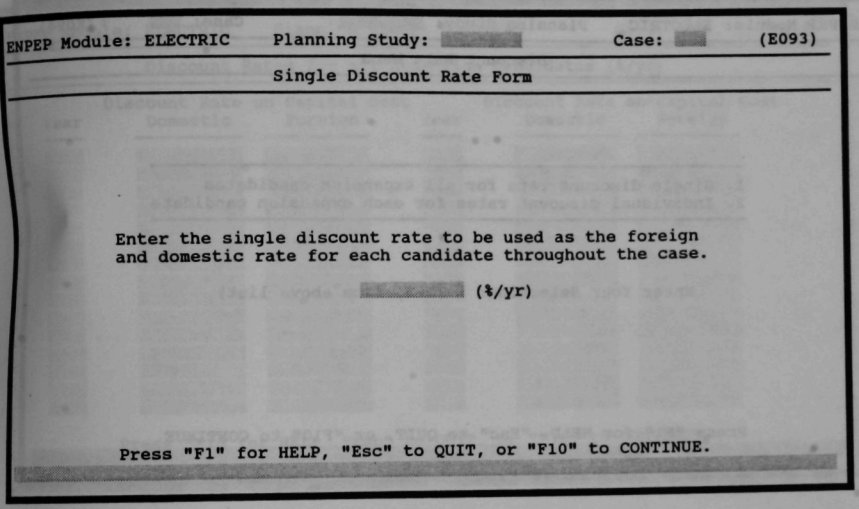
F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E090.

Reference

WASP-III Users' Manual, card-type B, p. 151.

7.3.70 Form E093 — Changing the Single Discount Rate for Capital Costs



Purpose

This form allows you to view or change a single capital cost discount rate for the entire case. Note that this discount rate is only for capital costs; you must also enter discount rates for operating costs (see Form E108). You advanced to Form E093 by selecting option 1 on Menu E092.

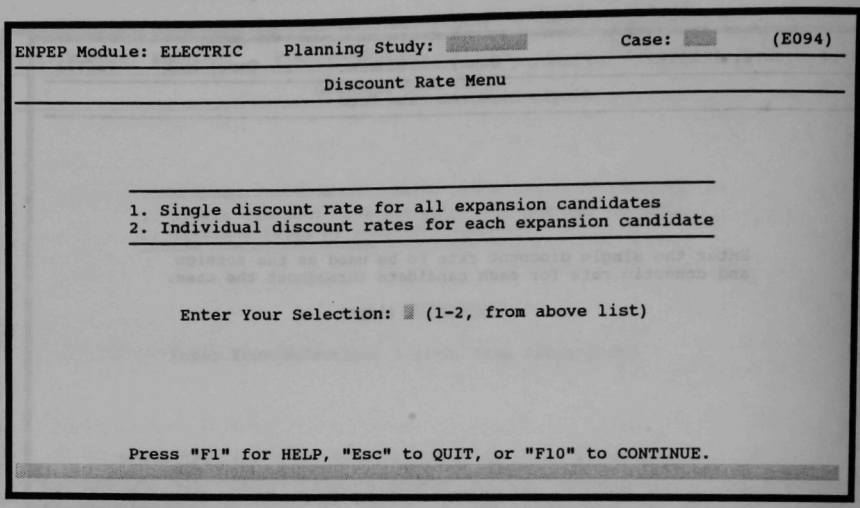
Options

- Enter, view, or change the single discount rate (%/yr) for both domestic and foreign capital costs.
- Press **F10** to save the displayed value and return to Menu E090.
- Press **F1** to obtain on-line help.
- Press **Esc** to return Menu E092.

Reference

WASP-III Users' Manual, card-type C1, p. 151.

7.3.71 Menu E094 — Selecting a Discount Rate Calculation Method



Purpose

This menu allows you to specify whether you want the discount rates specified by candidates or years. You advanced to Menu E094 by selecting option 2 on Menu E092.

Options

1 Select this option to specify the discount rates by candidate. You will advance to Form E095.

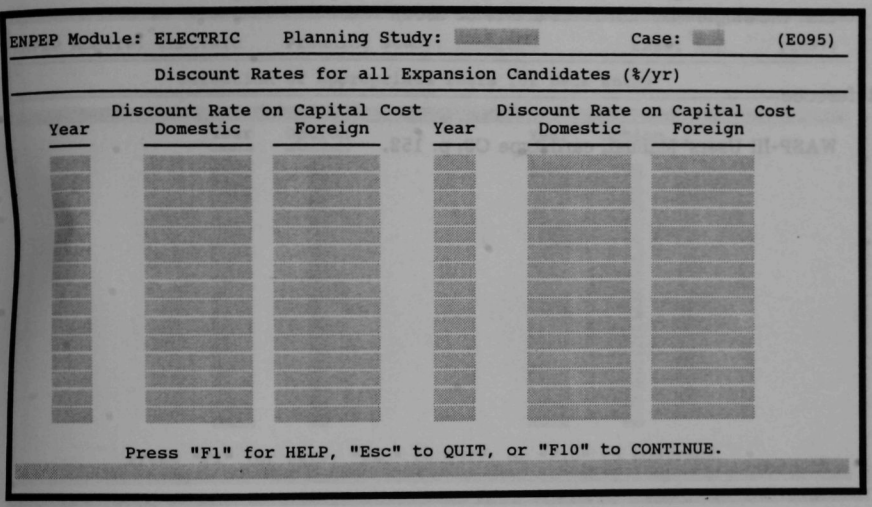
2 Select this option to specify the discount rates by year. You will advance first to Form E097 to select years and then to Form E096.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E092.

7.3.72 Form E095 — Changing Discount Rates by Year



Purpose

This form allows you to view or change the discount rate on both domestic and foreign capital cost by year ending with the last year for which the single discount rates are used. You advanced to Form E095 by selecting option 1 on Menu E094.

Options

- View or change the rates in the data fields described below; then press **F10** to save the displayed values and return to Menu E090.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E094.

Data Fields

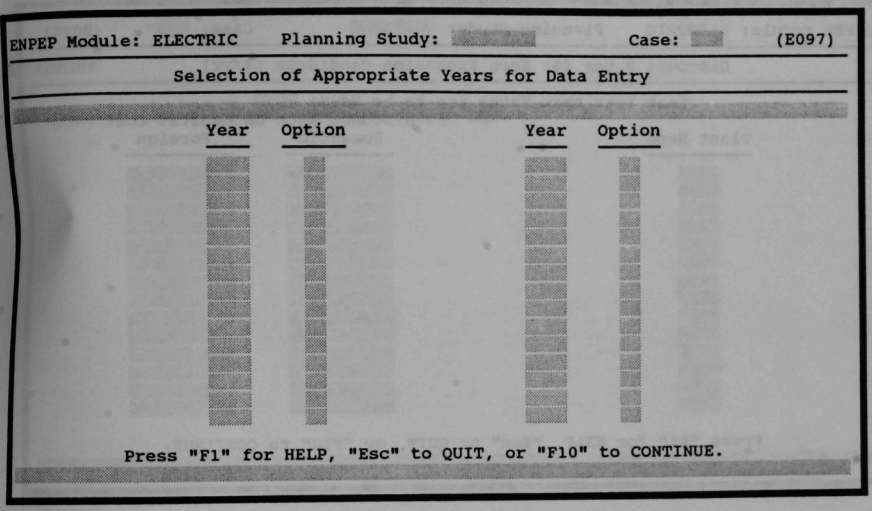
Domestic: Each of these fields contains the discount rate for domestic capital costs for all expansion candidates (for the period ending with the last year that the single discount rates are to be used).

Foreign: Each of these fields contains the discount rate for foreign capital costs for all expansion candidates (for the period ending with the last year that the single discount rates are to be used).

Reference

WASP-III Users' Manual, card-type C3, p. 152.

7.3.73 Form E097 — Selecting Years for Data Entry



Purpose

Use this form to select years for which you want to view or change data. You advanced to Form E097 by selecting option 2 on Menu E094 or option 5, 6, 7, 8, or 12 on Menu E090. Note that when changing the value for a particular year, the same value will be applied to subsequent years by default.

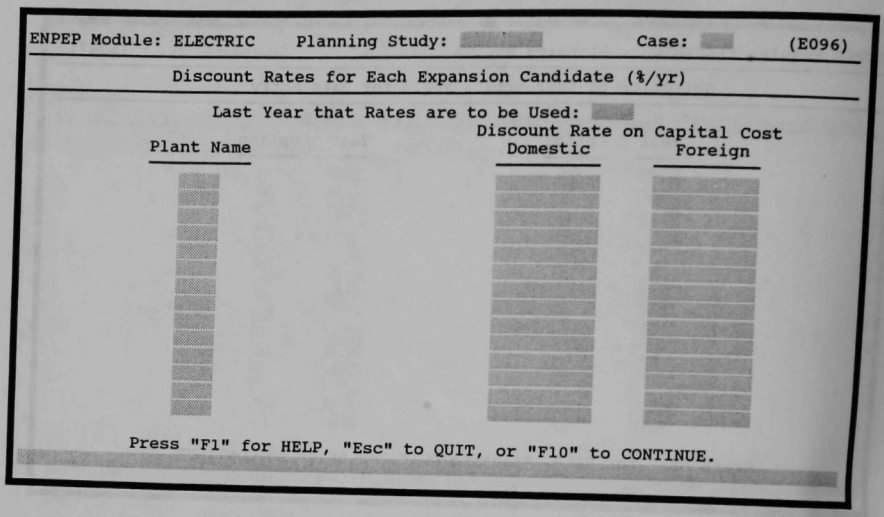
Options

- Select the years for data entry as described in the data fields below.
- Press **F10** to save your selections and continue. If you advanced from Menu E094, you will advance to Form E096. If you advanced by selecting option 5, 6, 7, 8, or 12 on Menu E090, you will advance to Form E098, E102, E103, E104, or E105, respectively.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E094 or E090.

Data Fields

Option: Enter **Y** in the field to the right of each year for which you want to view or change data.

7.3.74 Form E096 — Changing Discount Rates for Each Plant



Purpose

This form allows you to view or change the discount rate on both domestic and foreign capital costs for each plant. You advanced to Form E096 after selecting option 2 on Menu E094 and selecting years on Form E097.

Options

- View or change the rates in the data fields described below.
- Press **F10** to save the displayed values and advance to the next year that you selected on Form E097. After you view or change the values for the last year, press **F10** to return to Form E097.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E097. Escape will not delete the values saved with previous **F10** keystrokes.

Data Fields

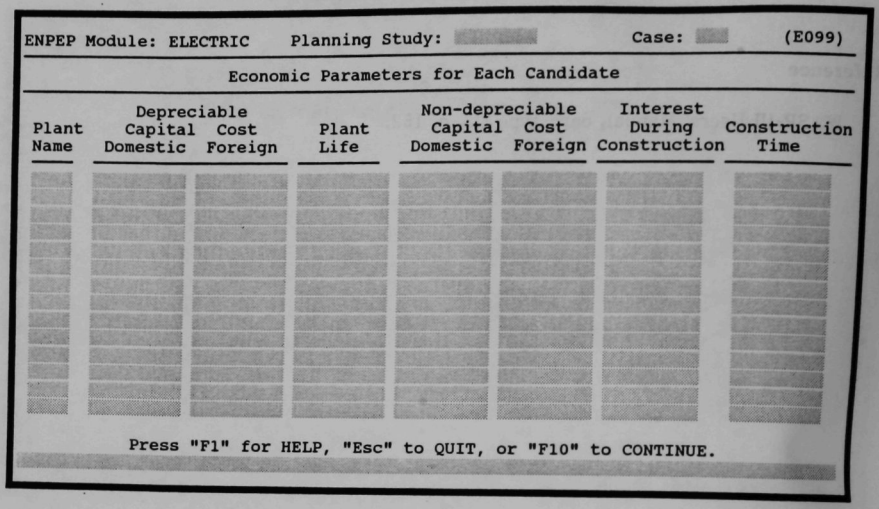
Domestic: Each of these fields contains the discount rate (%) for domestic capital costs for the corresponding expansion candidate.

Foreign: Each of these fields contains the discount rate (%) for foreign capital costs for the corresponding expansion candidate.

Reference

WASP-III Users' Manual, card-type C3, p. 152.

7.3.75 Form E099 — Changing Expansion Candidate Economic Data



Purpose

Form E099 allows you to view or change the economic data for each expansion candidate in the electric system. You advanced to this form by selecting option 3 on Menu E090.

Options

- View or change the values in the data fields described below. For hydro plants, leave all fields blank except for *plant life*.
- Press **F10** to save the displayed values and advance to Form E100 to view or change hydro plant data.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E090.

Data Fields

Depreciable Capital Cost Domestic: Each of these fields contains the depreciable domestic capital cost ($/kW) of each expansion candidate. This cost includes interest during construction.

Depreciable Capital Cost Foreign: Each of these fields contains the depreciable foreign capital cost ($/kW) of each expansion candidate. This cost includes interest during construction.

Plant Life: Each of these fields contains the plant life (in years and fractions of years) that will be used for salvage value calculations.

Nondepreciable Capital Cost Domestic: Each of these fields contains the nondepreciable domestic capital cost ($/kW).

Nondepreciable Capital Cost Foreign: Each of these fields contains the nondepreciable foreign capital cost ($/kW).

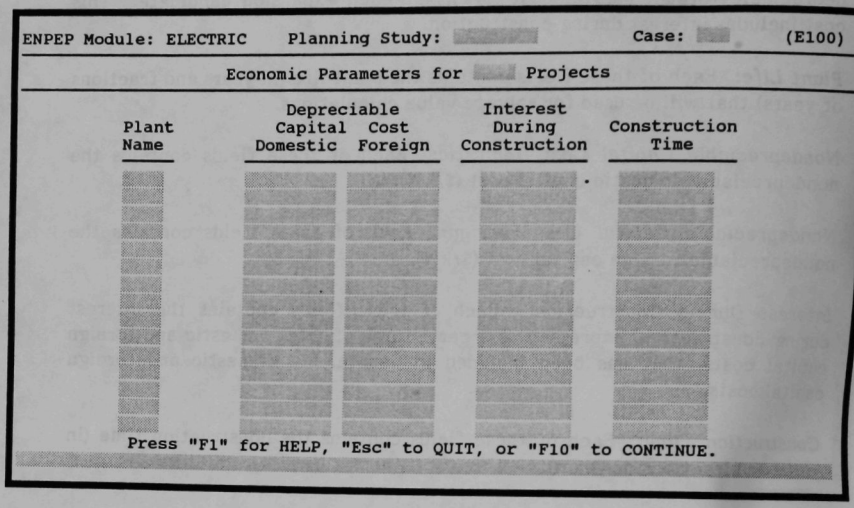
Interest During Construction: Each of these fields contains the interest during construction, expressed as a percentage of total domestic and foreign capital costs, that has been included in depreciable domestic and foreign capital costs.

Construction Time: Each of these fields contains the construction time (in years and fractions of years).

Reference

WASP-III Users' Manual, card-type 2, p. 152.

7.3.76 Form E100 — Changing Hydro Plant Economic Data



Purpose

This form allows you to view or change the economic data for each hydro project. You advanced to Form E100 after completing Form E099.

Options

- View or change the values in the data fields described below; then press **F10** to save the displayed values and return to Menu E090.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E099.

Data Fields

Domestic: Each of these fields contains the depreciable domestic capital cost ($/kW) of the corresponding hydro project. This cost includes interest during construction.

Foreign: Each of these fields contains the depreciable foreign capital cost ($/kW) of the corresponding hydro project. This cost includes interest during construction.

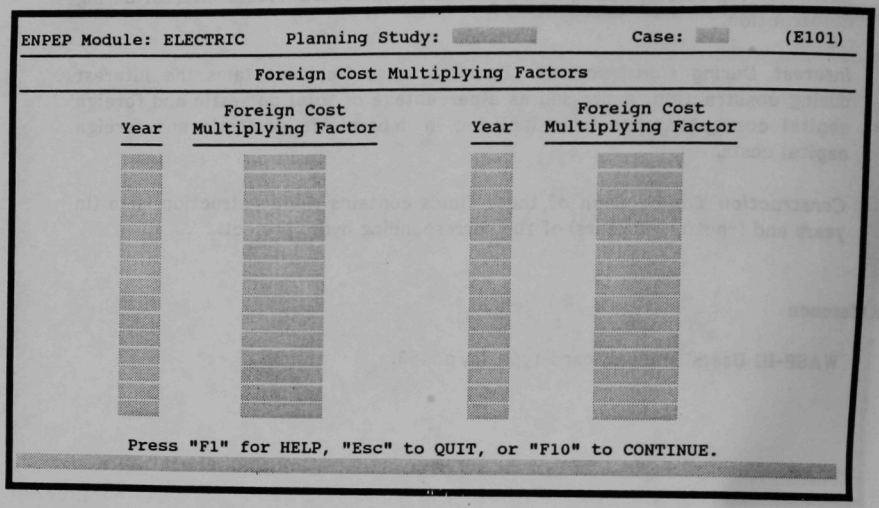
Interest During Construction: Each of these fields contains the interest during construction, expressed as a percentage of total domestic and foreign capital costs, that has been included in depreciable domestic and foreign capital costs.

Construction Time: Each of these fields contains the construction time (in years and fraction of years) of the corresponding hydro project.

Reference

WASP-III Users' Manual, card-type 2a, p. 153.

7.3.77 Form E101 — Changing Foreign Cost Multipliers



Purpose

This form allows you to view or change the foreign cost multipliers factors for any year in the study. You advanced to Form E101 by selecting option 4 on Menu E090.

Options

- View or change the factors in the data fields described below; then press **F10** to save the displayed values and return to Menu E090.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E090.

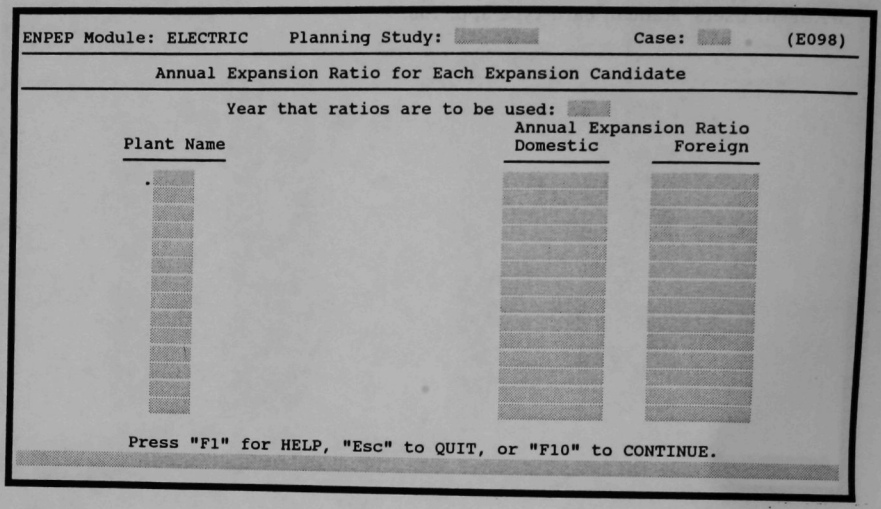
Data Fields

Foreign Cost Multiplying Factor: Each of these fields contains the factor with which DYNPRO will multiply all foreign costs. In general, you can use this factor to penalize foreign expenditures; therefore the factors should have values greater than 1.0, which is the default.

Reference

WASP-III Users' Manual, card-type 3, p. 153.

7.3.78 Form E098 — Changing Annual Escalation Ratios for Capital Costs



Purpose

Form E098 allows you to view or change both domestic and foreign annual escalation ratios for capital costs. During capital cost calculations, the capital cost from the previous year will be multiplied by this ratio to obtain the capital cost in the current year. You advanced to this form after selecting option 5 on Menu E090 and selecting years on Form E097.

Options

- View or change the ratios for each plant in the data fields described below. The default for all fields is 1.0.
- Press **F10** to save the displayed values and advance to the next year that you selected on Form E097. After you view or change the values for the last year, press **F10** to return to Form E097.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E097. Escape will not delete the values saved by previous **F10** keystrokes.

Data Fields

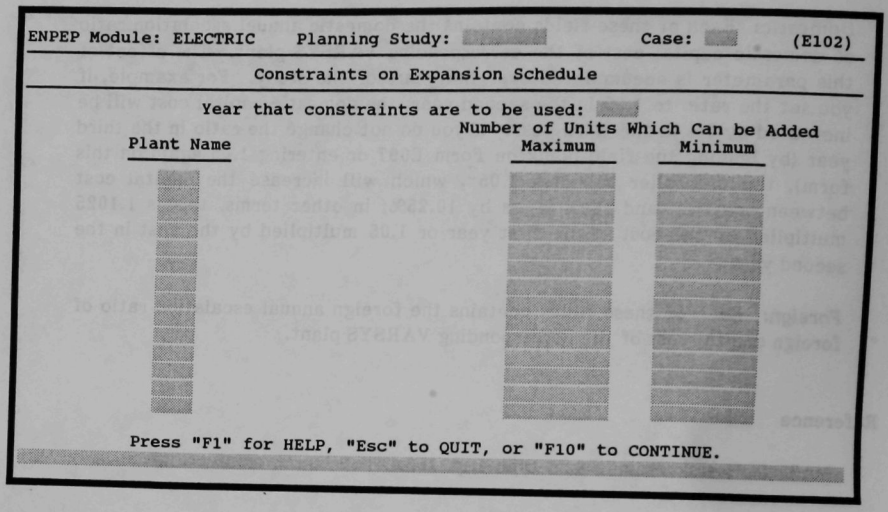
Domestic: Each of these fields contains the domestic annual escalation ratio of domestic capital cost of the corresponding VARSYS plant. The effect of this parameter is accumulated over the years of the study. For example, if you set the ratio to 1.05 in the second year, the domestic capital cost will be increased by 5% in the third year. If you do not change the ratio in the third year (by leaving the field blank on Form E097 or entering 1.05 again on this form), the multiplier becomes 1.05^2, which will increase the capital cost between the first and third years by 10.25%; in other terms, this is 1.1025 multiplied by the cost in the first year or 1.05 multiplied by the cost in the second year.

Foreign: Each of these fields contains the foreign annual escalation ratio of foreign capital cost of the corresponding VARSYS plant.

Reference

WASP-III Users' Manual, card-type 4, p. 153.

7.3.79 Form E102 — Changing the Constraints on Expansion



Purpose

This form allows you to view or change the minimum or maximum number of units that can be added per plant each year. You advanced to Form E102 after selecting option 6 on Menu E090 and selecting years to view or change on Form E097.

Options

- View or change the number of units in the data fields described below.
- Press **F10** to save the displayed values and advance to the next year that you selected on Form E097. After you view or change the data for the last year, press **F10** to return to Form E097.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E097. Escape will not delete the values saved by previous **F10** keystrokes.

Data Fields

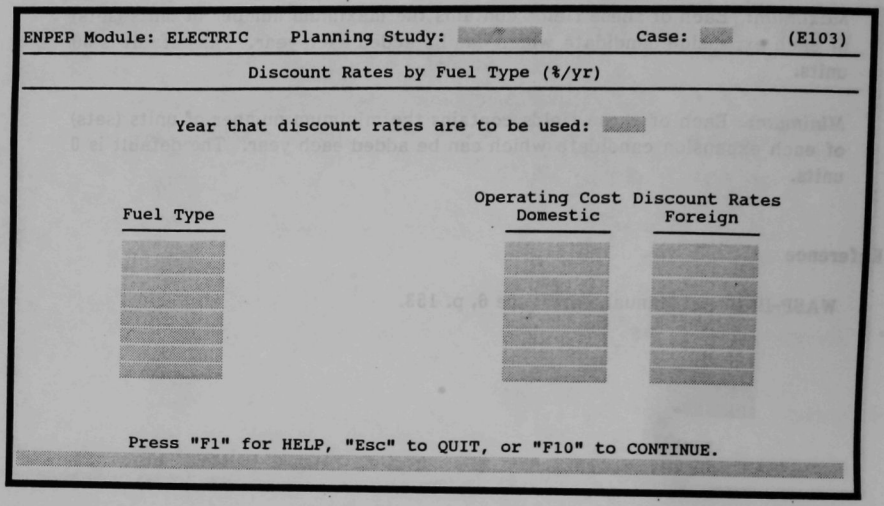
Maximum: Each of these fields contains the maximum number of units (sets) of each expansion candidate which can be added each year. The default is 50 units.

Minimum: Each of these fields contains the minimum number of units (sets) of each expansion candidate which can be added each year. The default is 0 units.

Reference

WASP-III Users' Manual, card-type 6, p. 153.

7.3.80 Form E103 — Changing Discount Rates by Fuel Type



Purpose

Form E103 allows you to view or change the operating cost discount rates by fuel type for the displayed year. You advanced to this form after selecting option 7 on Menu E090 and selecting years on Form E097.

Options

- View or change the rates in the data fields described below. The default for all fields is 0.0.
- Press **F10** to save the displayed values and advance to the next year that you selected on Form E097. After you view or change the rates for the last year, press **F10** to return to Form E097.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E097. Escape will not delete the values saved by previous **F10** keystrokes.

Data Fields

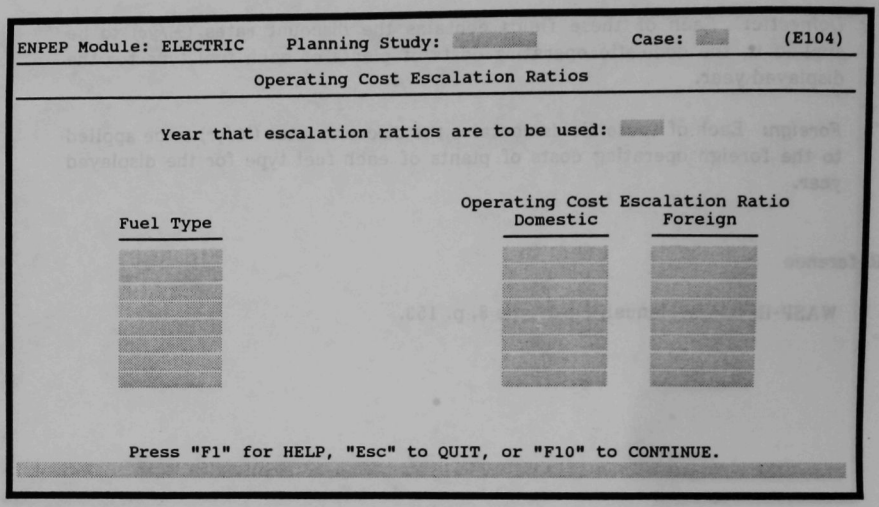
Domestic: Each of these fields contains the discount rates (%/yr) to be applied to the domestic operating costs of plants of each fuel type for the displayed year.

Foreign: Each of these fields contains the discount rates (%/yr) to be applied to the foreign operating costs of plants of each fuel type for the displayed year.

Reference

WASP-III Users' Manual, card-type 8, p. 153.

7.3.81 Form E104 — Changing Operating-Cost Escalation Ratios



Purpose

This form allows you to view or change the operating-cost escalation ratios for the displayed year. You advanced to Form E104 after selecting option 8 on Menu E090 and selecting years on Form E097.

Options

- View or change the ratios in the data fields described below. The default value for all fields is 1.0.
- Press **F10** to save the displayed values and advance to the next year that you selected on Form E097. After you press **F10** to save the values for the last year, you will return to Form E097.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E097. Escape will not delete the values saved with previous **F10** keystrokes.

Data Fields

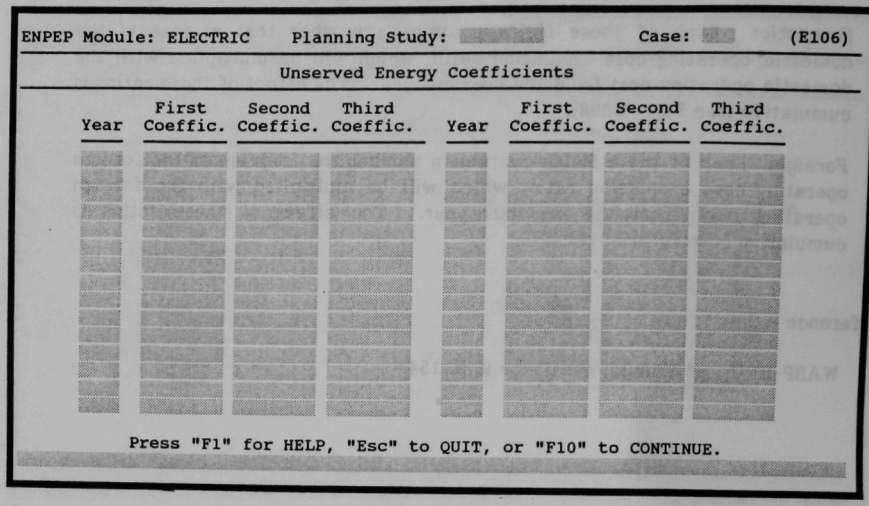
Domestic: Each of these fields contains a number that represents the domestic operating-cost escalation ratio, which will be multiplied with the domestic operating cost from the previous year. The effect of those ratios is cumulative (see Form E098).

Foreign: Each of these fields contains a number that represents the foreign operating-cost escalation ratio, which will be multiplied with the foreign operating cost from the previous year. The effect of these ratios is cumulative (see Form E098).

Reference

WASP-III Users' Manual, card-type 9, p. 154.

7.3.82 Form E106 — Changing Unserved Energy Coefficients



Purpose

This form allows you to view or change the unserved energy coefficients for any year. You advanced to Form E106 by selecting option 9 on Menu E090.

Options

- View or change the coefficients in the data fields described below. The default value for all fields is 0.0.
- Press **F10** to save the displayed values and return to Menu E090.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E090.

Data Fields

First Coefficient: Each of these fields contains a number that represents the first-order coefficient for the polynomial of unserved energy incremental cost ($/kWh) as a function of the unserved energy (fraction of annual energy).

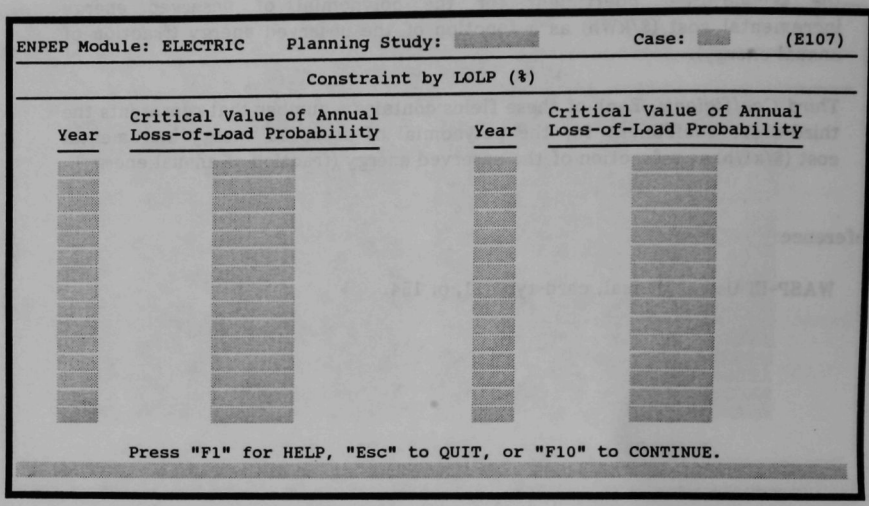
Second Coefficient: Each of these fields contains a number that represents the second-order coefficient for the polynomial of unserved energy incremental cost ($/kWh) as a function of the unserved energy (fraction of annual energy).

Third Coefficient: Each of these fields contains a number that represents the third-order coefficient for the polynomial of unserved energy incremental cost ($/kWh) as a function of the unserved energy (fraction of annual energy).

Reference

WASP-III Users' Manual, card-type 11, p. 154.

7.3.83 Form E107 — Changing LOLP Critical Values



Purpose

Form E107 allows you to view or change the critical LOLP value for each study year. You advanced to this form by selecting option 10 on Menu E090.

Options

- View or change the probabilities in the data fields described below; then press **F10** to save the displayed values and return to Menu E090.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E090.

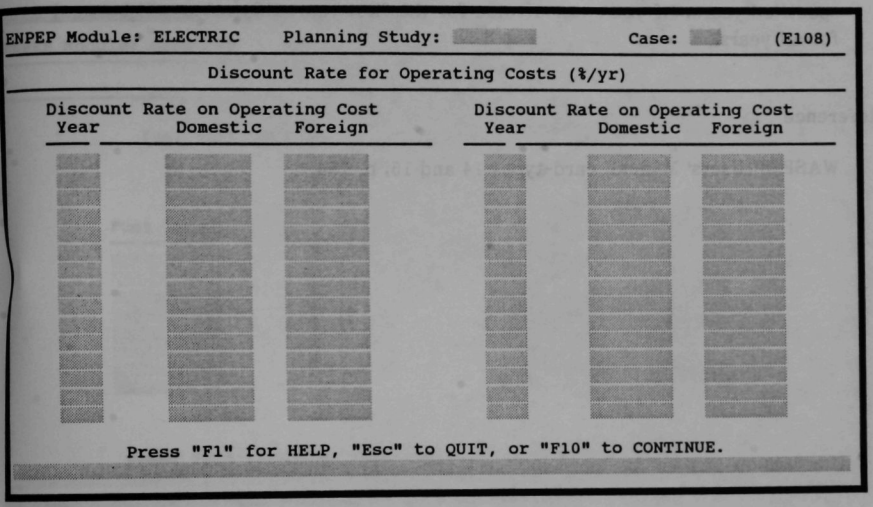
Data Fields

Critical Value: Each of these fields contains the critical value (%) of annual LOLP. The default value is 100.0. No solution will be allowed that has an annual LOLP greater than the critical value for the corresponding year.

Reference

WASP-III Users' Manual, card-type 12, p. 154.

7.3.84 Form E108 — Changing Operating-Cost Discount Rates



Purpose

This form allows you to view or change the discount rate for operating costs for any year. You advanced to Form E108 by selecting option 11 on Menu E090.

Options

- View or change the rates in the data fields described below; then press **F10** to save the displayed values and return to Menu E090.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E090.

Data Fields

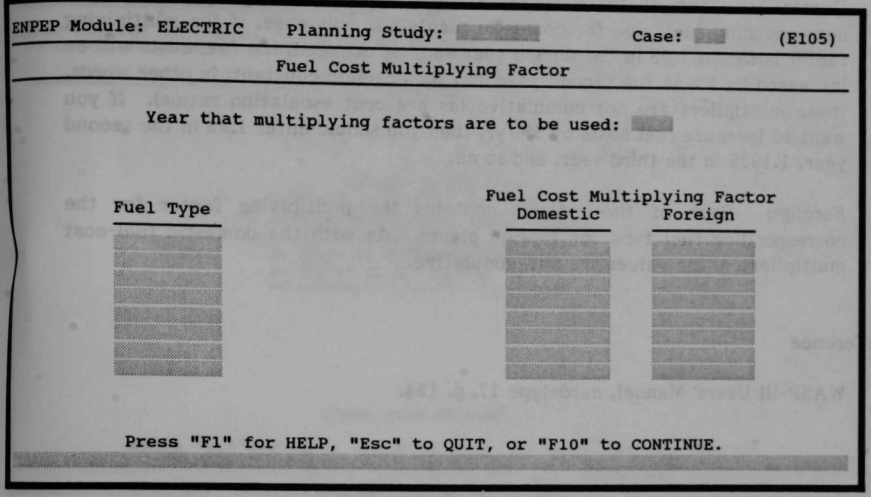
Domestic: Each of these fields contains a number that represents the single discount rate (%/yr) to be applied to all domestic operating costs for the specified years. Note that if you enter a value for the first year, this value will be used for all years (this is the recommended procedure).

Foreign: Each of these fields contains a number that represents the single discount rate (%/yr) to be applied to all domestic operating costs for the specified years. If you enter a value for the first year, this value will be used for all years.

Reference

WASP-III Users' Manual, card-types 14 and 15, p. 154.

7.3.85 Form E105 — Changing Fuel Cost Multipliers



Purpose

This form allows you to view or change the domestic and foreign fuel cost multiplying factors for the displayed year. These values permit sensitivity studies on fuel costs. You advanced to Form E105 after selecting option 12 on Menu E090 and selecting years on Form E097.

Options

- View or change the factors for each plant in the data fields described below. The default value for all fields is 1.0.
- Press **F10** to save the displayed values and advance to the next year that you selected on Form E097. After you view or change the values for the last year, press **F10** to return to Form E097.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form E097. Escape will not delete the values saved by previous **F10** keystrokes.

Data Fields

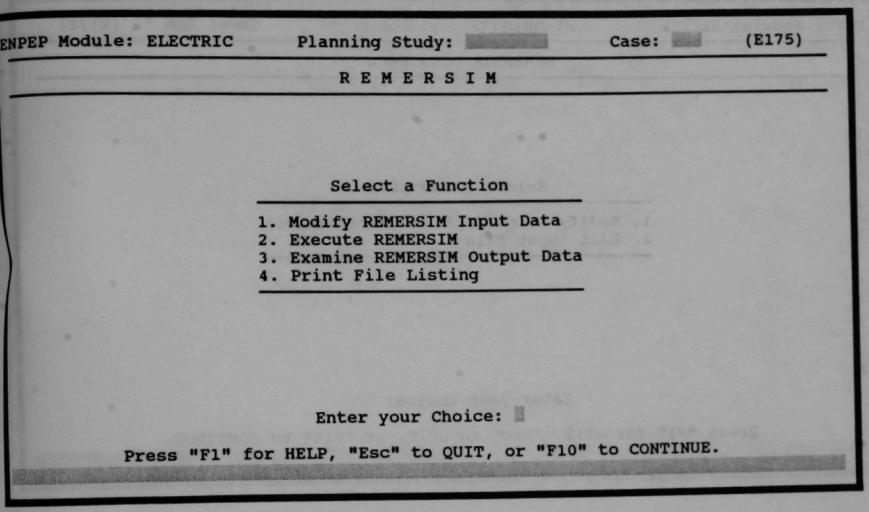
Domestic: Each of these fields contains the multiplying factor for the corresponding fuel type for domestic plants. In this case, if the multiplying factor is set to 1.05 in the second year and not changed, the fuel costs will be increased by 5% in the second year and then remain constant; in other words, these multipliers are not cumulative (as are cost escalation ratios). If you want to increase fuel costs by 5%/yr, then you should enter 1.05 in the second year, 1.1025 in the third year, and so on.

Foreign: Each of these fields contains the multiplying factor for the corresponding fuel type for foreign plants. As with the domestic fuel-cost multipliers, these values are not cumulative.

Reference

WASP-III Users' Manual, card-type 17, p. 154.

7.3.86 Menu E175 — REMERSIM Submodule Introduction



Purpose

Menu E175 allows you to view or change the REMERSIM (repeat merge and simulate) input and output and to execute the REMERSIM submodule. You advanced to this menu by selecting option 9 on Menu E003.

Options

1 Select this option to view or change the REMERSIM input data. You will advance to Menu E176.

2 Select this option to execute the REMERSIM submodule. You will return to Menu E175 after the submodule executes (see Menu E004).

3 Select this option to view the REMERSIM output file with the Paging Routine; after you view the output, press **Esc** to return to this menu.

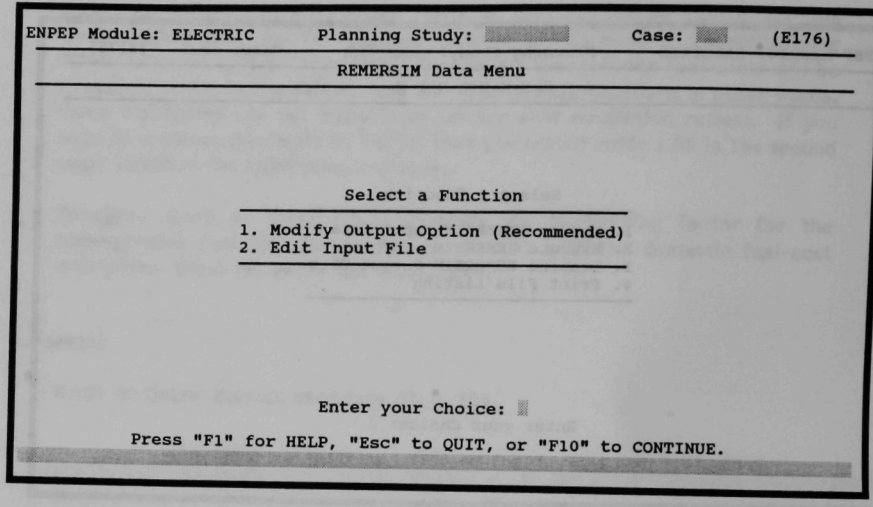
4 Select this option to obtain a listing of the REMERSIM input or output files. You will advance to Menu E033.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to advance to Form E500.

7.3.87 Menu E176 — Changing REMERSIM Input Data



Purpose

This menu allows you to select a method for viewing or changing the REMERSIM output options. You advanced to Menu E176 by selecting option 1 on Menu E175.

Options

1 Select this option to view or change the REMERSIM output options. You will advance to Form E074.

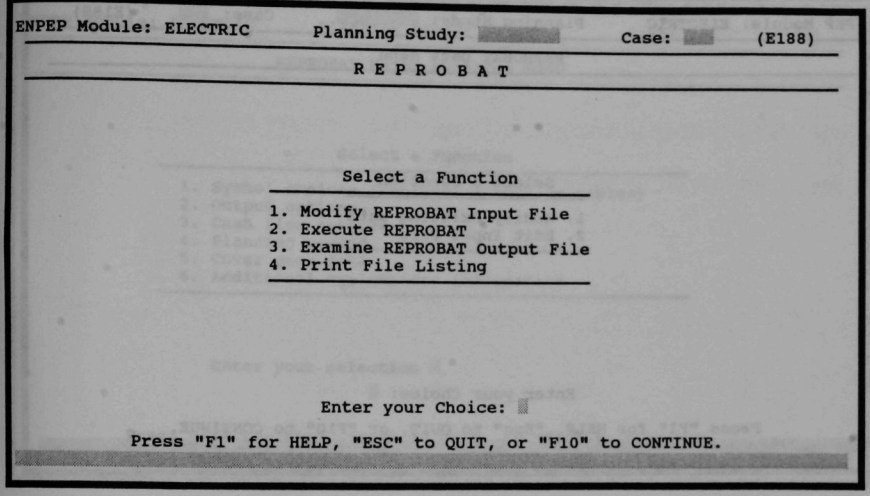
2 Select this option to view or change the REMERSIM output options as an actual card image. You will advance to the IBM Professional Editor and return to this menu after you finish viewing or changing the file.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E175.

7.3.88 Menu E188 — REPROBAT Submodule Introduction



Purpose

Menu E188 allows you to view or change the REPROBAT input and output files and execute the REPROBAT submodule. You advanced to this menu by selecting option 10 on Menu E003.

Options

1 Select this option to view or change the REPROBAT input data. You will advance to Menu E189.

2 Select this option to execute the REPROBAT submodule. You will advance to Menu E187.

3 Select this option to view the REPROBAT output file with the Paging Routine; after you view the file, press **Esc** to return to this menu.

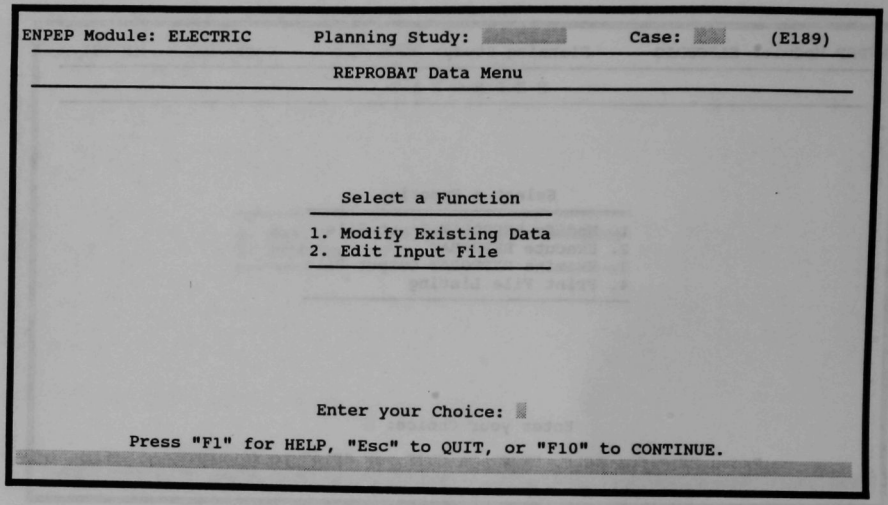
4 Select this option to obtain a listing of the REPROBAT input or output files. You will advance to Menu E033.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to advance to Form E500.

7.3.89 Menu E189 — Changing REPROBAT Input Data



Purpose

Menu E189 allows you to select a method for viewing or changing the REPROBAT input file. You advanced to this menu by selecting option 1 on Menu E188.

Options

1 Select this option to view or change REPROBAT input data by using forms. You will advance to Menu E190.

2 Select this option to view or change the REPROBAT input file as an actual card image. You will advance to the IBM Professional Editor and return to this menu after you finish viewing or changing the file.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E188.

7.3.90 Menu E190 — Selecting a REPROBAT Function

```
ENPEP Module: ELECTRIC      Planning Study:        Case:      (E190)

                    REPROBAT Major Function Menu

                          Select a Function

                1. Symbol choices (replaces blanks in tables)
                2. Output options
                3. Cash flow options
                4. Planning period
                5. Cover page data
                6. Additional explanatory information

                      Enter your selection

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This menu allows you to select a type of REPROBAT input data to view or change. You advanced to Menu E190 by selecting option 1 on Menu E189.

Options

1 Select this option to view or change the symbols used within tables of the report. You will advance to Menu E191.

2 Select this option to view or change the output options. You will advance to Form E192.

3 Select this option to view or change the cash flow options. You will advance to Form E193.

4 Select this option to view or change the planning period. You will advance to Form E194.

5 Select this option to view or change the cover page data. You will advance to Form E195.

6 Select this option to add a short description of the case to the report. You can add 50 lines of 60 characters each. You will advance to the IBM Professional Editor and return to this menu after you finish adding the text.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E189.

7.3.91 Menu E191 — Formatting REPROBAT Tables

```
ENPEP Module: ELECTRIC      Planning Study:        Case:      (E191)

                        SYMBOL CHOICES

        (Symbols are used to replace blank spaces in tables)

                        Select Symbol
                        ---------------
                        1.  Star (*)
                        2.  Hyphen (-)
                        3.  Apostrophe (')
                        4.  Dot (.)
                        5.  Blank
                        ---------------

                        Enter Your Symbol Choice

        Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This menu allows you to select a symbol with which to replace the blank spaces within the tables of the report. Of the five choices, the period is the recommended symbol (option 4). You advanced to Menu E191 by selecting option 1 on Menu E190.

Options

1 Select this option to replace each blank with an asterisk (*).

2 Select this option to replace each blank with a hyphen (-).

3 Select this option to replace each blank with an apostrophe (').

4 Select this option to replace each blank with a period (.).

5 Select this option if you do not want to replace blanks with a character.

F10 Press this key to continue after you select an option. You will return to Menu E190.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E190.

Reference

WASP-III Users' Manual, card-type X, p. 187.

7.3.92 Form E192 — Changing Output Options for ELECTRIC Submodules

```
ENPEP Module: ELECTRIC      Planning Study:        Case:      (E192)

                          OUTPUT OPTIONS

    Load system description (LOADSY)
    Fixed system description (FIXSYS)
    Variable system description (VARSYS)
    Constraints in the configuration generator module (CONGEN)
    Optimum solution (DYNPRO)
    Economic parameters and constraints (DYNPRO)
    Expected costs of operation (MERSIM)
    Cash flow of construction and fuel inventory costs

              N. No output for that section
              Y. Ouput will be produced for that section

         Press "F1" for HELP, "ESC" to QUIT, or "F10" to CONTINUE.
```

Purpose

This form allows you to view or change the output options for all of the submodules in ELECTRIC. You advanced to Form E192 by selecting option 2 on Menu E190.

Options

- Select the output to view or change as described in the data fields below. You must enter **Y** or **N** in all eight data fields before you can continue.
- Press **F10** to save your selections and return to Menu E190.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E190.

Data Fields

LOADSY: Enter **Y** to include the load system description in the report.

FIXSYS: Enter Y to include the fixed system description in the report.

VARSYS: Enter Y to include the variable system description in the report.

CONGEN: Enter Y to include the constraints in the configuration generator submodule in the report.

DYNPRO Optimum Solution: Enter Y to include the optimum solution calculated by the dynamic programming optimization submodule in the report.

DYNPRO Economic Parameters and Constraints: Enter Y to include the DYNPRO economic parameters and additional constraints in the report.

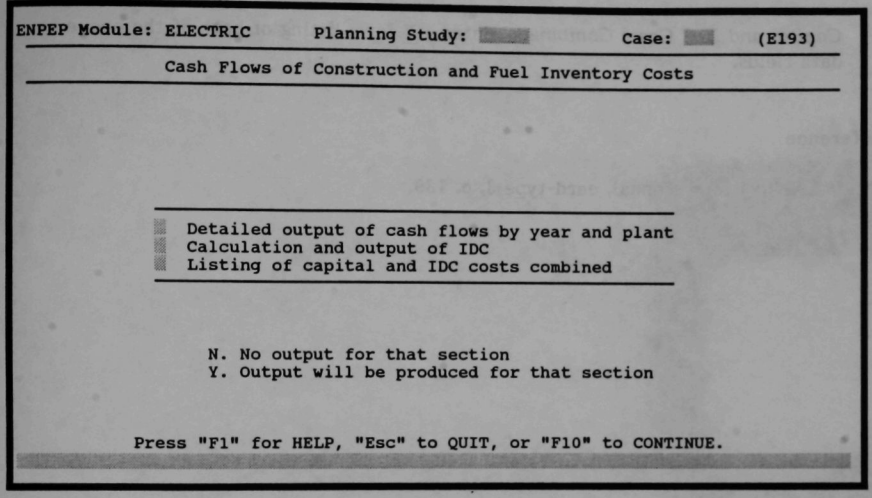
MERSIM: Enter Y to include the expected cost of operation in the report.

Cash Flow: Enter Y to include a summary of the cash flows of construction and fuel inventory costs in the report.

Reference

WASP-III Users' Manual, card-type 2, p. 188.

7.3.93 Form E193 — Changing Cash Flow Output Options



Purpose

This form allows you to view or change the cash flows of construction and fuel inventory costs. You advanced to Form E193 by selecting option 3 on Menu E190.

Options

- Select the output to view or change as described in the data fields below.
- Press **F10** to save your selections and return to Menu E190. You must enter a **Y** or **N** in all three data fields before you can continue.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E190.

Data Fields

Detailed Cash Flow Output by Year and Plant: Enter **Y** in this field to obtain a detailed cash flow output listing.

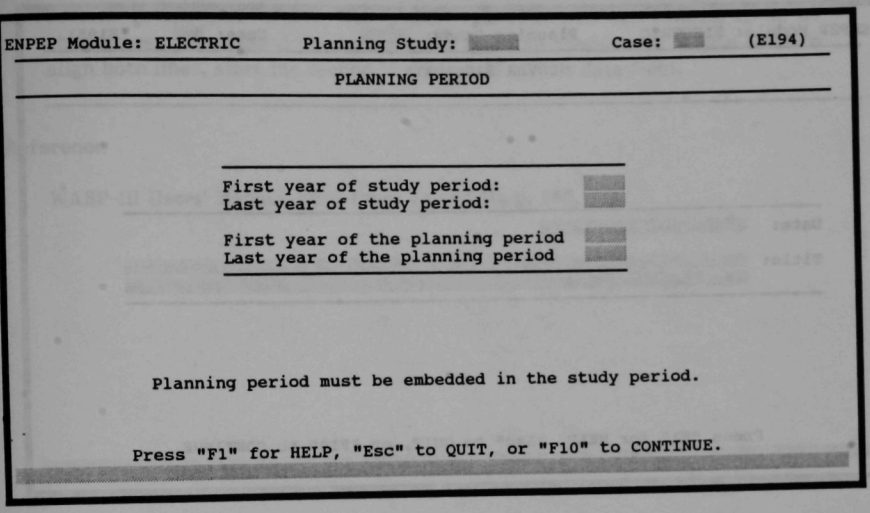
IDC Calculation and Output: Enter Y in this field to obtain a listing of the interest during construction (IDC) calculations and output.

Capital and IDC Costs Combined: Enter a Y for a listing of both of the above data fields.

Reference

WASP-III Users' Manual, card-type 3, p. 189.

7.3.94 Form E194 — Changing the Planning Period



Purpose

This form allows you to view or change the first and last years of the planning period. The planning period must be within the study period and it will default to the study period if you do not specify it. You advanced to Form E194 by selecting option 4 on Menu E190.

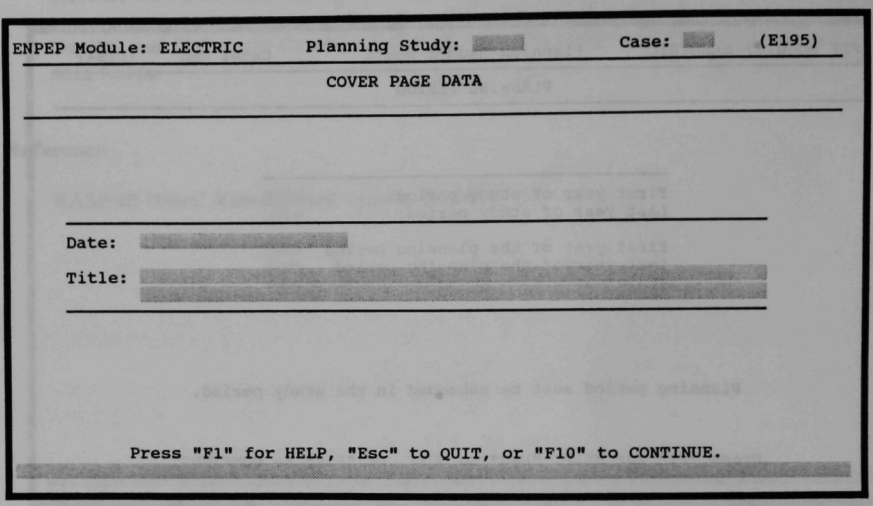
Options

- View or change the years; then press **F10** to save the displayed years and return to Menu E190.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E190.

Reference

WASP-III Users' Manual, card-type 4, p. 189.

7.3.95 Form E195 — Changing the Report Cover Page



Purpose

Form E195 allows you to view or change text on the report cover page. The title is automatically obtained from the case study description on Form E002; you can change the title by using the IBM Professional Editor (option 2 on Menu 189). You advanced to this form by selecting option 5 on Menu E190.

Options

- View or change the information in the data fields described below.
- Press **F10** to save the displayed information and return to Menu E190.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu E190.

Data Fields

Date: This field contains the date or any set of 20 characters. The text that you enter will be printed following the heading *DATE OF REPORT:*, which appears at the bottom of the REPROBAT title page.

Study Carried Out By: This field contains two lines that will be printed following the heading *STUDY CARRIED OUT BY:*, which appears at the bottom of the REPROBAT title page. The first line can contain up to 36 characters. The second line can contain up to 60 characters. If you want to align both lines, start the second in column 25 of this data field.

Reference

WASP-III Users' Manual, card-types 5a and 5b, p. 189.

7.3.96 Menu E187 — Selecting Fixed or Variable Expansion

```
ENPEP Module: ELECTRIC   Planning Study:          CASE:      (E187)
                    REPROBAT Expansion Selection Menu

                        Select a Function:

              1.  Fixed Expansion.
                  (only one configuration per year in SIMULNEW file)

              2.  Variable Expansion.
                  (REMERSIM must be run first)

                    Enter Your Choice:  (1-2, from above list)
          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu E187 allows you to select fixed or variable expansion for the REPROBAT submodule. You advanced to this menu by selecting option 2 on Menu E188.

Options

1 Select this option for a fixed expansion when no other configurations other than the fixed expansion exist in the MERSIM output file (SIMULNEW). This option is useful for examining output of an initial fixed expansion for a case study. You do not need to execute REMERSIM to select this option.

2 Select this option for a variable expansion; you must first execute the REMERSIM submodule for the current optimum solution.

F10 After you select an option, press this key to continue and execute REPROBAT. After REPROBAT executes, you will return to Menu E188 (see Menu E004).

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu E188.

CHAPTER 8

IMPACTS MODULE

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8.1 Introduction

This chapter describes the IMPACTS Module, which is one of eight modules in the Energy and Power Evaluation Program (ENPEP). The IMPACTS Module has been designed to allow you the flexibility to study the electric and nonelectric systems separately and to aggregate the results to provide estimates of environmental burdens and resource requirements for the entire energy system.

8.1.1 Objective

The IMPACTS Module is designed to calculate the environmental burdens and resource requirements for the energy supply systems (electric and nonelectric) that have been defined in the ELECTRIC and BALANCE Modules. Data from these and other modules in the ENPEP system are transferred to the IMPACTS Module for analysis. A hierarchy of menus is used to define a case for study and guide you through the branches of the IMPACTS Module. The module uses a convenient spreadsheet format that allows default environmental and resource coefficients to be scaled for country-specific conditions.

A systemwide approach is used to calculate the annual environmental burdens for the energy supply system. In this approach, effects on air, land, water, and human health and safety are calculated for all activities in the fuel supply chains, from the point of resource extraction or import through conversion or processing. The annual labor, material, and capital resources required to construct and operate energy facilities are also calculated. In addition, important economic indicators, such as annual expenditures for imported fuels and total system costs (capital and operating), are reported. This environmental and resource information facilitates energy planning and decision making.

8.1.2 Background

Energy planning requires making a variety of complex and interrelated decisions. These include decisions about fuels and their usage, mixes of production technologies, and levels of production. The analytical modules in the ENPEP system that precede the IMPACTS Module are designed to help you analyze these decisions and develop, for specific sets of assumptions, technical planning information.

In order to make integrated energy-system decisions, however, it is necessary to analyze and understand the systemwide implications of these decisions. This includes, for example, analyzing and understanding the systemwide impacts on land use and human health and safety, the need for different types of skilled laborers to meet capacity expansion schedules, and the implied annual level of expenditures for construction projects and imported fuels in relation to the projected gross domestic product (GDP). The IMPACTS Module is designed to provide this information. In essence, the IMPACTS Module supports energy planning and decision making by calculating and summarizing resource and environmental information about the planning strategies that are developed in the other ENPEP modules.

8.1.2.1 Energy-System Boundary

The boundary of the energy system represented in the IMPACTS Module is defined to correspond to the boundary of the region being studied (typically a country). This means that the environmental burdens and resource requirements occurring outside this region, such as those associated with extracting and transporting fuels that are

imported, are not considered. Within this boundary, a systemwide perspective has been adopted (except for nuclear) in which selected steps in the various fuel supply chains are considered: resource extraction (such as coal mining) or import, resource transportation, and resource conversion (such as in power plants) or processing (such as crude oil refining). End-use activities are not considered. Activities such as coal cleaning and natural gas processing are assumed to occur at the extraction site or import terminal. Indirect impacts, such as those associated with the production of coal mining equipment, are not included in the IMPACTS Module.

The only component of the nuclear fuel cycle that is treated in the IMPACTS Module is the power plant. That is, all other fuel cycle activities (mining, milling, conversion, enrichment, fabrication, reprocessing, and disposal) are assumed to occur outside the boundary of the energy system. From a modeling perspective, fabricated fuel elements are assumed to be delivered to the reactors, burned, and then shipped back to the fuel suppliers for disposal.

Annual environmental burdens and resource requirements (discussed in Secs. 8.1.3.2 and 8.1.3.3, respectively) are calculated for each step in the fuel supply chains for planning periods of up to 30 years. For the electric fuel supply system, the user must identify the transportation modes that are used to link resources (domestic and foreign) with the power plants. Six modes are represented in the module: rail, truck, pipeline, tanker, barge, and a category that you can define. In addition, you may designate a power plant as being sited at a mine mouth or import terminal. You must also specify transportation distances along the links in the fuel supply chains to characterize the system.

8.1.2.2 Information Sources

The IMPACTS Module was based on a variety of previously developed environmental and resource models and data bases. The major information sources are listed in Sec. 9.1.5 and described briefly as follows. The Wisconsin-IIASA Environmental Impact Model (EIM) is a detailed simulation model that focuses on the environmental impacts of electrical energy systems.[1,2] Another simulation model in the Wisconsin-IIASA set of energy and environment models focuses on the environmental impacts of petroleum and natural gas systems.[3] In contrast, the Brookhaven Energy System Optimization Model (BESOM) is a static energy resource optimization model that is designed to examine fuel substitution for the entire energy system within various constraints, including resource availability.[4] All of these models use a standard reference energy system approach, which is the approach used by the IMPACTS Module.

The Energy Supply Planning Model (ESPM), developed by Bechtel Corp., compliments the Wisconsin-IIASA models by focusing on the labor, material, and capital resources required for constructing and operating energy system facilities (both electric and nonelectric).[5,6] The resource estimates from ESPM are widely used in energy system evaluations. For example, they are included in handbooks and technical reports of environmental information that have been developed by the U.S. Department of

Energy (DOE) for energy technology policy analysis.[7-10] Environmental coefficients are taken from a number of other key handbooks and reports.[11-14]

Individually, none of these data bases or models provides the appropriate level of detail or breadth necessary for the IMPACTS Module. Furthermore, none of the models was designed for microcomputer or spreadsheet applications. While these factors made the development of a new model necessary, it is important to recognize that the underlying structure of models such as EIM served as a pattern for the IMPACTS Module and that the detailed environmental and resource coefficients from the Wisconsin-IIASA models, ESPM, and DOE data bases were adapted for use in the IMPACTS Module. In particular, a set of default environmental and resource coefficients were developed for the IMPACTS Module from these data sources.

Because the baseline conditions (for example, in terms of facility construction schedules, labor productivity, and health and safety statistics) in the country being analyzed may not coincide with the baseline conditions that were assumed in deriving the default coefficients, the IMPACTS Module has been designed to allow you the flexibility to individually scale each of the default coefficients. For example, if the number of coal mining fatalities per metric ton of underground coal mined is known, then you could change the default coefficient to reflect this country-specific condition. To enhance the module's usefulness, the default coefficients should be scaled whenever real data are available.

8.1.3 Approach

Information that is generated by the other ENPEP Modules is automatically formatted and loaded into the proper IMPACTS spreadsheets for analysis. In particular, the BALANCE Module, which determines the balance between supply and demand for the entire energy system, provides the IMPACTS Module with information about the nonelectric components of the energy system. Information about the electric components of the energy system is provided by the ELECTRIC Module, which determines the generating system expansion plan that meets demand and reliability needs at minimum cost. The MACRO Module provides GDP estimates, which are used in the comparative economic summaries.

If you desire, you can bypass the links with the other ENPEP Modules to use the IMPACTS Module as a stand-alone model to examine energy systems. All data requirements for the module are clearly specified on the forms and spreadsheets that collectively comprise the module. The forms and spreadsheets are detailed in Secs. 8.3 and 8.4, respectively.

8.1.3.1 Fuel and Technology Categories

Seventeen categories of fuels are included in the IMPACTS Module, as shown in Table 8.1. These categories were selected to allow you flexibility when specifying the

TABLE 8.1 Fuel Categories Represented in the IMPACTS Module

Fuel Category	Code
Domestic surface-mined coal (1)	C1
Domestic surface-mined coal (2)	C2
Domestic deep-mined coal (1)	C3
Domestic deep-mined coal (2)	C4
Imported coal (1)	C5
Imported coal (2)	C6
Domestic residual fuel oil	O1
Domestic distillate fuel oil	O2
Imported residual fuel oil	O3
Imported distillate fuel oil	O4
Domestic natural gas	G1
Imported natural gas	G2
Nuclear fuel	N
Hydroelectric (long-term storage)[a]	H1
Hydroelectric (short-term storage)	H2
User-defined category	T1
User-defined category	T2

[a]The hydroelectric categories are included as fuel categories for bookkeeping purposes only.

types of fuels used at energy facilities and so that the spreadsheets in the IMPACTS Module could be preprogrammed and preformatted. The distinctions between foreign and domestic fuels and between surface and deep-mined coals have important environmental and resource implications. Two categories that you can define (T1 and T2) are available to represent unique fuels of interest.

You must specify three characteristics for each fuel considered in the analysis: higher heating value, sulfur content, and ash content. Two different fuels may be assigned to each energy facility (for example, an oil-fired power plant may burn a blend of foreign and domestic fuel oil). However, you must specify the fractional split between

the two fuels. It is not necessary to include all fuel categories listed in Table 8.1 in a planning study.

Thirteen electricity generating technologies are represented in the IMPACTS Module, as shown in Table 8.2. Four different coal technologies and two light-water reactor categories, which could be used to distinguish between pressurized-water reactors and boiling-water reactors, are represented. A technology code must be assigned to each power plant considered in the IMPACTS Module. The default sizes and construction schedules are taken directly from ESPM[5,6] and are used for calculating resource requirements. You may shorten or lengthen the default construction schedules.

TABLE 8.2 Electric Generating Technologies Represented in the IMPACTS Module

Technology Type	Technology Code	Default Size (MW)	Default Construction Schedule (yr)
Coal-fired power plant, low-kcal fuel[a]	1.1	800	5
Coal-fired power plant, high-kcal fuel[b]	1.2	800	5
Atmospheric fluidized-bed power plant	1.3	800	5
Coal combined-cycle power plant	1.4	400	4
Oil-fired power plant	2.0	800	5
Gas-fired power plant, low-kcal fuel[c]	3.1	800	4
Gas-fired power plant, high-kcal fuel[d]	3.2	800	4
Pressurized-water reactor	4.1	1,100	9
Boiling-water reactor	4.2	1,100	9
Hydroelectric power plant	5.1	200	5
Pumped storage	5.2	1,000	7
Gas-fired turbine	6.0	133	2
User-defined technology type	7.0	--	--

[a]Low-kcal coal ≤ 4,610 kcal/kg.

[b]High-kcal coal > 4,610 kcal/kg.

[c]Low-kcal gas ≤ 8,900 kcal/m^3.

[d]High-kcal gas > 8,900 kcal/m^3.

Sources: default values are from Refs. 5 and 6.

Thirteen nonelectric energy system facilities and processes are represented in the IMPACTS Module, as shown in Table 8.3. The two user-defined categories can be used to represent special facilities or processes of interest. The default sizes and construction schedules shown in Table 8.3 are taken directly from ESPM.[5,6] As in the electric system, you may change the default construction schedules.

8.1.3.2 Environmental Burdens

Environmental burdens are classified in this module in terms of five categories: air, water, land, human health and safety, and solid wastes. These burdens represent

TABLE 8.3. Nonelectric Energy System Facilities and Activities Represented in the IMPACTS Module

Facility	Default Size[a]	Default Construction Schedule (yr)
Offshore crude oil import facility	1,700 TBOD	3
Onshore oil import facility	1,000 TBOD	3
Offshore oil production facility	20 TBOD	3
Onshore oil production facility	2 TBOD	2
High-yield gasoline refinery	200 TBOD	4
Low-yield gasoline refinery	200 TBOD	4
Onshore gas extraction facility	30 MMCFD	2
LNG import facility[b]	2,795 MMCFD	4
Coal import facility[c]	--	--
Underground coal mining facility	2 MMSTY	3
Surface coal mining facility	4 MMSTY	3
User-defined facility[c]	--	--
User-defined facility[c]	--	--

[a]Key to abbreviations: thousands of barrels of oil per day (TBOD), millions of cubic feet per day (MMCFD), or millions of short tons per year (MMSTY).

[b]Liquefied natural gas.

[c]This facility must be characterized by the user.

Sources: default values are from Refs. 5 and 6.

"quantified impacts," that is, they do not represent all the impacts known to occur. Rather, quantified impacts are those for which an adequate basis exists for their evaluation and characterization in mathematical terms. Many other potentially important impacts may not even be recognized.

The burdens, or quantified impacts, are calculated by means of "impact factors," which have been derived through analysis of available data in the literature (see Sec. 8.1.2.2). The factors are specified in the module as either a function of facility output (such as kWh) or as a function of production capacity (such as electrical capacity in MW). Although the majority of the factors are based on U.S. data, you can easily change each factor to reflect country-specific conditions. In some cases, time-dependent changes can be made, reflecting such measures as phased occupational safety standards or the introduction of control technologies (see Sec. 8.5.4).

The total annual quantified impacts associated with a particular fuel cycle activity are calculated by multiplying the appropriate impact factors for a particular year and a particular energy source by the use (or production capacity) of that source. Equation 8.1 describes this operation:

$$Q_{ijk} = E_{jk} \times I_{ijk} \qquad i = 1, 2, \ldots, n \tag{8.1}$$

where Q_{ijk} is equal to the quantified environmental impacts of type i in year j resulting from energy source k, E_{jk} is the quantity of energy source k used in year j, and I_{ijk} is the impact factor of type i in year j for energy source k. The quantified impacts can be summed over index j to obtain cumulative impacts for a particular energy source. Impacts with similar units can be summed over index i to obtain totals for a particular year and energy source or over index k to obtain totals for all energy sources in a particular year.

8.1.3.3 Resource Requirements

Four categories of resource requirements for energy facilities are calculated in the IMPACTS Module:

- construction labor requirements by year of construction,
- construction material requirements by year of construction,
- annual operating labor requirements over the life of the facility, and
- annual costs of both facility construction (capital expenditures) and operation (including fuel and maintenance).

The coefficients used for making these estimates of annual resource requirements are taken directly from ESPM.[5,6] For each construction schedule, the IMPACTS Module

considers the annual distributions of (1) nonmanual, technical person-hours, (2) nonmanual, nontechnical person-hours, (3) manual person-hours, (4) materials and equipment items, and (5) costs of labor, materials, and other construction costs. At a disaggregated level, 23 categories of construction labor, 9 categories of materials, and 27 categories of operating labor are evaluated. You can lengthen or shorten the default construction schedules and adjust the annual distributions cited above. These procedures are detailed in Sec. 8.4.

In contrast to the coefficients that are used to calculate environmental burdens (Sec. 8.1.3.2), the ESPM coefficients, which serve as default coefficients in the IMPACTS Module, are based on reference-size facilities (as specified in Tables 8.2 and 8.3). You can adjust these default values to reflect country-specific conditions. The relationship that is used for adjusting the default labor, material, and cost coefficients is based on the ratio of the actual facility size (from ELECTRIC or BALANCE) to the reference facility size (from ESPM). Mathematically,

$$A_{ij} = D_{ij} \times (S_i/B_i)^e \qquad (8.2)$$

where A_{ij} is the adjusted coefficient for facility type i and resource type j, D_{ij} is the corresponding default coefficient from ESPM, S_i is the capacity of facility type i considered in IMPACTS, B_i is the capacity of reference facility type i specified in ESPM, and e is a scaling exponent that you specify. When e = 1 (the default value), the adjustment is directly proportional to the ratio of facility sizes.

For more information about the calculations that the IMPACTS Module performs, see the appendix in Sec. 8.5.

8.1.4 Functions

Conceptually, the IMPACTS Module can be described in terms of five major functions:

- Calculating annual energy system fuel requirements and flows based on facility and process activity levels,
- Calculating annual capital and labor requirements for operating facilities and processes,
- Calculating capital, labor, and material requirements for discrete facility and process additions,
- Calculating annual environmental burdens for operating facilities and processes, and
- Aggregating common information, calculating important energy-planning indicators, and summarizing results.

As detailed in Sec. 8.5, the first function (calculating fuel requirements and flows) defines the technical configuration of the energy system and explicitly accounts for facility and process efficiencies and losses. Module results can be aggregated separately for the electric and nonelectric sectors and by type of resource or burden.

At the lowest level of the hierarchy for each submodule of the IMPACTS Module (electric, nonelectric, and energy systems), the environmental burdens and resource requirements are divided into six categories: five that deal with environmental burdens (air, water, land, human health and safety, and solid wastes) and one that encompasses all resource requirement calculations. This latter category includes calculations of annual facility construction labor and material requirements, capital expenditures, operating costs, and operating labor requirements.

Table 8.4 lists the input requirements for the IMPACTS Module. If only the electric system is being analyzed, for example, then only those inputs that are related to the electric system must be supplied. In addition to the input requirements in Table 8.4, you have the option of scaling any default coefficient in the module.

Selected outputs from the IMPACTS Module are listed below. Most of these outputs are displayed in tabular format (spreadsheets). The program that generates the spreadsheets (Framework II) has graphics capabilities that allows the data in any spreadsheet to be plotted in various ways (for example, bar graphs, line graphs, and pie charts). Several key submodule outputs can also be graphed with GrafTalk.

The following list summarizes IMPACTS Module outputs:

- Quantity of fuel consumed annually at electric power plants.
- Annual nuclear power plant charge and discharge mass balances.
- Quantity of fuel imported or produced domestically for electric power plants.
- Total annual operating costs and construction expenditures.
- Air emissions (by species) from facilities and processes.
- Water emissions (by species) from facilities and processes.
- Land use for waste disposal.
- Occupational health and safety statistics for power plant operations.
- Annual construction labor requirements.

TABLE 8.4 Summary of Input Requirements for the IMPACTS Module

Description of Input	Units	Spreadsheet	Source
Annual power plant generation	GWh	IBUGE	ELECTRIC or user
Power plant capacity	MW	IBUCH	ELECTRIC or user
Power plant heat rate	kcal/kWh	IBUCH	ELECTRIC or user
Number of operable power plants per year	--	IBUNO	ELECTRIC or user
Number of power plant additions per year	--	IBUEN	user
Power plant cooling modes	--	IBWEM	user
Higher heating value of fuels	varies	IBFCH	user
Sulfur content of fuels	%	IBFCH	user
Ash content of fuels	%	IBFCH	user
Nuclear reactor and fuel characteristics	--	IBNCH	user
Power plant fuel assignments	--	IBFAS	user
Fraction of coal cleaned	--	IBCFC	user
Transportation assignments by fuel type	--	IBTAS	user
Annual production levels for nonelectric facilities	TBOE[a]	INUGE	BALANCE or user
Nonelectric facility capacities	TBOE	INUCH	BALANCE or user
Nonelectric facility fuel assignments	--	INUCH	user
Number of operable nonelectric facilities per year	--	INUNO	BALANCE or user
Number of nonelectric facility additions per year	--	INUEN	BALANCE or user

[a]Thousands of barrels of oil equivalent.

- Annual construction material requirements.
- Domestic and foreign fuel bill.
- Ratio of the foreign fuel bill to the GDP.

8.1.5 References

1. Buehring, W.A., *A Model of Environmental Impacts from Electrical Generation in Wisconsin*, Ph.D. Dissertation, Department of Nuclear Engineering, University of Wisconsin, Madison (1975).

2. Foell, W.K., et al., *The Wisconsin-IIASA Set of Energy/Environment (WISE) Models for Regional Planning and Management: An Overview*, International Institute for Applied Systems Analysis Report RR-81-17, Laxenburg, Austria (1981).

3. Peerenboom, J.P., and J.R. Peerenboom, *A Regional Energy/Environment Model of Mexico's Petroleum and Natural Gas Industry*, Energy Research Center, University of Wisconsin, Madison (1980).

4. Cherniavsky, E.A., *Brookhaven Energy System Optimization Model*, Brookhaven National Laboratory Report BNL-19569 (1974).

5. Carasso, M., et al., *The Energy Supply Planning Model*, Bechtel Corp., San Francisco (1975).

6. *Energy Supply Planning Model Documentation*, Vols. I and II, Argonne National Laboratory (1981).

7. *Technology Characterizations Environmental Information Handbook*, U.S. Dept. of Energy Report DOE/EV-0072 (1980).

8. *Environmental Data Energy Technology Characterizations: Coal*, U.S. Dept. of Energy Report DOE/EV-0074 (1980).

9. *Environmental Data Energy Technology Characterizations: Petroleum*, U.S. Dept. of Energy Report DOE/EV-0075 (1980).

10. *Environmental Data Energy Technology Characterizations: Natural Gas*, U.S. Dept. of Energy Report DOE/EV-0076 (1980).

11. *Environmental Data for Energy Technology Policy Analysis*, The MITRE Corp. Report HCP/EV-6119/1, McLean, Va. (1979).

12. *Environmental Impacts, Efficiency, and Cost of Energy Supply and End Use*, Hittman Associates, Inc. Report PB-238784, Columbia, Md. (1974).

13. *Compilation of Air Pollutant Emission Factors*, U.S. Environmental Protection Agency Report AP-42, 3rd Ed. (1982).

14. Cavanaugh, E.C., et al., *Environmental Problem Definition for Petroleum Refineries, Synthetic Natural Gas Plants, and Liquefied Natural Gas Plants*, U.S. Environmental Protection Agency Report 600/2-75-068 (1975).

8.2 Structure

The functional structure of the IMPACTS Module, with its three main branches (electric, nonelectric, and energy system totals), is shown in Fig. 8.1. Note that the second functional level of the electric system is broken down into three main categories that correspond to the steps in a generic fuel cycle and a fourth category that aggregates the environmental burdens and resource requirements that were calculated for the three fuel-cycle steps. The hierarchy of the IMPACTS Module is shown in Fig. 8.2.

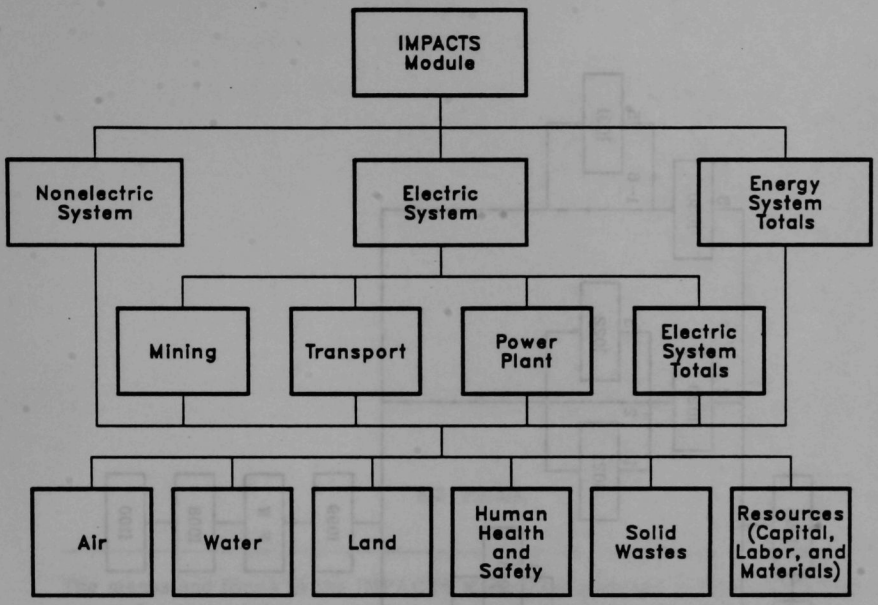


FIGURE 8.1 IMPACTS Module Functional Structure

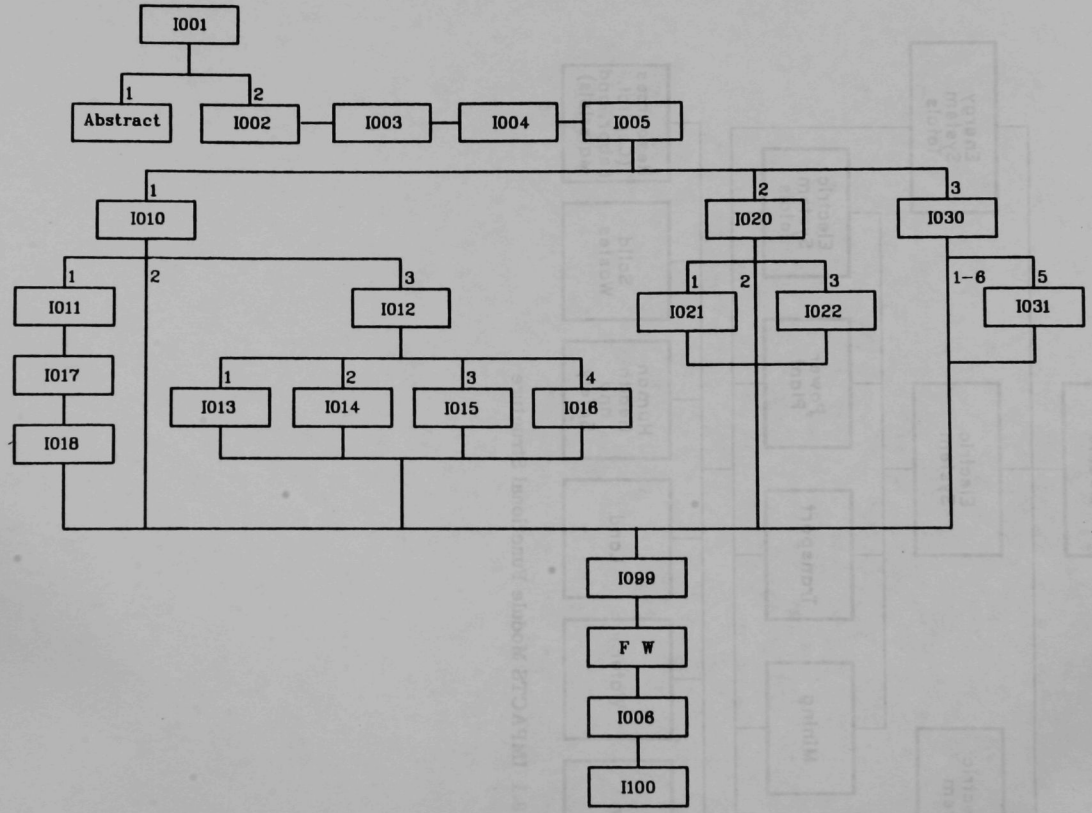


FIGURE 8.2 IMPACTS Module Hierarchy

8.3 Forms

The menus and forms in the IMPACTS Module are designed to help you define a case for study, guide you through the various branches of module, and allow you to access case-specific data generated by the other ENPEP Modules. Unlike a number of the other ENPEP Modules, however, you do not use the IMPACTS forms to enter data. Instead, the forms guide you to various spreadsheets on which to specify data.

8.3.1 Menu I001 — Introduction to IMPACTS

```
ENPEP Module: IMPACTS        Planning Study: DEMO1          (I001)
                    Introduction to IMPACTS

                        VERSION 1.0

                        Function
                    1  Module Description
                    2  Execute the module

                    Enter your choice:

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This menu introduces you to the IMPACTS Module. You can view the IMPACTS Module abstract, which briefly describes the module, or begin execution of the module. You advanced to Menu I001 by selecting option 7 on Menu X003 in the EXECUTIVE Module.

1 Select this option to view the IMPACTS Module abstract (IMPACTS.ABS). You will advance to the ENPEP Paging Routine. When you finish viewing the abstract, press **Esc** to return to this menu. (See the Introduction to this volume for more information on the Paging Routine.)

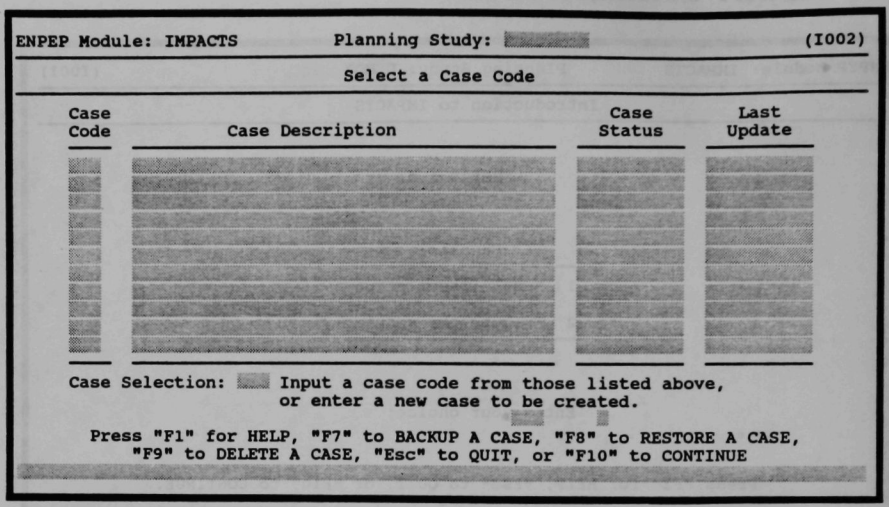
2 Select this option to execute the module. You will advance to Form I002.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help. (See the Introduction to this volume for more information about the on-line help available in ENPEP.)

Esc Press this key to return to Menu X003 in the EXECUTIVE Module.

8.3.2 Form I002 — Selecting a Case



Purpose

Form I002 allows you to select a case that contains data for this module. For each case, this form displays a three-digit case code, a case description, a status variable indicating whether the case is complete or incomplete, and a date indicating the last time the case was changed. You advanced to this form by selecting option 2 in Menu I001.

Options

- To choose a case to execute, enter the number of an existing case and press **F10**. You will be prompted to identify the disk drive on which the data are stored. The program will automatically store the case and disk-drive designation in the Data Dictionary and advance you to Form I003.

- To back up a case, enter the number of an existing case and press **F7**. After you verify the function by pressing **F10**, the program will prompt you to identify the disk drive where the data for that case are stored and the disk drive on which you want to back up the data. The program will write the Data Dictionary variables to a file. This file and all files associated with the case will be backed up onto separate disks for archiving purposes.

- To restore a case, enter the number of a case that you previously backed up and press **F8**. Verify the function by pressing **F10**. (If an existing case has the same number, you must first delete that case.) You will then be prompted to identify the disk drive that the data are to be restored onto (that is, where the data will reside when you execute the case) and the disk drive where the data are to be restored from. This will cause all data files associated with the case to be restored to the working dictionary, and the Data Dictionary variables will be written into the Data Dictionary.

- To create a case, enter the number of a case that does not exist and press **F10**. After you enter a description of the new case, press **F10** again. You will be prompted to identify the disk drive where the new case is to be stored, which case you want to copy, and the disk drive where the data are currently stored. Press **F10** each time you enter a disk-drive designation. A new case must be created by copying an existing case. This is done so that you can use most of the existing information and make only the changes needed for the new case.

- To delete a case, press **F9**. You will be prompted to ensure that you do not lose a case that you do not want deleted (press any key to continue or **Esc** to cancel this function). After you enter the case number, press **F10** to verify the function. You will then be prompted to identify the disk drive where the case is stored. All files and Data Dictionary variables for the case will then be deleted.

- Press **F1** to obtain on-line help.

- Press **Esc** to return to Menu I001.

8.3.3 Form I003 — Changing the Study Years and the Number of Facilities and Processes

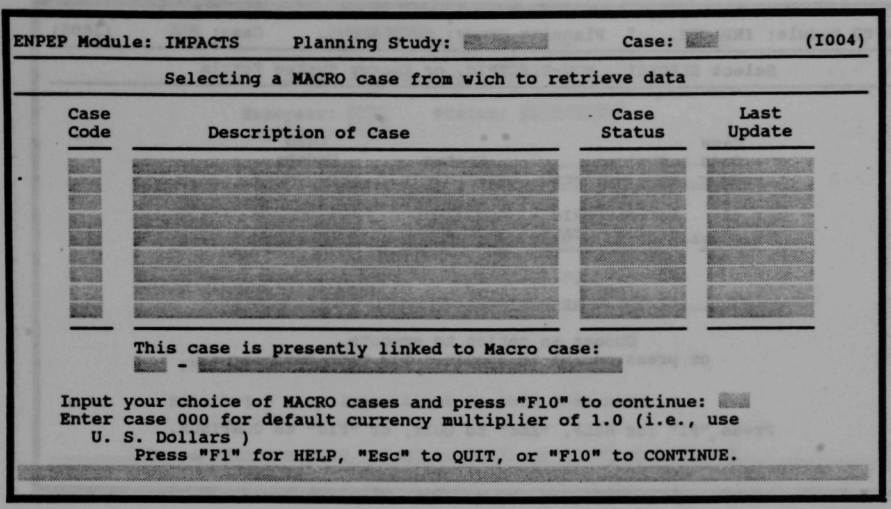
```
ENPEP Module: Impacts      Planning Study:          Case:      (I003)
                Designate the base and end years for this case

                              Base Year:
                               End Year:

                      Number of ELECTRIC Plants:
                  Number of Non-ELECTRIC Plants:

        Options:
            1 - No changes in current values -
                Press "F10" to CONTINUE.

            2 - Modify the base year, end year, or number of facilities
                for either the Electric or Nonelectric sectors.
                Make changes and press "F7" to save them.
                Changing any values will require retrieval or user
                input of case data and re-initialization of base
                data spreadsheets.

             Press "F1" for HELP, "F7" to CHANGE THE VALUES,
                  "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

This form allows you to view or change the beginning year, end year, and number of plants (both electric and nonelectric) for the displayed case. You advanced to Form I003 by selecting a case on Form I002. If you change any of the values, all status variables will be changed to *INCOMPLETE*, and you will need to re-execute all three submodules. For example, suppose you presently have a completed case for the years 2000-2010 and want to use a case for years 2005-2010. Unless you re-execute the submodules, the years 2000-2010 will appear on the base spreadsheets and cause errors, since all lookups are done by indexing from the base year.

- To use the existing values, press **F10**. You will advance to Form I004.
- To change the data for this case, enter the new values and press **F7**. You will be prompted to verify the new data by pressing **F10**. Any changes will change the case status values to *INCOMPLETE*. You will advance to Form I004.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form I002.

8.3.4 Form I004 — Selecting Data from the MACRO Module



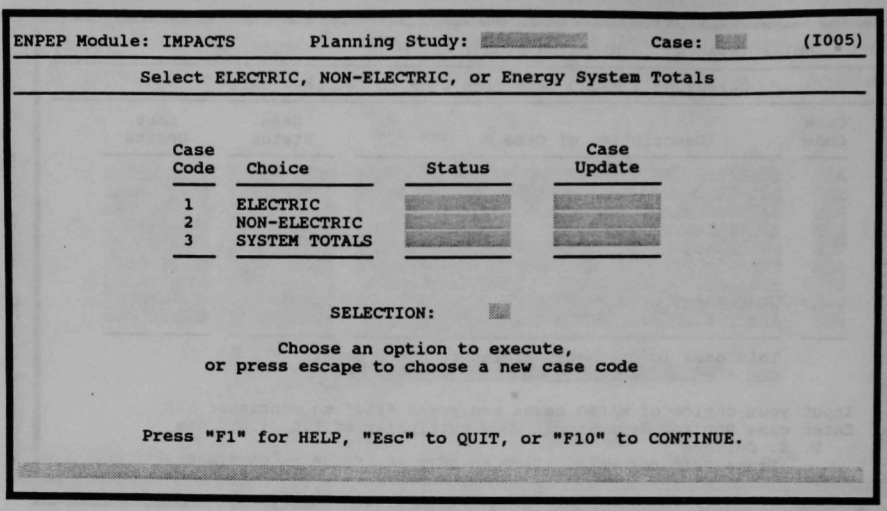
Purpose

Use this form to select a reference MACRO case from which to retrieve data. You may use the existing link, create a new link by choosing a new case, or break the link to the MACRO Module. You advanced to Form I004 after viewing or changing general case data on Form I003.

Options

- To use the current MACRO case, press **F10**.
- To choose a new MACRO case, enter the case number and press **F10**. (You may only reference cases that are *COMPLETE*.) You will be prompted to identify the disk drive on which the case is stored.
- To execute IMPACTS without a MACRO case (and use U.S. dollars), enter 000 and press **F10**. This will be referenced as MACRO case 000 in the Data Dictionary.
- After you complete one of the above options and verify your choice by pressing **F10** again, you will advance to Menu I005.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form I003.

8.3.5 Menu I005 — Selecting an IMPACTS Submodule



Purpose

Menu I005 allows you to execute an IMPACTS submodule. You can execute IMPACTS for a sector (such as resource requirements) without completing each submodule first. You advanced to this menu after selecting a MACRO reference case on Form I004.

Options

1 Select this option to enter the electric submodule. You will advance to Menu I010 to initiate an analysis of electric sector data.

2 Select this option to enter the nonelectric submodule. You will advance to Menu I020 to initiate an analysis of nonelectric sector data.

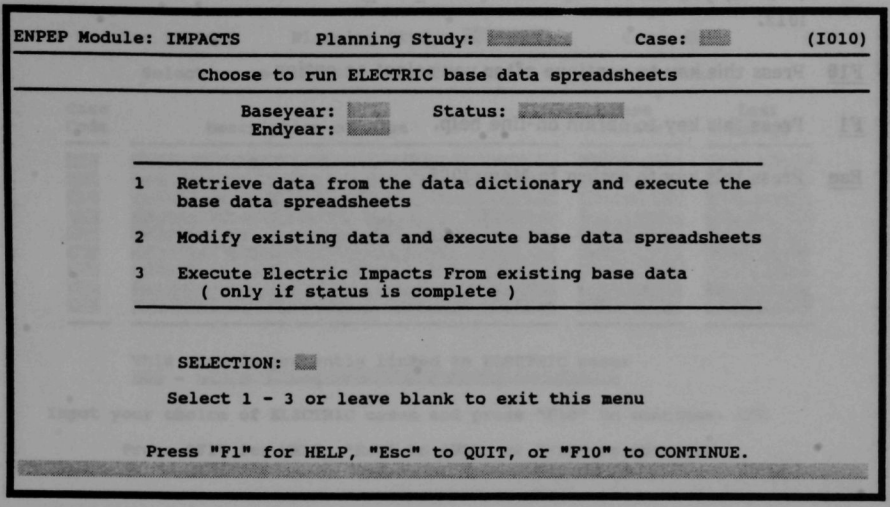
3 Select this option to enter the energy system totals submodule. You will advance to Menu I030 to begin aggregating environmental and resource information from the electric and nonelectric submodules.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Form I004.

8.3.6 Menu I010 — Selecting an Electric Submodule Function



Purpose

Use this menu to execute the base spreadsheets for and calculate the impacts from the electric sector (submodule). You may link to a case from the ELECTRIC Module to retrieve the data or enter data directly. You advanced to Menu I010 by selecting option 1 on Menu I005.

Options

1 Select this option to retrieve data from the Data Dictionary and execute the base spreadsheets. You will advance to Form I011 to select a case from the ELECTRIC Module. After retrieving the data from the Data Dictionary and selecting power plants to include in the electric system, you will advance to Framework II to view or change the files.

2 Select this option to directly enter, view, or change the base data and execute the base spreadsheets for the electric sector. This option allows you to use IMPACTS as a stand-alone model. You will advance first to Form I099 to enter Framework II and then to Spreadsheet IBUGE.

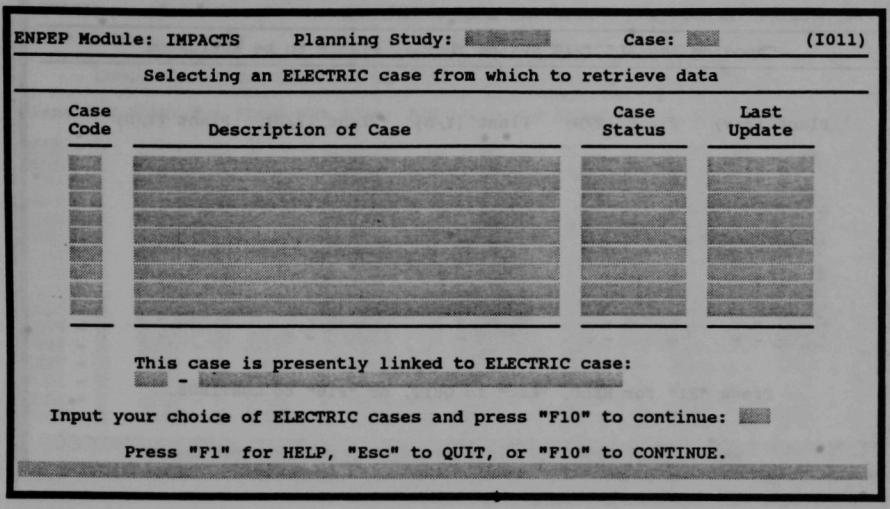
3 Select this option to calculate the impacts from the electric sector. You can select this option only if the base spreadsheets are complete (that is, you have completed option **1** or **2**). You will advance to Menu I012.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu I005.

8.3.7 Form I011 — Selecting Data from the ELECTRIC Module



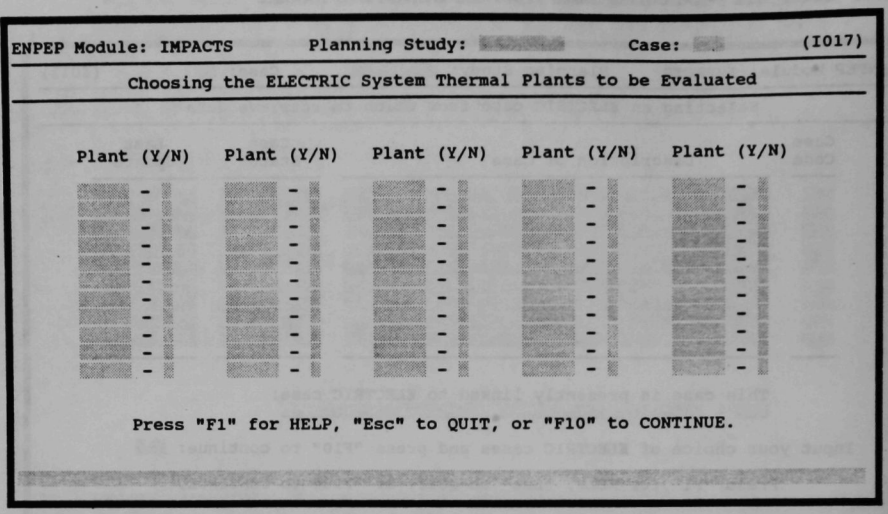
Purpose

This form allows you to select a reference ELECTRIC Module case from which to retrieve data. Selecting a new case for study will change the status of all sections of the electric sector to *INCOMPLETE* since the base spreadsheets will have a new data set. You advanced to Form I011 by selecting option 1 on Menu I010.

Options

- To use data from the current ELECTRIC reference case, press **F10**.
- To choose a new ELECTRIC reference case, enter the case that you wish to reference and press **F10**. (You may only use reference cases that are *COMPLETE*.) You will be prompted to identify the disk drive on which the case is stored.
- After you complete one of the above options and verify you choice by pressing **F10**, you will advance to Form I017 to select thermal plants.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu I010.

8.3.8 Form I017 — Selecting Thermal Plants



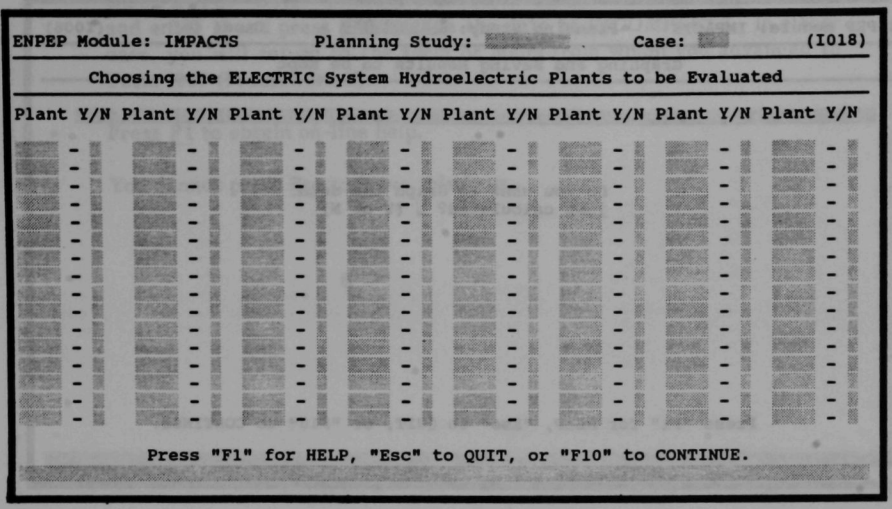
Purpose

Form I017 allows you to identify the thermal plants (from the ELECTRIC Module) that you want to include in the electric system. You advanced to this form after selecting an ELECTRIC case on Form I011.

Options

- Enter **Y** to the right of each thermal plant that you want to include in the electric system, and enter **N** to the right of each plant that you do not want to include.
- Press **F10** to save your selections and advance to Form I018 to select hydroelectric plants.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form I011.

8.3.9 Form I018 — Selecting Hydroelectric Plants



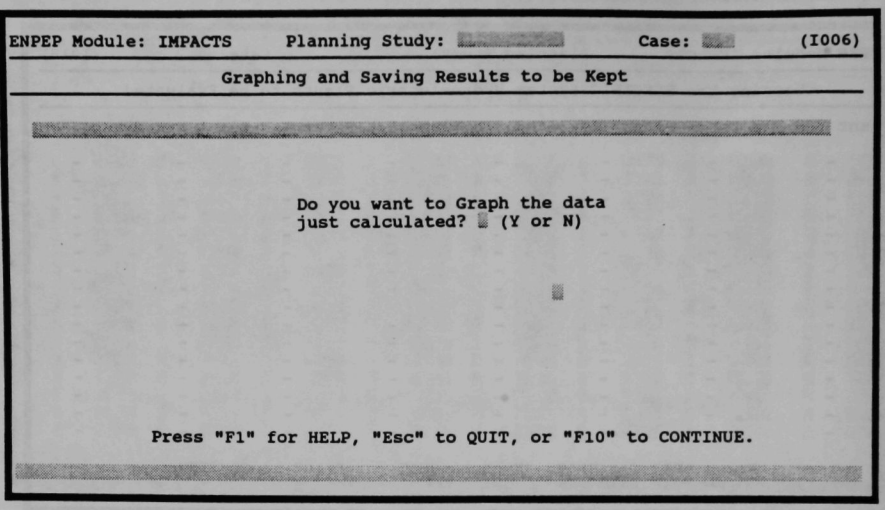
Purpose

Form I018 allows you to identify the hydroelectric plants (from the ELECTRIC Module) that you want to include in the electric system. You advanced to this form after selecting thermal plants on Form I017.

Options

- Enter **Y** to the right of each hydro plant that you want to include in the electric system, and enter **N** to the right of each plant that you do not want to include.
- Press **F10** to save your selections and advance first to Form I099 to enter Framework II and then to Spreadsheet IBUGE.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Form I017.

8.3.10 Form I006 — Saving and Graphing Spreadsheet Results



Purpose

This form allows you to graph and save the data that were calculated within any of the submodules. When you advance to Form I006 and the submodule has been successfully executed, you will be prompted as to whether you want to enter the graphics mode. If the submodule was interrupted (that is, **Ctrl-D Q** was pressed in Framework II before the submodule was finished executing), graphics cannot be performed and you will instead be prompted as to whether you want to save the data. These prompts are specific to each submodule. You advanced to this form after exiting Framework II or GrafTalk.

Options

- If you enter **Y** in response to the graphics prompt and press **F10**, you will enter GrafTalk (you will be prompted to select a type of graph). If you enter **N** and press **F10**, you will advance to the next prompt.

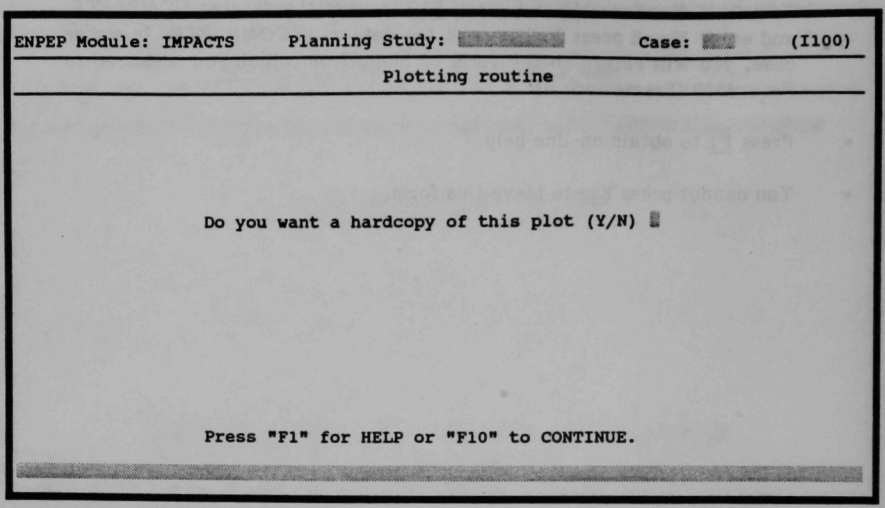
- After graphing data, responding with **N** to the graphics prompt, or interrupting Framework II, you will be prompted as to whether you want to save the data. Enter **Y** and press **F10** to save the data and advance to the next prompt. If you do not want to save the data, enter **N** and press **F10** to return to the form or menu from which you advanced to Form I099 (Framework II).

- If you respond to the prompt for saving data with **Y**, you will be prompted as to whether or not the data should be saved as *COMPLETE*. Enter **Y** and press **F10** to save the data as *COMPLETE*, and enter **N** and press **F10** to save the data as *INCOMPLETE*. In either case, you will return to the form or menu from which you advanced to Form I099 (Framework II).

- Press **F1** to obtain on-line help.

- You cannot press **Esc** to leave this form.

8.3.11 Form I100 — Plotting Graphics



Purpose

This form allows you to obtain a hardcopy of any graph that was generated by GrafTalk. You advanced to Form I100 by graphing the results of a submodule from Form I006.

Options

- Enter **Y** if you want to plot the graph (make sure that the plotter is on-line); enter **N** if you do not want to plot the graph.
- Press **F10** after you respond to the prompt. You will return to Form I006.
- Press **F1** to obtain on-line help.
- You cannot press **Esc** to leave this form.

8.3.12 Menu I012 — Calculating Electric Impacts

```
ENPEP Module: IMPACTS      Planning Study:          Case:        (I012)
                    Select group of Impacts to be executed

                                                          Last
     Selection                                  Status    Update
  1  Mining Impacts
  2  Transportation Impacts
  3  Power Plant Impacts

  4  Total Electric System Impacts
     ( Only to be run when 1-3 are 'COMPLETE' )

                  Selection:

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu I012 allows you to select a sector of the electric submodule to execute (see Fig. 8.1). You can view, change, or compute data for mining, transportation, or power plant impacts and then execute the spreadsheets for the electric system totals. You advanced to this menu by selecting option 3 on Menu I010.

Options

1 Select this option to calculate mining impacts. You will advance to Menu I013.

2 Select this option to calculate transportation impacts. You will advance to Menu I014.

3 Select this option to calculate power plant impacts. You will advance to Menu I015.

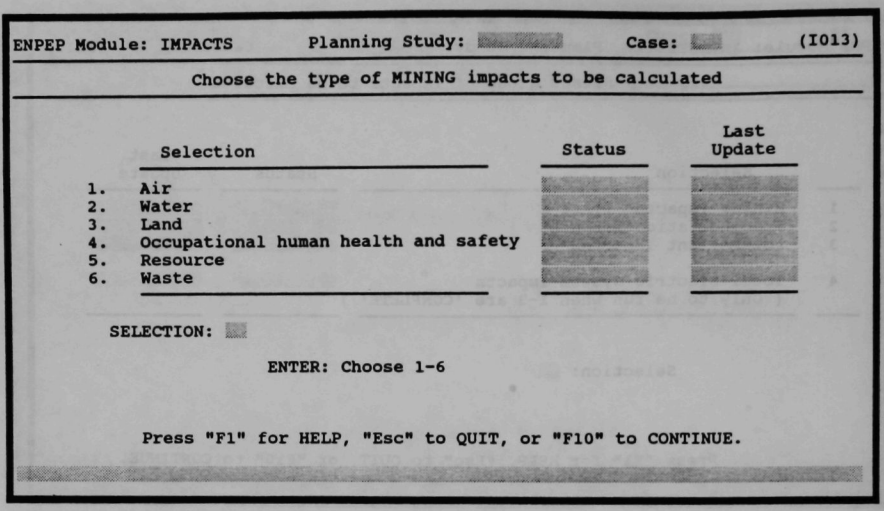
4 Select this option to aggregate the impacts from the electric system. You will advance to Menu I016.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu I010.

8.3.13 Menu I013 — Calculating Electric Sector Mining Impacts



Purpose

Menu I013 allows you to select a type of coal mining impacts to calculate. You can calculate the impacts to air, water, land, and health and safety and calculate the amount of solid waste resulting from mining. You advanced to this menu by selecting option 1 on Menu I012. Note that option 5 is not associated with any function; it appears on the screen only to preserve the menu's format.

Options

1 Select this option to calculate air impacts from mining. You will advance to Spreadsheet IMAEC.

2 Select this option to calculate water impacts from mining. You will advance to Spreadsheet IMWEC.

3 Select this option to calculate land impacts from mining. You will advance to Spreadsheet IPLSC.

4 Select this option to calculate occupational human health and safety impacts from mining. You will advance to Spreadsheet INHHC.

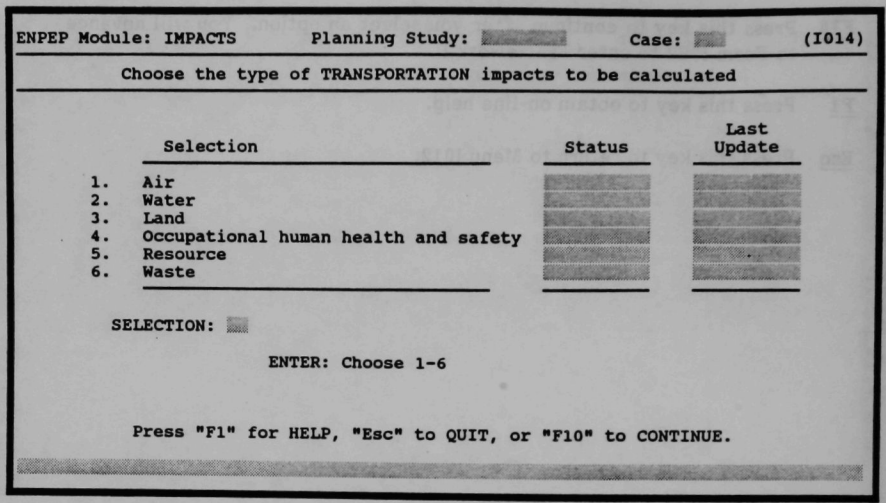
6 Select this option to calculate the amount of solid waste produced by mining. You will advance to Spreadsheet IMTSW.

F10 Press this key to continue after you select an option. You will advance to Form I099 to enter Framework II.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu I012.

8.3.14 Menu I014 — Calculating Electric Sector Transportation Impacts



Purpose

Menu I014 allows you to select which type of fuel transportation impacts to calculate. The categories of impacts are identical to those for mining on Menu I013. You advanced to this menu by selecting option 2 on Menu I012. Note that options **2**, **3**, **5**, and **6** are not associated with any function; they appear on the screen only to preserve the menu's format.

Options

1 Select this option to calculate air impacts from transportation. You will advance to Spreadsheet ITAEC.

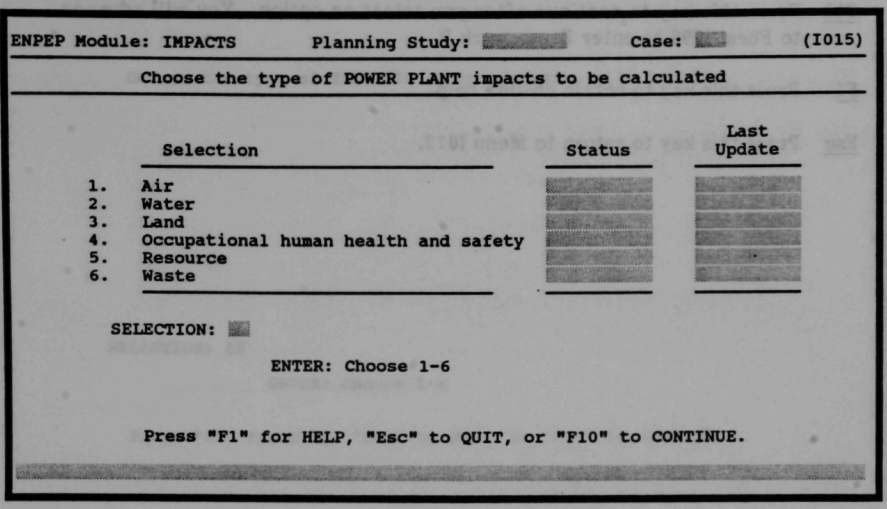
4 Select this option to calculate occupational human health and safety impacts from transportation. You will advance to Spreadsheet ITHHC.

F10 Press this key to continue after you select an option. You will advance to Form I099 to enter Framework II.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu I012.

8.3.15 Menu I015 — Calculating Electric Sector Power Plant Impacts



Purpose

Menu I015 allows you to select which type of power-plant impacts to calculate. The categories of impacts are identical to those for mining on Menu I013. You advanced to this menu by selecting option 3 on Menu I012.

Options

1 Select this option to calculate air impacts from power plants. You will advance to Spreadsheet IPAEC.

2 Select this option to calculate water impacts from power plants. You will advance to Spreadsheet IPWEC.

3 Select this option to calculate land impacts from power plants. You will advance to advance to Spreadsheet IPLSC.

4 Select this option to calculate occupational human health and safety impacts from power plants. You will advance to Spreadsheet IPHHC.

5 Select this option to calculate resource impacts from power plants. You will advance to Spreadsheet IPREC.

6 Select this option to calculate the amount of solid waste produced by power plants. You will advance to Spreadsheet IPTSL.

F10 Press this key to continue after you select an option. You will advance to Form I099 to enter Framework II.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu I012.

8.3.16 Menu I016 — Aggregating Electric Sector Impacts

```
ENPEP Module: IMPACTS        Planning Study:          Case:          (I016)

          Choose the type of ELECTRIC sector impacts to be totaled

                                                          Last
          Selection                          Status       Update
     1.   Air
     2.   Water
     3.   Land
     4.   Occupational human health and safety
     5.   Resource
     6.   Waste

        SELECTION:

                        ENTER: Choose 1-6

          Press "F1" for HELP, "Esc" to QUIT, or "F10" to CONTINUE.
```

Purpose

Menu I016 allows you to aggregate the data from the mining, transportation, and power plant impacts calculated from Menus I013, I014, and I015. You advanced to this menu by selecting option 4 on Menu I012. Note that option 5 is not associated with any function; it appears on the screen only to preserve the menu's format.

Options

1 Select this option to calculate the total air impacts from the electric sector. You will advance to Spreadsheet IEATO.

2 Select this option to calculate the total water impacts from the electric sector. You will advance to Spreadsheet IEWTO.

3 Select this option to calculate the total land impacts from the electric sector. You will advance to Spreadsheet IELTO.

4 Select this option to calculate the total occupational human health and safety impacts from the electric sector. You will advance to Spreadsheet IEHHS.

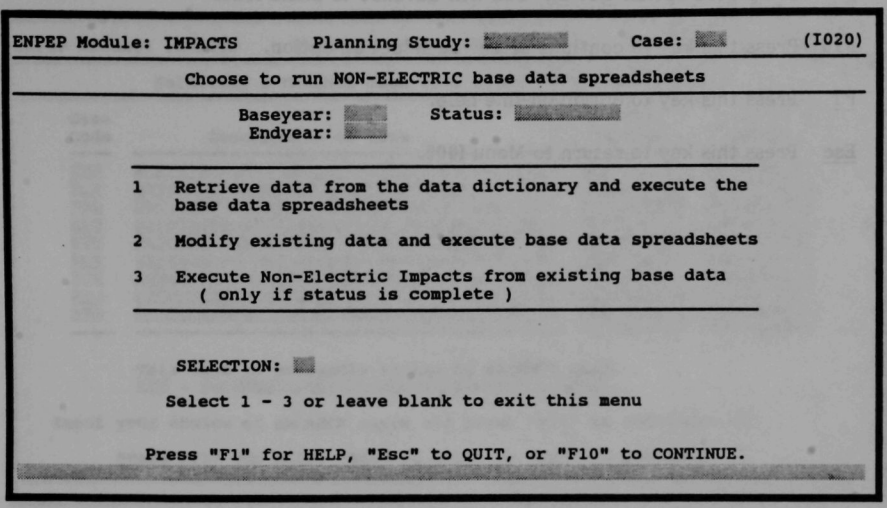
6 Select this option to calculate the total solid waste produced by the electric sector. You will advance to Spreadsheet IETTO.

F10 Press this key to continue after you select an option. You will advance to Form I099 to enter Framework II.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu I012.

8.3.17 Menu I020 — Selecting a Nonelectric Submodule Function



Purpose

Use this menu screen to execute the base spreadsheets for and calculate the impacts from the nonelectric sector (submodule). You may link to a case from the BALANCE Module from which to retrieve data (option 1) or enter data directly (option 2). You advanced to Menu I020 by selecting option 2 on Menu I005.

Options

1 Select this option to retrieve data from the Data Dictionary and execute the base spreadsheets. You will advance to Form I021 to choose a case from the BALANCE Module. After retrieving the data from the Data Dictionary, you will advance to Framework II to view or change the data.

2 Select this option to directly view, enter, or change the base data for the nonelectric submodule. This option allows you to use IMPACTS as a stand-alone model. You will advance first to Form I099 to enter Framework II and then to Spreadsheet INUGE.

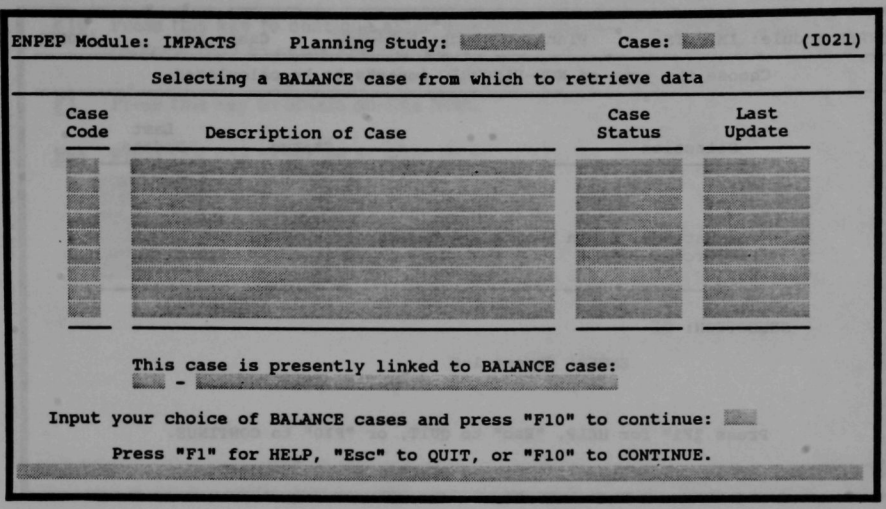
3 Select this option to execute the rest of the submodule. You can select this option only if the base spreadsheets are complete (that is, you have completed option **1** or **2**). You will advance to Menu I022.

F10 Press this key to continue after you select an option.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu I005.

8.3.18 Form I021 — Selecting Data from the BALANCE Module



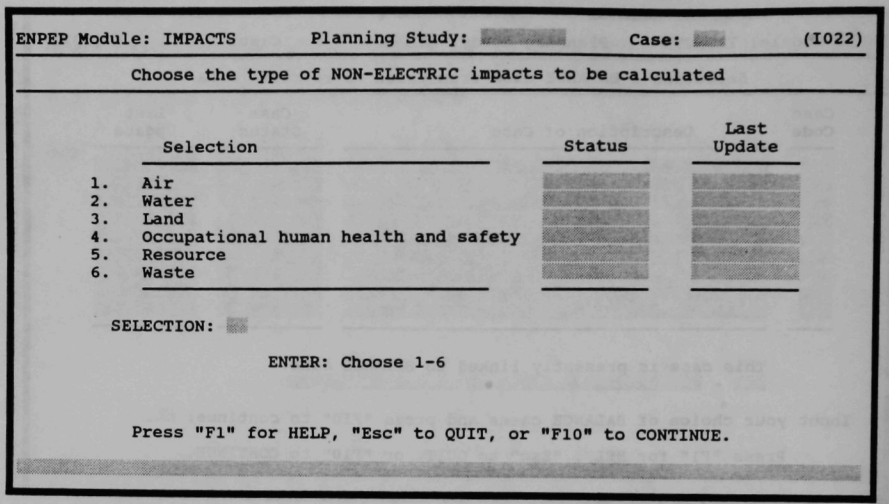
Purpose

Use this form to select a reference BALANCE case from which to retrieve data. You may use the existing link to the BALANCE Module or create a new link by selecting a new case. Selecting a new case for study will change the status of all nonelectric data to *INCOMPLETE* since the base spreadsheets will have a new data set. You advanced to Form I021 by selecting option 1 on Menu I020.

Options

- To use the data from the current BALANCE reference case, press **F10**.
- To choose a new BALANCE reference case, enter the case that you wish to reference and press **F10**. (You may only reference cases that are *COMPLETE*.) You will be prompted to identify the disk drive on which the case is stored.
- After you verify your selection by pressing **F10** again, you will advance first to Form I099 to enter Framework II and then to Spreadsheet INUGE.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu I020.

8.3.19 Menu I022 — Calculating Nonelectric Impacts



Purpose

This menu allows you to select which type of nonelectric impacts to calculate. The categories of impacts are identical to those in the electric submodule. You advanced to Menu I022 by selecting option 3 on Menu I020.

Options

1 Select this option to calculate air impacts from the nonelectric sector. You will advance to Spreadsheet INAEC.

2 Select this option to calculate water impacts from the nonelectric sector. You will advance to Spreadsheet INWEC.

3 Select this option to calculate land impacts from the nonelectric sector. You will advance to Spreadsheet INLCO.

4 Select this option to calculate occupational human health and safety impacts from the nonelectric sector. You will advance to Spreadsheet INHHC.

5 Select this option to calculate resource impacts from the nonelectric sector. You will advance to Spreadsheet INREC.

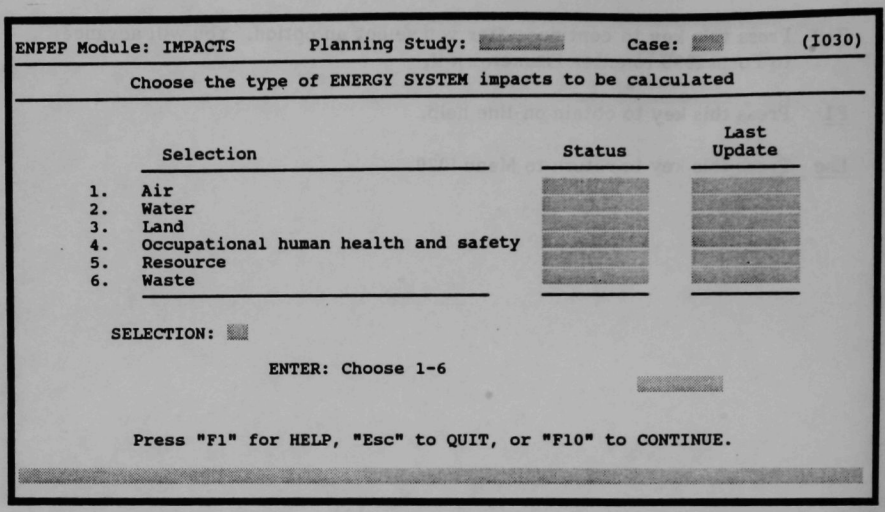
6 Select this option to calculate the amount of solid waste produced by the nonelectric sector. You will advance to Spreadsheet INTWE.

F10 Press this key to continue after you select an option. You will advance to Form I099 to enter Framework II.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu I020.

8.3.20 Menu I030 — Aggregating Energy System Impacts



Purpose

This menu allows you to select which type of total energy system impacts to calculate. The total energy system submodule aggregates the data from the electric and nonelectric submodules. You advanced to Menu I030 by selecting option 3 on Menu I005.

Options

1 Select this option to calculate the total air impacts from the energy system. You will advance to Spreadsheet IAATO.

2 Select this option to calculate the total water impacts from the energy system. You will advance to Spreadsheet IAWTO.

3 Select this option to calculate the total land impacts from the energy system. You will advance to Spreadsheet IALTO.

4 Select this option to calculate the total occupational human health and safety impacts from the energy system. You will advance to Spreadsheet IAHHS.

5 Select this option to calculate the total resource impacts from the energy system. You will advance to Form I031 to enter data for the current link to the MACRO Module. If you have bypassed the link to the MACRO Module, you will advance to Spreadsheet IARCR.

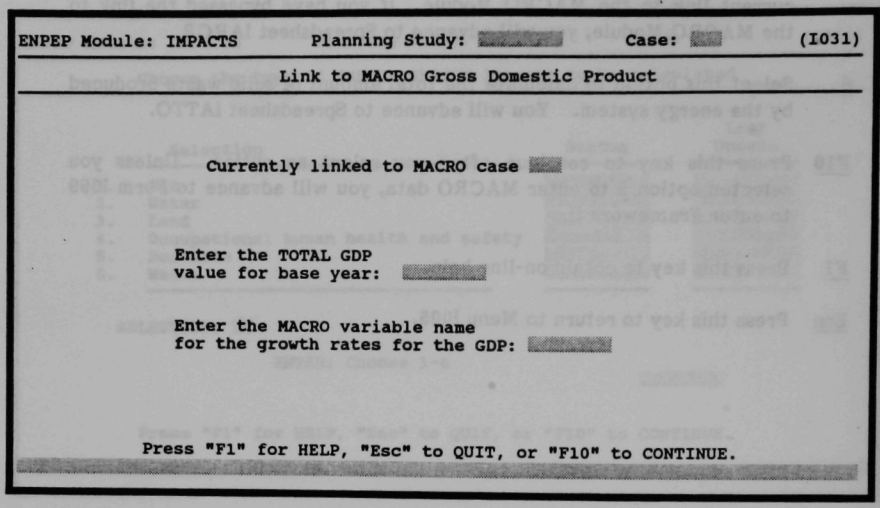
6 Select this option to calculate the total amount of solid waste produced by the energy system. You will advance to Spreadsheet IATTO.

F10 Press this key to continue after you select an option. Unless you selected option **5** to enter MACRO data, you will advance to Form I099 to enter Framework II.

F1 Press this key to obtain on-line help.

Esc Press this key to return to Menu I005.

8.3.21 Form I031 — Entering MACRO Module Variables



Purpose

Form I031 allows you to enter the base-year GDP value and the variable name of the GDP growth rates for the displayed MACRO case. You advanced to this form by selecting option 5 on Menu I030. If you bypassed the link to the MACRO Module (by entering Case 000 on Form I004), you will not advance to this form.

Options

- Enter the total GDP value for the base year.
- Enter the variable name for the GDP growth rates. It must be a name that exists in the data dictionary.
- Press **F10** to save the displayed values and advance first to Form I099 to enter Framework II and then to Spreadsheet IATTO.
- Press **F1** to obtain on-line help.
- Press **Esc** to return to Menu I030.

8.4 Spreadsheets

This section describes the spreadsheets for the IMPACTS module and how you use them. The spreadsheets are organized according to the functional structure shown in Fig. 8.1 (except those spreadsheets used by more than one submodule). Sections 8.4.1 through 8.4.71 describe the spreadsheets that characterize the technical aspects and environmental burdens associated with the electric system. Sections 8.4.72 through 8.4.105 describe the spreadsheets that characterize the technical aspects and environmental burdens associated with the nonelectric system. Sections 8.4.106 through 8.4.115 describe the spreadsheets that summarize the resource requirements and environmental burdens for the entire energy system (electric and nonelectric); sector totals for the energy system are meaningful only after you complete sector totals in the electric and nonelectric submodules.

8.4.1 IBUGE — Annual Electric Generation

```
:-------------------------------------------------------------------------:
:    Name:  IBUGE                                                         :
:   Title:  Annual power plant generation in each year of the             :
:           planning study                                                :
:  Source:  ELECTRIC Module or user                                       :
:   Units:  GWh                                                           :
:                                                                         :
:-------------------------------------------------------------------------:
: Plant   Sequence | Study Year  - - -  - - - - > Similarly for all       :
: Name    Number   |   2000       2001       2002      years and plants   :
:-------------------------------------------------------                  :
: NUC1        1     0.0000E+0  0.0000E+0  4.0000E+3                       :
: COA1        2     4.5000E+3  4.5000E+3  4.5000E+3                       :
: COA2        3     4.5000E+3  4.5000E+3  4.5000E+3                       :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet displays the annual quantity of electricity (GWh) generated by each plant in the generating system. You advanced to Spreadsheet IBUGE by selecting an ELECTRIC case on Form I011 or selecting option 2 on Menu I010 and entering Framework II on Form I099.

Options

- View or change the displayed values.
- Press **Alt-C** to advance to spreadsheet IBUCH, which contains the technical characteristics of the displayed plant types.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The annual plant energy assignments shown in this spreadsheet can be calculated in the ELECTRIC Module. The values represent the total energy generated by all units of the types listed (Spreadsheet IBUNO displays the number of units of each type in the system). If you are not using an ELECTRIC case, this spreadsheet will contain data from the case that you copied to create the current case (see Form I002). You should verify all data in this spreadsheet before continuing.

8.4.2 IBUCH — Power Plant Technical Characteristics

```
:-------------------------------------------------------------------------:
:    Name:  IBUCH                                                         :
:   Title:  Characteristics of ELECTRIC or user power plants              :
:  Source:  ELECTRIC Module or user                                       :
:   Units:  Shown in spreadsheet                                          :
:                                                                         :
:-------------------------------------------------                        :
:                      Maximum       Heat                                 :
: Plant     Sequence   Capacity      Rate                                 :
: Name      Number     (MW)          (kcal/kWh)                           :
:-------------------------------------------------                        :
: NUC1        1          800          2696                                 :
: COA1        2          800          2369                                 :
: COA2        3          800          2280                                 :
: OIL1        4          500          2439                                 :
: GAS1        5           75          2439                                 :
: HYD1        6          100             0                                 :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet displays key technical characteristics for each power plant. You advanced to Spreadsheet IBUCH after viewing the annual generation on IBUGE.

Options

- View or change the displayed values.
- Press **Alt-C** to advance to Spreadsheet IBUNO, which displays the number of units for each type of power plant.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The data in this spreadsheet can be determined from data developed by the ELECTRIC Module. The heat rate, which is a capacity-weighted average, is calculated as follows:

$$H = [(B \times A) + I(T-A)]/T$$

where:

H = average plant heat rate (kcal/kWh),

B = heat rate at minimum operating level (kcal/kWh),

A = minimum unit operating capacity (MW),

I = average incremental heat rate between minimum and maximum operating levels (kcal/kWh), and

T = maximum unit generating capacity (MW).

If you are not using an ELECTRIC case, this spreadsheet will contain data from the case that you copied to create the current case (see Form I002). You should verify all data in this spreadsheet before continuing.

8.4.3 IBUNO — Annual Number of Available Power Plants

Name:	IBUNO				
Title:	Number of electric power plants operable in each year of the planning study				
Source:	ELECTRIC Module or user				
Units:	Number of electric power plants operable in study years				
Plant Name	Sequence Number	Study Year - - - - - - - > 2000	2001	2002	Similarly for all years and plants
NUC1	1	0	0	1	
COA1	2	1	1	1	
COA2	3	1	1	1	

Purpose

This spreadsheet displays the number of electric power plants of each type that are available to meet electricity demands in each year of the planning study. You advanced to Spreadsheet IBUNO after viewing the technical characteristics on IBUCH.

Options

- View or change the displayed values.
- Press Alt-C to advance to Spreadsheet IBUEN, which contains information about additions to the electric system.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The generating system configuration displayed in this spreadsheet can be determined in the ELECTRIC Module. Because a generating unit may retire in the same year that a new unit of the same type is added, new additions to the system are displayed separately in Spreadsheet IBUEN and cannot be inferred from information in this spreadsheet. If you are not using an ELECTRIC case, this spreadsheet will contain data from the case that you copied to create the current case (see Form I002). You should verify all data in this spreadsheet before continuing.

8.4.4 IBUEN — Annual Number of New Power Plants

Name:	IBUEN
Title:	Number of electric power plants entering the system in each year of the planning study
Source:	ELECTRIC Module or user
Units:	Number of electric power plants entering system in study year

Plant Name	Sequence Number	Study Year 2000	2001	2002	> Similarly for all years and plants
NUC1	1	0	0	1	
COA1	2	0	0	0	
COA2	3	0	0	0	
OIL1	4	0	0	0	
GAS1	5	0	0	0	

Purpose

This spreadsheet displays the number and timing of new capacity additions to the electric system. You advanced to Spreadsheet IBUEN after viewing the power plant availability on IBUNO.

Options

- View or change the displayed values.
- Press Alt-C to advance to Spreadsheet IBWEM to enter or change data for characterizing power plant cooling systems.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

New additions to the generating system are displayed by the year of unit start-up. This information is used along with expenditure and construction profiles to calculate annual capital expenditures and labor requirements. These values can be provided by the ELECTRIC Module. If you are not using an ELECTRIC case, this spreadsheet will contain data from the case that you copied to create the current case (see Form I002). You should verify that the addition schedule is accurate before continuing.

8.4.5 IBWEM — Entering Power Plant Cooling System Data

```
:-------------------------------------------------------------------------:
:    Name:  IBWEM                                                         :
:   Title:  Functions specifying fractions of alternative                 :
:           cooling modes by plant type*                                  :
:  Source:  User input                                                    :
:   Units:  Half time in years                                            :
:                                                                         :
:-------------------------------------------------------------------------:
:             |--- Evaporative Cooling Tower ---|  ---> Similarly for     :
:                          Change    End    Half      dry cooling and     :
: Category    |Base Frac.   Year    Frac.   time      lake, pond, and spray :
:-------------------------------------------------                        :
: Coal            0         2005    .20      5                           :
: Oil             0         2005    .20      5                           :
: Gas             0         2005    .20      5                           :
: Nuclear         0         2005    .20      5                           :
:-------------------------------------------------------------------------:
:  * Fractions of units using once-through cooling are determined by      :
:    subtraction based on the fractions specified in the table:           :
:    Fraction Once Through = 1 - Frac. Evaporative Cooling -              :
:    Frac. Dry Cooling - Frac. Lake, Pond, and Spray                      :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet allows you to specify the mix of plant cooling systems (for four generic plant categories) as a function of time. You advanced to Spreadsheet IBWEM after viewing the power plant additions on Spreadsheet IBUEN.

Options

- You can enter or change any of the parameters in this screen, which are defined as follows:

  Base Frac. -- A real variable containing the base value of the function (the starting fraction).

  Change Year -- An integer variable denoting the year in which the change from the base value begins.

  End Frac. -- A real variable containing the asymptotic value of the function when exponential behavior is assumed (that is, when you desire a limiting fraction).

Half Time -- An integer variable that represents the number of years required to reach 50% of the difference between the base and end fractions.

- Press **Alt-C** to advance to Spreadsheet IBFCH, which contains the characteristics of the fuels represented.

- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet requires that you make decisions about the types of cooling systems that will be used over the planning period. Four general categories of power plants and four alternative categories of cooling systems are represented. Exponential functions are used to simulate time-dependent changes in the mix of cooling types (see Sec. 8.5.5). For example, suppose that all plants use once-through cooling until the year 2005, when evaporative cooling towers are expected to slowly penetrate the market. In the long run, it is expected that 20% of all power plants will use evaporative cooling towers. One-half of these long-run values are expected to be reached by the year 2010 (implying a *half time* of 5 years). The data in the sample spreadsheet reflect these assumptions.

8.4.6 IBFCH — Entering Power Plant Fuel Data

Name: IBFCH
Title: Characteristics of fuels represented in IMPACTS Module (used for both electric and nonelectric systems)
Source: User input
Units: Shown in spreadsheet*

Fuel Number	Fuel Type	High Heat Value	Units	Sulfur %	Ash %
1	C1	4793	kcal/kg	6.62	7.60
2	C2	5196	kcal/kg	.30	3.70
3	C3	7282	kcal/kg	2.80	7.60
4	C4	6194	kcal/kg	3.90	10.40
5	C5	4739	kcal/kg	.62	7.60
6	C6	6194	kcal/kg	3.90	10.40
7	O1	1.58E+6	kcal/bbl	2.00	.50
8	O2	1.47E+6	kcal/bbl	2.00	.50
9	O3	1.58E+6	kcal/bbl	2.00	.50
10	O4	1.47E+6	kcal/bbl	2.00	.50
11	G1	9120	kcal/m^3	.00	.00
12	G2	9120	kcal/m^3	.00	.00
13	N	N/A		N/A	N/A
14	H1	N/A		N/A	N/A
15	H2	N/A		N/A	N/A
16	T1	0		.00	.00
17	T2	0		.00	.00

* N/A ==> not applicable

Purpose

This spreadsheet displays the characteristics of the fuels that are represented in the entire IMPACTS Module. See Table 8.1 in Sec. 8.1.3 for an explanation of the fuel-type codes. You advanced to Spreadsheet IBFCH after viewing or changing data for cooling systems on IBWEM.

Options

- View or change the higher heating values and sulfur and ash contents for the fuels considered.
- Press Alt-C to advance to Spreadsheet IBNCH, which contains nuclear fuel and reactor characteristics.

- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You must supply the higher heating value (use the units specified in the spreadsheet), sulfur content (%), and ash content (%) for all fuel types considered in the analysis. The IMPACTS Module uses 17 fuel types within six major fuel categories (see Table 8.1). If you are using an ELECTRIC case, the higher heating values should correspond to those used in the ELECTRIC Module; the sulfur and ash contents must always be supplied independently.

8.4.7 IBNCH - Nuclear Fuel and Reactor Data

```
:-------------------------------------------------------------------------:
:    Name:  IBNCH                                                         :
:   Title:  Nuclear fuel and reactor characteristics                      :
:  Source:  User input                                                    :
:   Units:  Shown in spreadsheet*                                         :
:-------------------------------------------------------------------------:
:                                                          ----> For all  :
:  Nuclear        Burn up        Feed        Discharge          nuclear   :
:  Technology+     MW-d/t    Enrichment %  Enrichment %      characteristics :
:-------------------------------------------------------------------------:
:    4.1          3.036E+4     2.560E+0       7.300E-1                    :
:    4.2          3.036E+4     3.010E+0       8.500E-1                    :
:-------------------------------------------------------------------------:
:   * MW-d ==> Megawatt-days                                              :
:   + Default characteristics correspond to a PWR (4.1) and BWR (4.2)     :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet allows you to specify nuclear fuel and reactor characteristics. You advanced to Spreadsheet IBNCH after viewing or changing fuel data on IBFCH.

Options

- View or change any of the default values (see below).
- Press Alt-C to advance to Spreadsheet IBFAS, which allows you to change the type of fuel that is consumed at each plant.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet is used to define the characteristics of nuclear reactors and fuel. Two different reactors may be represented. The default values provided in the spreadsheet correspond to a pressurized-water reactor (PWR) and a boiling-water reactor (BWR). Before you change the default data, you must carefully coordinate all parameters.

8.4.8 IBFAS — Assigning Power Plant Fuel and Technology Types

Name: IBFAS
Title: Fuel assignments and technology type identification for electric power plants
Source: User input
Units: Technology type and fuel assignment

Plant Name	Sequence Number	Fuel Type 1	Percent Type 1	Fuel Type 2	Tech Type
NUC1	1	N	100		4.1
COA1	2	C2	50	C3	1.2
COA2	3	C1	75	C2	1.2
OIL1	4	O1	50	O3	2.0
GAS1	5	G1	75	G2	6.0
HYD1	6	H1	100		5.1

Purpose

This spreadsheet allows you to specify the fuels that are used by each of the power plants in the generating system. You advanced to Spreadsheet IBFAS after viewing or changing nuclear power plant data on IBNCH.

Options

- View or change the fuel assignments and technology-type designations.
- Press **Alt-C** to advance to Spreadsheet IBCFC, which allows you to specify the fraction of each type of coal that is cleaned.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet is used to associate specific fuels with specific power plants. Each plant can use a maximum of two different fuels, reflecting fuel switching, fuel blending, or changes in fuel availability during the year. The percentage of fuel type 2 used is determined by subtracting the percentage of fuel type 1 from 100. The technology-type designation allows greater flexibility in characterizing the generating plants. Refer to Table 8.2 for

descriptions of power plant technology types. It is recommended that a low-Btu coal plant refer to a plant that uses coal with a higher heating value greater than or equal to 4,610 kcal/kg. This technology-type designation must be consistent with the fuel characteristics in Spreadsheet IBFCH and the primary fuel-type assignment. It is further recommended that a low-Btu gas plant refer to a plant that uses natural gas with a higher heating value greater than or equal to 8,900 kcal/m^3.

8.4.9 IBCFC — Specifying Coal Preparation

```
:-------------------------------------------------------------------------:
:    Name:  IBCFC                                                         :
:   Title:  Fraction of each coal type used in                            :
:           electric power plants that is cleaned                         :
:  Source:  User input                                                    :
:   Units:  Shown in spreadsheet                                          :
:                                                                         :
:-------------------------------------------------                        :
:      Coal Type          Percent Cleaned                                 :
:-------------------------------------------------                        :
:         C1                    20%                                       :
:         C2                    20%                                       :
:         C3                    20%                                       :
:         C4                    0%                                        :
:         C5                    0%                                        :
:         C6                    0%                                        :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet allows you to specify the fraction of each coal type that is mechanically cleaned before being transported to the power plants. You advanced to Spreadsheet IBCFC after viewing or changing the fuel- and technology-type assignments on Spreadsheet IBFAS.

Options

- View or change the displayed values.
- Press **Alt-C** to advance to Spreadsheet IBFGE, which calculates the annual generation by fuel and technology classification.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

Coal is often prepared, or beneficiated, before being used. This could consist of any or all of the following: crushing and screening to a desired maximum size, cleaning to remove dust and noncoal materials, and drying to prepare the coal for shipping or use. These operations are assumed to take place near the mine or import terminal prior to transport. You can specify the fraction of coal that undergoes some type of beneficiation or cleaning. IMPACTS assumes that 25% of the coal is lost during cleaning.

8.4.10 IBFGE — Annual Electric Generation by Fuel Type

```
:-------------------------------------------------------------------------:
:    Name:  IBFGE                                                         :
:   Title:  Annual generation by fuel/technology classification           :
:  Source:  IBFAS and IBUGE                                               :
:   Units:  GWh                                                           :
:                                                                         :
:-------------------------------------------------------------------------:
: Study    |  - - - - - - Coal Steam - - - - - - - - ->  For all categories :
: Year     |    C1        C2        C3        C4         and years         :
:----------------------------------------------                           :
:  2000     3.3750E+3 3.3750E+3 2.2500E+3 0.0000E+0                       :
:  2001     3.3750E+3 3.3750E+3 2.2500E+3 0.0000E+0                       :
:  2002     3.3750E+3 3.3750E+3 2.2500E+3 0.0000E+0                       :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet displays the quantity of generation (GWh) for each type of fuel and generation technology. You advanced to Spreadsheet IBFGE after viewing or changing the amount of coal that is cleaned on IBCFC.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet IBFGP, which converts the annual generation data to percentages.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values in this spreadsheet are calculated by correlating the fuel assignment specifications in Spreadsheet IBFAS with the annual plant generation data in Spreadsheet IBUGE.

8.4.11 IBFGP — Annual Electric Generation by Fuel Type as Percentages

```
:-------------------------------------------------------------------------:
:   Name:   IBFGP                                                         :
:  Title:   Annual generation by fuel/technology classification           :
:           expressed in % of total generation                            :
: Source:   IBFGE                                                         :
:  Units:   Percent                                                       :
:                                                                         :
:-------------------------------------------------------------------------:
: Study   |  - - - - - - Coal Steam - - - - - - - - ->   For all categories :
: Year    |    C1        C2        C3        C4          and years        :
:---------------------------------------------------                      :
:  2000        19.67     38.69      .00       .00                         :
:  2001        20.84     42.00      .00       .00                         :
:  2002        21.03     48.52      .00       .00                         :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet displays the percentage of annual generation for each type of fuel. You advanced to Spreadsheet IBFGP after viewing the annual generation on IBFGE.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet IBFUS, which calculates the quantity of fuel that is consumed annually at the electric power plants.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet calculates the percentage of total generation produced by each fuel by the following formula:

percentage = (generation by fuel / total generation) × 100

Spreadsheet IBFGE supplies the generation data.

8.4.12 IBFUS — Annual Power Plant Fuel Consumption

```
:-------------------------------------------------------------------------:
:    Name:  IBFUS                                                         :
:   Title:  Quantity of fuel that is consumed annually                    :
:           at electric power plants                                      :
:  Source:  IBFGE, IBUCH, and IBFCH                                       :
:   Units:  Coal-t, Oil-bbl, Gas-m^3, Nuclear-t(UO2)                      :
:                                                                         :
:-------------------------------------------------------------------------:
: Study    |  - - - - - - - Coal Steam - - - - - - - ->  For all categories :
: Year     |    C1        C2         C3         C4        and years       :
:----------------------------------------------------                     :
:  2000     1.6055E+6  1.5195E+6  7.3198E+5  0.0000E+0                    :
:  2001     1.6055E+6  1.5195E+6  7.3198E+5  0.0000E+0                    :
:  2002     1.6055E+6  1.5195E+6  7.3198E+5  0.0000E+0                    :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet displays the calculated values for annual fuel consumption in the electric system for each technology and fuel type. You advanced to Spreadsheet IBFUS after viewing annual generation as percentages on IBFGP.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IBNCD, which summarizes the charge/discharge mass balances for the nuclear plants in the system.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values in this spreadsheet are calculated by correlating the plant-level, fuel-use data with plant-specific operating characteristics. The total quantity of fuel used for a given noncoal fuel type is determined by adding the values from all technology types. For example, the total quantity of oil (O1) used is the sum of O1 used in oil steam units and O1 used in oil-fired gas turbines. The basic form of the equation used to calculate these values is as follows:

$$Q = a(G \times H)/V$$

where:

Q = quantity consumed in appropriate units,

a = constant to convert to appropriate units,

G = generation (GWh) attributable to fuel type from Spreadsheet IBFGE,

H = heat rate (kcal/kWh) from Spreadsheet IBUCH, and

V = higher heating value of the fuel (kcal/kg, kcal/bbl, or kcal/m^3) from Spreadsheet IBFCH.

8.4.13 IBNCD — Annual Nuclear Mass Balances

Name: IBNCD
Title: Nuclear power plant charge/discharge mass balances
Source: IBNCH, IBUCH, and IBUGE
Units: Metric tons

Charge / Discharge	Study Year 2000	2001	2002	For all study years
UO2 charged	0.0000E+0	0.0000E+0	1.9547E+1	
Uranium charged	0.0000E+0	0.0000E+0	1.7230E+1	
U-235 charged	0.0000E+0	0.0000E+0	4.4109E-1	
Pu produced	0.0000E+0	0.0000E+0	1.4804E-1	
Fissile Pu produced	0.0000E+0	0.0000E+0	1.0200E-1	
Fission products produced	0.0000E+0	0.0000E+0	5.5396E-1	
Uranium discharged	0.0000E+0	0.0000E+0	1.6528E+1	
U-235 discharged	0.0000E+0	0.0000E+0	1.2065E-1	

Purpose

This spreadsheet displays the aggregated annual charge and discharge mass (t) balance data for operational nuclear power plants. You advanced to Spreadsheet IBNCD after viewing the fuel consumption data on IBFUS.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet IBTAS, which allows you to associate specific transportation modes with specific types of fuel.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The mass balance data summarized in this spreadsheet are calculated using the nuclear fuel and reactor characteristics from Spreadsheet IBNCH and the generation data from Spreadsheets IBUCH and IBUGE. The following equations are used:

$U1 = UO_2$ charged $= G \times H \times A \times (4.85 \times 10^{-2})/B$

$U2 =$ U charged $= U1/A$

$U3 =$ U-235 charged $= (U1/A)(F/100)$

$U4 =$ Pu produced $= P1 \times B \times U2 \times 10^{-6}$

$U5 =$ fissile Pu produced $= P2 \times B \times U2 \times 10^{-6}$

$U6 =$ fission products produced $= P3 \times B \times U2 \times 10^{-6}$

$U7 =$ Uranium discharged $= U2 - U6 - U4$

$U8 =$ U-235 discharged $= U2(D/100)$

where:

$G =$ generation (GWh) from IBUGE,

$H =$ heat rate (kcal/kWh) from IBUCH,

$A = (W + 32)/W =$ weight UO_2/weight U,

$W = 235(F/100) + 238[(100-F)/100]$,

$B =$ burn up (MW-d/t) from IBNCH,

$F =$ feed enrichment (%) from IBNCH,

$D =$ discharge enrichment (%) from IBNCH,

$P1 =$ Pu in spent fuel (g/MW-d) from IBNCH,

$P2 =$ fissile Pu in spent fuel (g/MW-d) from IBNCH, and

$P3 =$ fission product production (g/MW-d) from IBNCH.

8.4.14 IBTAS — Assigning Fuel Transportation

Name: IBTAS
Title: Electric sector transportation assignments by fuel types*
Source: User input
Units: Distances in km

Transport Mode		Fuel types C1	C2	C3	Similarly for all fuel types
Rail:	Fract.	.75	0	.50	
	Avg. Dist.	100	0	60	
Truck:	Fract.	.10	1	0	
	Avg. Dist.	10	20	0	
Pipeline:	Fract.	0	0	0	
	Avg. Dist.	0	0	0	
Tanker:	Fract.	0	0	0	
	Avg. Dist.	0	0	0	
Barge:	Fract.	0	0	.50	
	Avg. Dist.	0	0	45	
Other:	Fract.	0	0	0	
	Avg. Dist.	0	0	0	
Minemouth:	Fract.+	.25	0	0	

* Transportation fractions for a particular fuel type may be greater than 1.0, reflecting sequential transport modes.
\+ No transportation is required for mine-mouth facilities.

Purpose

Spreadsheet IBTAS shows the distribution of transport modes and distances (km) for each type of fuel that is used in the electric sector. You advanced to IBTAS after viewing the nuclear mass balances on Spreadsheet IBNCD.

Options

- You may enter new values in the spreadsheet, calculated as indicated below.
- Press Alt-C to advance to Spreadsheet IBTLC, which contains transportation loss coefficients.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

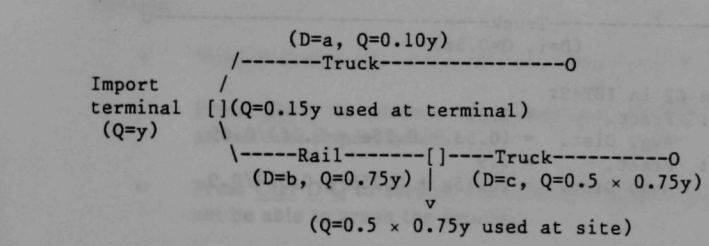
Background

The transportation assignments in this spreadsheet for each fuel type must account for all direct and indirect (that is, sequential) links in the transportation system. The fraction of fuel transported by each mode must be expressed as a function of the quantity of fuel imported or produced domestically. The average transport distance for each mode is a weighted average value (weighted by the quantity of fuel transported) that includes all relevant links in the transportation system. The following two examples illustrate how to calculate these input values.

Example 1. The transportation system in this example involves an import terminal for coal type C1 and two subsequent modes of transport: rail and truck. The rail system delivers 75% of the imported coal to a regional distribution center, from which 50% of the delivered coal is further distributed by truck. Fifteen percent of the imported coal is used at the terminal site. Note that the calculated transportation fractions sum to a number greater than 1.0 due to the sequential transport modes.

Legend:

[] = intermediate node
O = terminal node
D = distance transported
Q = quantity in t, bbl, or m^3



Total quantity of fuel transported by truck
= 0.10y + (0.5 × 0.75y)
= 0.475y

Total quantity of fuel transported by rail
= 0.75y

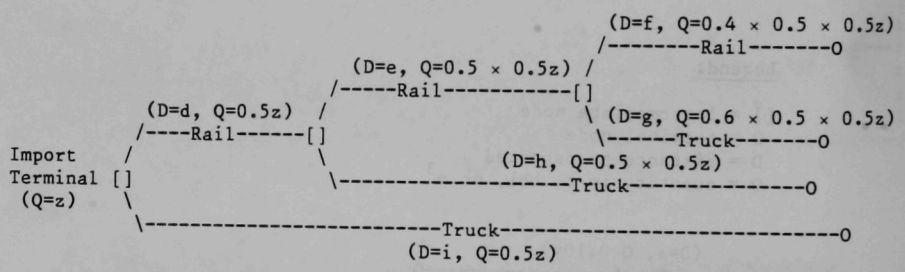
Weighted average transport distance for truck
= [0.10ya + (0.5 × 0.75yc)]/0.475y
= (0.10a + 0.375c)/0.475

Weighted average transport distance for rail
= b

Entries for fuel type C1 in IBTAS:

Rail:	Fract.	= 0.75
	Avg. Dist.	= b
Truck:	Fract.	= 0.475
	Avg. Dist	= (0.10a + 0.375c)/0.475
Mine mouth:	Fract.	= 0.15

Example 2. The following transportation system also involves an import terminal for coal (C2), with subsequent rail and truck transport. The rail system is used to deliver coal to two regional distribution centers and a large power plant, as shown.



Entries for fuel type C2 in IBTAS:

Rail:	Fract.	= 0.85
	Avg. Dist.	= (0.5d + 0.25e + 0.1f)/0.85
Truck:	Fract.	= 0.9
	Avg. Dist.	= (0.15g + 0.25h + 0.5i)/0.9

8.4.15 IBTLC — Changing Fuel Transportation Loss Coefficients

Name: IBTLC
Title: Average transportation loss coefficients
Source: Energy Alternatives: A Comparative Analysis
Units: Shown in spreadsheet

Transport Mode	Coal t/t-km	Oil bbl/bbl-km	Gas m^3/m^3-km	Other-A	Other-B
Rail	3.20E-4	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Truck	3.20E-4	6.00E-6	0.00E+0	0.00E+0	0.00E+0
Pipeline	0.00E+0	2.70E-5	2.20E-5	0.00E+0	0.00E+0
Tanker	0.00E+0	6.00E-6	0.00E+0	0.00E+0	0.00E+0
Barge	3.20E-4	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Other	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Minemouth*	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

* Refers to either a minemouth facility or an import terminal; in both cases, losses are independent of distance.

Purpose

Spreadsheet IBTLC displays the default loss coefficients that are applied to the various fuel transportation systems. You advanced to IBTLC after viewing of changing the transportation data on Spreadsheet IBTAS.

Options

- View or change any of the default coefficients in the spreadsheet.
- Press **Alt-C** to advance to Spreadsheet IBTFR, which calculates the annual fuel requirements.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

These loss coefficients are expressed in terms of the quantity of fuel lost per quantity of fuel transported per unit distance (t/t-km, bbl/bbl-km, or m^3/m^3-km). The coefficient for mine-mouth facilities is expressed as a quantity lost per quantity received or handled. These default coefficients are regionally sensitive and can be adjusted.

8.4.16 IBTFR — Annual Fuel Requirements

```
:-------------------------------------------------------------------------:
:   Name: IBTFR                                                           :
:  Title: Quantity of fuel imported, required annually from the domestic  :
:         resource base, or required from conversion facilities for electric :
:         power plants                                                    :
: Source: IBFUS, IBTAS, IBTLC, IBCFC                                      :
:  Units: Coal-t, Oil-bbl, Gas-m^3, Nuclear-t(UO2)                        :
:                                                                         :
:-------------------------------------------------------------------------:
:  Study  | Fuel Type - - - - - - - - - - > For all categories            :
:  Year   |    C1          C2          C3          and years              :
:---------------------------------------------------------               :
:   2000     1.7552E+6   1.6312E+6   7.9412E+5                           :
:   2001     1.7552E+6   1.6312E+6   7.9412E+5                           :
:   2002     1.7552E+6   1.6312E+6   7.9412E+5                           :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IBTFR shows the quantity of each fuel type that is required in each year of the planning study. You advanced to IBTFR after viewing or changing the transportation loss coefficients on Spreadsheet IBTLC.

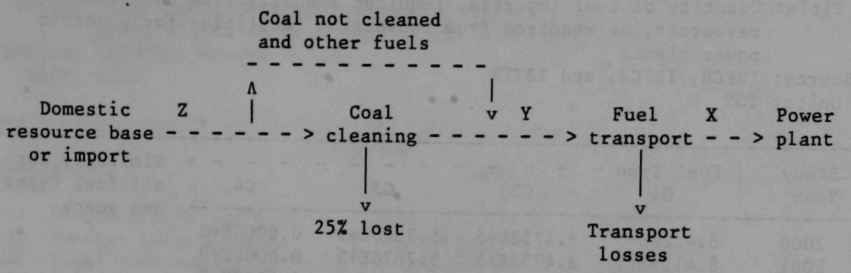
Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet IBTOE, which converts the information in this spreadsheet into tons of oil equivalents.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The quantities shown in this spreadsheet represent demands from the electric sector for the 17 fuels considered in IMPACTS. These quantities are calculated from the data on Spreadsheets IBFUS, IBTAS, IBTLC, and IBCFC. Depending on the fuel type (see Table 8.1 for descriptions), these represent the quantity of fuel imported (for C4, C5, O3, O4, G2, N, and potentially T1 and T2), required annually from the domestic resource base, or required from conversion facilities for electric power plants. The units for fuel quantities

are fuel-specific (t, bbl, or m^3). The following diagram illustrates the assumed sequence of steps in each fuel cycle:



$$Y = X/(1.0 - L)$$
$$Z = Y[(f/0.75) + (1.0 - f)]$$

where:

Z = quantity of fuel required (imported or from the domestic resource base),

f = fuel that is cleaned (fraction) from IBCFC,

Y = quantity of fuel that is transported from IBTAS,

X = quantity of fuel consumed at the power plants from IBFUS, and

L = total transport losses (fraction) for each fuel type from IBTLC.

8.4.17 IBTOE — Annual Fuel Requirements in Tons of Oil

```
:-------------------------------------------------------------------------:
:   Name: IBTOE                                                           :
:  Title: Quantity of fuel imported, required annually from domestic      :
:         resources, or required from conversion facilities for electric  :
:         power plants                                                    :
: Source: IBFCH, IBFGE, and IBTFR                                         :
:  Units: TOE                                                             :
:                                                                         :
:-------------------------------------------------------------------------:
:  Study  | Fuel Type - - - - - - - - - - - - - - - > Similarly for       :
:  Year   |     C1          C2          C3          C4      all fuel types :
:---------------------------------------------------------- and years     :
:   2000     8.4126E+5   8.4758E+5   5.7828E+5   0.0000E+0               :
:   2001     8.4126E+5   8.4758E+5   5.7828E+5   0.0000E+0               :
:   2002     8.4126E+5   8.4758E+5   5.7828E+5   0.0000E+0               :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IBTOE displays the annual fuel requirements for the electric sector in tons of oil equivalents (TOE), thereby providing a common basis for comparison. You advanced to IBTOE after viewing the annual fuel requirements on Spreadsheet IBTFR.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IBUCO, which contains the total operating and construction expenditures for electric power plants in each year of the planning study.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet converts the fuel use data in IBTFR to TOE. The conversion used for nuclear fuel is as follows:

$$\text{TOE/t-UO}_2 = 2.06 \times \text{burnup(MW-d/t)/A}$$

where A = weight UO_2/weight U (see IBNCD).

8.4.18 IBUCO — Annual Electric Cost Absolute Values

Name: IBUCO
Title: Total operating costs and construction expenditures for electric power plants in each year of the planning study
Source: ELECTRIC Module or user
Unit: $U.S.

Category	Study Year 2000	Study Year 2001	For all study years
A. Domestic Construction	1.0000E+8	1.0000E+8	
B. Foreign Construction	1.0000E+8	1.0000E+8	
C. Total Construction (A+B)	2.0000E+8	2.0000E+8	
D. O & M	1.0000E+8	1.0000E+8	
E. Domestic fuel	1.0000E+8	2.0000E+8	
F. Foreign fuel	1.0000E+8	1.0000E+8	
G. Total Fuel (E+F)	2.0000E+8	3.0000E+8	
H. Total Operation (D+G)	3.0000E+8	4.0000E+8	
I. Total Expenditures (C+D+G)	5.0000E+8	6.0000E+8	

Purpose

Spreadsheet IBUCO displays the total operating and construction expenditures for power plants in each study year. You advanced to IBUCO after viewing the fuel requirements in TOE on Spreadsheet IBTOE.

Options

- View or change the displayed values.
- Press **Alt-C** to advance to Spreadsheet IBUCP, which displays the costs in this spreadsheet as percentages.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The data in this spreadsheet can be obtained from the ELECTRIC Module. The category "total operation" (H) is calculated by summing O&M (D) and total fuel (G), while "total expenditures" (I) also includes construction expenditures (C). If you are not using an ELECTRIC case, IBUCO will contain data from the case you copied to create the current case (see Form I002).

8.4.19 IBUCP — Annual Electric Costs as Percentages

Name: IBUCP
Title: Total operating costs and construction expenditures for electric power plants expressed in % of total expenditures
Source: IBUCO
Unit: Percent

Category	Study Year 2000	2001	For all study years
A. Domestic Construction	20.0	20.0	
B. Foreign Construction	20.0	20.0	
C. Total Construction (A+B)	40.0	40.0	
D. O & M	20.0	20.0	
E. Domestic fuel	20.0	20.0	
F. Foreign fuel	20.0	20.0	
G. Total Fuel (E+F)	40.0	40.0	
H. Total Operation (D+G)	60.0	60.0	
I. Total Expenditures (C+D+G)	100.0	100.0	

Purpose

Spreadsheet IBUCP displays the percentage of annual expenditures for construction, operation and maintenance (O&M), and fuel for electric generating facilities. You advanced to IBUCP after viewing the electric sector costs on Spreadsheet IBUCO.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet uses the monetary values calculated in Spreadsheet IBUCO. Each entry is calculated as follows:

$$\text{percent} = (\text{monetary value})/(\text{total expenditure}) \times 100$$

8.4.20 IMAEC — Changing Coal Mining Air Emission Coefficients

```
:-------------------------------------------------------------------------:
:   Name:  IMAEC                                                          :
:  Title:  Uncontrolled air emissions coefficients and scaling factors for :
:          coal mining to support electric power plants                   :
: Source:  DOE/EV-0072                                                    :
:  Units:  Coefficients in short tons/10^12 Btu                           :
:                                                                         :
:-------------------------------------------------------                  :
:                Surface Mined Coal          Deep Mined Coal              :
: Category     Coefficient     Scalar    Coefficient     Scalar           :
:-------------------------------------------------------------------------:
: SO2          1.0000E-1    1.0000E+0    0.0000E+0    1.0000E+0           :
: NOX          1.5000E+0    1.0000E+0    0.0000E+0    1.0000E+0           :
: TSP          2.0000E-2    1.0000E+0    0.0000E+0    1.0000E+0           :
: CO           9.0000E-1    1.0000E+0    0.0000E+0    1.0000E+0           :
: HYDROCARBONS 2.0000E-2    1.0000E+0    0.0000E+0    1.0000E+0           :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IMAEC displays the default emission coefficients used in estimating uncontrolled air pollutant emissions from coal mining to support power plants. The five categories of emissions are sulfur dioxide (SO_2), nitrogen oxide (NO_x), total solid particulates (TSP), carbon monoxide (CO), and hydrocarbons. You can change the coefficients directly or change the scaling factors to adjust the coefficients. You advanced to IMAEC by selecting option 1 on Menu I013 and entering Framework II on Form I099.

Options

- View or change the scaling factors (or coefficients).
- Press Alt-C to advance to Spreadsheet IMASO, which calculates and displays the estimated total SO_2 emissions.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The emission coefficients are used to relate the quantity of a pollutant released to the atmosphere to a particular type of coal mining. You can scale the default coefficients for any pollutant to reflect local conditions. You must supply coefficients if emissions are associated with deep mining, since the default coefficients for deep mining are zero.

8.4.21 — Spreadsheets for Calculated Coal Mining Air Emissions

```
:-------------------------------------------------------------------------
:      Name:  IMASO
:     Title:  SO2 emissions from coal mining
:             to support electric power plants
:    Source:  IBTFR, IBFCH, and IMAEC
:     Units:  Metric Tons
:
:-----------------------------------------------
:  Study       Surface        Deep
:  Year     Mined Coal    Mined Coal       Total
:-----------------------------------------------
:  2000     6.0798E+0     0.0000E+0    6.0798E+0
:  2001     6.0798E+0     0.0000E+0    6.0798E+0
:  2002     6.0798E+0     0.0000E+0    6.0798E+0
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheets IMASO, IMANO, IMATS, IMACO, and IMAHC show the calculated SO_2, TSP, NO_x, CO, and hydrocarbon emissions (t) from coal mining to support electric power plants. You advanced to the spreadsheet shown here (IMASO) after viewing or changing the emission coefficients on Spreadsheet IMAEC. Since the NO_x, TSP, CO, and hydrocarbon emissions are calculated in the same manner, the corresponding spreadsheets, which have the same format, are not repeated in this document.

Options

- View the displayed values on each spreadsheet.
- Press Alt-C to advance to Spreadsheet IMANO, which calculates NO_x emissions. Similarly, press Alt-C when you finish viewing each of the emission spreadsheets (IMATS, IMACO, and IMAHC) to advance to the next spreadsheet.
- After you view Spreadsheet IMAHC, press Alt-C to advance to Spreadsheet IMATO, which summarizes emissions from coal mining.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values on each emission spreadsheet are calculated from information in Spreadsheets IBTFR, IBFCH, and IMAEC as follows:

$$\text{emissions} = C \times H \times Q \times U$$

where:

C = coefficient (tons/10^{12} Btu), obtained by multiplying the default coefficient and the scalar from Spreadsheet IMAEC,

H = higher heating value of fuel (kcal/kg, kcal/bbl, or kcal/m^3) from Spreadsheet IBFCH,

Q = quantity of fuel mined (t) from Spreadsheet IBTFR, and

U = conversion factor.

8.4.22 IMATO — Coal Mining Air Emission Summary

Name: IMATO
Title: Total air emissions from coal mining to support electric power plants
Source: IMASO, IMANO, IMATS, IMACO, and IMAHC
Units: Metric tons

Study Year	Emission Type → SO_2	NO_x	TSP	Similarly for CO and hydrocarbons
1991	2.6439E+0	3.9658E+1	5.2878E-1	
1992	3.1783E+0	4.7675E+1	6.3567E-1	
1993	4.0539E+0	6.0808E+1	8.1077E-1	
1994	4.6451E+0	6.9676E+1	9.2902E-1	
1995	4.8995E+0	7.3493E+1	1.0980E+0	
1996	5.4900E+0	8.2351E+1	1.0980E+0	
1997	6.2547E+0	9.3821E+1	1.2509E+0	

Purpose

Spreadsheet IMATO summarizes the air emissions (t) from coal mining to support power plants. You advanced to IMATO after viewing the hydrocarbon emissions on Spreadsheet IMAHC.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet summarizes the emissions (t) calculated on Spreadsheets IMASO, IMATS, IMACO, and IMAHC. You should verify these values before continuing.

8.4.23 IMWEC — Changing Coal Mining Water Emission Coefficients

Name: IMWEC
Title: Uncontrolled water emissions coefficients and scaling factors for coal mining to support electric power plants
Source: EPA - 600/2-75-068; DOE/EV-0072
Units: Short tons/10^12 Btu

	Surface Mined Coal		Deep Mined Coal	
Category	Coefficient	Scalar	Coefficient	Scalar
BOD	0.0000E+0	1.0000E+0	0.0000E+0	1.0000E+0
COD	0.0000E+0	1.0000E+0	0.0000E+0	1.0000E+0
Chloride	0.0000E+0	1.0000E+0	0.0000E+0	1.0000E+0
Phosphorus	0.0000E+0	1.0000E+0	0.0000E+0	1.0000E+0
TSS	4.8000E+0	1.0000E+0	1.9000E+1	1.0000E+0
TDS	3.5600E+1	1.0000E+0	3.9000E+1	1.0000E+0
Organics	0.0000E+0	1.0000E+0	0.0000E+0	1.0000E+0

Purpose

Spreadsheet IMWEC displays the default emission coefficients used in estimating uncontrolled water pollutant emissions from coal mining to support electric power plants. The seven categories of water emissions are biochemical oxygen demand (BOD), chemical oxygen demand (COD), chloride, phosphorus, total suspended solids (TSS), total dissolved solids (TDS), and organics. Biochemical oxygen demand is the amount of oxygen required by bacteria to convert organic material into stable compounds. Chemical oxygen demand is the amount of oxygen required to convert (oxidize) organic compounds into stable forms (usually carbon dioxide and water). Thus, COD includes all compounds requiring oxidation, while BOD includes only the biodegradable fraction. You advanced to this spreadsheet by selecting option 2 on Menu I013 and entering Framework II on Form I099.

Options

- View or change the scaling factors (or coefficients). (Note that since a number of the default coefficients are zero, changing the scaling factor alone will have no effect.)

- Press Alt-C to advance to Spreadsheet IMWBD, which calculates and displays mining water BOD.

- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The emission coefficients are used to relate the quantity of a pollutant released to water to a particular type of mining technology. You can scale emission coefficients for BOD, COD, chloride, phosphorus, TSS, TDS, and organics to reflect local conditions.

8.4.24 Spreadsheets for Calculated Coal Mining Water Emissions

```
:-------------------------------------------------------------------------:
:      Name:  IMWBD                                                       :
:     Title:  Mining water biological oxygen demands                      :
:    Source:  IBTFR, IBFCH, and IMWEC                                     :
:     Units:  Metric tons                                                 :
:                                                                         :
:-------------------------------------------------                        :
: Scenario      Surface        Deep                                       :
:   Year      Mined Coal    Mined Coal       Total                        :
:-------------------------------------------------                        :
:   2000      0.0000E+0     0.0000E+0      0.0000E+0   |                  :
:   2001      0.0000E+0     0.0000E+0      0.0000E+0   |      For all     :
:   2002      0.0000E+0     0.0000E+0      0.0000E+0   v      study years  :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheets IMWBD, IMWCD, IMWCL, IMWPH, IMWTS, IMWTD, and IMWOG show the calculated BOD, COD, chloride, phosphorus, TSS, TDS, and organics water emissions (t) from coal mining to support electric power plants. You advanced to the spreadsheet shown here (IMWBD) after viewing or changing the water emission coefficients on Spreadsheet IMWEC. Since the COD, chloride, phosphorus, TSS, TDS, and organics emissions are calculated in the same manner, the corresponding spreadsheets, which have the same format, are not repeated in this document.

Options

- View the displayed values on each spreadsheet.
- Press **Alt-C** to advance to Spreadsheet IMWCD, which calculates COD emissions. Similarly, press **Alt-C** when you finish viewing each of the remaining water emission spreadsheets (IMWCL, IMWPH, IMWTS, IMWTD, and IMWOG) to advance to the next spreadsheet.
- After you view Spreadsheet IMWOG, press **Alt-C** to advance to Spreadsheet IMWTO, which summarizes water emissions from coal mining.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values on each water emission spreadsheet are calculated from information in Spreadsheets IBTFR, IBFCH, and IMWEC as follows:

$$\text{emissions} = C \times H \times Q \times U$$

where:

C = emission coefficient (tons/10^{12} Btu), obtained by multiplying the default coefficient and the scalar from Spreadsheet IMWEC,

H = higher heating value (kcal/kg, kcal/bbl, or kcal/m^3) of fuel from Spreadsheet IBFCH,

Q = quantity of fuel mined (t) from Spreadsheet IBTFR, and

U = conversion factor.

8.4.25 IMWTO — Coal Mining Water Emission Summary

Name: IMWTO
Title: Total emissions to water from mining operations to support electric power plants
Source: IMWBD, IMWCD, IMWCL, IMWPH, IMWTS, IMWTD, and IMWOG
Units: Metric tons

Study Year	Emission Type BOD	COD	Chloride	Similarly for all pollutants and years
1991	0.0000E+0	0.0000E+0	0.0000E+0	
1992	0.0000E+0	0.0000E+0	0.0000E+0	
1993	0.0000E+0	0.0000E+0	0.0000E+0	
1994	0.0000E+0	0.0000E+0	0.0000E+0	
1995	0.0000E+0	0.0000E+0	0.0000E+0	
1996	0.0000E+0	0.0000E+0	0.0000E+0	
1997	0.0000E+0	0.0000E+0	0.0000E+0	

Purpose

Spreadsheet IMWTO summarizes the water emissions from coal mining to support power plants. You advanced to this spreadsheet after viewing the organics emissions on Spreadsheet IMWOG.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet summarizes the emissions (t) calculated on Spreadsheets IMWBD, IMWCD, IMWCL, IMWPH, IMWTS, IMWTO, and IMWOG. You should verify these values before continuing.

8.4.26 IPLSC — Changing Incremental Land Use Coefficients

Name: IPLSC
Title: Default coefficients and scaling factors for calculating land use for power plant and mining wastes
Source: User input
Units: Coefficients in m^2/t

Type	Default Coefficient	Scaling Factor
Ash Disposal	9.60E-2	1.0000
Sulfur Sludge	8.60E-1	1.0000
Coal Cleaning Waste	5.20E-2	1.0000
Underground Mining Waste	1.70E-3	1.0000
Surface Coal Mining (C1)	4.46E-1	1.0000
Surface Coal Mining (C2)	4.46E-1	1.0000

Purpose

Spreadsheet IPLSC displays the default coefficients and scaling factors for calculating incremental land use for waste and surface mining to support electric generating facilities. You advanced to IPLSC by selecting option 3 on Menu I013 or I015 and entering Framework II on Form I099.

Options

- View or change any of the scaling factors.
- Press Alt-C to advance to a spreadsheet that contains the incremental land use for waste disposal. If you advanced from Menu I013, the spreadsheet is IMLDC; if you advanced from Menu I015, the spreadsheet is IPLDW.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change the scaling factors to adjust the coefficients to reflect country-specific conditions. Note that this spreadsheet is used to calculate

incremental land use for both coal mining and power plant operations. The default coefficients are based on the following assumptions:

Ash Disposal: All waste banks are 10.7 m high and the ash volume is 1.03 m^3/t.

Sulfur Sludge: The sludge accumulation rate is 13.3 tons/ton of sulfur removed and the sludge volume is 0.69 m^3/t.

Coal Cleaning Waste: All waste banks are piled 10.7 m high and the refuse volume is 0.56 m^3/t.

Underground Mining Waste: The solid waste per quantity of coal mined is 0.56 m^3/t. (Applicable to C3 and C4 only [refer to Spreadsheet IBFCH].)

Surface Coal Mining: The land disturbed per quantity of coal mined is 4.46×10^5 $m^2/10^6$ t. (Applicable to C1 and C2 only [refer to IBFCH].)

8.4.27 IMLDW — Annual Coal Mining Land Use

```
:-------------------------------------------------------------------------:
:    Name:  IMLDW                                                         :
:   Title:  Land use for waste disposal and surface coal mining           :
:           to support electric power plants                              :
: Source:   IBTFR, IMTSW, and IPLSC                                       :
:   Units:  m^2 of land disturbed per year                                :
:                                                                         :
:-------------------------------------------------------------------      :
: Study  |      Coal          Underground        Surface                   :
: Year   |  Cleaning Waste   Mining Waste     Coal Mining                  :
:-------------------------------------------------------------------      :
: 2000        1.3437E+4         1.3500E+3         1.5103E+6  |  For all   :
: 2001        1.3437E+4         1.3500E+3         1.5103E+6  |  study     :
: 2002        1.3437E+4         1.3500E+3         1.5103E+6  v  years     :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IMLDW displays the calculated quantity of land (m^2) used for waste disposal and surface coal mining to support electric power plants. You advanced to IMLDW after viewing or changing the land use coefficients on Spreadsheet IPLSC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values are calculated using the following equations:

$$\text{coal cleaning waste} = C1 \times S1 \times W \times 5.2 \times 10^{-2}$$

$$\text{underground mining waste} = C2 \times S2 \times M \times 1.7 \times 10^{-3}$$

$$\text{surface coal mining waste} = (Q1 \times I1 \times R1) + (Q2 \times I2 \times R2)$$

where:

C1 = default land use coefficient (m^2/t) from Spreadsheet IPLSC,

S1 = scaling factor from IPLSC,

W = total solid wastes (t) from cleaning plant from Spreadsheet IMTSW,

C2 = default land use coefficient (m^2/t) from IPLSC,

S2 = scaling factor from IPLSC,

M = quantity (t) of underground coal mined for C3 and C4 (t) from Spreadsheet IBTFR,

Q1 and Q2 = quantity (t) of coal C1 and C2 mined, respectively, from IBTFR,

I1 and I2 = area (m^3) of land disturbed per quantity (t) of coal C1 and C2 mined, respectively, from IPLSC, and

R1 and R2 = scaling factors for coal C1 and C2, respectively, from IPLSC.

8.4.28 INHHC — Changing Mining and Nonelectric Health and Safety Coefficients

```
:-------------------------------------------------------------------------:
:   Name  INHHC                                                           :
:  Title:  Occupational health and safety coefficients and scaling        :
:          factors for energy system processes or facilities              :
: Source:  Hittman Associates                                             :
:  Units:  Coefficients in number/10^12 Btu; severity rates in PDL/injury* :
:                                                                         :
:-------------------------------------------------------------------------:
:        Process or          Injury      Injuries     Injuries  --> Similarly :
:         Facility       Severity Rate Coefficients  Scalars    for fatality :
:-------------------------------------------------------------- multipliers :
: Offshore oil import       0.0000E+0    0.0000E+0   1.0000E+0   and scalars :
: Onshore oil import        0.0000E+0    0.0000E+0   1.0000E+0   for all     :
: Offshore oil production   8.8800E-3    2.6100E-4   1.0000E+0   facilities  :
:-------------------------------------------------------------------------:
: * PDL = Person Days Lost                                                 :
:       = injury severity rate * injuries coefficient * injuries scalar   :
:           + fatalities coefficient * 6000                               :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INHHC allows you to view or change the default injury and fatality coefficients for the mining and nonelectric sectors. You advanced to INHHC by selecting option 4 on Menu I013 or I022 and entering Framework II on Form I099.

Options

- View or change the scaling factors (or coefficients).
- Press Alt-C to advance to a spreadsheet that calculates the human health and safety impacts. If you are in the mining sector, this spreadsheet is IMHCS; if you are in the nonelectric sector, this spreadsheet is INHHS.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

It is recommended that you change the scaling factors to adjust the coefficients. Note that this spreadsheet is used to calculate impacts for both the mining and nonelectric sectors.

8.4.29 IMHCS — Coal Cleaning Health and Safety Impacts

Name: IMHCS
Title: Occupational health and safety for cleaning of coal for electric generating technologies
Source: INHHC, IBFCH, IBCFC, and IBTFR
Units: Shown in spreadsheet

Scenario Year	Injuries	Fatalities	Person-Days Lost	
2000	4.6602E-1	7.5571E-3	4.5818E+1	For all
2001	4.6602E-1	7.5571E-3	4.5818E+1	study
2002	4.6602E-1	7.5571E-3	4.5818E+1	v years

Purpose

Spreadsheet IMHCS displays the calculated occupational human health and safety impacts associated with coal cleaning. You advanced to IMHCS after viewing or changing the health and safety coefficients on Spreadsheet INHHC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IMHHS, which calculates and displays the occupational human health and safety impacts for coal mining.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values are calculated by using the following relationships and summing the resulting values for all coal types:

$$\text{number of injuries or fatalities} = C \times H \times M \times I \times S$$

$$\text{person-days lost} = (N \times J) + (F \times 6{,}000)$$

where:

C = quantity (t) of coal that is cleaned from Spreadsheets IBTFR and IBCFC,

H = higher heating value of the coal (kcal/kg) from Spreadsheet IBFCH,

M = conversion factor,

I = injury coefficient (number per 10^{12} Btu) from Spreadsheet INHHC,

S = scaling factor from INHHC,

N = number of injuries,

J = injury severity rate from INHHC, and

F = number of fatalities.

8.4.30 IMHHS — Coal Mining Health and Safety Impacts

Name: IMHHS
Title: Occupational health and safety coefficients and scaling factors for mining and cleaning of coal
Source: IBCFC, IBFCH, IBTFR, and INHHC
Units: Shown in spreadsheet

Scenario Year	Injuries	Fatalities	Person-Days Lost	
2000	2.2667E+1	2.2344E-1	1.3966E+3	For all study years
2001	2.2667E+1	2.2344E-1	1.3966E+3	
2002	2.2667E+1	2.2344E-1	1.3966E+3	

Purpose

Spreadsheet IMHHS displays occupational human health and safety statistics for coal mining to support electric power plants. You advanced to IMHHS after viewing the health and safety impacts from coal cleaning on IMHCS.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet summarizes the occupational health and safety impacts from coal mining, including coal cleaning. The procedures used to calculate these values are similar to those used in Spreadsheet IMHCS. All fatalities are counted as 6,000 person-days lost.

8.4.31 IMTSW — Annual Coal Cleaning Solid Waste Production

```
:-------------------------------------------------------------------------:
:   Name:  IMTSW                                                          :
:  Title:  Total solid wastes from coal cleaning                          :
:          to support electric power plants                               :
: Source:  IBTFR and IBCFC                                                :
:  Units:  Metric tons                                                    :
:                                                                         :
:-------------------------------------------                              :
:    Year              Total Solid Wastes                                 :
:-------------------------------------------                              :
:    2000                   2.5841E+5          |                         :
:    2001                   2.5841E+5          |    For all              :
:    2002                   2.5841E+5          v    study years          :
:-------------------------------------------------------------------------:
```

Purpose

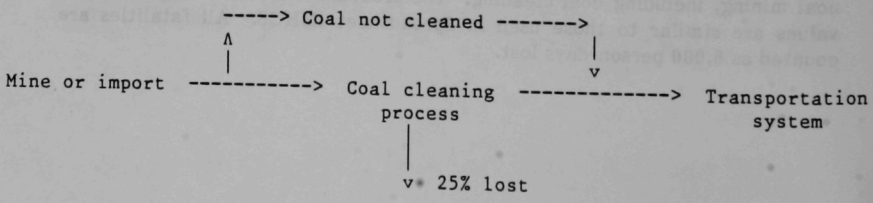
Spreadsheet IMTSW displays the annual quantities (t) of solid waste produced by coal cleaning to support electric generating facilities. You advanced to IMTSW by selecting option 6 on Menu I013 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values shown are calculated based on the following assumptions:



- 25% of all coal cleaned is lost (waste),
- 1% of the waste is lost to air, and
- 0.1% of the waste is lost to black-water solids.

These assumptions imply that 98.9% (1.0 - 0.01 - 0.001) of the waste produced by coal cleaning plants is solid waste. The equation for calculating the solid waste is as follows:

$$\text{solid waste} = 0.989 \times 0.25 \times Q \times [1 - \{(1 - F)/[(F / 0.75) + (1 - F)]\}]$$

where:

Q = quantity of fuel imported or mined (t, bbl, or m^3) from Spreadsheet IBTFR and

F = coal that is cleaned (fraction) from Spreadsheet IBCFC.

8.4.32 ITAEC — Fuel Transportation Air Emission Coefficients

```
:-------------------------------------------------------------------------:
:   Name: ITAEC                                                           :
:  Title: Default air emissions coefficients for transportation of fuel   :
:         to electric power plants*                                       :
: Source: Hittman Associates                                              :
:  Units: Short tons/10^12 Btu-mile                                       :
:                                                                         :
:-------------------------------------------------------------------------:
:   Transport   |          Emission Type                                  :
:     Mode      |   SO2        NOX         TSP          CO          HC    :
:-------------------------------------------------------------------------:
: Train - coal     2.6500E+0   3.0500E+0   3.3800E+1   2.8500E+0   2.0600E+0 :
: Barge - coal     7.3800E-1   6.8900E-1   1.7400E+1   5.9000E-1   4.4300E-1 :
: Truck - coal     8.9100E-2   1.2200E+0   1.6400E+1   7.4300E-1   1.2200E-1 :
: Pipeline - oil   3.5700E-1   4.8900E+0   1.7200E-1   2.9800E+0   4.9000E-1 :
: Tanker - oil     5.1500E-1   3.3700E-1   3.7500E-2   6.1400E-3   1.9000E-2 :
: Truck - oil      1.3700E+0   1.8700E+1   6.5800E+1   1.1400E+1   1.8700E+0 :
: Barge - oil      0.0000E+0   0.0000E+0   0.0000E+0   0.0000E+0   0.0000E+0 :
: Pipeline - gas   0.0000E+0   1.0300E+2   0.0000E+0   0.0000E+0   0.0000E+0 :
:-------------------------------------------------------------------------:
:  *  Emission coefficient = default coefficient * scaling factor (in ITAEM) :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet displays the default emission coefficients (tons/Btu-mi) used in estimating air pollutant emissions for the transportation of fuels to electric generating facilities. You advanced to Spreadsheet ITAEC by selecting option 1 on Menu I014.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet ITAEM, which displays the transportation air emission scaling factors.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can adjust these default coefficients by changing the scaling factors on Spreadsheet ITAEM.

8.4.33 ITAEM — Changing Fuel Transportation Air Emission Coefficients

Name: ITAEM
Title: Air emission scaling factors for transportation of fuel to electric power plants
Source: User input
Units: Scaling factors*

Transport Mode	Emission Type TSP	NOX	SO2	HC	CO
Train - coal	1.0000	1.0000	1.0000	1.0000	1.0000
Barge - coal	1.0000	1.0000	1.0000	1.0000	1.0000
Truck - coal	1.0000	1.0000	1.0000	1.0000	1.0000
Pipeline - oil	1.0000	1.0000	1.0000	1.0000	1.0000
Tanker - oil	1.0000	1.0000	1.0000	1.0000	1.0000
Truck - oil	1.0000	1.0000	1.0000	1.0000	1.0000
Barge - oil	1.0000	1.0000	1.0000	1.0000	1.0000

* Emission coefficient = default coefficient (in ITAEC) * scaling factor

Purpose

Spreadsheet ITAEM allows you to adjust the default coefficients for air emissions from fuel transportation for the electric sector. You advanced to ITAEM after viewing the coefficients on Spreadsheet ITAEC.

Options

- View or change any of the scaling factors.
- Press Alt-C to advance to Spreadsheet ITATO, which calculates and displays the air emissions produced during the transportation of fuels to electric generating facilities.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change the values in this spreadsheet to scale the default coefficients on Spreadsheet ITAEC to country-specific conditions.

8.4.34 ITATO — Fuel Transportation Air Emission Summary

```
:-------------------------------------------------------------------------:
:   Name: ITATO                                                           :
:  Title: Total air emissions from transporting fuel to electric power    :
:         plants                                                          :
: Source: IBCFC, IBFCH, IBTAS, IBTFR, ITAEC, and ITAEM                    :
:  Units: Metric tons                                                     :
:                                                                         :
:-------------------------------------------------------------------------:
:  Study  |                    Emission Type                               :
:  Year   |   SO2        NOX        TSP          CO          HC          :
:-------------------------------------------------------------------------:
:   2000    9.8896E+1  3.4799E+2  1.7383E+3   1.7274E+2   8.1191E+1       :
:   2001    9.8896E+1  3.4799E+2  1.7383E+3   1.7274E+2   8.1191E+1       :
:   2002    9.5752E+1  3.0492E+2  1.7367E+3   1.4649E+2   7.6875E+1       :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet ITATO displays the calculated air emissions from the transportation of fuel to electric generating facilities. You advanced to ITATO after viewing or changing the scaling factors on Spreadsheet ITAEM.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

These values are calculated for each fuel type, transportation mode, and pollutant using the following formulas:

quantity of fuel i transported = $R / [(F/0.75) + (1 - F)]$

emissions = $\{R / [(F/0.75) + (1-F)]\} \times H \times A \times C \times S \times M$

where:

R = quantity of fuel (t, bbl, or m^3) imported or produced domestically from Spreadsheet IBTFR,

F = coal that is cleaned (fraction) from Spreadsheet IBCFC,

H = higher heating value of fuel (kcal/kg, kcal/bbl, or kcal/m^3) from Spreadsheet IBFCH,

A = transportation sector assignment from Spreadsheet IBTAS,

C = default emission coefficient (tons/10^{12} Btu-miles) from Spreadsheet ITAEC,

S = scaling factor from Spreadsheet ITAEM, and

M = conversion factor.

8.4.35 ITHHC — Changing Fuel Transportation Health and Safety Coefficients

Name: ITHHC
Title: Occupational health and safety coefficients and scaling factors for transportation of fuel to electric power plants
Source: Hittman Associates
Units: Coefficients in number per 10^12 Btu; severity rate in PDL/injury*

Transportation Mode	Injury Severity Rate	Injuries Coefficients	Injuries Multipliers	Fatalities Coefficients
Train - coal	5.9500E+1	5.8500E-1	1.0000E+0	6.1000E-2
Barge - coal	2.4300E-1	3.2100E-3	1.0000E+0	1.9300E-3
Truck - coal	4.5400E+1	6.9200E-1	1.0000E+0	3.2400E-2
Pipeline - oil	8.4600E-2	2.8000E-3	1.0000E+0	3.3600E-5
Tanker - oil	0.0000E+0	0.0000E+0	1.0000E+0	0.0000E+0
Truck - oil	0.0000E+0	0.0000E+0	1.0000E+0	0.0000E+0
Barge - oil	0.0000E+0	0.0000E+0	1.0000E+0	0.0000E+0
Pipeline - gas	3.2400E+1	1.3800E-2	1.0000E+0	4.0000E-5

* PDL = Person days lost

Purpose

Spreadsheet ITHHC shows the default coefficients and scaling factors used for calculating occupational health and safety impacts associated with transporting fuels to power plants. You advanced to ITHHC by selecting option 4 on Menu I014 and entering Framework II on Form I099.

Options

- View or change the scaling factors (or coefficients).
- Press **Alt-C** to advance to Spreadsheet ITHHS, which calculates and displays the occupational health and safety impacts for fuel transportation.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default coefficients are based on U.S. accident statistics and should be adjusted, using the scaling factors, whenever more specific data are available.

8.4.36 ITHHS — Fuel Transportation Health and Safety Impacts Summary

Name: ITHHS
Title: Occupational health and safety for the transportation of fuel to electric power plants
Source: IBCFC, IBFCH, IBTFR, IBTAS, and ITHHC
Units: Shown in spreadsheet

Study Year	Number of Injuries	Number of Fatalities	Person-Days Lost	
2000	1.1852E+2	3.9672E+0	2.6652E+4	For all study years
2001	1.1852E+2	3.9672E+0	2.6652E+4	
2002	9.1335E+1	3.6410E+0	2.4692E+4	

Purpose

Spreadsheet ITHHS shows the calculated occupational health and safety impacts for fuel transportation to electric power plants. You advanced to ITHHS after viewing or changing the health and safety coefficients on Spreadsheet ITHHC.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The occupational health and safety impacts for fuel transportation are calculated by adding the results (for all fuel types and transport modes) of the following equations:

$$T = R / [(F/0.75) + (1 - F)]$$

$$\text{injuries or fatalities} = C \times T \times H \times M \times D \times S$$

$$\text{person-days lost} = (I \times V) + (A \times 6{,}000)$$

where:

T = quantity of fuel (t, bbl, or m^3) transported,

R = quantity of fuel imported or produced domestically from Spreadsheet IBTFR,

F = coal cleaned (fraction) from Spreadsheet IBCFC,

C = conversion factor,

H = higher heating value of fuel (kcal/kg, kcal/bbl, or kcal/m^3) from Spreadsheet IBFCH,

M = fraction of fuel transported by mode from Spreadsheet IBTAS,

D = default health and safety coefficient (injuries per 10^{12} Btu) from Spreadsheet ITHHC,

S = scaling factor for default coefficient from ITHHC,

I = calculated injuries for each type of fuel and transportation mode,

V = injury severity rate (person-days lost per injury) from ITHHC, and

A = calculated fatalities for each type of fuel and transportation mode.

8.4.37 IPAEC — Power Plant Air Emission Coefficients

Name: IPAEC
Title: Electric power plant uncontrolled air emissions coefficients
Source: EPA/AP-42
Units: Shown in spreadsheet+

Category	Units	SO2 V	SO2 C	---> Similarly for TSP, NO_x, CO_2, and CO
Low HHV Coal*	kg/t	15	0	
Inter. HHV Coal**	kg/t	17.50	0	
High HHV Coal***	kg/t	19.50	0	
Oil Steam	kg/1000 L	19	0	
Gas Steam	kg/million m^3	0	9.60	
Gas Turbines-Oil	kg/1000 L	16.80	0	
Gas Turbines-Gas	kg/million m^3	15000	0	
Other	kg/10^6 kcal	0	0	
Other	kg/10^6 kcal	0	0	

\+ V and C represent the variable and constant in the formula: V * (sulfur or ash content in %) + C
* Low HHV Coal < 4610 kcal/kg
** 4610 < Inter HHV Coal < 5830 kcal/kg
*** High HHV Coal > 5830 kcal/kg

Purpose

Spreadsheet IPAEC shows the default emission coefficients used in estimating uncontrolled air pollutant emissions (SO_2, TSP, NO_x, CO, and CO_2) from electric generating facilities. You advanced to IPAEC by selecting option 1 on Menu I015 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet IPAEM, which displays air emission scaling factors.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The emission coefficients are used to relate the quantity of a pollutant released to the atmosphere to a particular type of generating technology. The coefficients are expressed as weight of pollutant divided by unit weight or volume of that activity (for example, kg of SO_2 emitted per t of coal combusted). The emission coefficients for SO_2, NO_x, and TSP can be scaled in Spreadsheet IPAEM to reflect local conditions or the effects of pollution control equipment. The emission coefficients for CO and CO_2 can be scaled in Spreadsheet IPASM.

8.4.38 IPAEM — Changing Power Plant Air Emission Coefficients for SO_2, TSP, and NO_x

Name: IPAEM
Title: Functions for scaling uncontrolled electric power plant air emissions+
Source: User input
Units: Half time in years

Category	Base Mult.	Change Year	End Mult.	Half Time	---> Similarly for TSP and NO_x
	SO2				
Low HHV Coal *	1	2005	0	5	
Inter. HHV Coal **	1	2005	0	5	
High HHV Coal ***	1	2005	0	5	
Oil Steam	1	2005	0	5	
Gas Steam	1	2005	0	5	
Gas Turbines-Oil	1	2005	0	5	
Gas Turbines-Gas	1	2005	0	5	
Other	1	2005	0	5	
Other	1	2005	0	5	

\+ Coefficients correspond to a time dependent exponential scaling function: Scaling factor = End Mult. + (Base Mult. - End Mult.) * exp(-0.693((Current Year - Change Year)/Half Time))
* Low HHV Coal < 4610 kcal/kg
** 4610 < Inter HHV Coal < 5830 kcal/kg
*** High HHV Coal > 5830 kcal/kg

Purpose

This spreadsheet allows you to scale the uncontrolled SO_2, TSP, and NO_x emissions as a function of time to reflect country-specific conditions (such as the current and planned use of pollution control equipment). You advanced to Spreadsheet IPAEM after viewing the default coefficients on IPAEC.

Options

- View or change any of the parameters, which are defined as follows:

  Base Mult. -- A real variable containing the base (initial) value of the function.

Change Year -- An integer variable denoting the year in which the change from the initial value begins.

End Mult. -- A real variable containing the asymptotic value of the function when exponential behavior is desired.

Half Time -- An integer variable containing the number of years required to reach 50% of the difference between the base and end multipliers.

- Press **Alt-C** to advance to Spreadsheet IPASM, which displays the scaling factors for CO and CO_2 air emissions.

- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

Time-dependent changes in emissions can be approximated with this exponential scaling function, which decreases toward a limiting, or asymptotic value (that is, from an initial level to a more stringent level). For example, SO_2 emissions from coal-fired power plants using low-Btu coal in the first year of the study may be uncontrolled (*Base Mult.* = 1), but approach a 60% control level in the long term and reach the 30% control level by 2010, ten years after the study begins (when *Half Time* = 5, *Change Year* = 2005, and *End Mult.* = 0.4).

8.4.39 IPASM — Changing Power Plant Air Emission Coefficients for CO and CO_2

Name: IPASM
Title: Scaling factors for uncontrolled CO and CO2 emitted from electric power plants
Source: User input
Units: Scaling factors

Category	CO Scalar	CO2 Scalar
Low HHV Coal*	1.0000	1.0000
Inter. HHV Coal**	1.0000	1.0000
High HHV Coal***	1.0000	1.0000
Oil Steam	1.0000	1.0000
Gas Steam	1.0000	1.0000
Gas Turbines-Oil	1.0000	1.0000
Gas Turbines-Gas	1.0000	1.0000
Other	1.0000	1.0000
Other	1.0000	1.0000

* Low HHV Coal < 4610 kcal/kg
** 4610 < Inter HHV Coal < 5830 kcal/kg
*** High HHV Coal > 5830 kcal/kg

Purpose

This spreadsheet displays the scaling factors for CO and CO_2 releases from electric power plants. You advanced to IPASM after viewing or changing the scaling function parameters (for SO_2, TSP, and NO_x) on Spreadsheet IPAEM.

Options

- View or change the scaling factors.
- Press Alt-C to advance to Spreadsheet IPASO, which shows annual SO_2 emissions from power plants.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change these scaling factors to adjust the default coefficients in Spreadsheet IPAEC.

8.4.40 Spreadsheets for Calculated Power Plant Air Emissions

```
:-------------------------------------------------------------------------:
:     Name:  IPASO                                                        :
:    Title:  Electric power plant SO2 emissions                           :
:   Source:  IBFCH, IBFUS, IPAEC, and IPAEM                               :
:    Units:  Metric tons                                                  :
:                                                                         :
:-------------------------------------------------------------------------:
: Study  |  - - - - - Fuel Type - - - - - - -                              :
: Year   |   Coal        Oil        Gas        Other       Total          :
:-------------------------------------------------------------------------:
: 2000     2.3394E+5   1.9583E+4   0.0000E+0   0.0000E+0   2.5352E+5      :
: 2001     2.3394E+5   1.9583E+4   0.0000E+0   0.0000E+0   2.5352E+5      :
:  |                                                                      :
:  v                                                                      :
: For all years in study                                                  :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheets IPASO, IPATS, IPANO, IPACO, and IPAC2 show the calculated air emissions from all electric generating facilities. You advanced to the spreadsheet shown here (IPASO) after viewing or changing the CO and CO_2 scaling factors on Spreadsheet IPASM. Since the TSP, NO_x, CO, and CO_2 emissions are calculated in the same manner, the corresponding spreadsheets, which have the same format, are not repeated in this document.

Options

- View the displayed values on each spreadsheet.
- Press **Alt-C** to advance to Spreadsheet IPATS, which calculates the TSP emissions. Similarly, press **Alt-C** when you finish viewing each of the remaining power plant air emissions spreadsheets (IPANO, IPACO, and IPAC2) to advance to the next spreadsheet.
- After you view IPAC2, press **Alt-C** to advance to Spreadsheet IPATO, which summarizes power plant air emissions.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values shown in each spreadsheet are calculated from the data in Spreadsheets IBFCH, IPAEC, IBFUS, and IPAEM or IPASM as follows:

$$\text{quantity of pollutant emitted} = [(P \times V) + C] \times Q \times E \times U$$

where:

P = ash or sulfur content of fuel (%) from IBFCH,

V = variable part of emission coefficient from IPAEC,

C = constant part of emission coefficient from IPAEC,

E = value of exponential scaling function from IPAEM or scaling factor from IPASM,

Q = quantity of fuel combusted (t, bbl, or m^3) from IBFUS, and

U = multiplier used for conversion of units.

Refer to Spreadsheet IPAEC for the coefficient units.

8.4.41 IPATO — Power Plant Air Emission Summary

```
:-------------------------------------------------------------------------:
:   Name: IPATO                                                           :
:  Title: Summary of electric power plant air emissions                   :
: Source: IPASO, IPATS, IPANO, IPACO and IPAC2                            :
:  Units: Metric Tons                                                     :
:                                                                         :
:-------------------------------------------------------------------------:
:   Study     - - - -      Emission Type  - - ->  Similarly for TSP,      :
:   Year          SO2          NOx                CO, and CO2 and         :
:-------------------------------------------------------------------      :
:   1991      3.8520E+5    5.7394E+4              all study years         :
:   1992      4.5349E+5    6.6980E+4                                      :
:   1993      5.5258E+5    7.9993E+4                                      :
:   1994      6.2952E+5    9.0890E+4                                      :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IPATO summarizes the air emissions from electric power plants. You advanced to IPATO after viewing the CO_2 emissions on Spreadsheet IPAC2.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IPANC, which displays the default coefficients and scaling factors for calculating radioactive releases to air.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet summarizes the emissions (t) displayed on Spreadsheets IPASO, IPATS, IPANO, IPACO, and IPAC2.

8.4.42 IPANC — Changing Nuclear Power Plant Air Emission Coefficients

Name: IPANC
Title: Coefficients and scaling factors for calculating radioactive releases to air at nuclear power plants*
Source: DOE/EV-0072; user input for scaling factors
Units: Coefficients in Curies/10^12 Btu produced

Radionuclide	Default Coefficient for Tech. 4.1	Scaling Factor for Tech. 4.1	Default Coefficient for Tech. 4.2	Scaling Factor for Tech. 4.2
Krypton-85	3.900E+0	1.000	1.640E+3	1.000
Total Krypton	1.010E+1	1.000	6.240E+3	1.000
Xenon-133	4.880E+2	1.000	1.520E+3	1.000
Xenon-135m	4.210E+0	1.000	3.620E+2	1.000
Total Xenon	5.410E+2	1.000	7.030E+3	1.000
Iodine-131	5.280E-3	1.000	5.540E-2	1.000
Iodine-133	2.000E-3	1.000	3.310E-1	1.000
Total Iodine	7.280E-3	1.000	3.860E-1	1.000
Tritium	7.420E+0	1.000	6.270E+0	1.000

* Emission coefficient = default coefficient * scaling factor

Purpose

Spreadsheet IPANC shows the default coefficients and scaling factors used in calculating radioactive releases to air from nuclear power plants. You advanced to IPANC after viewing the power plant air emission summary on IPATO.

Options

- View or change the scaling factors.
- Press Alt-C to advance to Spreadsheet IPANR, which calculates the radioactive releases to air from nuclear power facilities.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You may adjust the default coefficients by changing the scaling factors.

8.4.43 IPANR — Nuclear Power Plant Air Emission Summary

```
:-------------------------------------------------------------------------:
:   Name: IPANR                                                           :
:  Title: Radioactive releases to air at nuclear power plants             :
: Source: IBUGE and IPANC                                                 :
:  Units: Curies/year                                                     :
:                                                                         :
:-------------------------------------------------------------------------:
:                |Study Year - - - - - - - - ->  For all years in the     :
: Radionuclide   |   2000        2001        2002        planning study    :
:----------------------------------------------------                     :
: Krypton-85      0.0000E+0   0.0000E+0   5.3227E+1                       :
:   Total Krypton 0.0000E+0   0.0000E+0   1.3784E+2                       :
: Xenon-133       0.0000E+0   0.0000E+0   6.6602E+3                       :
: Xenon-135m      0.0000E+0   0.0000E+0   5.7458E+1                       :
:   Total Xenon   0.0000E+0   0.0000E+0   7.3836E+3                       :
: Iodine-131      0.0000E+0   0.0000E+0   7.2061E-2                       :
: Iodine-133      0.0000E+0   0.0000E+0   2.7296E-2                       :
:   Total Iodine  0.0000E+0   0.0000E+0   9.9357E-2                       :
: Tritium         0.0000E+0   0.0000E+0   1.0127E+2                       :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet shows the calculated radioactive releases (Ci/yr) to air from nuclear power plants. You advanced to Spreadsheet IPANR after viewing or changing the coefficients on IPANC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IPATE, which displays the thermal emissions lost to air from electric power plants.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

These values are calculated from information in Spreadsheets IBUGE and IPANC by the formula:

radioactive release = C × S × G × M

where:

C = default coefficient ($Ci/10^{12}$ Btu) from IPANC,

S = scaling factor from IPANC,

G = unit generation (GWh) from IBUGE, and

M = 3.4120×10^{-6} (conversion factor).

8.4.44 IPATE — Electric Thermal Air Emission Summary

```
:-------------------------------------------------------------------------:
:   Name:  IPATE                                                          :
:  Title:  Thermal emissions from electric power plants                   :
: Source:  IBUGE, IBUCH, and IBFAS                                        :
:  Units:  kcal                                                           :
:                                                                         :
:-----------------------------------------                                :
:        Study                  Heat Lost                                 :
:        Year                    to Air                                   :
:-----------------------------------------                                :
:        2000                   3.27E+12      |    For all                :
:        2001                   3.27E+12      v    study years            :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IPATE displays the amount of heat (kcal) rejected to air from all power plants. You advanced to IPATE after viewing the radioactive air releases on IPANR.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values displayed here are obtained from the following equation:

$$\text{heat rejected} = [(1 - 859.8/H) \times G \times H \times 10^6](P/100)$$

where:

H = heat rate (kcal/kWh) from Spreadsheet IBUCH,

G = unit generation (GWh) from Spreadsheet IBUGE, and

P = heat rejected to air (% -- see Table 8.5).

TABLE 8.5 Heat Rejected from Electric Power Plants

Power Plant Technology	Heat Rejected (%) Air	Water
Coal-fired	18	82
Oil-fired	21	79
Gas-fired	21	79
Nuclear	0	100
Turbine	100	0

Source: Ref. 7.

8.4.45 IPWEC — Power Plant Water Emission Coefficients

```
:-------------------------------------------------------------------------:
:   Name:  IPWEC                                                          :
:  Title:  Electric power plant uncontrolled water emission coefficients  :
: Source:  DOE/EV-0072; HCP/EV-6119/1 (Mitre Corp.)                       :
:  Units:  Short tons/10^12 Btu of plant output                           :
:                                                                         :
:-------------------------------------------------------------------------:
: Category            BOD***       ---> Similarly for COD, phosphorus,    :
:---------------------------------      chloride, TSS, and TDS             :
: Low HHV coal*      1.41E+0                                              :
: High HHV coal**    1.41E+0                                              :
: Oil steam          3.97E-1                                              :
: Gas steam          3.96E-1                                              :
: Gas turbine-oil    0.00E+0                                              :
: Gas turbine-gas    0.00E+0                                              :
: Nuclear            1.00E-1                                              :
: Other              0.00E+0                                              :
: Other              0.00E+0                                              :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet shows the default water emission coefficients used in estimating uncontrolled water pollutant emissions (BOD, COD, chloride, phosphorus, TSS, and TDS) from electric generating facilities. You advanced to Spreadsheet IPWEC by selecting option 2 on Menu I015 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet IPWES, which displays the water emission scaling factors.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The emission coefficients are used to relate the quantity of a pollutant released to water to a particular generating technology. You can scale the emission coefficients for BOD, COD, chloride, phosphorus, TSS, and TDS in Spreadsheet IPWEM to reflect the effects of pollution control technologies.

8.4.46 IPWES — Changing Power Plant Water Emission Coefficients

```
:-------------------------------------------------------------------------:
:   Name:  IPWES                                                          :
:  Title:  Scaling factors for uncontrolled electric                      :
:          power plant water emissions                                    :
: Source:  User input                                                     :
:  Units:  Scaling factors                                                :
:                                                                         :
:-------------------------------------------------------------------------:
:                          BOD              COD                           :
: Category                 Scalar           Scalar      - - ->            :
:-----------------------------------------------------                    :
: Western Coal             1.0000           1.0000                        :
: Eastern Coal             1.0000           1.0000      Similarly for     :
: Oil Steam                1.0000           1.0000        phosphorous,    :
: Gas Steam                1.0000           1.0000        chloride, TSS,  :
: Gas Turbines-Oil         1.0000           1.0000        and TDS         :
: Gas Turbines-Gas         1.0000           1.0000                        :
: Nuclear                  1.0000           1.0000                        :
: Other                    1.0000           1.0000                        :
: Other                    1.0000           1.0000                        :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IPWES displays the scaling factors for changing the default water emission coefficients. You advanced to IPWES after viewing the default coefficients on Spreadsheet IPWEC.

Options

- View or change the scaling factors.
- Press **Alt-C** to advance to Spreadsheet IPWBD, which calculates BOD from power plants.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change these scaling factors to adjust the default coefficients in Spreadsheet IPWEC.

8.4.47 Spreadsheets for Calculated Power Plant Water Emissions

```
:-------------------------------------------------------------------------:
:       Name:  IPWBD                                                      :
:      Title:  Biological oxygen demands for water effluents from electric :
:              power plants                                               :
:     Source:  IBFGE, IBFCH, IPWEC, and IPWES                             :
:      Units:  Metric tons                                                :
:                                                                         :
:-------------------------------------------------------------------------:
: Study |  - - - - - - Fuel Type - - - - - - -                             :
: Year  |  Coal       Oil        Gas        Nuclear     Other      Total  :
:-------------------------------------------------------------------------:
: 2000  3.9280E+1  2.5806E+0  0.0000E+0  0.0000E+0  0.0000E+0  4.1861E+1 :
: 2001  3.9280E+1  2.5806E+0  0.0000E+0  0.0000E+0  0.0000E+0  4.1861E+1 :
: 2002  3.9280E+1  1.3517E+0  0.0000E+0  1.2381E+0  0.0000E+0  4.1870E+1 :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheets IPWBD, IPWCD, IPWCL, IPWPH, IPWTS, and IPWTD show the calculated water emissions from electric generating facilities. You advanced to the spreadsheet shown here (IPWBD) after viewing or changing the scaling factors on Spreadsheet IPWES. Since the COD, chloride, phosphorus, TSS, and TDS emissions are calculated in the same manner, the corresponding spreadsheets, which have the same format, are not repeated in this document.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet IPWCD, which displays the COD emissions. Similarly, press Alt-C to advance to each of the remaining water emission spreadsheets (IPWCL, IPWPH, IPWTS, and IPWTD).
- After you finish viewing Spreadsheet IPWTD, press Alt-C to advance to IPWTO, which summarizes water emissions from power plants.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

These values are calculated from Spreadsheets IBFGE, IBFCH, IPWEC, and IPWES by the formula:

$$\text{water emissions} = E \times Q \times C \times U$$

where:

E = value of scaling factor from IPWES,

Q = quantity of fuel consumed (t, bbl, or m^3) from IBFCH and IBFGE,

C = coefficient (tons/10^{12} Btu) from IPWEC, and

U = conversion factor.

8.4.48 IPWTO — Power Plant Water Emission Summary

Name: IPWTO
Title: Summary of electric power plant water emissions
Source: IPWBD, IPWCD, IPWPH, IPWCL, IPWTS, and IPWTD
Units: Metric tons

Study Year	Emission Type - - - - - > BOD	COD	Similarly for phosphorus, chloride, TSS, and TSP and all study years
1991	6.2109E+1	5.9643E+3	
1992	7.3354E+1	7.0563E+3	
1993	8.9976E+1	8.6884E+3	
1994	1.0260E+2	9.9124E+3	

Purpose

This spreadsheet summarizes the water emissions from electric power plants. You advanced to Spreadsheet IPWTO after viewing the TDS emissions on IPWTD.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IPWNC, which contains the default coefficients and scaling factors for radioactive releases to water.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet summarizes the emissions (t) displayed in Spreadsheets IPWBD, IPWCD, IPWCL, IPWPH, IPWTS, and IPWTD.

8.4.49 IPWNC — Changing Coefficients for Nuclear Power Plant Water Emissions

```
:-------------------------------------------------------------------------:
:   Name: IPWNC                                                           :
:  Title: Coefficients for calculating radioactive releases               :
:         to water for nuclear power plants*                              :
: Source: DOE/EV-0072; user input for scaling factor                      :
:  Units: Coefficients in curies/10^12 Btu produced                       :
:                                                                         :
:-------------------------------------------------------------------------:
:                |   Default      Scaling      Default      Scaling       :
:                |  Coefficient    Factor     Coefficient    Factor       :
: Radionuclide   | for Tech. 4.1 for Tech. 4.1 for Tech. 4.2 for Tech. 4.2 :
:-------------------------------------------------------------------------:
: Xe-135         | 1.2800E-1      1.0000      1.4400E-2      1.0000       :
: I-131          | 9.6400E-2      1.0000      1.2900E-2      1.0000       :
: I-133          | 2.1700E-2      1.0000      8.5400E-3      1.0000       :
: Co-60          | 2.2800E-2      1.0000      1.5000E-2      1.0000       :
: Sr-90          | 4.4300E-4      1.0000      4.0900E-4      1.0000       :
: Mo-99          | 4.2200E-3      1.0000      4.4600E-3      1.0000       :
: Cs-134         | 4.0800E-2      1.0000      4.7500E-2      1.0000       :
: Cs-137         | 5.2800E-2      1.0000      6.9100E-2      1.0000       :
:   Subtotal     | 3.6716E-1                  1.7231E-1                    :
: H-3 (Tritium)  | 2.1100E+1      1.0000      1.1400E+0      1.0000       :
:   Total        | 2.1467E+1                  1.3123E+0                    :
:-------------------------------------------------------------------------:
:  * Emission coefficients = default coefficient * scaling factor         :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IPWNC shows the default coefficients and scaling factors for calculating radioactive releases to water. You advanced to IPWNC after viewing the water emission summary on IPWTO.

Options

- View or change the scaling factors.
- Press **Alt-C** to advance to Spreadsheet IPWNR, which displays the radioactive releases to water from nuclear power plants.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can adjust the default coefficients by changing the scaling factors.

8.4.50 IPWNR — Nuclear Power Plant Water Emission Summary

Name: IPWNR
Title: Radioactive releases to water at nuclear power plants
Source: IBFAS, IBUGE, and IPWNC
Units: Curies/year

Radionuclide	Study Year 2000	2001	2002	For all study years
Xe-135	0.0000E+0	0.0000E+0	1.7469E+0	
I-131	0.0000E+0	0.0000E+0	1.3157E+0	
I-133	0.0000E+0	0.0000E+0	2.9616E-1	
Co-60	0.0000E+0	0.0000E+0	3.1117E-1	
Sr-90	0.0000E+0	0.0000E+0	6.0461E-3	
Mo-99	0.0000E+0	0.0000E+0	5.7595E-2	
Cs-134	0.0000E+0	0.0000E+0	5.5684E-1	
Cs-137	0.0000E+0	0.0000E+0	7.2061E-1	
Subtotal	0.0000E+0	0.0000E+0	5.0110E+0	
H-3 (Tritium)	0.0000E+0	0.0000E+0	2.8797E+2	
Total	0.0000E+0	0.0000E+0	2.9298E+2	

Purpose

Spreadsheet IPWNR shows the calculated radioactive releases (Ci/yr) to water from nuclear power plants. You advanced to IPWNR after viewing or changing the coefficients on Spreadsheet IPWNC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IPWRQ, which displays the coefficients for calculating total water losses from cooling systems.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

These values are obtained from Spreadsheets IBUGE and IPWNC by the formula:

Radioactive release = $C \times S \times G \times U$

where:

C = default release coefficient ($Ci/10^{12}$ Btu) from IPWNC,

S = scaling factor from IPWNC,

G = unit generation (GWh) from IBUGE, and

U = conversion factor.

Spreadsheet IBFAS provides the information to correlate the data with the nuclear plant types.

8.4.51 IPWRQ — Changing Coefficients for Water Losses from Power Plant Cooling Systems

```
:-------------------------------------------------------------------------:
:   Name:  IPWRQ                                                          :
:  Title:  Electric power plant water losses due to evaporation           :
:          and drift, by cooling mode*                                    :
: Source:  DOE/EV-0072 and IBWEM; user input for scaling factors          :
:  Units:  m^3/kWh(e)                                                     :
:                                                                         :
:-------------------------------------------------------------------------:
:                          |  Default Loss      Scaling                   :
: Category                 |   Coefficient       Factor                   :
:-------------------------------------------------------------------------:
: Once Through                   1.70E-3          1.00E+0                 :
: Evaporative Cooling Tower      2.50E-3          1.00E+0                 :
: Dry Cooling Tower              0.00E+0          1.00E+0                 :
: Lake, Pond, Spray              3.00E-3          1.00E+0                 :
:-------------------------------------------------------------------------:
: * Water loss coefficient = Default loss coefficient * scaling factor    :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IPWRQ shows the default coefficients (m^3/kWh) and scaling factors for calculating water losses due to cooling system evaporation and drift. You advanced to IPWRQ after viewing the radioactive water emissions on Spreadsheet IPWNR.

Options

- View or change the scaling factors for each cooling category.
- Press **Alt-C** to advance to Spreadsheet IPWTR, which displays the total water requirements.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default coefficients are used to calculate the net water requirements for coal, oil steam, gas steam, and nuclear power plants. The fraction of each cooling mode applicable in each year of the study is determined from Spreadsheet IBWEM. You can adjust the coefficients by changing the scaling factors.

8.4.52 IPWTR — Power Plant Water Requirement Summary

```
:-------------------------------------------------------------------:
:   Name: IPWTR                                                     :
:  Title: Electric power plant water requirements                   :
:         and thermal discharge to water                            :
: Source: IBFAS, IBUCH, IBUGE, IBWEM, and IPWRQ                     :
:  Units: Water requirements-m^3; heat lost-kcal                    :
:                                                                   :
:-------------------------------------------------------------------:
:                                 Water          Heat Lost          :
:          Year                Requirements    to Water            :
:-------------------------------------------------------------------:
:          2000                 1.8870E+1      1.3429E+13          :
:          2001                 1.8870E+1      1.3429E+13          :
:          2002                 2.3970E+1      1.9527E+13          :
:-------------------------------------------------------------------:
```

Purpose

Spreadsheet IPWTR displays the calculated values for total power plant water requirements (m^3) and thermal discharges (kcal) to water. You advanced to IPWTR after viewing or changing the coefficients on IPWRQ.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values presented in this spreadsheet are calculated from the data on Spreadsheets IPWRQ, IBUGE, IBWEM, and IBUCH as follows (summed over all plant and cooling types):

total water requirements = $C \times M \times G \times E$

heat lost to water = $[(1 - 859.8/H) \times G \times H \times 10^6](P/100)$

where:

C = default loss coefficient (m^3/kWh) from IPWRQ,

M = scaling multiplier from IPWRQ,

G = quantity of fuel consumed (t, bbl, or m^3) from IBUGE,

E = fraction of plants using cooling type i from IBWEM,

H = heat rate (kcal/kWh) from IBUCH, and

P = heat rejected (%) to cooling water (see Table 8.5).

The information on Spreadsheet IBFAS correlates the data with power plant technology types.

8.4.53 IPLDW — Incremental Land Use for Waste Disposal

```
:-------------------------------------------------------------------------:
:     Name:  IPLDW                                                        :
:    Title:  Incremental land use for waste disposal at electric          :
:            power plants                                                 :
:   Source:  IPLSC and IPTSL                                              :
:    Units:  m^2 of land disturbed per year                               :
:                                                                         :
:-------------------------------------------------------------------------:
: Study  |                                                                :
: Year   | Ash Disposal      Sulfur Sludge          Total                 :
:-------------------------------------------------------------------------:
: 2000     1.1388E+4         1.1542E+4          2.2930E+4                 :
: 2001     1.1388E+4         1.1542E+4          2.2930E+4                 :
: 2002     1.1311E+4         1.1930E+4          2.3240E+4                 :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IPLDW displays the calculated incremental land use (m^2/yr) for waste disposal at electric power facilities. You advanced to IPLDW after viewing or changing the incremental land use coefficients on Spreadsheet IPLSC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IPLSE, which displays the default land use coefficients for electric generating facilities.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values are calculated using the following equations:

ash disposal = A × B × S1 × C

sulfur sludge = L × D × S2 × C

where:

A = ash collected (t) from Spreadsheet IPTSL,

B = default coefficient for ash disposal (m^2/t) from Spreadsheet IPLSC,

S1 = scaling factor for ash disposal from IPLSC,

C = conversion factor,

L = sulfur collected (t) from IPTSL,

D = default coefficient for sulfur sludge (m^2/t) from IPLSC, and

S2 = scaling factor for sulfur sludge from IPLSC.

8.4.54 IPLSE — Changing Power Plant Land Use Coefficients

Name: IPLSE
Title: Default coefficients and scaling exponents for calculating electric power plant land use*
Source: User input
Units: Coefficients in m^2

Type	Default Coefficient	Scaling Exponent
Coal Power Plants	8.10E+5	1.0
Oil Power Plants	4.05E+5	1.0
Gas Power Plants	2.02E+5	1.0
Nuclear Power Plants	2.60E+6	1.0
Hydroelectric Plants	1.60E+6	1.0
Pumped Storage	8.10E+6	1.0
Turbines	4.05E+4	1.0

* Default Coefficient * (plant size / reference size) ** scaling exponent

Purpose

Spreadsheet IPLSE displays the default coefficients (m^2) and scaling exponents for calculating total land use for electric generating facilities. You advanced to IPLSE after viewing the incremental land use on Spreadsheet IPLDW.

Options

- View or change any of the scaling exponents.
- Press **Alt-C** to advance to Spreadsheet IPLTR, which displays the total land use for the storage of waste from electric generating facilities.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The scaling exponents allow you to adjust unit sizes. See Table 8.2 for the power plant reference sizes.

8.4.55 IPLTR — Power Plant Land Use Summary

```
:-------------------------------------------------------------------------:
:    Name:  IPLTR                                                         :
:   Title:  Land use for electric power plant sites                       :
:  Source:  IBFAS, IBUCH, IBUNO, and IPLSE                                :
:   Units:  m^2 of land occupied                                          :
:                                                                         :
:-------------------------------------------------------------------------:
:  Study |Power Plant Category  - - - - - - - - - - - - - - -             :
:  Year  |   Coal        Oil        Gas       Nuclear     Hydro    Turbines:
:-------------------------------------------------------------------------:
:  2000   1.6200E+6  2.5313E+5  0.0000E+0  0.0000E+0  8.0000E+5  2.2838E+4 :
:  2001   1.6200E+6  2.5313E+5  0.0000E+0  0.0000E+0  8.0000E+5  2.2838E+4 :
:  2002   1.6200E+6  2.5313E+5  0.0000E+0  1.8909E+6  1.6000E+6  2.2838E+4 :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IPLTR displays the quantity of land (m^2) used at all power plants. You advanced to IPLTR after viewing or changing the coefficients on IPLSE.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values displayed here are obtained from the following equation:

$$\text{land used} = C1 \times N \times (S / C2)^F$$

where:

C1 = default land use coefficient (m^2) for each power plant type from Spreadsheet IPLSE,

S = actual facility size (MW) from Spreadsheet IBUCH,

N = number of plants in operation from Spreadsheet IBUNO,

C2 = reference facility size (see Table 8.2), and

F = scaling exponent from IPLSE.

Information from Spreadsheet IBFAS correlates the data with power plant technology types.

8.4.56 IPHHC — Changing Power Plant Health and Safety Coefficients

Name: IPHHC
Title: Occupational and public health and safety coefficients and scaling factors for electric power plants
Source: Hittman Associates
Units: Coefficients in number/10^12 Btu; severity rates in PDL/injury

Category	Injury Severity Rate	Injuries Coefficients	Injuries --> Multipliers	Similarly for fatalities
Coal-fired power plant	4.4100E+0	1.0600E-1	1.0000E+0	
Oil-fired power plant	2.5000E+0	5.9900E-2	1.0000E+0	
Gas-fired power plant	2.3600E+0	5.6700E-2	1.0000E+0	
Nuclear power plant	3.0000E-1	1.5300E-2	1.0000E+0	
Hydroelectric power plant	0.0000E+0	0.0000E+0	1.0000E+0	
Pumped storage power plant	0.0000E+0	0.0000E+0	1.0000E+0	
Oil-turbine power plant	0.0000E+0	0.0000E+0	1.0000E+0	
Other	0.0000E+0	0.0000E+0	1.0000E+0	
Premature deaths (SO2)	N/A	N/A	N/A	

Purpose

Spreadsheet IPHHC displays coefficients for occupational and public health and safety impacts from power plant operation. You advanced to IPHHC by selecting option 4 on Menu I015 and entering Framework II on Form I099.

Options

- View or change the scaling factors.
- Press **Alt-C** to advance to Spreadsheet IPHHS, which displays the occupational human health and safety impacts for power plants.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

These coefficients are used to calculate occupational human health and safety impacts for electric generating facilities (in Spreadsheet IPHHS). The estimates for premature deaths due to SO_2 exposure are based solely on the quantity (t) of SO_2 emitted.

8.4.57 IPHHS — Power Plant Health and Safety Summary

Name: IPHHS
Title: Occupational and public health and safety for electric power plants
Source: IBFAS, IBUCH, IBUGE, IPHHC, and IPASO
Units: Shown in spreadsheet

Study Year	Number of Injuries	Number of Fatalities	Person-Days Lost	Premature Deaths (SO2)
2000	5.2032E+3	5.4501E+1	3.4901E+5	2.5352E+1
2001	5.2032E+3	5.4501E+1	3.4901E+5	2.5352E+1
2002	5.2688E+3	5.5019E+1	3.5161E+5	2.4419E+1

Purpose

Spreadsheet IPHHS displays the calculated occupational human health and safety statistics for operating electric generating facilities. You advanced to IPHHS after viewing or changing the coefficients on Spreadsheet IPHHC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

It is assumed that each fatality results in 6,000 person-days lost. The values shown above are calculated by summing (for all plants in the generating system) the results of the following equations:

number of injuries or fatalities = $U \times H \times M \times C \times S$

person-days lost = $(I \times V) + (F \times 6{,}000)$

premature deaths = $T \times K \times A$

where:

U = unit generation (GWh) from Spreadsheet IBUGE,

H = heat rate (kcal/kWh) from Spreadsheet IBUCH,

M = conversion factor,

C = injury coefficients (injuries/10^{12} Btu) from Spreadsheet IPHHC,

S = injury multipliers from IPHHC,

I = number of injuries (calculated for each plant),

V = severity of injuries from IPHHC,

F = number of fatalities,

T = quantity of SO_2 emitted (t) to the air from Spreadsheet IPASO,

K = fatality coefficient from IPHHC, and

A = fatality multiplier from IPHHC.

Information from Spreadsheet IBFAS correlates the data with power plant technology types.

8.4.58 IPREC — Changing Electric Construction Labor and Material Coefficients

Name: IPREC
Title: Scaling exponents for adjusting default labor and materials coefficients based on actual plant sizes
Source: User input
Units: Scaling exponents

Plant Name	Sequence Number	Construction Labor	Construction Materials	Operating Labor
NUC1	1	1.000	1.000	1.000
COA1	2	1.000	1.000	1.000
COA2	3	1.000	1.000	1.000
OIL1	4	1.000	1.000	1.000
GAS1	5	1.000	1.000	1.000
HYD1	6	1.000	1.000	1.000

Purpose

Spreadsheet IPREC allows you to change the default exponents that are used to adjust default labor and material coefficients based on actual plant sizes. You advanced to IPREC by selecting option 5 on Menu I015 and entering Framework II on Form I099.

Options

- View the exponents or change them so that the resulting coefficients are consistent with planning assumptions and country-specific conditions.
- Press **Alt-C** to advance to Spreadsheet IPRCS, which contains the default construction schedules for electric power plants.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change the scaling exponents to adjust the default coefficients in Spreadsheets IPRCC, IPRMC, and IPROC to reflect country-specific conditions. The following formula is used:

$$\text{adjusted coefficient} = C(D/E)^F$$

where:

C = default coefficient (10^3 person-h per reference-size plant) based on ESPM information from Spreadsheet IPRCC, IPRMC, or IPROC,

D = size of unit being built or operated (MW) from Spreadsheet IBUCH,

E = size of reference plant used in deriving C (see Table 8.2), and

F = scaling exponent from this spreadsheet.

8.4.59 IPRCS — Annual Electric Construction Labor and Material Schedules

Name: IPRCS
Title: Scheduling distributions by year of construction for electric power plants
Source: ESPM (Bechtel Corp.)
Units: Distribution in percent per construction year

Category		Nonmanual Technical Person-Hours	Nonmanual Nontechnical Person-Hours	Manual Person-Hours	Materials and Equipment Items
LWR	1	0%	0%	0%	0%
	2	4%	4%	0%	0%
	3	8%	8%	0%	1%
	4	11%	11%	0%	4%
	5	11%	11%	7%	12%
	6	13%	13%	16%	19%
	7	16%	16%	22%	28%
	8	18%	18%	27%	22%
	9	14%	14%	23%	10%
	10	5%	5%	5%	4%

--> Similarly for low- and high-Btu coal, combined cycle, fluidized bed, low- and high-Btu gas, oil fired, gas turbine, hydroelectric, pumped storage, and other

Purpose

Spreadsheet IPRCS shows the default labor and material construction schedules (%/yr) for electric generating facilities. You advanced to IPRCS after viewing or changing the viewing the electric construction coefficients on Spreadsheet IPREC.

Options

- View or change the labor or resource distribution schedules for any type of plant.
- Press Alt-C to advance to Spreadsheet IPRCC, which contains the construction labor coefficients.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default data shown in this spreadsheet are from the ESPM model developed by Bechtel Corp. These values represent the fraction of total labor or resources that are used in each year of the construction period. You can shorten the default construction schedules by assigning fractions of 0. For example, if a nuclear power plant can be constructed in eight years (instead of nine years as shown in the spreadsheet), you can assign 0's to year 2 of the ten-year default construction schedule and redistribute the annual fractions over the remaining eight years such that they total 100% in each of the four categories. You cannot lengthen construction schedules beyond the time periods specified.

8.4.60 IPRCC — Electric Construction Labor Coefficients

Name: IPRCC
Title: Construction Labor Coefficients for electric generating technologies
Source: ESPM (Bechtel Corp.)
Units: Thousand person-hours per reference-size facility

Category	LWR	- - - - - - >
Chemical Engineer	0	Similarly for low- and high-Btu
Civil Engineer	638	coal, combined cycle, fluidized
Electrical Engineer	500	bed, low- and high-Btu gas,
Mechanical Engineer	408	oil fired, gas turbine, dam and
Mining Engineer	0	hydroelectric, pumped storage,
Nuclear Engineer	72	and all labor categories
Geological Engineer	0	
Petroleum Engineer	0	

Purpose

Spreadsheet IPRCC displays the default construction labor coefficients for reference-size electric generating facilities. You advanced to this spreadsheet after viewing or changing the scaling exponents on IPREC.

Options

- View or change the default coefficients; however, it is recommended that you preserve the original data by changing the scaling exponents in IPREC.
- Press **Alt-C** to advance to Spreadsheet IPRCR, which calculates the total annual manpower construction requirements.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default coefficients are taken from ESPM and are based on the reference plant sizes in Table 8.2. Refer to Spreadsheet IPREC for a description of the plant-size scaling that you can use to adjust these values.

8.4.61 IPRCR — Electric Construction Labor Summary

```
:-------------------------------------------------------------------------:
:   Name: IPRCR                                                           :
:  Title: Total construction labor requirements for electric power        :
:         plants under construction in each year of the planning study    :
: Source: IBFAS, IBUCH, IBUEN, IPRCC, IPRCS, and IPREC                    :
:  Units: Persons/year*                                                   :
:                                                                         :
:-------------------------------------------------------------------------:
:                      Study Year - - - - - - -        For each study     :
:      Category            2000       2001      2002  -->  year and labor  :
:-------------------------------------------------------  category        :
: Chemical Engineer         0.0        0.0       0.0                      :
: Civil Engineer           83.4       71.0      59.5                      :
: Electrical Engineer      59.4       50.9      45.7                      :
: Mechanical Engineer      48.6       41.4      36.8                      :
: Mining Engineer           0.0        0.0       0.0                      :
:-------------------------------------------------------------------------:
:  * Fractions indicate less than full year employment                    :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IPRCR displays the calculated construction labor requirements. You advanced to IPRCR after viewing the labor coefficients on Spreadsheet IPRCC.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet IPROC, which displays the operating labor coefficients.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The information shown in this spreadsheet is calculated by coordinating (1) power plant characteristics (from Spreadsheets IBFAS and IBUCH), (2) the on-line dates for all power plants (from Spreadsheet IBUEN), (3) the corresponding power plant construction lead times and scheduling

distributions (from Spreadsheet IPRCS), and (4) the adjusted construction labor coefficients (from Spreadsheets IPRCC and IPREC).

An example expansion schedule includes three new plants: two coal-fired plants, with on-line dates of 2005 and 2006, and one gas turbine, with an on-line date of 2002. The coal-fired plants have five-year construction schedules while the gas turbine has a two-year construction schedule (as indicated in IPRCS). The table below shows the overlapping distributions of labor (for example, pipe fitters, which are in the manual labor category) over the study period. In this case, y1 represents the total number of pipe fitters required in the first year (2000) of construction of coal plant 1.

	Study Year						
Plant	2000	2001	2002	2003	2004	2005	2006
coal plant 1	y1	y2	y3	y4	y5	on-line	
coal plant 2		z1	z2	z3	z4	z5	on-line
gas turbine 1	x1	x2	on-line				

The total number of pipe fitters required for all construction activities throughout the generating system in the year 2001 is calculated as follows:

total pipe fitters in 2001 = y2 + z1 + x2

IMPACTS automatically calculates these quantities for all years in the planning study.

8.4.62 IPROC — Electric Operating Labor Coefficients

Name: IPROC
Title: Operating labor coefficients for electric power plants
Source: ESPM (Bechtel Corp.)
Units: Persons/year per reference-size facility

Category	LWR	Coal-Fired --> Low Btu	Similarly for high-Btu coal, combined cycle, fluidized bed, low- and high-Btu gas, gas turbine, dam and hydro-electric, pumped storage, and all labor categories
Chemical Engineer	0.0	0.0	
Civil Engineer	0.9	0.8	
Electrical Engineer	2.7	3.5	
Mechanical Engineer	2.7	1.7	
Mining Engineer	0.0	0.0	
Nuclear Engineer	1.2	0.0	
Geological Engineer	0.0	0.0	

Purpose

Spreadsheet IPROC displays the default operating labor coefficients for reference-size electric generating facilities. You advanced to IPROC after viewing the labor summary on Spreadsheet IPRCR.

Options

- View or change the default coefficients; however, it is recommended that you preserve the original data base by changing the scaling exponents in IPREC.
- Press **Alt-C** to advance to Spreadsheet IPROR, which calculates the total annual labor needed to operate the electric power plants.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default coefficients are taken from ESPM and are based on the default plant sizes listed in Table 8.2. Refer to Spreadsheet IPREC for a description of the plant-size scaling algorithm that you can use to adjust these values.

8.4.63 IPROR — Electric Operating Labor Summary

Name: IPROR
Title: Total operating labor requirements for electric power plants in each year of the planning study
Source: IBFAS, IBUCH, IBUNO, IPREC, and IPROC
Units: Persons/year*

Category	Study Year - - - - - - > 2000	2001	2002	For all study years and labor categories
Chemical Engineer	0.0	0.0	0.0	
Civil Engineer	0.0	0.0	0.7	
Electrical Engineer	9.3	9.3	11.3	
Mechanical Engineer	4.9	4.9	7.1	
Mining Engineer	0.0	0.0	0.0	

* Fractions indicate less than full year employment

Purpose

Spreadsheet IPROR displays the calculated operating labor requirements for the electric generating system. You advanced to IPROR after viewing the operating labor coefficients on Spreadsheet IPROC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IPRMC, which displays the material requirements for constructing electric power plants.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The information displayed in this spreadsheet is calculated with data from Spreadsheets IBUNO, IPROC, IBUCH, and IPREC and the following equation:

$$\text{workers per year} = P \times C \times (S/D)^{E}$$

where:

P = number of on-line plants each year from IBUNO,

C = coefficients (persons/yr per reference-size plant) from IPROC,

S = plant size (MW) from IBUCH,

D = default plant size (see Table 8.2), and

E = exponential scalar from IPREC and IPROC.

The displayed values are for each labor category for all plants. Information from Spreadsheet IBFAS correlates the data with power plant characteristics.

8.4.64 IPRMC — Electric Construction Material Coefficients

```
:-------------------------------------------------------------------------:
:   Name:  IPRMC                                                          :
:  Title:  Raw materials coefficients for the construction of power plants :
: Source:  ESPM (Bechtel Corp.)                                           :
:  Units:  Short tons per reference-size facility                         :
:                                                                         :
:-------------------------------------------------------------------------:
:            Category                LWR      --> Similarly for low- and high- :
:-------------------------------------------     Btu coal, combined cycle,     :
: Concrete                        5.6400E+5      fluidized bed, low- and high- :
: Stainless Steel                 2.0280E+3      Btu gas, oil fired, gas       :
: Total Steel                     7.1259E+4      turbines, dam and hydro-      :
: Copper, Brass, Bronze           2.3886E+3      electric, and pumped storage  :
: Aluminum and Castings           7.1939E+2                                    :
: Manganese                       4.1433E+2                                    :
: Chromium                        4.7791E+2                                    :
: Nickel                          8.1520E+1                                    :
: Cast Iron                       9.0092E+2                                    :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IPRMC displays the default construction material coefficients for reference-size electric generating facilities. You advanced to this spreadsheet after viewing the operating labor requirements on IPROR.

Options

- View or change the default coefficients; however, it is recommended that you preserve the original data by changing the scaling exponents in IPREC.
- Press **Alt-C** to advance to Spreadsheet IPRMR, which calculates the total annual material requirements for power plant construction.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default coefficients are taken from ESPM and are based on the reference plant sizes in Table 8.2. Refer to Spreadsheet IPREC for a description of the plant-size scaling that you can use to adjust these values.

8.4.65 IPRMR — Electric Construction Material Summary

Name: IPRMR
Title: Total raw materials required for construction of electric power plants in each year of the planning study
Source: IBFAS, IBUCH, IBUEN, IPRCS, IPREC, and IPRMC
Units: Metric tons

Category	Study Year - - - - - - - - > 2000	2001	2002	For all study years
Concrete	1.4490E+5	1.5143E+5	9.9573E+4	
Total Steel	4.5848E+2	5.2849E+2	4.0124E+2	
Stainless Steel	2.0732E+4	2.3427E+4	1.8270E+4	
Copper, Brass, Bronze	5.8015E+2	6.4471E+2	4.8297E+2	
Aluminum and Castings	1.7671E+2	1.9691E+2	1.4859E+2	
Manganese	1.1744E+2	1.3164E+2	1.0043E+2	
Nickel	1.9243E+1	2.1781E+1	1.6146E+1	

Purpose

Spreadsheet IPRMR displays the calculated material requirements for the construction of electric generating facilities. You advanced to IPRMR after viewing the material coefficients on Spreadsheet IPRMC.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The information shown in this spreadsheet is automatically calculated by coordinating (1) power plant characteristics from Spreadsheets IBFAS and IBUCH, (2) the on-line dates for all power plants (from Spreadsheet IBUEN), (3) the corresponding power plant construction lead times and scheduling distributions (from Spreadsheet IPRCS), and (4) the adjusted construction material coefficients (from Spreadsheets IPRMC and IPREC). Refer to Spreadsheet IPRCR for an example.

8.4.66 IPTSL — Power Plant Solid Waste Summary

Name: IPTSL
Title: Limestone requirements and wastes collected at electric power plants
Source: IBFCH, IBFUS, IPASO, and IPATS
Units: Metric tons

Study Year	Ash Collected	Sulfur Collected	Limestone Required
2000	1.1863E+5	1.3421E+4	5.6369E+4
2001	1.1863E+5	1.3421E+4	5.6369E+4
2002	1.1782E+5	1.3872E+4	5.8261E+4

Purpose

Spreadsheet IPTSL shows the ash and sulfur wastes collected from electric coal generating facilities and the total limestone requirements. You advanced to IPTSL by selecting option 6 on Menu I015.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values are obtained from Spreadsheets IBFUS, IBFCH, IPASO, and IPATS and the following equations:

$$\text{ash collected} = \sum[F \times A) - E]$$

$$\text{sulfur collected} = \sum[F \times S) - P]$$

$$\text{limestone requirements} = C \times T$$

where:

F = quantity of fuel consumed (t, bbl, or m^3) from IBFUS,

A = ash (%) in each type of coal from IBFCH,

E = total SO_2 emissions (t) from IPASO,

S = sulfur (%) in each type of coal from IBFCH,

P = total particulate emissions (t) from IPATS,

C = conversion factor, and

T = sulfur collected (t).

8.4.67 IEATO — Electric Air Emission Summary

Name: IEATO
Title: Total air emissions for the electric sector
Source: IMATO, ITATO, and IPATO
Units: Metric tons

Scenario Year	SO2	NOX	TSP	CO	CO2	HC
2000	2.5362E+5	4.5289E+4	1.1919E+5	1.6938E+3	8.5382E+2	8.2407E+1
2001	2.5362E+5	4.5289E+4	1.1919E+5	1.6938E+3	8.5382E+2	8.2407E+1
2002	2.4429E+5	4.3282E+4	1.1895E+5	1.5203E+3	8.1455E+2	7.8091E+1

Purpose

Spreadsheet IEATO displays total air emissions for the electric sector. You advanced to IEATO by selecting option 1 on Menu I016 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet adds and displays air emissions (t) from all activities in the electric sector, namely coal mining (Spreadsheet IMATO), fuel transportation (Spreadsheet ITATO), and power plant operations (Spreadsheet IPATO).

8.4.68 IEWTO — Electric Water Emission Summary

```
:-------------------------------------------------------------------------:
:    Name:  IEWTO                                                         :
:   Title:  Total water emissions for the electric sector                 :
:  Source:  IMWTO, IPWTO, and IPWTR                                       :
:   Units:  Metric tons                                                   :
:                                                                         :
:-------------------------------------------------------------------------:
: Scenario |                                                              :
:  Year    |    BOD           COD       ---> Similarly for chloride,     :
:----------------------------------          phosphorus, TSS, TDS, organics, :
:  2000      4.1861E+1     4.0452E+3         and water requirements       :
:  2001      4.1861E+1     4.0452E+3                                      :
:  2002      4.1870E+1     3.9381E+3                                      :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IEWTO displays total water emissions (t) and requirements (m^3) for the electric sector. You advanced to IEWTO by selecting option 2 on Menu E016 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet adds and displays water emissions (t) from all activities in the electric sector, namely coal mining (Spreadsheet IMWTO) and power plant operations (Spreadsheets IPWTO and IPWTR).

8.4.69 IELTO — Electric Land Use Summary

```
:-------------------------------------------------------------------------:
:   Name:  IELTO                                                          :
:  Title:  Total land used in the electric sector                         :
: Source:  IMLDW, IPLTR, and IPLDW                                        :
:  Units:  m^2 of land disturbed per year                                 :
:                                                                         :
:-------------------------------------------------------------------------:
:              |    Land Used for        ---> Similarly for land used for :
: Scenario     |   Waste from Coal            surface coal mining, power   :
:   Year       | Mining and Cleaning          plants, waste disposal at power :
:-------------------------------------       plants, and all electric sector :
:   2000          1.4787E+4                  activities                   :
:   2001          1.4787E+4                                               :
:   2002          1.4787E+4                                               :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IELTO displays total land use requirements (m^2/yr) for the electric sector. You advanced to IELTO by selecting option 3 on Menu I016 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet adds and displays the quantity of land used for all activities in the electric sector, namely coal mining (Spreadsheet IMLDW) and power plant operations (Spreadsheets IPLTR and IPLDW).

8.4.70 IEHHS — Electric Health and Safety Impacts Summary

Name: IEHHS
Title: Aggregate occupational health and safety for the electric sector
Source: IMHHS, IMHCS, ITHHS, and IPHHS
Units: Shown in spreadsheet

Scenario Year	Injuries	Fatalities	Person-Days Lost
2000	5.3449E+3	5.8699E+1	3.7710E+5
2001	5.3449E+3	5.8699E+1	3.7710E+5
2002	5.3833E+3	5.8891E+1	3.7775E+5

Purpose

Spreadsheet IEHHS displays total occupational human health and safety impacts for the electric sector. You advanced to IEHHS by selecting option 4 on Menu I016 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet adds and displays occupational health and safety impacts from all activities in the electric sector, namely coal mining (from Spreadsheets IMHHS and IMHCS), fuel transportation (from Spreadsheet ITHHS), and power plant operations (from Spreadsheet IPHHS).

8.4.71 IETTO — Electric Solid Waste Production Summary

Name: IETTO
Title: Total solid waste for the electric sector
Source: IPTSL and IMTSW
Units: Metric tons

Scenario Year	Total Waste from Mining of Coal	Total Waste from Power Plants	Total Waste from the Electric Sector
2000	2.5841E+5	1.3205E+5	3.9046E+5
2001	2.5841E+5	1.3205E+5	3.9046E+5
2002	2.5841E+5	1.3169E+5	3.9010E+5

Purpose

Spreadsheet IETTO displays the calculated solid wastes that are produced throughout the electric sector. You advanced to IETTO by selecting option 6 on Menu I016 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet adds and displays the quantity of solid wastes (t) produced from all activities in the electric sector, namely coal mining (Spreadsheet IMTSW) and power plant operations (Spreadsheet IPTSL).

8.4.72 INUGE — Nonelectric Facility Production Levels

```
:-------------------------------------------------------------------------:
:   Name:  INUGE                                                          :
:  Title:  Annual import or production level for each resource            :
:          and conversion facility                                        :
: Source:  BALANCE Module or user                                         :
:  Units:  Thousands of barrels of oil equivalent per year                :
:                                                                         :
:-------------------------------------------------------------------------:
: Facility Sequence | Study Year - - - - - - - - ->  For all              :
: Name     Number   |   2000       2001       2002    study years        :
:-------------------------------------------------------                  :
: one         1     1.0000E+2  1.0000E+2  1.0000E+2                      :
: two         2     2.0000E+2  2.0000E+2  2.0000E+2                      :
: thr         3     3.0000E+2  3.0000E+2  3.0000E+2                      :
: fou         4     4.0000E+2  4.0000E+2  4.0000E+2                      :
: fiv         5     5.0000E+2  5.0000E+2  5.0000E+2                      :
: six         6     6.0000E+2  6.0000E+2  6.0000E+2                      :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INUGE displays the annual output of each resource and conversion facility. You advanced to INUGE by selecting a BALANCE case on Form I021 or selecting option 2 on Menu I020 and entering Framework II on Form I099.

Options

- View or change the displayed values.
- Press Alt-C to advance to Spreadsheet INUCH, which displays the resource and conversion facility characteristics.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

These annual production and output levels can be determined in the BALANCE Module. The values shown in this spreadsheet are totals, representing the aggregated output (TBOE) of all facilities of the types listed. Spreadsheet INUNO displays the number of each type in the system. If you are not using a BALANCE case, this spreadsheet will contain data from the case you copied to create the current case (see Form I002). You should verify all data in this spreadsheet before continuing.

8.4.73 INUCH — Changing Nonelectric Facility Characteristics

```
:-------------------------------------------------------------------------:
:   Name:  INUCH                                                          :
:  Title:  Resource and conversion facility characteristics               :
: Source:  BALANCE Module or user                                         :
:  Units:  Capacities in thousands of barrels of oil equivalent per year  :
:                                                                         :
:-------------------------------------------------------------------      :
:   Facility    Sequence      Maximum        Unit        Fuel             :
:     Name       Number       Capacity       Type        Type             :
:-------------------------------------------------------------------      :
: one              1             500          1          01               :
: two              2              33          2          02               :
: thr              3             502          4          04               :
: fou              4           50232          6          04               :
: fiv              5           24235          7          G2               :
: six              6            2322          3          03               :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INUCH displays key technical characteristics for each resource and conversion facility. You advanced to INUCH after viewing the output levels on Spreadsheet INUGE.

Options

- Enter, view, or change the fuel type for each facility.
- Press **Alt-C** to advance to Spreadsheet INUNO, which displays the number of on-line units for each facility type.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The maximum capacity (TBOE) and unit type designation can be obtained from the BALANCE Module. You must specify the type of fuel that each facility consumes, produces, or processes. The characteristics of these fuels are defined in Spreadsheet IBFCH. If you are not using a BALANCE case, this spreadsheet will contain data from the case you copied to create the current case (see Form I002).

8.4.74 INUNO — Annual Available Nonelectric Facilities

```
:-------------------------------------------------------------------------:
:   Name:  INUNO                                                          :
:  Title:  Number of resource and conversion facilities operable          :
:          in each year of the planning study                             :
: Source:  BALANCE Module or user                                         :
:  Units:  Number of facilities operable in study year                    :
:                                                                         :
:-------------------------------------------------------------------------:
: Facility Sequence | Study Year - - - - - ->      For all                :
: Name     Number   | 2000    2001    2002         study years            :
:-------------------------------------------                              :
: one        1        1       1       1                                   :
: two        2        1       1       1                                   :
: thr        3        1       1       1                                   :
: fou        4        1       1       1                                   :
: fiv        5        1       1       1                                   :
: six        6        1       1       1                                   :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INUNO displays the number of resource and conversion facilities of each type that are available to meet system demands in each study year. You advanced to INUNO after viewing the facility characteristics on INUCH.

Options

- View or change the displayed values.
- Press **Alt-C** to advance to Spreadsheet INUEN, which contains information about additions to the resource and conversion system.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The resource and conversion system configuration displayed in INUNO can be determined in the BALANCE Module. Because a resource or conversion facility may retire in the same year that a new facility of the same type is added, new additions to the system are displayed separately in Spreadsheet INUEN and cannot be inferred from information in this spreadsheet. If you are not using a BALANCE case, this spreadsheet will contain data from the case you copied to create the current case.

8.4.75 INUEN — Annual Nonelectric Facility Additions

```
:-------------------------------------------------------------------------:
:   Name:  INUEN                                                          :
:  Title:  Number of resource and conversion facilities entering          :
:          the system in each year of the planning study                  :
: Source:  BALANCE Module or user                                         :
:  Units:  Number of facilities entering system in study year             :
:                                                                         :
:-------------------------------------------------------------------------:
: Facility Sequence | Study Year - - - - - >    For all                  :
: Name     Number   | 2000    2001    2002      study years              :
:-------------------------------------------------------------------------:
: one         1        0       0       0                                  :
: two         2        0       0       0                                  :
: thr         3        0       0       0                                  :
: fou         4        0       0       0                                  :
: fiv         5        0       0       0                                  :
: six         6        0       0       1                                  :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INUEN displays the number and timing of resource and conversion facility additions to the nonelectric sector. You advanced to INUEN after viewing the annual number of operable facilities on INUNO.

Options

- View or change the displayed values.
- Press **Alt-C** to advance to Spreadsheet INUCC, which contains the total capital cost of each new resource and conversion facility.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

New additions to the nonelectric sector are displayed by the year of facility start-up. This information is used along with construction and expenditure profiles to calculate annual capital expenditures and labor requirements. This data can be obtained from the BALANCE Module. If you are not using a BALANCE case, this spreadsheet will contain data from the case that you copied to create the current case (see Form I002).

8.4.76 INUCC — Annual Nonelectric Facility Construction Costs

```
:-------------------------------------------------------------------------:
:   Name:  INUCC                                                          :
:  Title:  Total capital cost for each new resource and conversion        :
:          facility in year of start-up                                   :
: Source:  BALANCE Module or user                                         :
:  Units:  $U.S.                                                          :
:                                                                         :
:-------------------------------------------------------------------------:
: Facility Sequence | Study Year - - - -  - - ->    For all              :
: Name     Number   |   2000       2001       2002      study years       :
:-------------------------------------------------------                  :
: one         1     0.0000E+0  0.0000E+0  0.0000E+0                       :
: two         2     0.0000E+0  0.0000E+0  0.0000E+0                       :
: thr         3     0.0000E+0  0.0000E+0  0.0000E+0                       :
: fou         4     0.0000E+0  0.0000E+0  0.0000E+0                       :
: fiv         5     0.0000E+0  0.0000E+0  0.0000E+0                       :
: six         6     0.0000E+0  0.0000E+0  6.0000E+1                       :
: Total             0.0000E+0  0.0000E+0  6.0000E+1                       :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INUCC displays the annual capital costs for the construction of resource and conversion facilities. You advanced to INUCC after viewing the annual facility additions on Spreadsheet INUEN.

Options

- View or change the displayed values.
- Press **Alt-C** to advance to Spreadsheet INUOC, which displays the annual costs for nonelectric facilities.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The data in INUCC can be calculated in the BALANCE Module. These values represent the total capital costs ($) of new facilities in the year of start-up; the costs must be distributed over the construction schedules. If you are not using a BALANCE case, INUCC will contain data from the case you copied to create the current case (see Form I002). (This cost information differs from that in Spreadsheet IBUCO, which provides construction expenditures by year of construction rather than total construction expenditures in the start-up year.)

8.4.77 INUOC — Annual Nonelectric Facility Costs

```
:-------------------------------------------------------------------------:
:   Name:  INUOC                                                          :
:  Title:  Annual O&M and fuel costs for all resource and                 :
:          conversion facilities                                          :
: Source:  BALANCE Module or user                                         :
:  Units:  $U.S.                                                          :
:                                                                         :
:-------------------------------------------------------------------------:
:                | Scenario Year  - - - - - - - - >    For all           :
: Category       |    2000        2001        2002      study years       :
:-----------------------------------------------------                    :
: O&M            1.0000E+1  1.0000E+1  1.0000E+1                          :
: Domestic fuel  2.0000E+1  2.0000E+1  2.0000E+1                          :
: Foreign fuel   3.0000E+1  3.0000E+1  3.0000E+1                          :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INUOC displays the annual O&M and domestic and foreign fuel costs (U.S. $) for the nonelectric sector. You advanced to INUOC after viewing the nonelectric construction costs on Spreadsheet INUCC.

Options

- View or change the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The information in this spreadsheet can be obtained from the BALANCE Module. If you are not using a BALANCE case, this spreadsheet will contain data from the case you copied to create the current case (see Form I002). You should verify these values before continuing.

8.4.78 INAEC — Nonelectric Air Emission Coefficients

```
:-------------------------------------------------------------------------:
:   Name:  INAEC                                                          :
:  Title:  Uncontrolled air emissions coefficients for resource           :
:          and conversion facilities                                      :
: Source:  EPA - 600/2-75-068; DOE/EV-0072                                :
:  Units:  Shown in spreadsheet                                           :
:                                                                         :
:-------------------------------------------------------------------------:
: Category                      Units              SO2     --> Similarly  :
:-------------------------------------------------------------  for NOx,  :
: Offshore Oil Import       Short tons/10^12 Btu  0.0000E+0   TSP, CO, HC, :
: Onshore Oil Import        Short tons/10^12 Btu  0.0000E+0   and all non- :
: Offshore Oil Production   Short tons/10^12 Btu  2.1200E+0   electric     :
: Onshore Oil Production    Short tons/10^12 Btu  1.3600E+1   facilities   :
: High - Gasoline Refinery  lbs/day *             2.2750E+4                :
: Low - Gasoline Refinery   lbs/day *             1.6000E+4                :
: Onshore Gas Production    Short tons/10^12 Btu  1.4246E+3                :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INAEC shows the default emission coefficients used for estimating uncontrolled air pollutant emissions (SO_2, NO_x, TSP, CO, and hydrocarbons) from resource and conversion facilities. You advanced to INAEC by selecting option 1 on Menu I022 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet INAEM, which displays the emission scaling factors.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The emission coefficients are used to relate the quantity of a pollutant released to the atmosphere to a particular type of production or conversion facility. The emission coefficients for SO_2, NO_x, and TSP can be scaled in Spreadsheet INAEM to reflect local conditions. The emission coefficients for CO and hydrocarbons can be scaled in Spreadsheet INASM.

8.4.79 INAEM — Changing Nonelectric Air Emission Coefficients for SO_2, TSP, and NO_x

Name: INAEM
Title: Functions for scaling uncontrolled air emissions from resource and conversion facilities*
Source: User input
Units: Half time in years

SO2

Category	Base Mult.	Change Year	End Mult.	Half Time	-> Similarly for NO_x and TSP
Offshore Oil Import	1	2005	0	5	
Onshore Oil Import	1	2005	0	5	
Offshore Oil Production	1	2005	0	5	
Onshore Oil Production	1	2005	0	5	
High - Gasoline Refinery	1	2005	0	5	
Low - Gasoline Refinery	1	2005	0	5	
Onshore Gas Production	1	2005	0	5	
LNG Import Facility	1	2005	0	5	
Coal Import Facility	1	2005	0	5	
Underground Coal Mining	1	2005	0	5	
Surface Coal Mining	1	2005	0	5	

* Coefficients correspond to a time dependent exponential scaling function of the form:

Scaling factor=End Mult. + (Base Mult. - End Mult.) * exp(-0.693((Current Year - Change Year)/Half Time))

Purpose

This spreadsheet allows you to scale the uncontrolled SO_2, TSP, and NO_x emissions as a function of time to reflect country-specific conditions. You advanced to Spreadsheet INAEM after viewing the default coefficients on INAEC.

Options

- View or change any of the parameters, which are defined as follows:

  Base Mult. -- A real variable containing the base value of the function.

  Change Year -- An integer variable denoting the year in which the change from the initial value begins.

End Mult. -- A real variable containing the asymptotic value of the function when exponential behavior is desired.

Half Time -- An integer variable containing the number of years required to reach 50% of the difference between the base and end multipliers.

- Press Alt-C to advance to Spreadsheet INASM, which contains scaling factors for adjusting CO and hydrocarbon emissions.

- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

Time-dependent changes in emissions can be approximated with this exponential function, which decreases toward a limiting or asymptotic value (that is, from an initial level to a more stringent level). For example, SO_2 emissions in the first year of the study (2000) may be uncontrolled (*Base Mult.* = 1), but, starting in 2005, approach a 50% long-term control level and reach one half of this control level by 2010 (when *Half Time* = 5, *Change Year* = 2005, and *End Mult.* = 0.5).

8.4.80 INASM — Changing Nonelectric CO and Hydrocarbon Emission Coefficients

Name: INASM
Title: Scaling factors for CO and hydrocarbon emissions from resource and conversion facilities
Source: User input
Units: Scaling factors

Category	Emission Scalars CO	HC
Offshore Oil Import	1.0000E+0	1.0000E+0
Onshore Oil Import	1.0000E+0	1.0000E+0
Offshore Oil Production	1.0000E+0	1.0000E+0
Onshore Oil Production	1.0000E+0	1.0000E+0
High - Gasoline Refinery	1.0000E+0	1.0000E+0
Low - Gasoline Refinery	1.0000E+0	1.0000E+0
Onshore Gas Production	1.0000E+0	1.0000E+0
LNG Import Facility	1.0000E+0	1.0000E+0
Coal Import Facility	1.0000E+0	1.0000E+0
Underground Coal Mining	1.0000E+0	1.0000E+0
Surface Coal Mining	1.0000E+0	1.0000E+0

Purpose

This spreadsheet allows you to adjust the default uncontrolled CO and hydrocarbon emission coefficients. You advanced to Spreadsheet INASM after viewing or changing the scaling function parameters (for SO_2, TSP, and NO_x) on Spreadsheet IPAEM.

Options

- View or change any of the scaling factors.
- Press **Alt-C** to advance to Spreadsheet INASO, which displays the SO_2 emissions from nonelectric facilities.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change these linear scaling factors to adjust the default CO and hydrocarbon coefficients in Spreadsheet INAEC.

8.4.81 Spreadsheets for Calculated Nonelectric Air Emissions

```
:-------------------------------------------------------------------------:
:   Name:  INASO                                                          :
:  Title:  SO2 emissions from resource and conversion facilities          :
: Source:  INAEC, INAEM, and INUGE                                        :
:  Units:  Metric tons                                                    :
:                                                                         :
:-------------------------------------------------------------------------:
:  Study   Oil Import        Gas      Gas Production   Coal Import         :
:  Year  and Production    Refinery     and Import     and Mining    Total  :
:-------------------------------------------------------------------------:
:  2000    1.0936E+1      1.4835E+1     4.7569E+4      0.0000E+0   4.7595E+4 :
:  2001    1.0936E+1      1.4835E+1     4.7569E+4      0.0000E+0   4.7595E+4 :
:  2002    1.0936E+1      1.4835E+1     4.7569E+4      0.0000E+0   4.7595E+4 :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheets INASO, INANO, INATS, INACO, and INAHC show the calculated air emissions from all resource and conversion facilities. You advanced to the spreadsheet shown here (INASO) after viewing or changing the CO and hydrocarbon emission scaling factors on Spreadsheet INASM. Since the NO_x, TSP, CO, and hydrocarbon emissions are calculated in the same manner, the corresponding spreadsheets, which have the same format, are not repeated in this document.

Options

- View the displayed values on each spreadsheet.
- Press Alt-C to advance to Spreadsheet INANO, which displays the NO_x emissions. Similarly, press Alt-C when you finish viewing each of the remaining air emission spreadsheets (INATS, INACO, and INAHC) to advance to the next spreadsheet.
- After you finish viewing INAHC, press Alt-C to advance to Spreadsheet INATO, which summarizes the air emissions from nonelectric facilities.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values on each spreadsheet are calculated by the following formulas:

refinery air emissions = $2.3 \times 10^{-6} \times G \times C \times S$

other facility air emissions = $5.26 \times 10^{-3} \times G \times C \times S$

where:

G = facility production level (TBOE) from Spreadsheet INUGE,

C = emission coefficient (tons/10^{12} Btu or lb/d) from Spreadsheet INAEC, and

S = exponential scaling fraction from Spreadsheet INAEM or linear scalar from Spreadsheet INASM.

8.4.82 INATO — Nonelectric Air Emission Summary

```
:-------------------------------------------------------------------------:
:   Name:  INATO                                                          :
:  Title:  TOTAL air emissions from resource and conversion               :
:          facilities                                                     :
: Source:  INASO, INANO, INATS, INACO, and INAHC                          :
:  Units:  Metric tons                                                    :
:                                                                         :
:-------------------------------------------------------------------------:
:  Study                                                                  :
:  Year        SO2           NOX           TSP       - - - >             :
:-------------------------------------------------------                 :
:  1991     2.3546E+4     1.9038E+3     3.2311E+2      Similarly for       :
:  1992     1.9136E+4     1.6698E+3     3.3289E+2      CO and hydro-       :
:  1993     2.0125E+4     1.7567E+3     3.5000E+2      carbons             :
:  1994     2.1389E+4     1.8602E+3     3.6772E+2                          :
:  1995     2.3942E+4     2.0175E+3     3.7397E+2                          :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet summarizes air emissions (t) from resource and conversion facilities. You advanced to Spreadsheet INATO after viewing the hydrocarbon emissions on INAHC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet summarizes the air emissions (t) calculated in Spreadsheets INASO, INANO, INATS, INACO, and INAHC.

8.4.83 INWEM — Changing Nonelectric Water Emission Coefficients

```
:-------------------------------------------------------------------------:
:  Name:  INWEM                                                           :
: Title:  Scaling factors for uncontrolled water emissions                :
:         from resource and conversion facilities                         :
:Source:  User input                                                      :
: Units:  Scaling factors                                                 :
:                                                                         :
:-------------------------------------------------------------------------:
:                          |  - -  - Emission Scalars - - - - >           :
: Category                 |   BOD        COD                             :
:-------------------------------------------------------------------------:
: Offshore Oil Import      1.0000E+0   1.0000E+0                           :
: Onshore Oil Import       1.0000E+0   1.0000E+0          Similarly        :
: Offshore Oil Production  1.0000E+0   1.0000E+0          for chloride,    :
: Onshore Oil Production   1.0000E+0   1.0000E+0          phosphorus,      :
: High - Gasoline Refinery 1.0000E+0   1.0000E+0          TSS, and TDS     :
: Low - Gasoline Refinery  1.0000E+0   1.0000E+0                           :
: Onshore Gas Production   1.0000E+0   1.0000E+0                           :
: LNG Import Facility      1.0000E+0   1.0000E+0                           :
: Coal Import Facility     1.0000E+0   1.0000E+0                           :
: Underground Coal Mining  1.0000E+0   1.0000E+0                           :
: Surface Coal Mining      1.0000E+0   1.0000E+0                           :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INWEM displays the scaling factors used to adjust the coefficients of water emissions from resource and conversion facilities. You advanced to INWEM by selecting option 2 on Menu I022 and entering Framework II on Form I099.

Options

- View or change the scaling factors for any category.
- Press **Alt-C** to advance to Spreadsheet INWEC, which displays the default water emission coefficients.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change the scaling factors to adjust the default coefficients to reflect country-specific conditions.

8.4.84 INWEC — Nonelectric Water Emission Coefficients

```
:-------------------------------------------------------------------------:
:   Name:  INWEC                                                          :
:  Title:  Nonelectric uncontrolled water emissions coefficients          :
: Source:  EPA - 600/2-75-068; DOE/EV-0072                                :
:  Units:  Shown in spreadsheet                                           :
:                                                                         :
:-------------------------------------------------------------------------:
: Category                      Units              BOD  -->  Similarly    :
:-------------------------------------------------------     for COD,    :
: Offshore Oil Import       Short tons/10^12 Btu  0.0000E+0  chloride,   :
: Onshore Oil Import        Short tons/10^12 Btu  0.0000E+0  phosphorus, :
: Offshore Oil Production   Short tons/10^12 Btu  0.0000E+0  TSS, TDS,   :
: Onshore Oil Production    Short tons/10^12 Btu  0.0000E+0  and all     :
: High - Gasoline Refinery  lbs/day *             0.0000E+0  nonelectric :
: Low - Gasoline Refinery   lbs/day *             0.0000E+0  facilities  :
: Onshore Gas Production    Short tons/10^12 BTU  1.7100E+0               :
: LNG Import Facility       Short tons/10^12 BTU  0.0000E+0               :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet shows the default water emission coefficients used in estimating water pollutant emissions (BOD, COD, chloride, phosphorus, TSS, TSD, and organics) from resource and conversion facilities. You advanced to Spreadsheet INWEC after viewing or changing the scaling factors on INWEM.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet INWBD, which shows the calculated BOD emissions from resource and conversion facilities.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The emission coefficients are used to relate the quantity of a pollutant released to water to a particular type of resource or conversion facility. The default emission coefficients for BOD, COD, chloride, phosphorus, TSS, TDS, and organics can be scaled in Spreadsheet INWEM to reflect local conditions.

8.4.85 Spreadsheets for Calculated Nonelectric Water Emissions

Name: INWBD
Title: Nonelectric water biological oxygen demands
Source: INUGE, INWEC, and INWEM
Units: Metric tons

Scenario Year	Oil Import and Production	Gas Refinery	Gas Production and Import	Coal Import and Mining	Total
2000	0.0000E+0	0.0000E+0	3.0756E+8	0.0000E+0	3.0756E+8
2001	0.0000E+0	0.0000E+0	3.0756E+8	0.0000E+0	3.0756E+8
2002	0.0000E+0	0.0000E+0	3.0756E+8	0.0000E+0	3.0756E+8

Purpose

Spreadsheets INWBD, INWCD, INWCL, INWPH, INWTS, INWTD, and INWOG show the calculated water emissions from resource and conversion facilities. You advanced to the spreadsheet shown here (INWBD) after viewing the default coefficients on Spreadsheet INWEC. Since the COD, chloride, phosphorus, TSS, TDS, and organic emissions are calculated in the same manner, the corresponding spreadsheets, which have the same format, are not repeated in this document.

Options

- View the displayed values on each spreadsheet.
- Press Alt-C to advance to Spreadsheet INWCD, which displays the COD. Similarly, press Alt-C to advance to each of the remaining water emission spreadsheets (INWCL, INWPH, INWTS, INWTD, and INWOG).
- After you finish viewing Spreadsheet INWOG, press Alt-C to advance to INWTO, which summarizes water emissions from nonelectric facilities.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

These values are calculated as follows:

refinery water emissions = $2.3 \times 10^{-6} \times G \times C \times S$

other facility water emissions = $5.26 \times 10^{-6} \times G \times C \times S$

where:

G = facility production (TBOE) from Spreadsheet INUGE,

C = emission coefficient (tons/10^{12} Btu or lb/d) from Spreadsheet INWEC, and

S = scaling factor from Spreadsheet INWEM.

8.4.86 INWTO — Nonelectric Water Emission Summary

```
:-------------------------------------------------------------------------:
:   Name:  INWTO                                                          :
:  Title:  Total water emissions for resource and                         :
:          conversion facilities                                          :
: Source:  INWBD, INWCD, INWCL, INWPH, INWTS, INWTD, and INWOG            :
:  Units:  Metric tons                                                    :
:                                                                         :
:-------------------------------------------------------------------------:
:    Study     Biological      Chemical          ---> Similarly for       :
:    Year   Oxygen Demands Oxygen Demands          chloride, phosphorus,    :
:-----------------------------------------        TSS, and TDS and all     :
:    1991      2.7374E+1       1.7929E+2          study years              :
:    1992      2.2032E+1       1.4430E+2                                   :
:    1993      2.3171E+1       1.5176E+2                                   :
:-------------------------------------------------------------------------:
```

Purpose

This spreadsheet summarizes water emissions from resource and conversion facilities. You advanced to Spreadsheet INWTS after viewing the organic emissions on INWOG.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet INWRC, which contains the coefficients for nonelectric water requirements.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet summarizes the water emissions (t) calculated in Spreadsheets INWBD, INWCD, INWCL, INWPH, INWTS, INWTD, and INWOG.

8.4.87 INWRE — Changing Nonelectric Water Requirement Coefficients

```
:-------------------------------------------------------------------------:
:   Name:  INWRE                                                          :
:  Title:  Scaling exponents for water requirement resource and           :
:          conversion facilities                                          :
: Source:  User input                                                     :
:  Units:  Scaling exponents                                              :
:                                                                         :
:-----------------------------------------                                :
: Category                  Scaling Exponents                             :
:-----------------------------------------                                :
: Offshore Oil Import           1.0000E+0                                 :
: Onshore Oil Import            1.0000E+0                                 :
: Offshore Oil Production       1.0000E+0                                 :
: Onshore Oil Production        1.0000E+0                                 :
: High - Gasoline Refinery      1.0000E+0                                 :
: Low - Gasoline Refinery       1.0000E+0                                 :
: Onshore Gas Production        1.0000E+0                                 :
: LNG Import Facility           1.0000E+0                                 :
: Coal Import Facility          1.0000E+0                                 :
: Underground Coal Mining       1.0000E+0                                 :
: Surface Coal Mining           1.0000E+0                                 :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INWRE allows you to adjust the default coefficients for estimating the water requirements of nonelectric facilities. You advanced to INWRE after viewing the nonelectric water emission summary on Spreadsheet INWTO.

Options

- View or change the scaling exponents.
- Press Alt-C to advance to Spreadsheet INWRC, which contains the nonelectric water requirement coefficients.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can use these scaling exponents to adjust the coefficients on Spreadsheet INWRC to reflect local conditions.

8.4.88 INWRC — Nonelectric Water Requirement Coefficients

Name: INWRC
Title: Coefficients for resource and conversion facilities water requirements
Source: EPA - 600/2-75-068; DOE/EV-0072
Units: Shown in spreadsheet

Category	Units	Water Requirements
Offshore Oil Import	Acre-feet/10^12 Btu	0.0000E+0
Onshore Oil Import	Acre-feet/10^12 Btu	0.0000E+0
Offshore Oil Production	Acre-feet/10^12 Btu	0.0000E+0
Onshore Oil Production	Acre-feet/10^12 Btu	0.0000E+0
High - Gasoline Refinery	lbs/day *	0.0000E+0
Low - Gasoline Refinery	lbs/day *	0.0000E+0
Onshore Gas Production	Acre-feet/10^12 Btu	0.0000E+0
LNG Import Facility	Acre-feet/10^12 Btu	0.0000E+0
Coal Import Facility	Acre-feet/10^12 Btu	0.0000E+0
Underground Coal Mining	Acre-feet/10^12 Btu	2.3000E+0
Surface Coal Mining	Acre-feet/10^12 Btu	2.8000E+0

* Based on 200,000 barrels/day crude capacity.

Purpose

Spreadsheet INWRC shows the default coefficients used in estimating water requirements for resource and conversion facilities. You advanced to INWRC after viewing or changing the scaling exponents on Spreadsheet INWRE.

Options

- View or change the displayed coefficients.
- Press Alt-C to advance to Spreadsheet INWTR, which contains the calculated water requirements for resource and conversion facilities.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The coefficients relate the quantity of water required at a particular resource or conversion facility to the energy content of the fuel produced.

8.4.89 INWTR — Nonelectric Water Requirement Summary

```
:-------------------------------------------------------------------------:
:    Name:  INWTR                                                         :
:   Title:  Total water requirements for nonelectric facilities           :
:  Source:  INUCH, INUGE, INWRC, and INWRE                                :
:   Units:  Cubic meters                                                  :
:                                                                         :
:-------------------------------------------------------------------------:
: Scenario   Oil Import       Gas       Gas Production   Coal Import      :
:  Year   and Production    Refinery      and Import     and Mining    Total :
:-------------------------------------------------------------------------:
:  2000     0.0000E+0      0.0000E+0     0.0000E+0      0.0000E+0   0.0000E+0 :
:  2001     0.0000E+0      0.0000E+0     0.0000E+0      0.0000E+0   0.0000E+0 :
:  2002     0.0000E+0      0.0000E+0     0.0000E+0      0.0000E+0   0.0000E+0 :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INWTR shows the calculated water requirements for resource and conversion facilities. You advanced to INWTR after viewing the coefficients on Spreadsheet INWRC.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

These values are calculated from the values in Spreadsheets INUCH, INUGE, INWRC, and INWRE by the formula:

$$\text{water requirements} = (G/N) \times C \times (N/P)^{S} \times U$$

where:

G = facility production level (TBOE) from INUGE,

N = facility size (TBOE) from INUCH,

C = coefficient (acre-ft/10^{12} Btu or lb/d) from INWRC,

P = reference facility size (see Table 8.3),

S = scaling exponent from INWRE, and

U = multiplier used for conversion of units.

8.4.90 INLCO — Nonelectric Land Use Coefficients

```
:-------------------------------------------------------------------------:
:   Name:  INLCO                                                          :
:  Title:  Coefficients for land used for nonelectric facilities          :
: Source:  ESPM                                                          :
:  Units:  m^2 per reference-size facility                               :
:                                                                        :
:-------------------------------------------------                       :
:        Category                 Coefficient                            :
:-------------------------------------------------                       :
:  Offshore Oil Import              1.0100E+6                            :
:  Onshore Oil Import               8.0500E+5                            :
:  Offshore Oil Production          2.0200E+5                            :
:  Onshore Oil Production           5.0600E+6                            :
:  High - Gasoline Refinery         8.0900E+6                            :
:  Low - Gasoline Refinery          8.0900E+6                            :
:  Onshore Gas Production           8.0600E+5                            :
:  LNG Import Facility              2.0200E+6                            :
:  Coal Import Facility             0.0000E+0                            :
:  Underground Coal Mining          6.0700E+4                            :
:  Surface Coal Mining              1.2100E+5                            :
:  Other 1                          0.0000E+0                            :
:  Other 2                          0.0000E+0                            :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INLCO shows the default coefficients (m^2 per reference-size facility) used in determining the amount of land used by resource and conversion facilities. You advanced to INLCO by selecting option 3 on Menu I022 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet INLSE, which displays the scaling exponents.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change the scaling exponents on Spreadsheet INLSE to adjust these land use coefficients.

8.4.91 INLSE — Changing Nonelectric Land Use Coefficients

```
:-------------------------------------------------------------------------:
:   Name: INLSE                                                           :
:  Title: Nonelectric plant-size scaling exponents                        :
: Source: User input                                                      :
:  Units: Scaling exponents                                               :
:                                                                         :
:-------------------------------------                                    :
:       Plant                Scaling                                      :
:       Number              Exponent                                      :
:-------------------------------------                                    :
:         1                1.0000E+0                                      :
:         2                1.0000E+0                                      :
:         3                1.0000E+0                                      :
:         4                1.0000E+0                                      :
:         5                1.0000E+0                                      :
:         6                1.0000E+0                                      :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INLSE shows the scaling exponents that you can use to adjust the land use coefficients. You advanced to INLSE after viewing the default coefficients on Spreadsheet INLCO.

Options

- View or change any of the scaling exponents.
- Press **Alt-C** to advance to Spreadsheet INLPR, which calculates the total quantity of land used at resource and conversion facilities.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change the scaling exponents to adjust nonelectric land use coefficients. See Table 8.3 for reference facility sizes.

8.4.92 INLPR — Nonelectric Land Use Summary

```
:-------------------------------------------------------------------------:
:   Name:  INLPR                                                          :
:  Title:  Land used at power plant site                                  :
: Source:  INLSE, INUCH, INUNO, and INLCO                                 :
:  Units:  m^2 of land occupied                                           :
:                                                                         :
:-------------------------------------------------------------------------:
: Study  | Oil Import        Gas      - - - - - - - - - - - - - - - - >     :
: Year   |and Production   Refinery                                       :
:--------------------------------      Similarly for all                  :
: 2000      4.4647E+5      6.1242E+6   facilities and                     :
: 2001      4.4647E+5      6.1242E+6   study years                        :
: 2002      4.4647E+5      6.1242E+6                                      :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INLPR displays the quantity of land (m^2) used at resource and conversion facilities. You advanced to INLPR after viewing or changing the scaling exponents on Spreadsheet INLSE.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values are obtained from Spreadsheets INLSE, INUCH, INUNO, and INLCO and the following equation:

$$\text{land use} = N \times C1(S / C2)^F$$

where:

C1 = land use coefficient (m^2 per reference-size facility) from INLCO,

S = actual facility size (TBOE) from INUCH,

N = number of facilities in operation from INUNO,

C2 = reference facility size (see Table 8.3), and

F = scaling exponent from INLSE.

8.4.93 INHHS — Nonelectric Health and Safety Impacts Summary

```
:-------------------------------------------------------------------------:
:   Name: INHHS                                                           :
:  Title: Occupational health and safety for                              :
:         resource and conversion facilities                              :
: Source: INHHC, INUCH, and INUGE                                         :
:  Units: Shown in spreadsheet                                            :
:                                                                         :
:-------------------------------------------------------------           :
:    Study     Number of          Number of          Person-Days           :
:    Year       Injuries          Fatalities           Lost                :
:-------------------------------------------------------------           :
:    2000     1.0177E-1          1.4066E-3          8.6140E+0  |  For all  :
:    2001     1.0177E-1          1.4066E-3          8.6140E+0  |  study years :
:    2002     1.0177E-1          1.4066E-3          8.6140E+0  v           :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INHHS displays the calculated occupational human health and safety impacts from the nonelectric sector. You advanced to INHHS after viewing or changing the coefficients on Spreadsheet INHHC.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

These values are calculated by the following formulas:

number of injuries or fatalities = $U \times M \times C \times S$

person-days lost = $(I \times S) + (F \times 6{,}000)$

where:

U = facility production level (TBOE) from Spreadsheet INUGE,

M = conversion factor,

C = default coefficient (injuries/10^{12} Btu) from Spreadsheet INHHC,

S = scaling factor from INHHC,

I = number of injuries calculated for each facility,

S = severity of injuries from INHHC, and

F = number of fatalities calculated for each facility.

Information from Spreadsheet INUCH correlates the data with nonelectric facility characteristics.

8.4.94 INREC — Changing Nonelectric Labor and Material Coefficients

```
:-------------------------------------------------------------------------:
:   Name: INREC                                                           :
:  Title: Facility-size scaling exponents for adjusting labor and         :
:         materials coefficients for resource and conversion facilities   :
: Source: User input                                                      :
:  Units: Scaling exponents                                               :
:                                                                         :
:-------------------------------------------------------------------------:
: Facility     Sequence  Construction   Construction     Operation        :
: Name          Number      Labor         Materials        Labor          :
:-------------------------------------------------------------------------:
: one             1        1.000          1.000          1.000           :
: two             2        1.000          1.000          1.000           :
: thr             3        1.000          1.000          1.000           :
:  |                                                                      :
:  |     For every plant                                                  :
:  v                                                                      :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INREC allows you to change the default exponents that are used to adjust default labor and material coefficients based on actual plant sizes. You advanced to INREC by selecting option 5 on Menu I022 and entering Framework II on Form I099.

Options

- View or change the exponents.
- Press **Alt-C** to advance to Spreadsheet INRCS, which contains the default construction labor and material schedules for resource and conversion facilities.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change the scaling exponents to adjust the default coefficients in Spreadsheets INRCC, INRMC, and INROC to reflect country-specific conditions. The following formula is used:

adjusted coefficient = $C(D/E)^F$

where:

C = default coefficient from INRCC, INRMC, or INROC,

D = size of unit being built or operated (TBOE) from Spreadsheet INUCH,

E = default size of facility used in deriving C (see Table 8.3), and

F = scaling exponent from this spreadsheet.

8.4.95 INRCS — Changing Nonelectric Construction Labor and Material Schedules

Name: INRCS
Title: Scheduling distributions by year of construction for resource and conversion facilities
Source: ESPM (Bechtel Corp.)
Units: Distributions in percent

Category		Nonmanual Technical Person-Years	Nonmanual Nontechnical Person-Years	Manual Person-Years	-------- >
Offshore	1	30%	25%	20%	Similarly for
Crude Oil	2	45%	45%	40%	materials and
Import	3	25%	30%	40%	equipment items;
Onshore	1	30%	25%	20%	costs of labor,
Oil Import	2	45%	45%	40%	materials, and
	3	25%	30%	40%	construction; and all facilities

Purpose

Spreadsheet INRCS shows the default construction labor and material schedules for resource and conversion facilities. You advanced to INRCS after viewing or changing the construction labor and material coefficients on Spreadsheet INREC.

Options

- View or change the manpower or resource distribution schedules for any type of facility.
- Press **Alt-C** to advance to Spreadsheet INRCC, which contains the default labor coefficients for nonelectric facilities.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default data shown in this spreadsheet are from the ESPM model developed by Bechtel Corp. These values represent the fraction of total labor

or resources that are used in each year of the construction period. You can shorten the default construction schedules by assigning fractions of 0. For example, if an offshore oil import facility can be constructed in two years (instead of the 3 years shown in the spreadsheet), you can assign 0's to year 1 of the three-year default construction schedule and redistribute the annual fractions over the remaining two years such that they total 100% in each of the five categories. Construction schedules cannot be lengthened beyond the time periods specified.

8.4.96 INRCC — Nonelectric Construction Labor Coefficients

Name: INRCC
Title: Construction labor coefficients for resource and conversion facilities
Source: ESPM (Bechtel Corp.)
Units: Thousand person-hours per reference-size facility

Category	Offshore Crude Oil Import	Onshore Oil Import	-----> For all facilities and labor categories
Chemical Engineer	0.0	0.0	
Civil Engineer	90.0	60.0	
Electrical Engineer	40.0	25.0	
Mechanical Engineer	80.0	55.0	
Mining Engineer	0.0	0.0	

Purpose

Spreadsheet INRCC displays the default construction labor coefficients for reference-size resource and conversion facilities. You advanced to INRCC after viewing the labor coefficients on Spreadsheet INRCS.

Options

- View or change the default coefficients; however, it is recommended that you preserve the original data by changing the scaling exponents in INREC.
- Press Alt-C to advance to Spreadsheet INRCR, which calculates the total annual construction labor requirements.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default coefficients are taken directly from ESPM (Bechtel Corp.) and are based on the reference plant sizes in Table 8.3. Refer to Spreadsheet INREC for a description of the plant-size scaling that you can use to adjust these values.

8.4.97 INRCR — Nonelectric Construction Labor Summary

Name: INRCR
Title: Construction labor requirements for resource and conversion facilities
Source: INUEN, INRCC, INRCS, INREC, and INUCH
Units: Persons/year

Category	Study Year 2000	2001	
Chemical Engineer	18.6	27.9	For all
Civil Engineer	31.4	60.9	categories
Electrical Engineer	21.0	46.9	and years
Mechanical Engineer	55.2	11.2	

Purpose

Spreadsheet INRCR displays the calculated construction labor requirements for resource and conversion facilities. You advanced to INRCR after viewing the labor coefficients on Spreadsheet INRCC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet INROC, which displays the operating labor coefficients.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The information shown in this spreadsheet is calculated by coordinating (1) nonelectric facility characteristics from Spreadsheet INUCH, (2) the on-line dates for all facilities (from Spreadsheet INUEN), (3) the corresponding facility construction lead times and scheduling distributions (from Spreadsheet INRCS), and (4) the adjusted construction labor coefficients (from Spreadsheets INRCC and INREC). Fractions refer to less than a full year of employment. Refer to Spreadsheet IPRCR for an example.

8.4.98 INROC — Nonelectric Operating Labor Coefficients

Name: INROC
Title: Operating labor coefficients for resource and conversion facilities
Source: ESPM (Bechtel Corp.)
Units: Persons per reference-size facility

Category	Offshore Crude Oil Import	Onshore ---> Oil Import	For all plant types and categories
Chemical Engineer	3.3	2.0	
Civil Engineer	1.1	1.0	
Electrical Engineer	2.0	1.0	
Mechanical Engineer	4.0	3.0	

Purpose

Spreadsheet INROC displays the default operating labor coefficients for reference-size resource and conversion facilities. You advanced to INROC after viewing the labor summary on Spreadsheet INRCR.

Options

- View or change the default coefficients; however, it is recommended that you preserve the original data by changing the scaling exponents in INREC.
- Press Alt-C to advance to Spreadsheet INROR, which displays the total annual labor needed to operate resource and conversion facilities.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default coefficients are taken directly from ESPM (Bechtel Corp.) and are based on the default facility sizes in Table 8.3. Refer to Spreadsheet INREC for a description of the facility-size scaling algorithm that can be used to adjust these values and the sizes of specific facilities under consideration.

8.4.99 INROR — Nonelectric Operating Labor Summary

```
:-------------------------------------------------------------------------:
:   Name:  INROR                                                          :
:  Title:  Operating labor requirements for all resource and conversion   :
:          facilities operating in each year of the planning study        :
: Source:  INUNO, INROC, and INREC                                        :
:  Units:  Persons                                                        :
:                                                                         :
:-------------------------------------------------------------------------:
:                          | Study Year - - - - - - - - - - - - - - ->     :
: Category                 |   2000        2001          2002             :
:--------------------------------------------------------------  For all  :
: Chemical Engineer          423.9         423.9         423.9   labor    :
: Civil Engineer               9.2           9.2           9.2   categories :
: Electrical Engineer         13.8          13.8          13.8   and years :
: Mechanical Engineer         17.0          17.0          17.0             :
: Mining Engineer              0.0           0.0           0.0             :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INROR displays the calculated operating labor requirements for resource and conversion facilities. You advanced to INROR after viewing the operating labor coefficients on Spreadsheet INROC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet INRMC, which displays the material requirements for constructing nonelectric facilities.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The information displayed in this spreadsheet is calculated by coordinating (1) the on-line dates of all facilities (from Spreadsheet INUNO) and (2) the adjusted operating labor coefficients (from Spreadsheets INROC and INREC). See Spreadsheet IPROR for an example.

8.4.100 INRMC — Nonelectric Construction Material Coefficients

Name: INRMC
Title: Raw materials coefficients for resource and conversion facilities
Source: ESPM (Bechtel Corp.)
Units: Short tons per reference-size facility

Category	Offshore Crude Oil Import	----> Similarly for each type of resource and conversion facility
Concrete	6.4250E+4	
Stainless Steel	8.8235E+2	
Total Steel	1.3535E+5	
Copper, Brass, Bronze	6.7390E+2	
Aluminum and Castings	4.1531E+2	
Manganese	7.2484E+2	
Chromium	2.0117E+2	
Nickel	3.5960E+1	
Cast Iron	9.4487E+2	

Purpose

Spreadsheet INRMC displays the default construction material coefficients for reference-size resource and conversion facilities. You advanced to this spreadsheet after viewing the operating labor requirements on INROR.

Options

- View or change the default coefficients; it is recommended that you preserve the original data by changing the scaling exponents in INREC.
- Press Alt-C to advance to Spreadsheet INRMR, which calculates the total annual construction material requirements.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default coefficients are taken directly from ESPM (Bechtel Corp.) and are based on the reference plant sizes in Table 8.3. Refer to Spreadsheet INREC for a description of the plant-size scaling that you can use to adjust these values.

8.4.101 INRMR — Nonelectric Construction Material Summary

Name: INRMR
Title: Raw materials required for all resource and conversion facilities under construction in each year of the planning study
Source: INUEN, INRMC, INUCH, INREC, and INRCS
Units: Metric tons

Category	Study Year -> 2000	2001	2002	For all study years
Concrete	1.3061E+4	2.4221E+5	2.8220E+5	
Stainless Steel	1.9354E+2	8.7132E+2	8.8739E+2	
Total Steel	1.2547E+4	1.8816E+5	2.1441E+5	
Copper, Brass, Bronze	1.6904E+2	1.5250E+3	1.7002E+3	
Aluminum and Castings	5.9750E+1	4.9258E+2	5.3724E+2	
Manganese	7.0345E+1	1.2668E+3	1.4589E+3	
Chromium	5.2478E+1	6.5152E+2	7.3974E+2	
Nickel	6.5314E+0	3.0152E+1	3.0829E+1	
Cast Iron	2.5456E+2	1.9651E+3	2.1411E+3	

Purpose

Spreadsheet INRMR displays the calculated material requirements for the construction of resource and conversion facilities. You advanced to INRMR after viewing the material coefficients on Spreadsheet INRMC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet INROR, which displays annual capital requirements for facility construction.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The information shown in INRMR is calculated by coordinating (1) nonelectric facility characteristics (from Spreadsheet INUCH), (2) the on-line dates for all facilities (from Spreadsheet INUEN), (3) the corresponding construction lead times and scheduling distributions (from Spreadsheet INRCS), and (4) the adjusted construction material coefficients (from Spreadsheets INRMC and INRCC). Refer to Spreadsheet IPRCR for an example.

8.4.102 INRDR — Nonelectric Capital Cost Summary

Name: INRDR
Title: Distributed capital costs for the construction of resource and conversion facilities
Source: INUCC, INRCS, and INUCH
Units: $U.S.

Facility Name	Sequence Number	Study Year 2000	2001	2002	For all study years
one	1	0.0000E+0	0.0000E+0	0.0000E+0	
two	2	0.0000E+0	0.0000E+0	0.0000E+0	
thr	3	0.0000E+0	0.0000E+0	0.0000E+0	
fou	4	4.0000E+1	1.6000E+2	1.6000E+2	
fiv	5	0.0000E+0	2.2500E+2	2.7500E+2	
six	6	2.4000E+2	3.0000E+2	0.0000E+0	

Purpose

Spreadsheet INRDR shows the annual capital requirements for constructing resource and conversion facilities. You advanced to INRDR after viewing the raw material requirements on Spreadsheet INRMR.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values shown in this spreadsheet are calculated by applying the construction schedule cost distributions (Spreadsheet INRCS) to the facility capital costs (Spreadsheet INUCC). Spreadsheet INUCH provides nonelectric facility characteristics.

8.4.103 INTWE — Changing Nonelectric Solid Waste Production Coefficients

```
:-------------------------------------------------------------------------:
:   Name:  INTWE                                                          :
:  Title:  Exponents for scaling solid waste                              :
:          production coefficients to size*                               :
: Source:  User input                                                     :
:  Units:  Scaling exponents                                              :
:                                                                         :
:-------------------------------------------------------------------------:
: Category                              Scaling Exponents                 :
:-------------------------------------------------------------------------:
: Offshore Oil Import                      1.0000E+0                      :
: Onshore Oil Import                       1.0000E+0                      :
: Offshore Oil Production                  1.0000E+0                      :
: Onshore Oil Production                   1.0000E+0                      :
: High - Gasoline Refinery                 1.0000E+0                      :
: Low - Gasoline Refinery                  1.0000E+0                      :
: Onshore Gas Production                   1.0000E+0                      :
: LNG Import Facility                      1.0000E+0                      :
: Coal Import Facility                     1.0000E+0                      :
: Underground Coal Mining                  1.0000E+0                      :
: Surface Coal Mining                      1.0000E+0                      :
:-------------------------------------------------------------------------:
:*(Facility size/reference facility size)**scaling exponent               :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet INTWE shows the scaling exponents that you can use to adjust default solid waste coefficients. You advanced to INTWE by selecting option 6 on Menu I022 and entering Framework II on Form I099.

Options

- View or change any of the scaling exponents.
- Press Alt-C to advance to Spreadsheet INTWC, which contains the default solid waste coefficients.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

You can change the scaling exponents to adjust the default coefficients to reflect local conditions.

8.4.104 INTWC — Nonelectric Solid Waste Production Coefficients

Name: INTWC
Title: Uncontrolled total solid waste coefficients for resource and conversion facilities
Source: EPA - 600/2-75-068; DOE/EV-0072
Units: Shown in spreadsheet

Category	Units	Solid Wastes
Offshore Oil Import	Short tons/10^12 Btu	0.0000E+0
Onshore Oil Import	Short tons/10^12 Btu	0.0000E+0
Offshore Oil Production	Short tons/10^12 Btu	0.0000E+0
Onshore Oil Production	Short tons/10^12 Btu	0.0000E+0
High - Gasoline Refinery	lb/day*	1.4000E+4
Low - Gasoline Refinery	lb/day*	8.0000E+3
Onshore Gas Production	Short tons/10^12 Btu	0.0000E+0
LNG Import Facility	Short tons/10^12 Btu	0.0000E+0
Coal Import Facility	Short tons/10^12 Btu	0.0000E+0
Underground Coal Mining	Short tons/10^12 Btu	0.0000E+0
Surface Coal Mining	Short tons/10^12 Btu	0.0000E+0

* Based on 200,000 barrels/day crude capacity.

Purpose

Spreadsheet INTWC shows the default coefficients used in estimating solid waste production from resource and conversion facilities. You advanced to INTWC after viewing or changing the scaling exponents on INTWE.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet INTSW, which displays the nonelectric solid waste production summary.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The default coefficients relate the quantity of solid wastes to a particular type of facility and are expressed as the weight of pollutant divided by the weight or volume of that activity. You can adjust these values in INTWE.

8.4.105 INTSW — Nonelectric Solid Waste Production Summary

Name: INTSW
Title: Total solid wastes for resource and conversion facilities
Source: INTWC, INTWE, INUCH, and INUGE
Units: Metric tons

Scenario Year	Oil Import and Production	Gas Refinery	Gas Production and Import	Coal Import and Mining	Total
2000	0.0000E+0	7.4176E+0	0.0000E+0	0.0000E+0	7.4176E+0
2001	0.0000E+0	7.4176E+0	0.0000E+0	0.0000E+0	7.4176E+0
2002	0.0000E+0	7.4176E+0	0.0000E+0	0.0000E+0	7.4176E+0

Purpose

Spreadsheet INTSW displays the total solid wastes (t) produced at each type of facility. You advanced to INTSW after viewing the solid waste coefficients on Spreadsheet INTWC.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

The values shown here are calculated by the following formulas:

$$\text{gas refinery solid wastes} = (G/U) \times C \times (U/P)^E \times N$$

$$\text{other facility solid wastes} = G \times C \times (U/P)^E \times N$$

where:

G = facility production level (TBOE) from Spreadsheet INUGE,

U = facility size (TBOE) from Spreadsheet INUCH,

C = coefficients (tons/10^{12} Btu or lb/d) from Spreadsheet INTWC,

P = default facility size (see Table 8.3),

E = scaling exponent from Spreadsheet INTWE, and

N = constant.

8.4.106 IAATO — Energy System Air Emission Summary

```
:-------------------------------------------------------------------------
:    Name:  IAATO
:   Title:  Total air emissions for the electric and nonelectric sectors
:  Source:  ITATO, IPATO, and INATO
:   Units:  Metric tons
:
:-------------------------------------------------------------------------
:  Scenario
:  Year        SO2          NOX          TSP          CO          CO2          HC
:-------------------------------------------------------------------------
:  2000    3.0121E+5    4.8197E+4    1.1927E+5    1.7383E+3    8.5382E+2    1.8284E+2
:  2001    3.0121E+5    4.8197E+4    1.1927E+5    1.7383E+3    8.5382E+2    1.8284E+2
:  2002    2.9188E+5    4.6191E+4    1.1903E+5    1.5648E+3    8.1455E+2    1.7852E+2
:-------------------------------------------------------------------------
```

Purpose

Spreadsheet IAATO displays the total energy system air emissions. You advanced to IAATO by selecting option 1 on Menu I030 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet totals the values calculated for the electric and nonelectric sectors on Spreadsheets IEATO and INATO.

8.4.107 IAWTO — Energy System Water Emissions and Requirements

```
:-------------------------------------------------------------------------:
:    Name:  IAWTO                                                         :
:   Title:  Total water requirements for the Electric and                 :
:           Nonelectric sectors                                           :
:  Source:  IMWTO, IMWTR, IPWTO, and IPWTR                                :
:   Units:  Metric tons                                                   :
:                                                                         :
:-------------------------------------------------------------------------:
:                                                                         :
: Scenario                                                                :
:   Year        BOD            COD      ---->   Similarly for chloride,  :
:-------------------------------------------    phosphorus, TSS, TDS,     :
: 2000      4.1023E+3      4.4192E+3           organics, and total water  :
: 2001      4.1023E+3      4.4192E+3           requirements               :
: 2002      3.9952E+3      4.3121E+3                                      :
:-------------------------------------------------------------------------:
```

Purpose

Spreadsheet IAWTO displays the total energy system water emissions (t) and requirements (m^3). You advanced to IAWTO by selecting option 2 on Menu I030 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet totals the values calculated for the electric and nonelectric sectors on Spreadsheets IMWTO, IMWTR, IPWTO, and IPWTR.

8.4.108 IALTO — Energy System Land Use Summary

Name:	IALTO		
Title:	Total land used in the electric and nonelectric sectors		
Source:	IMLDW, IPLTR, IPLDW, and INLPR		
Units:	m^2 of land disturbed per year		
Scenario Year	Waste from Coal Mining and Cleaning	Land Used at Electric Sector Power Plants	---> Similarly for waste disposal at power plants and non-electric facilities and total land used
2000	1.4787E+4	2.6960E+6	
2001	1.4787E+4	2.6960E+6	
2002	1.4787E+4	5.3869E+6	

Purpose

Spreadsheet IALTO displays the total energy system land impacts. You advanced to IALTO by selecting option 3 on Menu I030 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet totals the values calculated for the electric and the nonelectric sectors on Spreadsheets IMLDW, IPLTR, IPLDW, and INLPR. The land impacts for mining in the electric sector are not included in the nonelectric sector.

8.4.109 IAHHS — Energy System Health and Safety Impacts Summary

Name:	IAHHS
Title:	Aggregate occupational health and safety for electric and nonelectric sectors
Source:	IMHCS, ITHHS, IPHHS, and INHHS
Units:	Shown in spreadsheet

Scenario Year	Injuries	Fatalities	Person-Days Lost
2000	5.3223E+3	5.8477E+1	3.7571E+5
2001	5.3223E+3	5.8477E+1	3.7571E+5
2002	5.3607E+3	5.8669E+1	3.7636E+5

Purpose

Spreadsheet IAHHS displays the total energy system human health and safety impacts. You advanced to IAHHS by selecting option 4 on Menu I030 and entering Framework II on Form I099.

Options

- View the displayed values.
- Press Alt-C to advance to Form I006.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet totals the values calculated for the electric and nonelectric sectors on Spreadsheets IMHCS, ITHHS, IPHHS, and INHHS.

8.4.110 IARCR — Energy System Construction Labor Summary

Name: IARCR
Title: Construction labor requirements for the electric and nonelectric systems
Source: INRCR and IPRCR
Units: Persons

Category	Scenario Year 2000	2001	
Chemical Engineer	1.8630E+1	2.7945E+1	For all study years and labor categories
Civil Engineer	1.1475E+2	1.3192E+2	
Electrical Engineer	8.0391E+1	9.7861E+1	

Purpose

Spreadsheet IARCR displays the total construction labor requirements for the energy system. You advanced to IARCR by selecting option 5 on Menu I030, identifying MACRO parameters on Form I031, and entering Framework II on Form I099. If you are not using a MACRO case, you advanced from Menu I030 and Form I099.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IAROR, which displays operating labor requirements.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet totals the values calculated for the electric and nonelectric sectors in Spreadsheets IPRCR and INRCR.

8.4.111 IAROR — Energy System Operating Labor Summary

Name: IAROR
Title: Operating labor requirements for the electric and nonelectric systems
Source: IPROR and INROR
Units: Persons

Category	Scenario Year 2000	2001	2002	For all study years and labor categories
Chemical Engineer	4.2393E+2	4.2393E+2	4.2393E+2	
Civil Engineer	9.2002E+0	9.2002E+0	9.8620E+0	
Electrical Engineer	2.3102E+1	2.3102E+1	2.5087E+1	

Purpose

Spreadsheet IAROR displays the total operating labor requirements for the energy system. You advanced to IAROR after viewing construction labor requirements on Spreadsheet IARCR.

Options

- View the displayed values.
- Press Alt-C to advance to Spreadsheet IARMR, which displays construction material requirements.
- Press Ctrl-D Q to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet totals the values calculated for the electric and nonelectric sectors on Spreadsheets IPROR and INROR.

8.4.112 IARMR — Energy System Construction Material Summary

Name: IARMR
Title: Raw materials required for all facilities in the electric and nonelectric systems
Source: IPRMR and INRMR
Units: Metric tons

Category	Scenario Year 2000	2001	2002 -> For each year in the study
Concrete	1.5797E+5	3.9364E+5	3.8177E+5
Stainless Steel	6.5202E+2	1.3998E+3	1.2886E+3
Total Steel	3.3279E+4	2.1159E+5	2.3268E+5
Copper, Brass, Bronze	7.4919E+2	2.1697E+3	2.1832E+3
Aluminum and Castings	2.3646E+2	6.8949E+2	6.8583E+2
Manganese	1.8778E+2	1.3985E+3	1.5593E+3
Chromium	1.6339E+2	7.7860E+2	8.3604E+2
Nickel	2.5774E+1	5.1933E+1	4.6975E+1
Cast Iron	5.5294E+2	2.2731E+3	2.3454E+3

Purpose

Spreadsheet IARMR displays the total construction material requirements for the energy system. You advanced to IARMR after viewing the operating labor requirements on Spreadsheet IAROR.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IARCO, which summarizes the costs of the energy system.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not able to graph the results.

Background

This spreadsheet totals the values calculated for the electric and nonelectric sectors in Spreadsheets IPRMR and INRMR.

8.4.113 IARCO — Energy System Cost Summary

Name: IARCO
Title: Aggregate costs of the electric and nonelectric systems
Source: INRDR and IBUCC
Units: $U.S.

Category	Scenario Year - - - - - > 2000	2001	2002	For all
Electric Capital Cost	1.0000E+8	1.0000E+8	1.0000E+8	study
Nonelectric Capital Cost	1.1000E+8	1.1000E+8	1.1000E+8	years
Total Capital cost	2.1000E+8	2.1000E+8	2.1000E+8	
Electric Operating Cost	5.1000E+8	5.1000E+8	5.1000E+8	
Nonelectric Operating Cost	3.7000E+8	3.7000E+8	3.7000E+8	
Total Operating Cost	8.8000E+8	8.8000E+8	8.8000E+8	
Domestic fuel bill	3.2510E+8	3.2510E+8	3.2510E+8	
Foreign fuel bill	2.5010E+8	2.5010E+8	2.5010E+8	
Total fuel bill	5.7520E+8	5.7520E+8	5.7520E+8	
Total system cost	1.6652E+9	1.6652E+9	1.6652E+9	

Purpose

Spreadsheet IARCO displays the expenditure profiles for the energy system. You advanced to IARCO after viewing the material requirements on Spreadsheet IARMR.

Options

- View the displayed values.
- Press **Alt-C** to advance to Spreadsheet IARCD, which displays the cost distributions for the energy system.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet totals the values calculated for the electric and nonelectric sectors on Spreadsheets IBUCC and INRDR.

8.4.114 IARCD — Energy System Cost Distributions

Name: IARCD
Title: Total system cost distribution for the electric and non-electric sectors
Source: INRDR and IBUCC
Units: $U.S.

Category	-- Study Year ---------> 1991	1992	For all years
Electric Capital Cost	15.70%	12.14%	
Nonelectric Capital Cost	2.42%	.90%	
Total Capital Cost	18.12%	13.04%	
Electric Operating Cost	5.04%	5.63%	
Nonelectric Operating Cost	9.73%	11.40%	
Total Operating Cost	14.77%	17.03%	
Domestic fuel bill	14.52%	20.00%	
Foreign fuel bill	52.58%	49.93%	
Total fuel bill	67.10%	69.93%	
Total system cost	100.00%	100.00%	
Foreign fuel bill/GDP	6.47%	5.65%	
Total Energy System Cost/GDP	12.31%	11.32%	

Purpose

Spreadsheet IARCD displays the distributions of total energy system cost for capital, operating, and fuel expenditures. You advanced to IARCD after viewing the cost summary on Spreadsheet IARCO.

Options

- View the displayed values.
- Press **Alt-C** to advance to Form I006.
- Press **Ctrl-D Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet displays the data from Spreadsheets INRDR and IBUCC as percent of total expenditures.

8.4.115 IATTO — Energy System Solid Waste Production Summary

Name: IATTO
Title: Total solid waste for the entire system
Source: IPTSL and INTSW
Units: Metric tons

Scenario Year	Total Waste from the Electric Sector Power Plants	Total Waste from the Nonelectric Sector Facilities	Total Waste from the Entire System
2000	1.3205E+5	7.4176E+0	1.3206E+5
2001	1.3205E+5	7.4176E+0	1.3206E+5
2002	1.3169E+5	7.4176E+0	1.3170E+5

Purpose

Spreadsheet IATTO displays the total energy system solid waste production. You advanced to IATTO by selecting option 6 on Menu I030.

Options

- View the displayed values.
- Press **Alt**-**C** to advance to Form I006.
- Press **Ctrl**-**D** **Q** to escape; Framework II will be interrupted and you will not be able to graph the results.

Background

This spreadsheet totals the values calculated for the electric and nonelectric sectors on Spreadsheets IPTSC and INTSW.

8.5 Appendix: IMPACTS Module Calculations and Mathematical Relationships

This appendix illustrates the calculations that IMPACTS performs by describing the fuel system for a coal-fired plant. Note that the descriptions of spreadsheets (Sec. 8.4) also contain information about IMPACTS functions.

8.5.1 Assumptions

For a complete description of the IMPACTS Module, review each of the individual spreadsheets that comprise the module (Sec. 8.4). To facilitate an understanding of the basic calculations in the IMPACTS Module, Fig. 8.3 displays an illustrative fuel supply system for a coal-fired power plant. This fuel supply system results from the systemwide perspective described in Sec. 8.1 and provides the framework for describing an analysis of fuel flows, environmental burdens, and resource requirements.

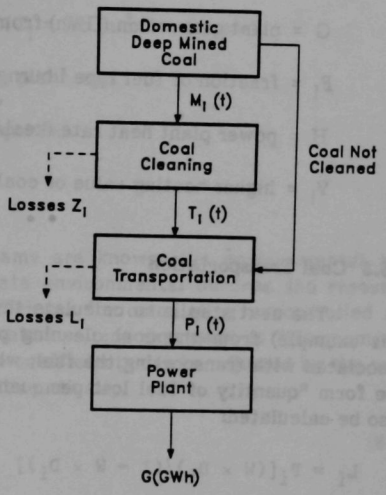


FIGURE 8.3 Illustrative Fuel Supply System for a Coal-Fired Power Plant

To simplify this example, the following assumptions have been made: (1) domestic surface-mined coal (C1) is the only fuel burned at the power plant (two fuel types per plant are allowed in the IMPACTS Module), (2) coal is transported from the mine to the power plant by rail, and (3) one-half of the coal burned at the power plant is mechanically cleaned (before transportation). The required specifications include the fuel characteristics (higher heating value, sulfur content, and ash content), technology designation (from Table 8.2), and average transport distance. These specifications are entered into preformatted spreadsheets. Information about plant size (MW), heat rate (kcal/kWh), and annual level of generation (GWh) can be passed directly to the IMPACTS Module from the ELECTRIC Module.

The following sections detail the sequence of calculations that are performed in the IMPACTS Module to determine the fuel flows along the links in the fuel supply system and calculate the resulting impacts. The strategy followed is to start at the power plant and work backward through each step in the system (as defined in Fig. 8.3).

8.5.2 Power Plant Fuel Requirements

The quantity of fuel required at the power plant in any year is based on the characteristics of the power plant and fuel:

$$P_i = (G \times F_i \times H \times 10^3)/V_i \qquad (8.3)$$

where:

P_i = quantity of coal type i (t) burned at power plant,

G = plant generation (GWh) from the ELECTRIC Module,

F_i = fraction of fuel type i burned (F_i = 1.0 in this example),

H = power plant heat rate (kcal/kWh) from the ELECTRIC Module, and

V_i = higher heating value of coal type i (kcal/kg).

8.5.3 Coal Transportation

The next step is to calculate the quantity of coal that is transported (by rail in this example) from the coal cleaning plant and mine to the power plant. The losses associated with transporting the fuel, which are based on default coefficients that are of the form "quantity of fuel lost per quantity of fuel transported per unit distance," must also be calculated:

$$L_i = P_i[(W \times D_i)/(1 - W \times D_i)] \quad (8.4)$$

$$T_i = P_i + L_i = P_i[1/(1 - W \times D_i)] \quad (8.5)$$

where:

L_i = quantity of coal type i (t) lost in transport,

T_i = quantity of coal type i (t) transported,

W = rail transportation loss factor for coal (t/t·km),

D_i = average transport distance (km), and

P_i = quantity of coal type i (t) burned at power plant.

8.5.4 Coal Requirements at the Mine

To calculate the coal required from the mine, it is necessary to account for the fact that 50% of the coal burned at the power plant is mechanically cleaned (by assumption) and that a fraction of the coal is lost. The IMPACTS Module assumes that 25% of the coal that is cleaned is lost in waste streams.

$$M_i = [(C_i/0.75) + (1 - C_i)] \times T_i \quad (8.6)$$

$$Z_i = 0.25 \times M_i\{1 - (1 - C_i)/[(C_i/0.75) + (1 - C_i)]\} \quad (8.7)$$

where:

M_i = quantity of coal type i (t) required from the mine,

C_i = fraction of coal type i that is cleaned (C_i = 0.5 in this example),

Z_i = quantity of coal (t) lost at the cleaning plant, and

T_i = quantity of coal type i (t) that is transported.

8.5.5 Burdens and Resources

Once these fuel flows and waste streams are known, the environmental and resource coefficients can be applied to calculate environmental burdens and resource requirements. For example, the default coefficients for calculating uncontrolled air emissions from the power plant (such as SO_2 emissions) are expressed as "kilograms of emissions per metric ton of coal burned." These coefficients can be adjusted by the user to reflect time-dependent levels of control. Mathematically,

$$S_j = A_{ij} \times P_{ij} \times E \times N \qquad (8.8)$$

where:

S_j = SO_2 emissions (t) from plant type j,

A_{ij} = uncontrolled SO_2 emission factor for burning fuel type i (kg/t) in plant type j (which may be a function of the fuel's sulfur or ash content),

P_{ij} = quantity of coal type i (t) burned in plant type j,

E = value of the exponential scaling function for SO_2 emissions, and

N = conversion factor.

Similar procedures are used to calculate the other environmental burdens and resource requirements. The labor, material, and capital resources required for constructing new facilities are calculated directly based on (1) the construction schedule, (2) the applicable distributions of labor, materials, and costs over that construction schedule, (3) the date of plant start-up, and (4) the plant size.

The exponential scaling function (E in Eq. 8.8) is used to adjust a coefficient from an initial (or base) value to a limiting (or end) value, as illustrated in Fig. 8.4. The function approaches the limiting value in an asymptotic fashion over a time period defined by the user. To use this function, you must specify the following:

- initial value (IV),
- year in which the change from the initial value begins (CY),

- limiting value that will be reached (LV), and
- number of years required to achieve 50% of the difference between the initial value and the limiting value (HT).

The value of the scaling function in year t is determined as follows:

for $t \leq CY$, scaling factor = IV and

for $t > CY$, scaling factor = $LV + [(IV - LV) \times \exp(-0.693(t-CY)/HT)]$.

As an example, the default value for uncontrolled NO_x emitted from coal-fired power plants is 10.50 kg NO_x/t of coal burned. Based on available information, you may be able to specify that (1) the current (1986) rate of NO_x emissions is 60% of the uncontrolled rate (IV = 0.6), (2) boiler modifications, which will begin in 1998, will reduce the rate to 40% of the uncontrolled rate (LV = 0.4 and CY = 1998), and (3) it will take 20 yr to achieve one-half of this reduction (HT = 20). The NO_x emission rate from 1986 to 1998 would be 6.3 kg NO_x/t (0.6 × 10.50), while the emission rate in 2010 would be 5.6 kg NO_x/t (0.532 × 10.50). In 2018, the emission rate would be one-half of the uncontrolled rate (5.25 kg NO_x/t).

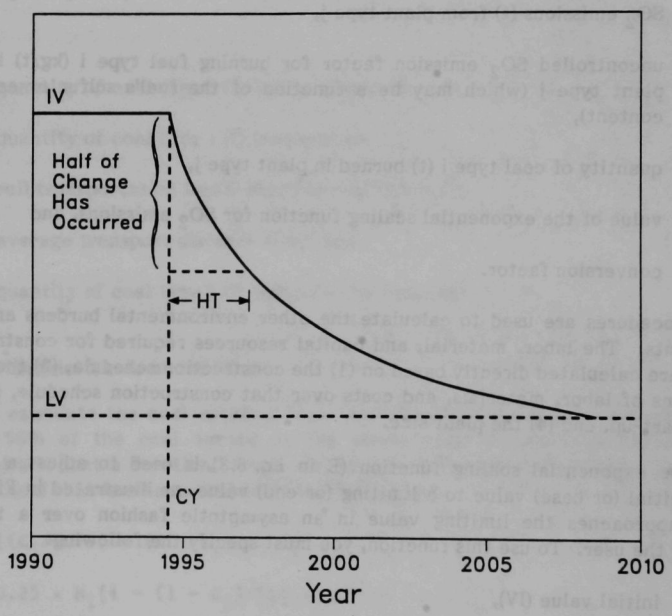
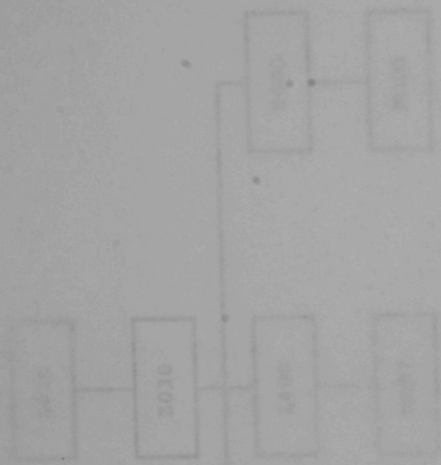
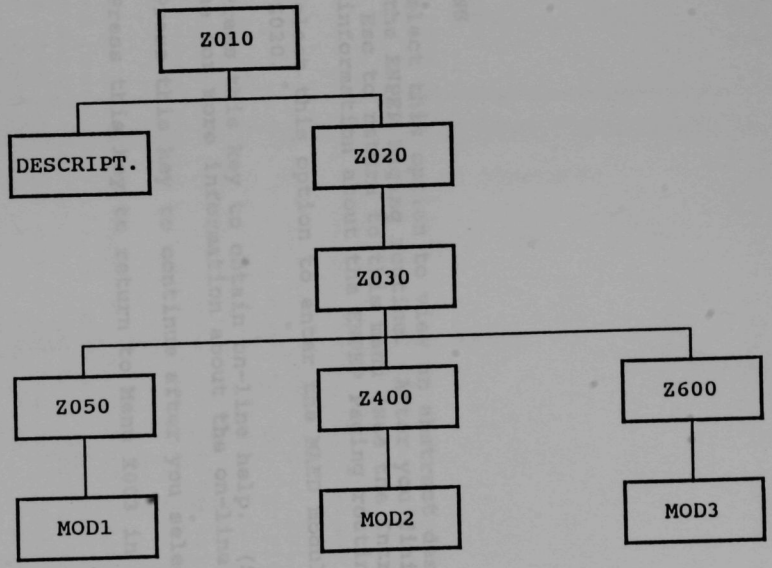


FIGURE 8.4 Exponential Function for Representing Time-Dependent Parameter Changes



MAED Module



STRUCTURE OF THE MAED MODULE

FORM NUMBER - Z010
PURPOSE

Menu Z010 is an introduction to the MAED Module. You advanced to this menu by selecting option 6 on Menu X003 in the EXECUTIVE Module.

OPTIONS

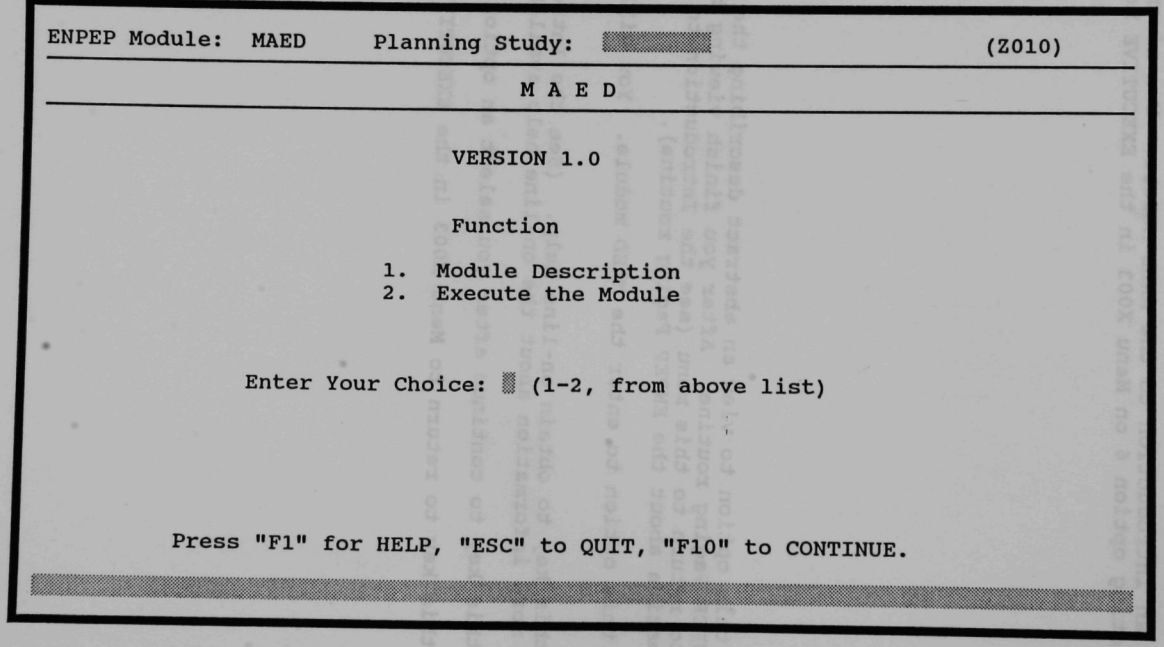
1 Select this option to view an abstract describing the MAED Module with the ENPEP Paging routine. After you finish viewing the abstract, press Esc to return to this menu (see the Introduction to this volume for more information about the ENPEP Paging routine).

2 Select this option to enter the MAED module. You will advance to Menu Z020.

F1 Press this key to obtain on-line help. (See the Introduction to this volume for more information about the on-line help available in ENPEP.)

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu X003 in the EXECUTIVE Module.


ENPEP Module: MAED Planning Study: (Z010)
M A E D
VERSION 1.0
Function
1. Module Description
2. Execute the Module
Enter Your Choice: (1-2, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z020 Selecting a Case

PURPOSE

This form displays the different cases that you can execute in the MAED module. This form also displays the status of each case (COMPLETE or INCOMPLETE) and the date on which each case was last revised. Use Form Z020 to select a case study , backup (archive) a case, restore a case, create a case, or delete a case. You advance to this form by selecting option 2 on Menu Z010.

Options

To create a case, enter the number of a case that does not exist and press F10. You will be prompted to identify the disk drive where the new case is to be stored. A new case is created by copying an existing case. This is done so that you can use most of the existing information and make only the changes needed for the new case.

To backup a case, enter the number of an existing case and press F7. After you verify the function by pressing F10, the program will prompt you to identify the disk drive where the data for that case are stored and the disk drive on which you want to back up the data. The program will write the Data Dictionary variables to a file. This file and all files associated with the case will be backed up onto separate disks for archiving purposes.

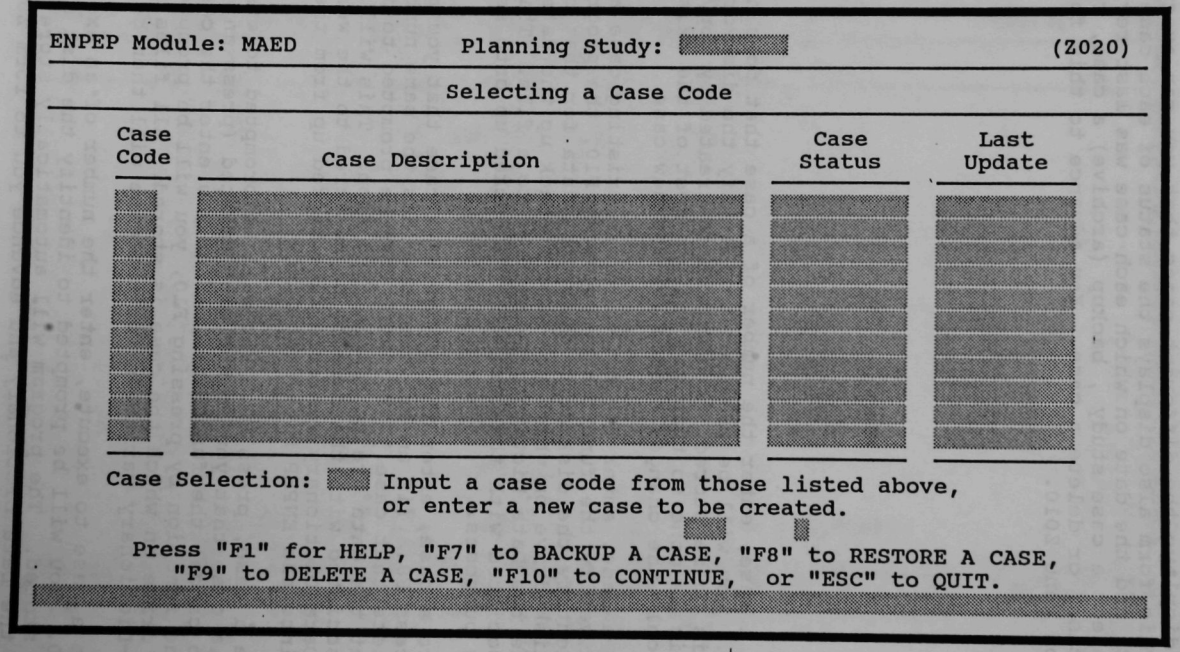
To restore a case, enter the number of a case that you previously backed up and press F8. (if an existing case has the same number, you must first delete that case.) You will then be prompted to identify the disk drive that the data are to be restored from. This will cause all data files associated with the case to be restored to the working directory, and the Data Dictionary variable file backed up from the disks will be written into the ENPEP Data Dictionary.

To delete a case, press F9. You will be prompted to ensure that you do not lose a case that you do not want deleted (press any key to continue or Esc to cancel the function). After you enter the case number and verify the function by pressing F10, you will be prompted to identify the disk drive on which the case is stored. All files for this case and all Data-Dictionary variables for the case will then be deleted.

To choose a case to execute, enter the number of an existing case and press F10. You will be prompted to identify the disk drive on which the data are stored. The program will automatically store the case and disk drive in the Data Dictionary and advance you to form Z030

F1 to obtain on-line help.

E[illegible] to the previous Menu Z010.


ENPEP Module: MAED
Planning Study:
(Z020)
Selecting a Case Code
Case Code
Case Description
Case Status
Last Update
Case Selection:
Input a case code from those listed above,
or enter a new case to be created.
Press "F1" for HELP, "F7" to BACKUP A CASE, "F8" to RESTORE A CASE,
"F9" to DELETE A CASE, "F10" to CONTINUE, or "ESC" to QUIT.

FORM NUMBER - Z030
PURPOSE

Menu Z030 allows you to select a MAED submodule to execute. You must complete SUBMOD 1, SUBMOD 2, and SUBMOD 3 sequentially. You advance to this menu by selecting a case on Menu Z020.

OPTIONS

1 Select this option to enter SUBMOD 1. You will advance to Menu Z050.

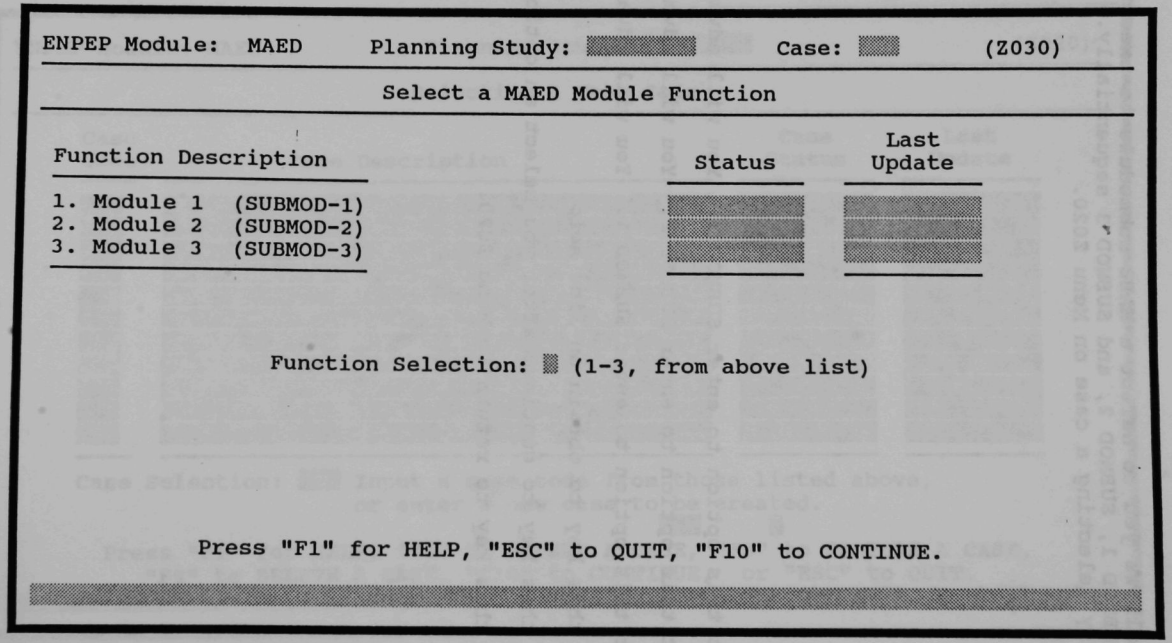
2 Select this option to enter SUBMOD 2. You will advance to Menu Z400.

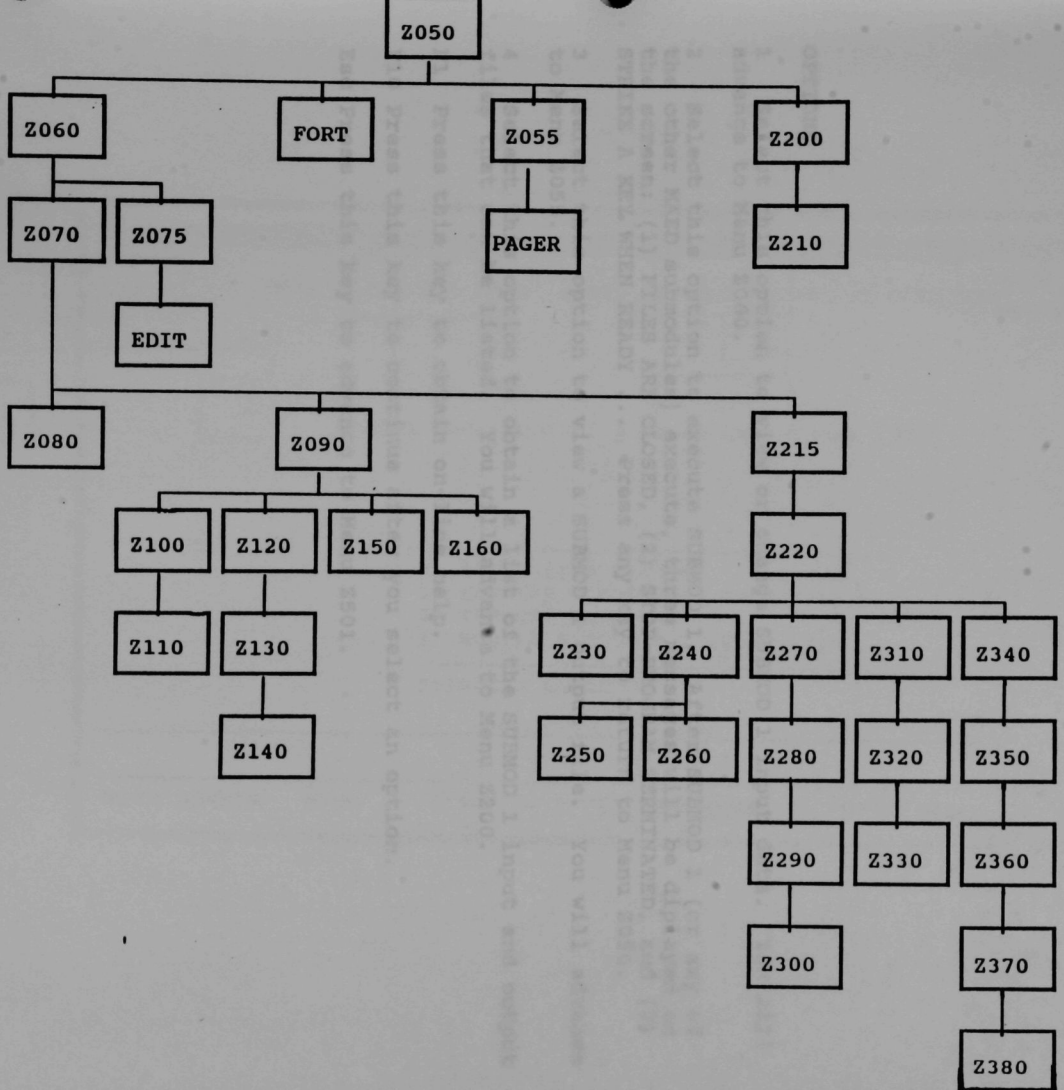
3 Select this option to enter SUBMOD 3. You will advance to Menu Z600.

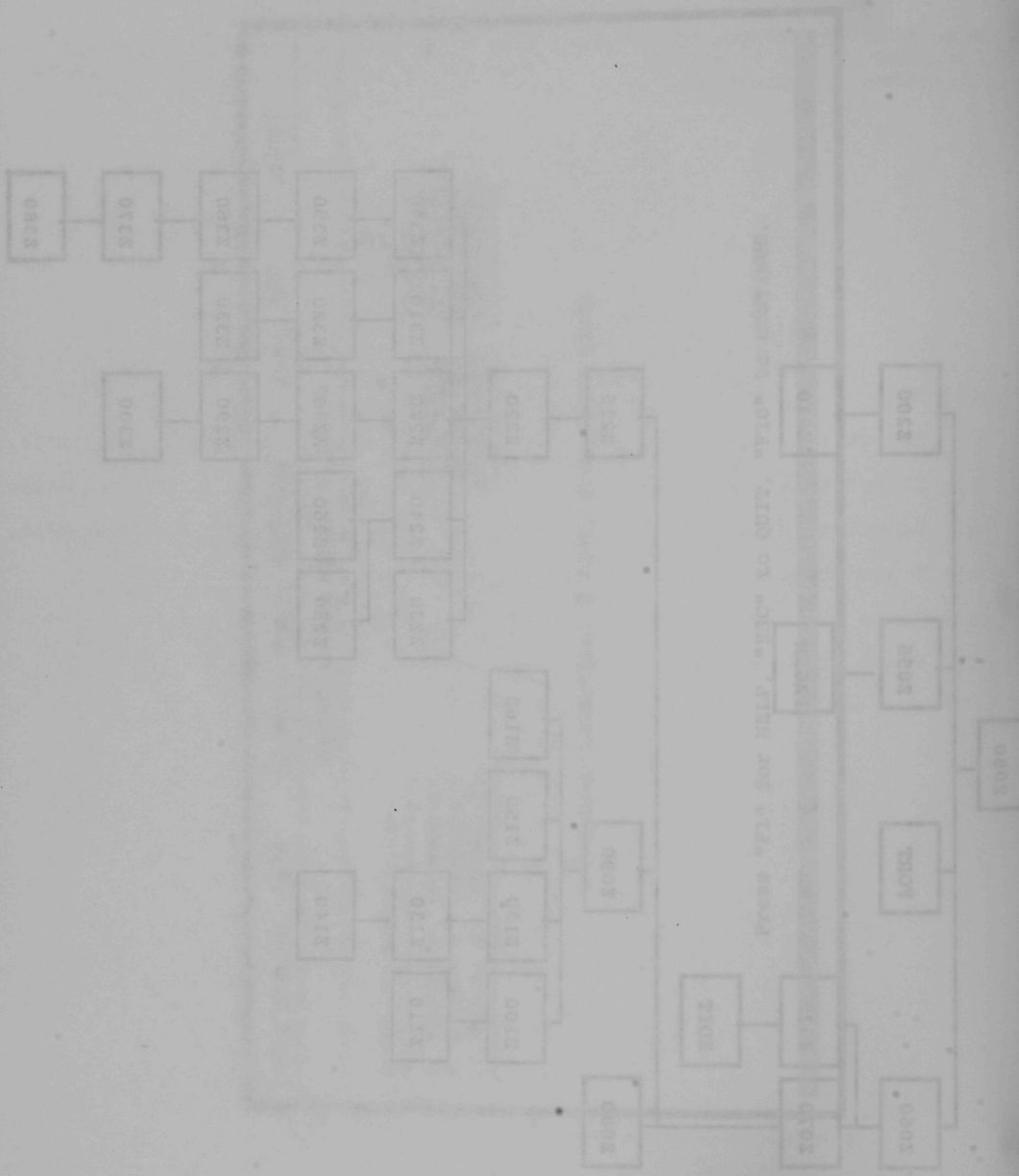
F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z020.


ENPEP Module: MAED
Planning Study:
Case:
(Z030)
Select a MAED Module Function
Function Description
Status
Last Update
1. Module 1 (SUBMOD-1)
2. Module 2 (SUBMOD-2)
3. Module 3 (SUBMOD-3)
Function Selection: (1-3, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.


Z050
Z060
FORT
Z055
Z200
Z070
Z075
PAGER
Z210
EDIT
Z080
Z090
Z215
Z100
Z120
Z150
Z160
Z220
Z110
Z130
Z230
Z240
Z270
Z310
Z340
Z140
Z250
Z260
Z280
Z320
Z350
Z290
Z330
Z360
Z300
Z370
Z380



FORM NUMBER - Z050
PURPOSE

Menu Z050 allows you to view or change the SUBMOD 1 input and output and to execute the SUBMOD 1 program. You advance to this menu by selecting option 1 on Menu Z030.

OPTIONS

1 Select this option to view or change SUBMOD 1 input data. You will advance to Menu Z060.

2 Select this option to execute SUBMOD 1. After SUBMOD 1 (or any of the other MAED submodules) execute, three messages will be diplayed on the screen: (1) FILES ARE CLOSED, (2) STOP-PROGRAM TERMINATED, and (3) STRIKE A KEY WHEN READY ... Press any key to return to Menu Z050.

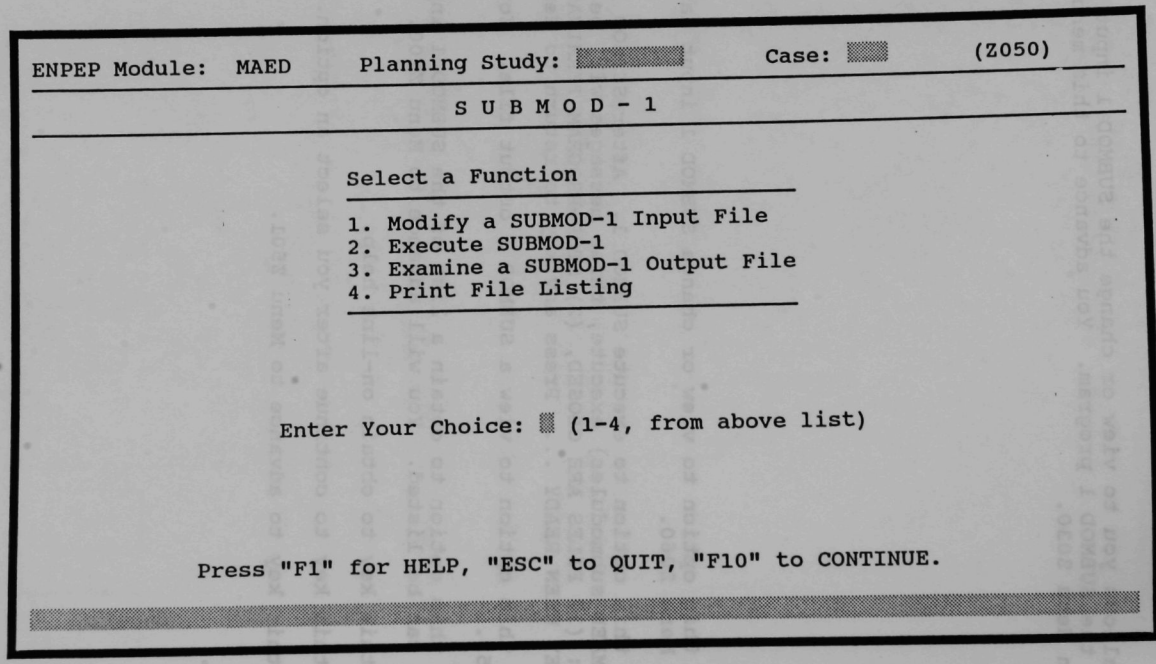
3 Select this option to view a SUBMOD 1 output file. You will advance to Menu Z055.

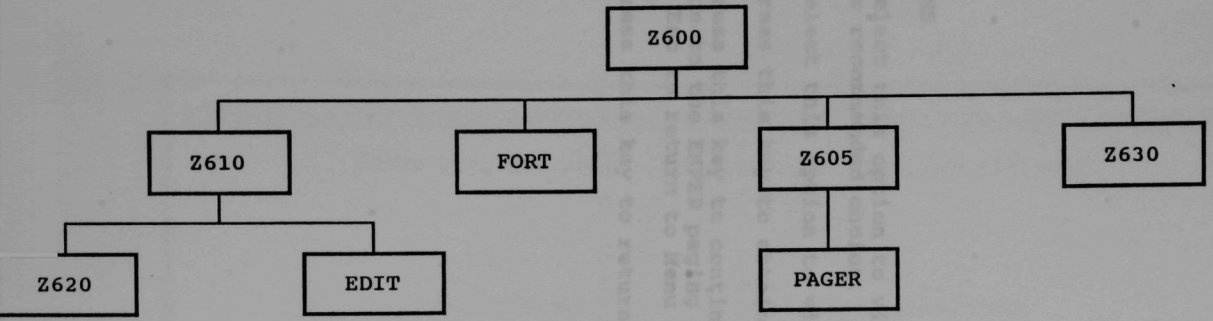
4 Select this option to obtain a list of the SUBMOD 1 input and output files that can be listed. You will advance to Menu Z200.

F1 Press this key to obtain on-line help.

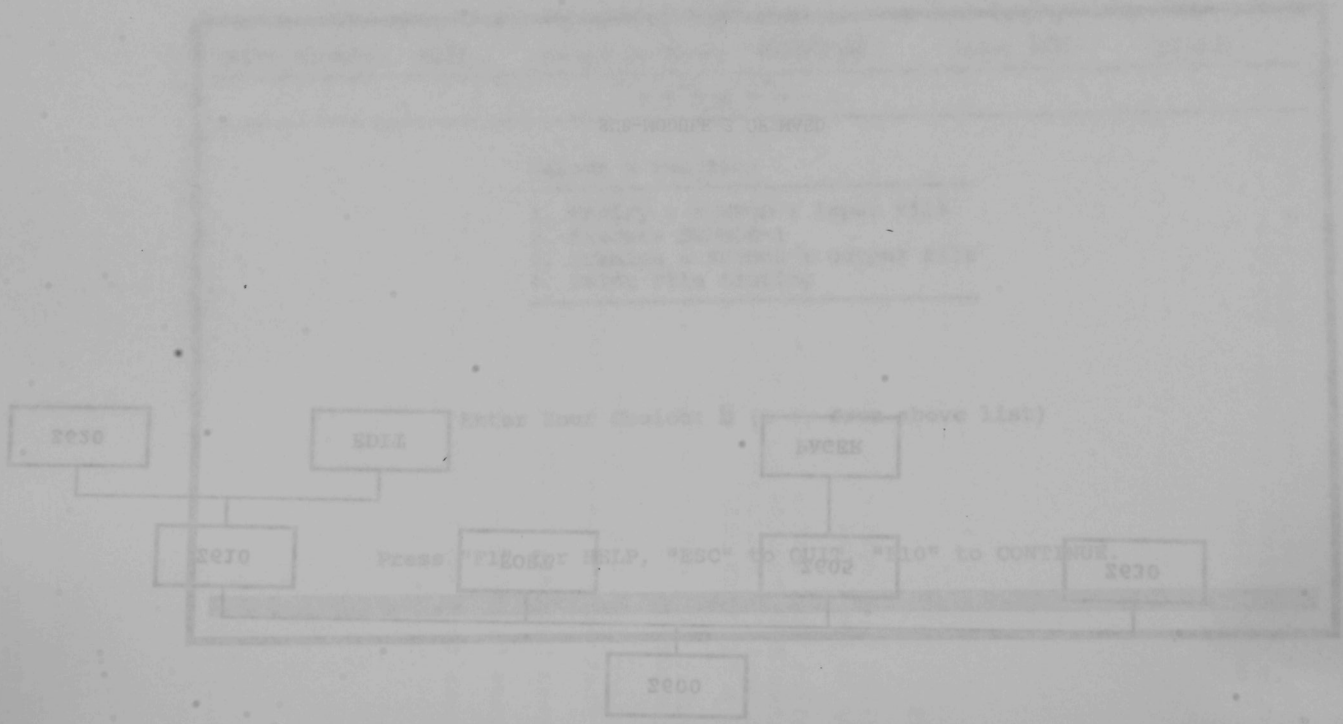
F10 Press this key to continue after you select an option.

Esc Press this key to advance to Menu Z501.


ENPEP Module: MAED Planning Study: Case: (Z050)
S U B M O D - 1
Select a Function
1. Modify a SUBMOD-1 Input File
2. Execute SUBMOD-1
3. Examine a SUBMOD-1 Output File
4. Print File Listing
Enter Your Choice: (1-4, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.



SUB-MODULE 3 OF MAED



FORM NUMBER - Z055
PURPOSE

Menu Z055 allows you to view the SUBMOD 1 output. You advance to this menu by selecting option 3 on Menu Z050.

OPTIONS

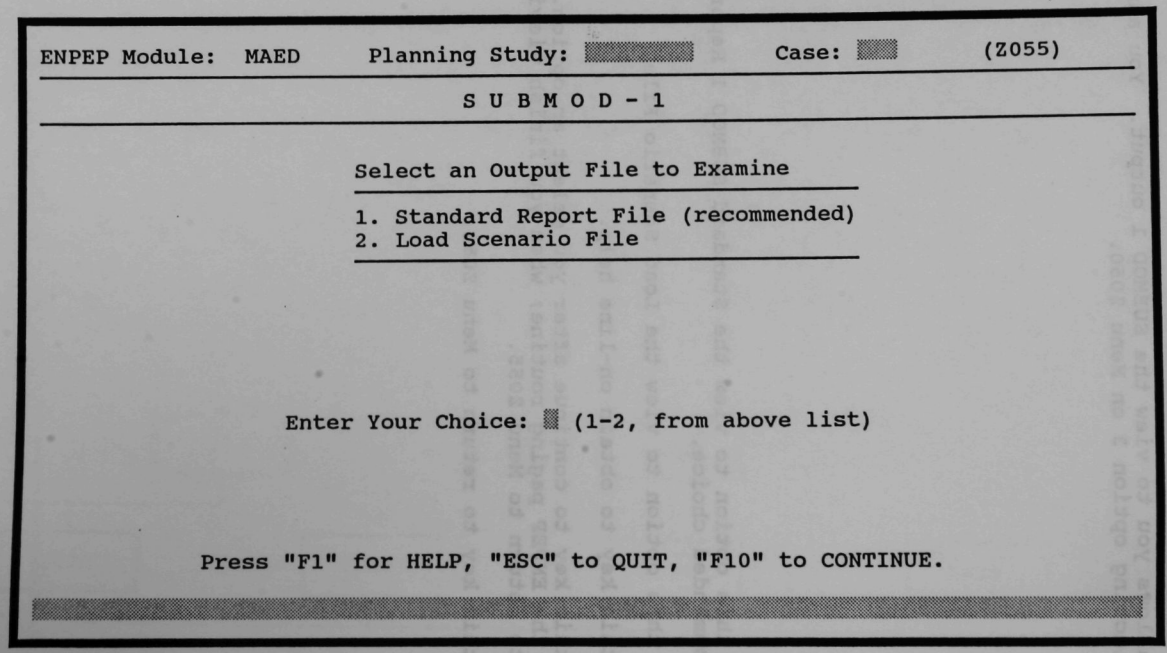
1 Select this option to view the Standard SUBMOD 1 Report File. This is the recommended choice.

2 Select this option to view the Load Scenario File.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option. You will advance to the ENPEP paging routine; when you finish viewing the output, press Esc to return to Menu Z055.

Esc Press this key to return to Menu Z050.


ENPEP Module: MAED Planning Study: Case: (Z055)
S U B M O D - 1
Select an Output File to Examine
1. Standard Report File (recommended)
2. Load Scenario File
Enter Your Choice: (1-2, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z060
PURPOSE

The purpose of Menu Z060 is to select a method for viewing or changing SUBMOD 1 input data. You advance to this menu by selecting option 1 on Menu Z050.

OPTIONS

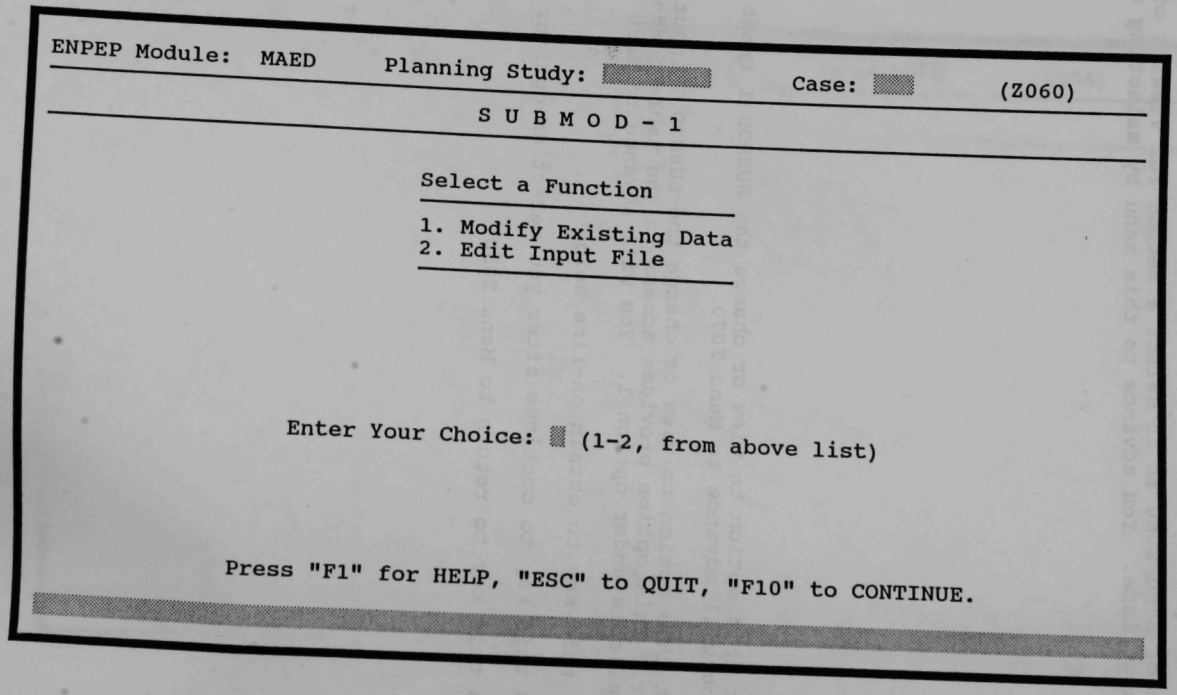
1 Select this option to view or change the SUBMOD 1 input data by using forms. You will advance to Menu Z070.

2 Select this option to view or change the SUBMOD 1 input data using the editor. This option provides access to the table header file which is not available under option 1. You will advance to Menu Z075.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z050.


ENPEP Module: MAED
Planning Study:
Case:
(Z060)
S U B M O D - 1
Select a Function
1. Modify Existing Data
2. Edit Input File
Enter Your Choice: (1-2, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z070
PURPOSE

Menu Z070 allows you to choose the SUBMOD 1 input data you wish to view or change. You advance to this form by selecting option 1 from Menu Z060.

OPTIONS

1 Select this option to view or change the scenario definition (SD) data of SUBMOD 1. You will advance to Menu Z080.

2 Select this option to view or change the constant parameters (CP) data of SUBMOD 1. You will advance to Menu Z090.

3 Select this option to view or change the time dependent parameters (TP) of SUBMOD 1. You will advance to Menu Z215.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z060.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z070)

S U B M O D - 1

Select an Input File to Modify

1. Scenario Definition (SD)
2. Constant Parameters (CP)
3. Time Dependent Parameters (TP)

Enter your Choice: [redacted] (1-3, from above list)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z075
PURPOSE

Menu Z075 allows you to choose the SUBMOD 1 input data you wish to edit as a card image file. You advance to this form by selecting option 2 from Menu Z060.

OPTIONS

1 Select this option to view or change the scenario definition (SD) data of SUBMOD 1 as an actual card image file. You will advance to the editor and return to Menu Z075 when you finish viewing or changing the file.

2 Select this option to view or change the constant parameters (CP) data of SUBMOD 1 as an actual card image file. You will advance to the editor and return to Menu Z075 when you finish viewing or changing the file.

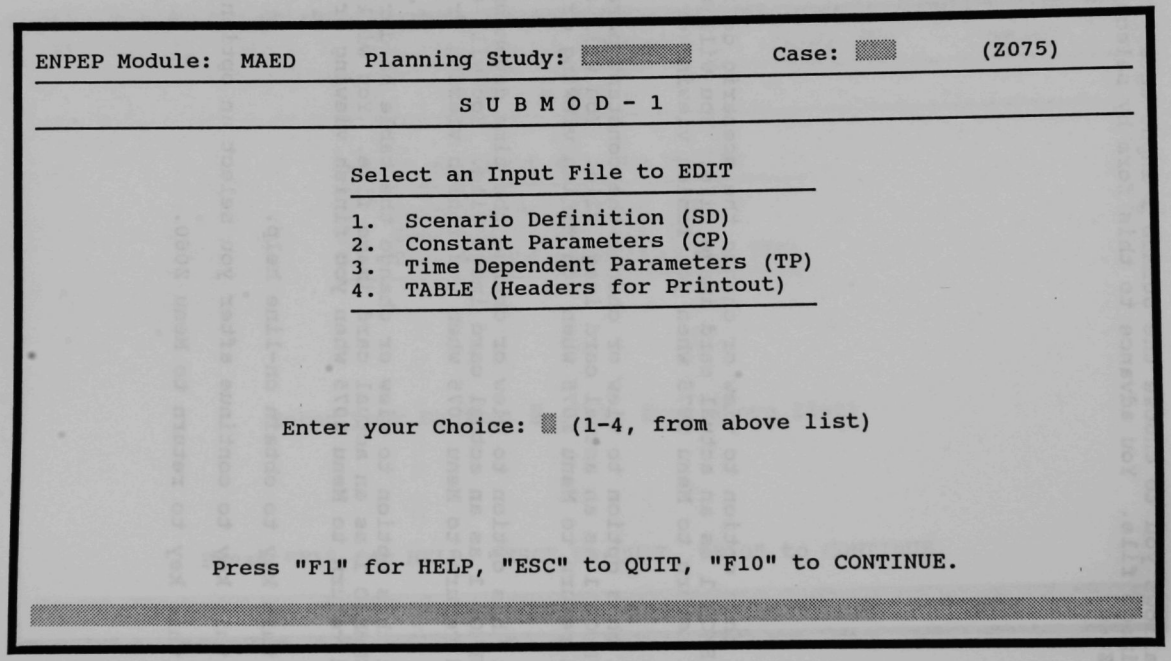
3 Select this option to view or change the time dependent parameters (TP) of SUBMOD 1 as an actual card image file. You will advance to the editor and return to Menu Z075 when you finish viewing or changing the file.

4 Select this option to view or change the table header information files of SUBMOD 1 as an actual card image file. You will advance to the editor and return to Menu Z075 when you finish viewing or changing the file.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z060.


ENPEP Module: MAED Planning Study: Case: (Z075)
S U B M O D - 1
Select an Input File to EDIT
1. Scenario Definition (SD)
2. Constant Parameters (CP)
3. Time Dependent Parameters (TP)
4. TABLE (Headers for Printout)
Enter your Choice: (1-4, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z080
PURPOSE

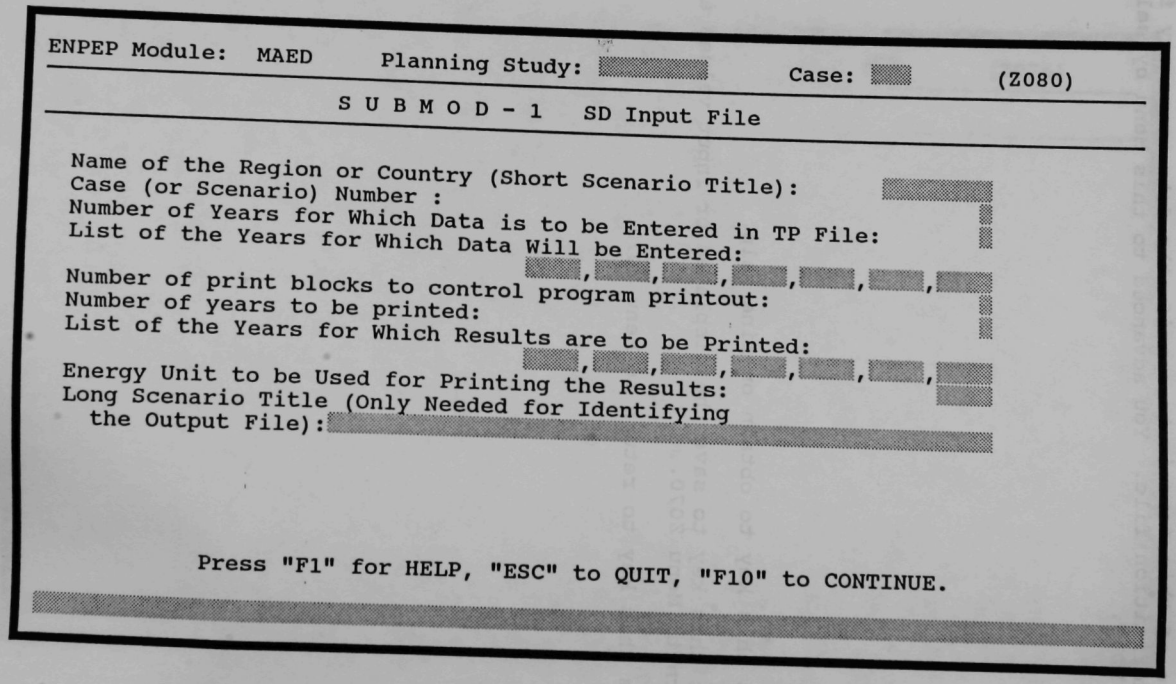
The purpose of this form is to specify the data necessary for the scenario definition file. You advanced to this Menu by selecting option 1 on Menu Z070.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed or input values as the SD file and return to Menu Z070.

Esc Press this key to return to Menu Z070.


ENPEP Module: MAED Planning Study: Case: (Z080)
S U B M O D - 1 SD Input File
Name of the Region or Country (Short Scenario Title):
Case (or Scenario) Number :
Number of Years for Which Data is to be Entered in TP File:
List of the Years for Which Data Will be Entered:
Number of print blocks to control program printout:
Number of years to be printed:
List of the Years for Which Results are to be Printed:
Energy Unit to be Used for Printing the Results:
Long Scenario Title (Only Needed for Identifying
the Output File):
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z090
PURPOSE

This is the menu from which you select a type of SUBMOD 1 input data to view or change. You advance to this form by selecting option 2 from Menu Z070.

OPTIONS

1 Select this option to view or change the GDP-Formation parameters. You will advance to Menu Z100. NOT RECOMMENDED.

2 Select this option to view or change the Industry parameters. You will advance to Menu Z120.

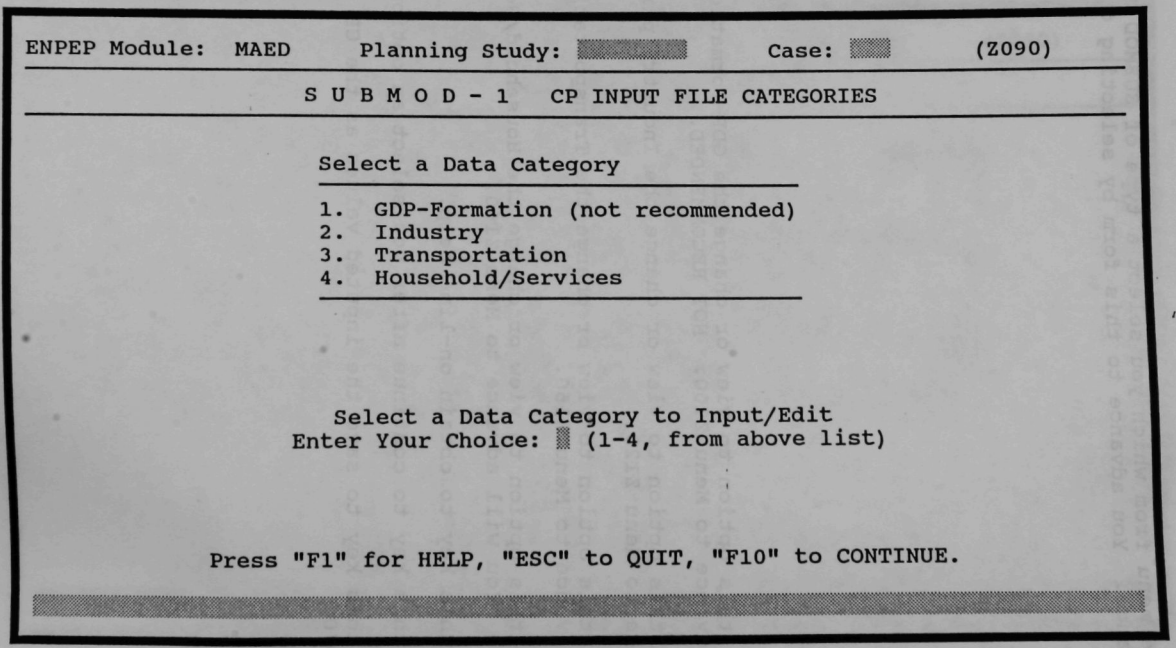
3 Select this option to view or change the Transportation parameters. You will advance to Menu Z150.

4 Select this option to view or change the Household/Services parameters. You will advance to Menu Z160.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to save the inputed values as the CP file and return to Menu Z070.


ENPEP Module: MAED Planning Study: Case: (Z090)
S U B M O D - 1 CP INPUT FILE CATEGORIES
Select a Data Category
1. GDP-Formation (not recommended)
2. Industry
3. Transportation
4. Household/Services
Select a Data Category to Input/Edit
Enter Your Choice: (1-4, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z100
PURPOSE

Form Z100 allows you to enter, view or change GDP-formation data of the major economic sectors. You advanced to this form by selection option 1 on Menu Z090.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Form Z110 for additional GDP data to input.

Esc Press this key to return to Menu Z090.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z100)

S U B M O D - 1 CP Input File - GDP-Formation

Equations to determine the GDP Formation of the major economic sectors.

Agriculture: YAG= A + B * Total GDP
WHERE: A=[redacted] (10**9 monetary units) B=[redacted] (fraction)

Construction: YB = A + B * GCFB
WHERE: A=[redacted] (10**9 monetary units) B=[redacted] (fraction)

Mining: YMIN= A + B * YMAN
WHERE: A=[redacted] (10**9 monetary units) B=[redacted] (fraction)

Manufacturing: YMAN= A + B * GCF + C * TPCG
WHERE: A:[redacted] (10**9 monetary units) B=[redacted] (fraction)
C=[redacted] (fraction)

Energy: YEN= A + B * Total GDP
WHERE: A=[redacted] (10**9 monetary units) B=[redacted] (fraction)

Services: YSER= A + B * TPCSER
WHERE: A=[redacted] (10**9 monetary units) B=[redacted] (fraction)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z110
PURPOSE

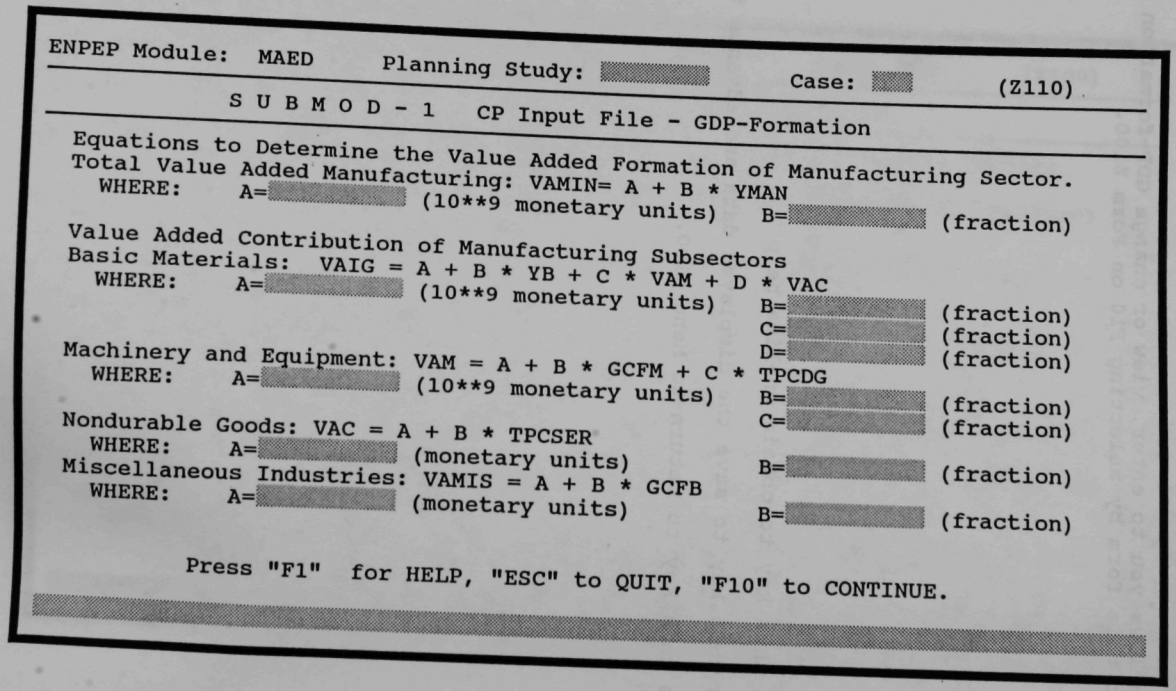
Form Z110 allows you to enter, view or change GDP-formation data. You advanced to this form by selecting F10 on Form Z100.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z090.

Esc Press this key to return to Menu Z100.


ENPEP Module: MAED Planning Study: Case: (Z110)
S U B M O D - 1 CP Input File - GDP-Formation
Equations to Determine the Value Added Formation of Manufacturing Sector.
Total Value Added Manufacturing: VAMIN= A + B * YMAN
WHERE: A= (10**9 monetary units) B= (fraction)
Value Added Contribution of Manufacturing Subsectors
Basic Materials: VAIG = A + B * YB + C * VAM + D * VAC
WHERE: A= (10**9 monetary units) B= (fraction)
C= (fraction)
D= (fraction)
Machinery and Equipment: VAM = A + B * GCFM + C * TPCDG
WHERE: A= (10**9 monetary units) B= (fraction)
C= (fraction)
Nondurable Goods: VAC = A + B * TPCSER
WHERE: A= (monetary units) B= (fraction)
Miscellaneous Industries: VAMIS = A + B * GCFB
WHERE: A= (monetary units) B= (fraction)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z120
PURPOSE

Menu Z120 allows you to enter, view or change Industry data. You advanced to this form by selecting Option 2 on Menu Z090.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z130.

Esc Press this key to return to Menu Z090.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z120)

S U B M O D - 1 CP Input File - Industry Data

Specify Energy Intensity (Energy Consumption per Monetary Unit of Value Added) of the Industry Sectors in Base Year.

SECTOR	Motor Fuels (10**3 kcal/m.u.)	ENERGY FORM Electricity (kW.h/m.u.)	Thermal Uses (10**3 kcal/m.u.)
AGRICULTURE	[redacted]	[redacted]	[redacted]
CONSTRUCTION	[redacted]	[redacted]	[redacted]
MINING	[redacted]	[redacted]	[redacted]
MANUFACTURING:			
BASIC MATERIALS	[redacted]	[redacted]	[redacted]
MACHINERY & EQUIPMENT	[redacted]	[redacted]	[redacted]
NONDURABLE GOODS	[redacted]	[redacted]	[redacted]
MISCELLANEOUS INDUSTRIES	[redacted]	[redacted]	[redacted]

(All Values Must be Given in Terms of Final Energy, Except Thermal Uses in Manufacturing Subsectors which must be Specified in Useful Energy Terms)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z130
PURPOSE

Form Z130 allows you to enter, view or change Industry data. You advanced to this form by selecting F10 on Menu Z120.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Form Z140.

Esc Press this key to return to Menu Z120.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z130)

S U B M O D - 1 CP Input File - Industry Data

Specify Share (fraction) of Useful Thermal Energy Demand by Subsector.

SUBSECTOR	TEMPERATURE LEVEL Medium Steam Generation	High Furnace/ Direct Heat	Low Space/Water Heating
BASIC MATERIALS	[redacted]	[redacted]	[redacted]
MACHINERY & EQUIPMENT	[redacted]	[redacted]	[redacted]
NONDURABLE GOODS	[redacted]	[redacted]	[redacted]
MISCELLANEOUS INDUSTRIES	[redacted]	[redacted]	[redacted]

The Sum of the Entries in EVERY Row MUST Add up to 1.0
or the Sum of the Entries in EVERY Row MUST Add up to 0.0

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z140
PURPOSE

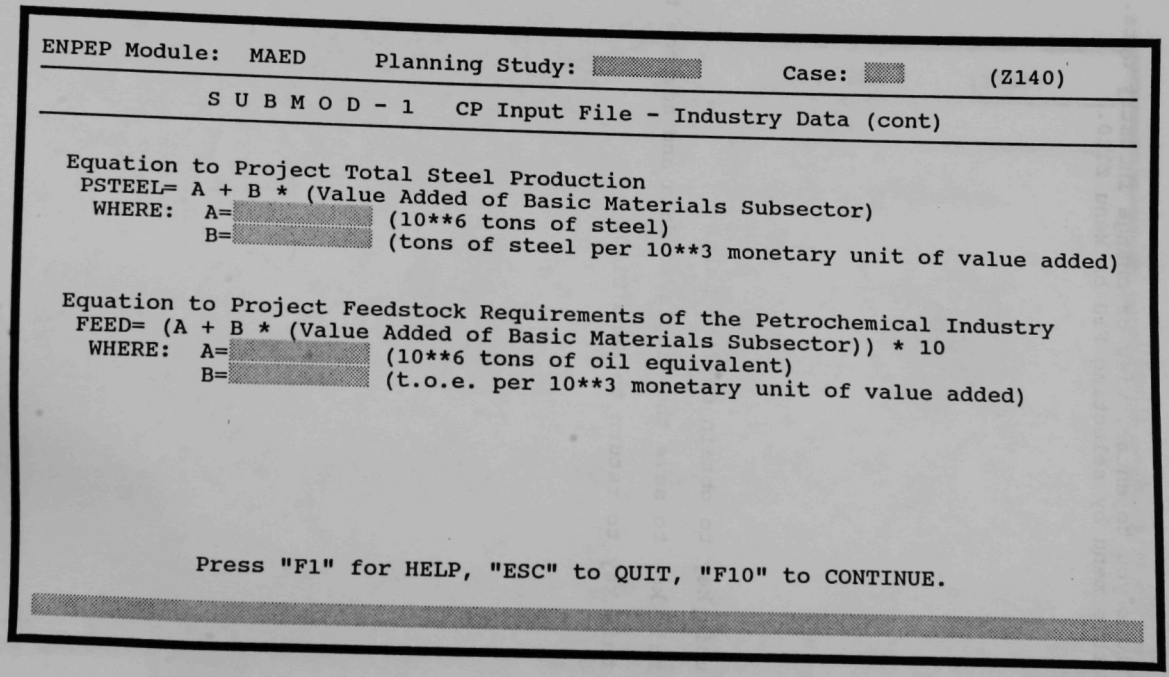
Menu Z130 allows you to enter, view or change Industry data. You advanced to this menu by selecting F10 on Menu Z130.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z090.

Esc Press this key to return to Menu Z130.


ENPEP Module: MAED Planning Study: Case: (Z140)
S U B M O D - 1 CP Input File - Industry Data (cont)
Equation to Project Total Steel Production
PSTEEL= A + B * (Value Added of Basic Materials Subsector)
WHERE: A= (10**6 tons of steel)
B= (tons of steel per 10**3 monetary unit of value added)
Equation to Project Feedstock Requirements of the Petrochemical Industry
FEED= (A + B * (Value Added of Basic Materials Subsector)) * 10
WHERE: A= (10**6 tons of oil equivalent)
B= (t.o.e. per 10**3 monetary unit of value added)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z150
PURPOSE

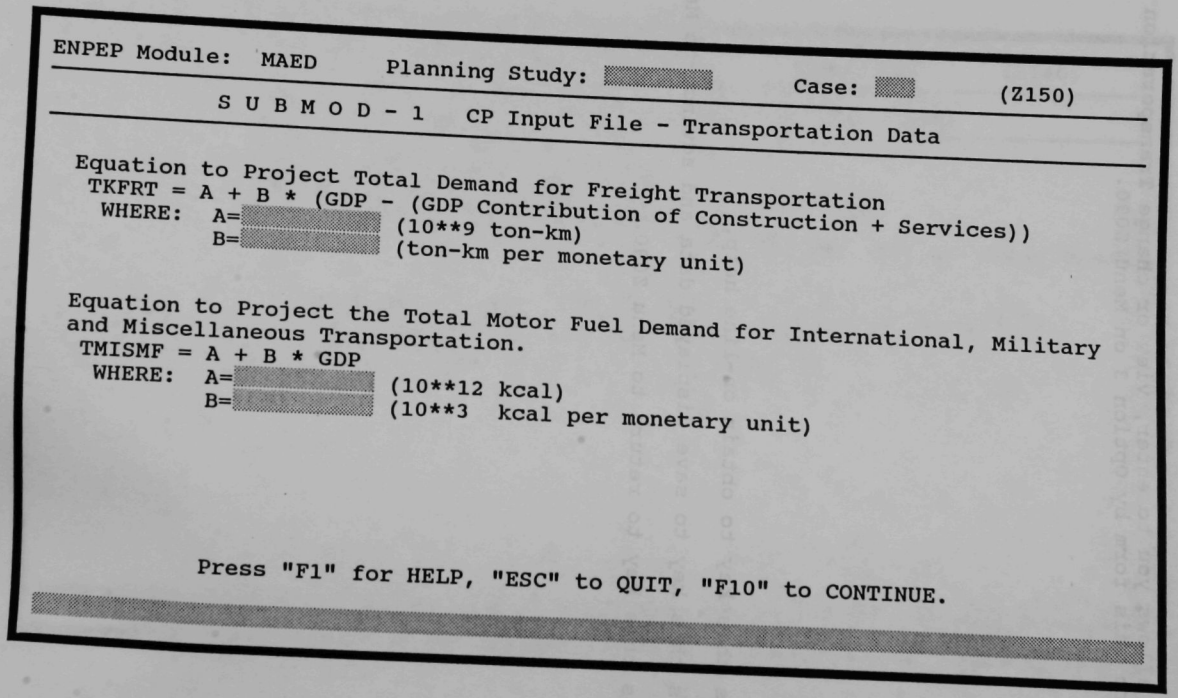
Form Z150 allows you to enter, view or change Transporation data. You advanced to this form by Option 3 on Menu Z090.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save displayed data and advance to Menu Z090.

Esc Press this key to return to Menu Z090.


ENPEP Module: MAED Planning Study: Case: (Z150)
S U B M O D - 1 CP Input File - Transportation Data
Equation to Project Total Demand for Freight Transportation
TKFRT = A + B * (GDP - (GDP Contribution of Construction + Services))
WHERE: A= (10**9 ton-km)
B= (ton-km per monetary unit)
Equation to Project the Total Motor Fuel Demand for International, Military and Miscellaneous Transportation.
TMISMF = A + B * GDP
WHERE: A= (10**12 kcal)
B= (10**3 kcal per monetary unit)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z160
PURPOSE

Menu Z160 allows you to enter, view or change Household and Services data. You advanced to this form by Option 4 on Menu Z090.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z090.

Esc Press this key to return to Menu Z090.

```
ENPEP Module:  MAED     Planning Study:            Case:       (Z160)
-------------------------------------------------------------------------
        S U B M O D - 1   CP Input File - Household/Services Data
-------------------------------------------------------------------------
  Degree-Day:                                          (degree-day)
  Fraction of Dwellings located in areas
    where space heating is required:                   (fraction)
  Total Stock of Dwellings in Base Year:               (10**6 dwellings)
  Specific Space Heating Requirements of "Old" Dwellings by Type:
   Single Family House with Central Heat:              (10**3 kcal/dwellings/year)
   Apartment with Central Heating:                     (10**3 kcal/dwellings/year)
   Dwelling with Room Heat Only:                       (10**3 kcal/dwellings/year)
  Share of Floor Area Heated (or with
   Thermal Uses) in the Services Sector:               (fraction)
  Total Floor Area of Services Sector
   Buildings in Base Year:                             (10**6 square meters)
  Constant Used to Project the Services
   Sector Share in Total Labor Force:                  (fraction)
  Specific Thermal Uses Requirements of "Old" Service
   Sector Buildings (useful energy):                   (10**3 kcal/sq.m/year)
  Amount of Non-commercial Fuels used in
   Household in the Base Year:                         (10**6 tons coal equiv.)
          Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.
```

FORM NUMBER - Z200
PURPOSE

Menu Z200 allows you to obtain a listing of SUBMOD 1 input or output files, or to terminate the listing that is currently in progress. You advance to this menu by selecting option 4 on Menu Z050.

OPTIONS

1 Select this option to choose an input file to list. You will advance to Menu Z210.

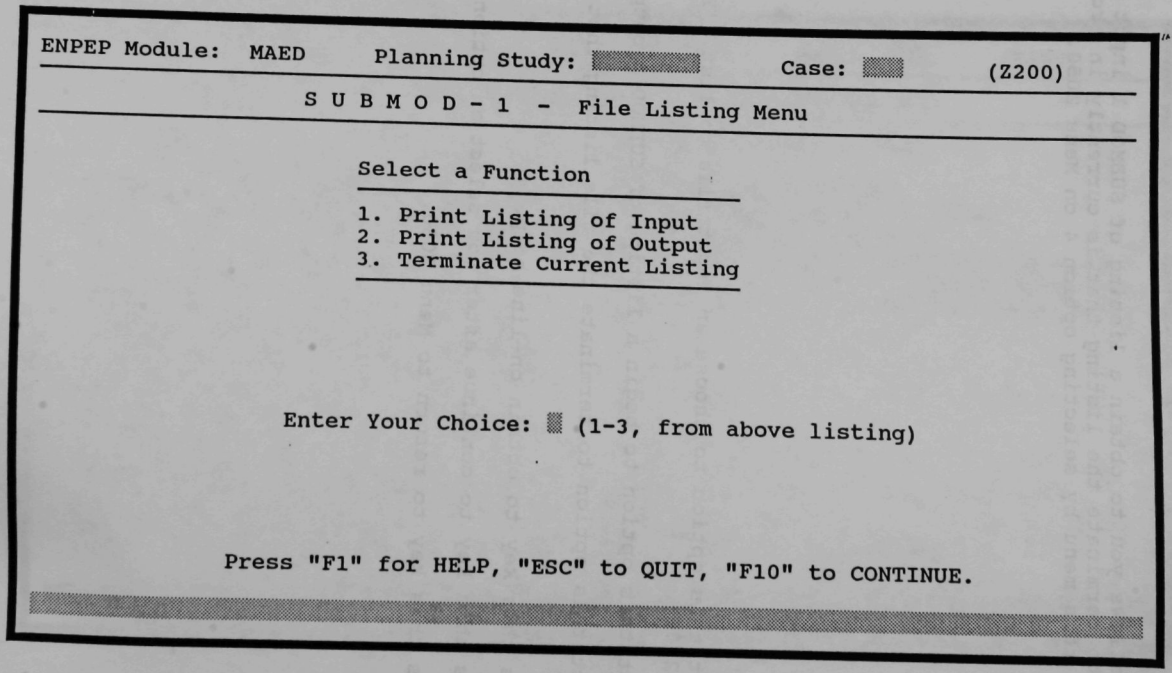
2 Select this option to begin a listing of SUBMOD 1 output file.

3 Select this option to terminate the file listing that is currently in progress.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z050.


ENPEP Module: MAED Planning Study: Case: (Z200)
S U B M O D - 1 - File Listing Menu
Select a Function
1. Print Listing of Input
2. Print Listing of Output
3. Terminate Current Listing
Enter Your Choice: (1-3, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z210
PURPOSE

The purpose of this menu is to select an input file to be listed. You advance to this menu by selecting Option 1 on Z200.

OPTIONS

1 Select this option to begin a listing of the scenario definition file.

2 Select this option to begin a listing of the constant parameters file.

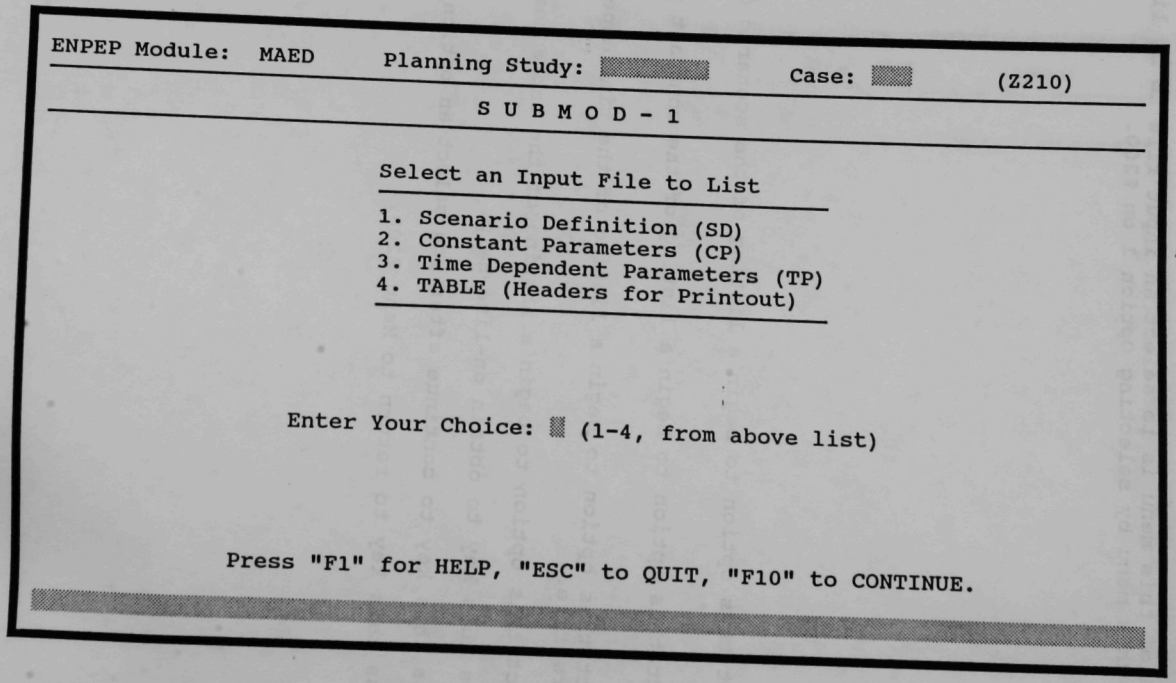
3 Select this option to begin a listing of the time dependent parameters file.

4 Select this option to begin a listing of the table headers file.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z200.


ENPEP Module: MAED Planning Study: Case: (Z210)
S U B M O D - 1
Select an Input File to List
1. Scenario Definition (SD)
2. Constant Parameters (CP)
3. Time Dependent Parameters (TP)
4. TABLE (Headers for Printout)
Enter Your Choice: (1-4, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z215
PURPOSE

Menu Z215 allows you to select a year for which the technical parameter data will be updated or viewed. You advance to this menu by selecting Option 3 on Menu Z070.

OPTIONS

1 Select this option to update the first year of the study. You will advance to Menu Z220.

2 Select this option to update the second year of the study. You will advance to Menu Z220.

3 Select this option to update the third year of the study. You will advance to Menu Z220.

4 Select this option to update the fourth year of the study. You will advance to Menu Z220.

5 Select this option to update the fifth year of the study. You will advance to Menu Z220.

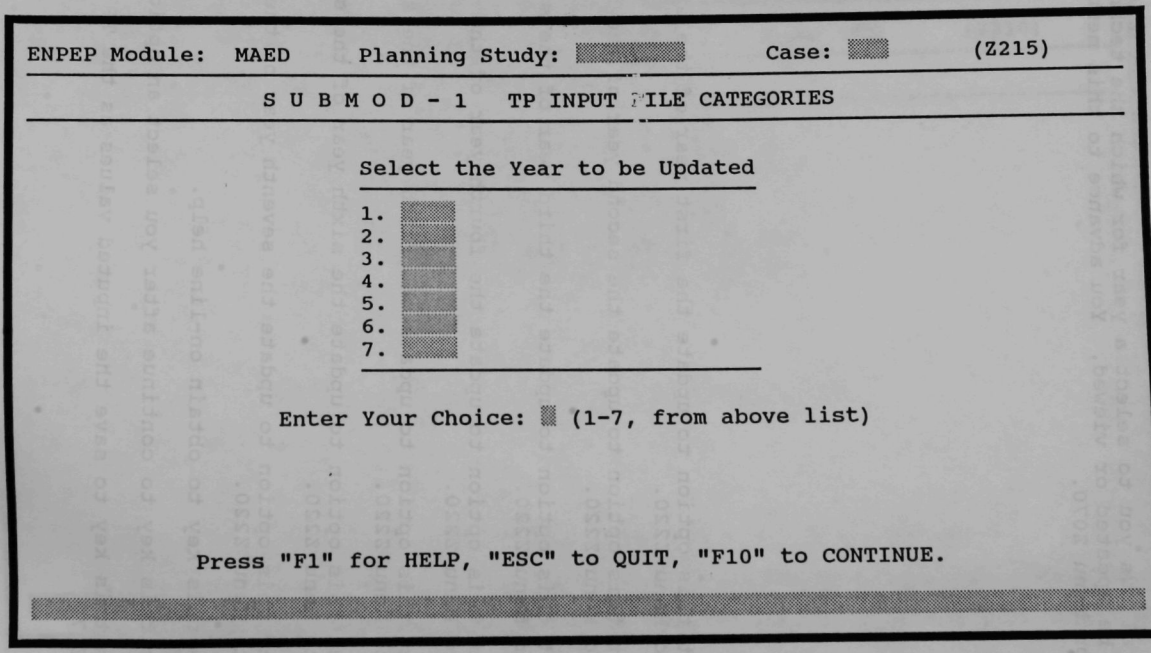
6 Select this option to update the sixth year of the study. You will advance to Menu Z220.

7 Select this option to update the seventh year of the study. You will advance to Menu Z220.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to save the inputed values as the TP file and return to Menu Z070.


ENPEP Module: MAED Planning Study: Case: (Z215)
S U B M O D - 1 TP INPUT FILE CATEGORIES
Select the Year to be Updated
1.
2.
3.
4.
5.
6.
7.
Enter Your Choice: (1-7, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z220
PURPOSE

Menu Z220 allows you to select a data category from the technical parameters file to update or view. You advance to this menu by selecting F10 on Menu Z215.

OPTIONS

1 Select this option to update the demography data for the year selected on Menu 215. You will advance to Menu Z230.

2 Select this option to update the macroeconomic data for the year selected on Menu Z215. You will advance to Menu Z240.

3 Select this option to update the industrial data for the year selected on Menu Z215. You will advance to Menu Z270.

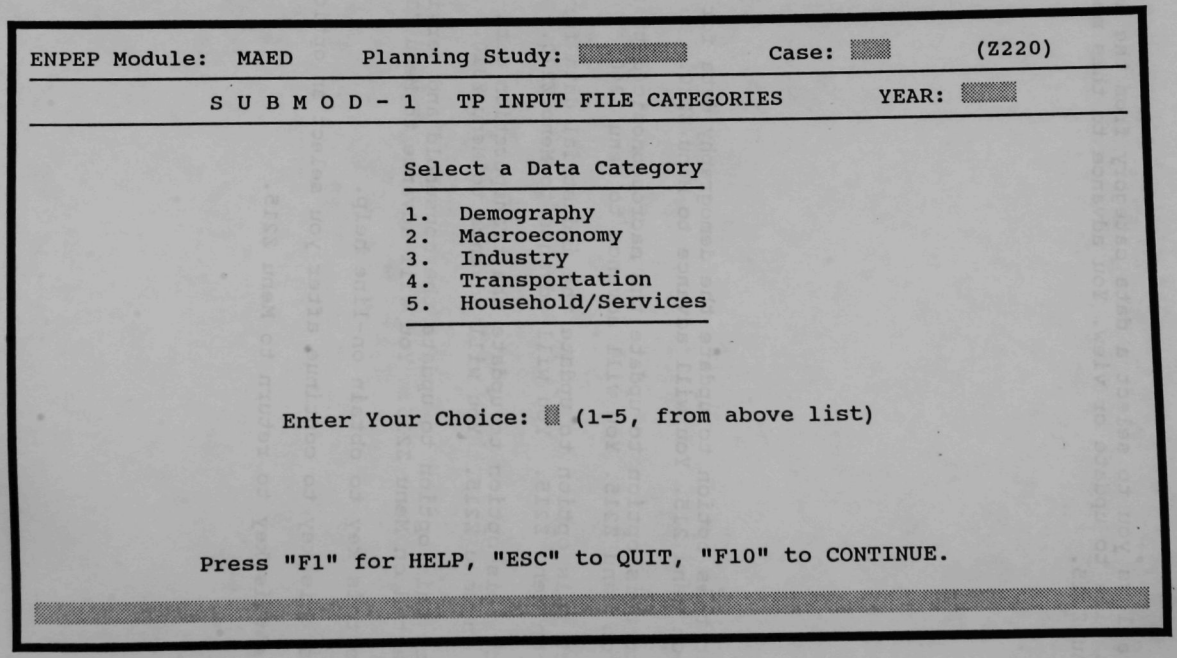
4 Select this option to update the transporation data for the year selected on Menu Z215. You will advance to Menu Z310.

5 Select this option to update the household and services data for the year selected on Menu Z215. You will advance to Menu Z340.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z215.


ENPEP Module: MAED Planning Study: Case: (Z220)
S U B M O D - 1 TP INPUT FILE CATEGORIES YEAR:
Select a Data Category
1. Demography
2. Macroeconomy
3. Industry
4. Transportation
5. Household/Services
Enter Your Choice: (1-5, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z230
PURPOSE

Menu Z230 allows you to update demographic data for the year specified. You advance to this menu by selecting Option 1 on Menu Z220.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save data and return to menu Z220.

Esc Press this key to return to Menu Z220.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z230)

S U B M O D - 1 - TP Input File - Demography Data YEAR: [redacted]

Total Population:	[redacted]	(10**6 persons)
Potential Work Force (Fraction of Population of age 15-64 in Total Population):	[redacted]	(fraction)
Fraction of Potential Work Force Actually Working	[redacted]	(fraction)
Share of Population Living Outside Large Cities (1 - fraction of urban population):	[redacted]	(fraction)
Share of Rural Population in Total:	[redacted]	(fraction)
Average Household Size:	[redacted]	(persons/dwelling)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z240
PURPOSE

Menu Z240 allows you to update macroeconomic data for the year specified. You advance to this menu by selecting Option 2 on Menu Z220.

OPTIONS

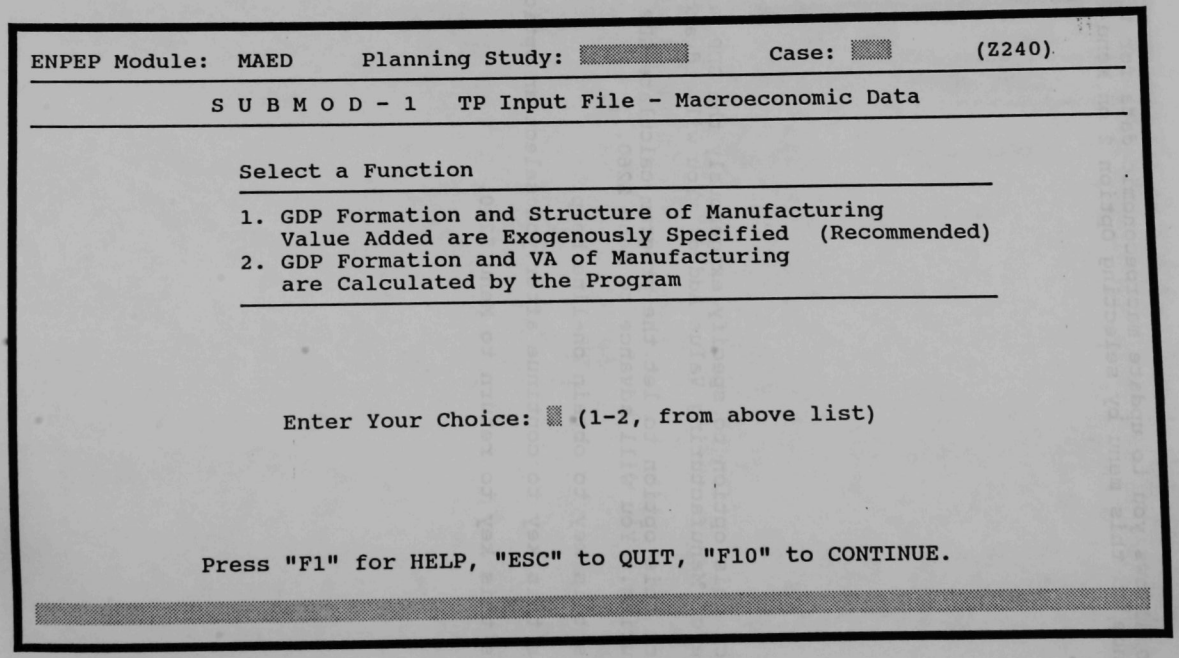
1 Select this option to specify exogenously the GDP Formation and Structure of Manufacturing Value Added. You will advance to Menu Z250.

2 Select this option to let the program calculate GDP and VA of Manufacturing. You will advance to Menu Z260.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z220.


ENPEP Module: MAED Planning Study: Case: (Z240)
S U B M O D - 1 TP Input File - Macroeconomic Data
Select a Function
1. GDP Formation and Structure of Manufacturing
Value Added are Exogenously Specified (Recommended)
2. GDP Formation and VA of Manufacturing
are Calculated by the Program
Enter Your Choice: (1-2, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z250
PURPOSE

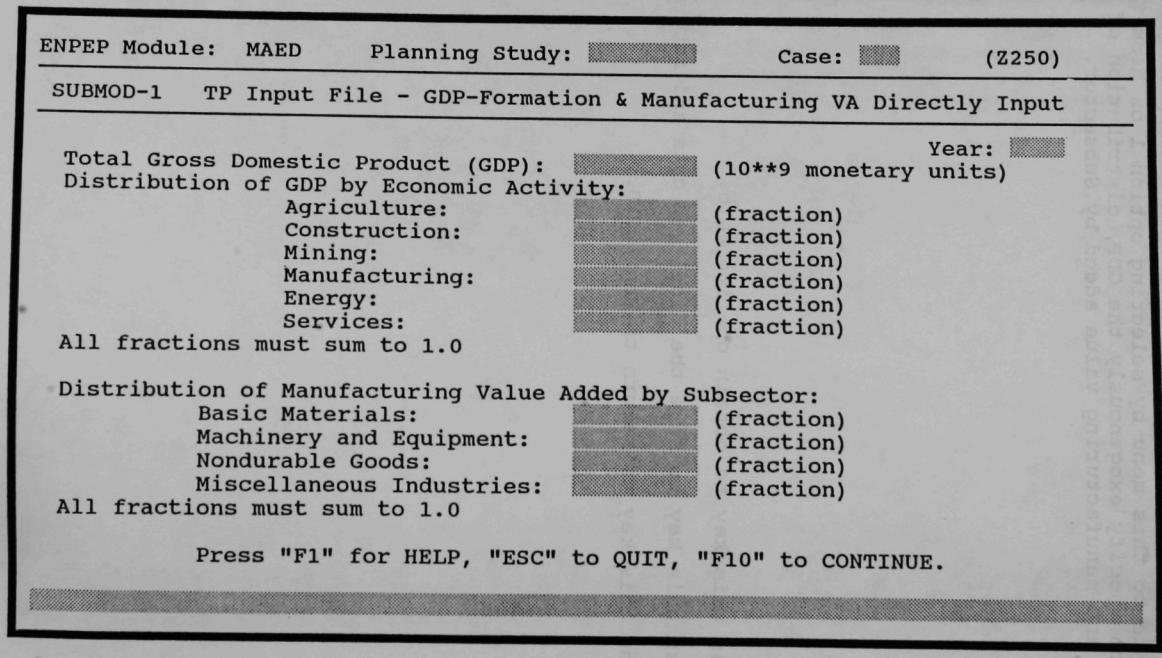
You advance to this menu by selecting option 1 on Menu Z240. This form is used to specify exogenously the GDP, distribution of GDP by economic activity and manufacturing value added by Subsector.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and return to Menu Z220.

Esc Press this key to return to Menu Z220.


ENPEP Module: MAED Planning Study: Case: (Z250)
SUBMOD-1 TP Input File - GDP-Formation & Manufacturing VA Directly Input
Year:
Total Gross Domestic Product (GDP): (10**9 monetary units)
Distribution of GDP by Economic Activity:
Agriculture: (fraction)
Construction: (fraction)
Mining: (fraction)
Manufacturing: (fraction)
Energy: (fraction)
Services: (fraction)
All fractions must sum to 1.0
Distribution of Manufacturing Value Added by Subsector:
Basic Materials: (fraction)
Machinery and Equipment: (fraction)
Nondurable Goods: (fraction)
Miscellaneous Industries: (fraction)
All fractions must sum to 1.0
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z260
PURPOSE

You advance to this menu by selecting option 2 on Menu Z240. Form Z260 allows you to scecify the investment and private consumption formation shares.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and return to Menu Z220.

Esc Press this key to return to Menu Z220.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z260)

SUBMOD-1 TP Input File - GDP-Formation & Manufacturing VA calculated

Year: [redacted]

Total Gross Domestic Product (GDP): [redacted] (10**9 monetary units)

Share of GDP Spent on Investments: [redacted] (fraction)
Share of Investments Spent in Construction: [redacted] (fraction)
Share of Investments Spent in Machinery & Equipment: [redacted] (fraction)

Share of Private Consumption Expenditures in Total GDP: [redacted] (fraction)
Share of Private Consumption Spent in Durable Goods: [redacted] (fraction)
Share of Private Consumption spent in Nondurable Goods: [redacted] (fraction)
Share of Private Consumption spent in Services: [redacted] (fraction)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z270
PURPOSE

You advance to this menu by selecting option 3 on Menu Z220. Form Z270 specifies the ratio of energy intensity, in the year specified on Menu Z215 to the base year, by energy form and by sector.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z280.

Esc Press this key to return to Menu Z220.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z270)

S U B M O D - 1 TP Input File - Industry Data Year: [redacted]

Ratio (Fraction) of Energy Intensity in the Current Year
Relative to the Base Year.

SECTOR	ENERGY FORM Motor Fuels	Electricity	Thermal Uses
AGRICULTURE	[redacted]	[redacted]	[redacted]
CONSTRUCTION	[redacted]	[redacted]	[redacted]
MINING	[redacted]	[redacted]	[redacted]
MANUFACTURING	[redacted]	[redacted]	[redacted]

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z280
PURPOSE

You advance to this menu by selecting F10 on Menu Z270. Form Z280 specifies data for the manufacturing sector, for the year selected on Menu Z215.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z290.

Esc Press this key to return to Menu Z220.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z280)

S U B M O D - 1 TP Input File - Industry Data - (cont) Year: [redacted]

MANUFACTURING:

Share of Useful Thermal Energy Demand:		
- For Steam and Space/Water Heating Together:	[redacted]	(fraction)
- For Steam Generation Only:	[redacted]	(fraction)
Share of Low Temperature Process Heat in the Low and Medium Temperature Process Heat:	[redacted]	(fraction)
Penetration of Electricity in the Various Markets of Useful Thermal Energy Demand by temperature Range:		
- Medium Temperature (Steam Generation):	[redacted]	(fraction)
- High Temperature (Furnace/Direct Heat):	[redacted]	(fraction)
- Low Temperature (Space/Water Heating):	[redacted]	(fraction)
Average Electricity Penetration into Thermal Uses:	[redacted]	(fraction)
Heat Pump Share in Low and Medium Temperature Thermal Uses:	[redacted]	(fraction)
Performance Coefficient of Electric Heat Pumps (Thermal Energy Extracted/Electric Energy input):	[redacted]	(th./el.)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z290
PURPOSE

You advance to this menu by selecting F10 on Menu Z280. Form Z290 specifies data for the manufacturing sector for the year selected on Menu Z215.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z300.

Esc Press this key to return to Menu Z220.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z290)

S U B M O D - 1 TP Input File - Industry Data (cont) Year: [redacted]

MANUFACTURING (cont)

District Heat Penetration in Low and Medium
Temperature Thermal Uses: [redacted] (fraction)

Solar Penetration in:
- Low Temperature Process Heat, Space/Water Heating: [redacted] (fraction)
- Medium Temperature Process Heat: [redacted] (fraction)

Aproximate Share of Useful Thermal Energy Demand
that can be met by a solar installation: [redacted] (fraction)

Share of Low Temperature Steam and Space/Water Heating Supplied
by Fossil Fuels with Cogeneration of Electricity: [redacted] (fraction)

System Efficiency of Cogeneration: [redacted] (fraction)

Ratio of Heat to Electricity in the output
of Cogeneration Systems: [redacted] (kW.h steam/kW.h electricity)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z300
PURPOSE

You advance to this menu by selecting F10 on Menu Z290. Form Z300 specifies data for the manufacturing sector for the year selected on Menu Z215.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and return to Menu Z220.

Esc Press this key to return to Menu Z220.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z300)

S U B M O D - 1 TP Input File - Industry Data (cont) Year: [redacted]

MANUFACTURING (cont):

Average Efficiency of Fossil Fuel Use in Thermal Process Relative to the Efficiency of Electricity by Temperature Range:

- Medium Temperature (Steam Generation): [redacted] (fraction)
- High Temperature (Furnace/Direct Heat): [redacted] (fraction)
- Low Temperature (Space/Water Heating): [redacted] (fraction)

Average Efficiency of Fossil Fuel Use for all Thermal Uses Relative to the Efficiency of Electricity: [redacted] (fraction)

Share of Steel Produced in Non-electric Furnaces: [redacted] (fraction)
Consumption of Pig Iron in Non-electric Steel Works: [redacted] (fraction)
Coke Input in Blast Furnace per unit output Pig Iron: [redacted] (kg/ton)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z310
PURPOSE

You advance to this menu by selecting option 4 on Menu Z220. Form Z310 allows you to update freight transportation data for the year selected on Menu Z215.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z320.

Esc Press this key to return to Menu Z220.

```
ENPEP Module:  MAED     Planning Study: ▒▒▒▒▒▒▒▒     Case: ▒▒▒      (Z310)
   SUBMOD-1   TP Input File - Transportation Data - Freight      Year: ▒▒▒▒
 Total Freight Transportation made by Truck:          ▒▒▒▒▒▒▒▒  (fraction)
 Total Freight Transportation made by Rail:           ▒▒▒▒▒▒▒▒  (fraction)
 Total Freight Transportation made by Barge:          ▒▒▒▒▒▒▒▒  (fraction)
 Total Freight Transportation made by Pipeline:       ▒▒▒▒▒▒▒▒  (fraction)
 Share of Local Truck Transportation in Total
   Freight Transportation made by Truck:              ▒▒▒▒▒▒▒▒  (fraction)
 Share in the Total Freight Transportation made
   by Rail of: - Electric Trains:                     ▒▒▒▒▒▒▒▒  (fraction)
               - Steam Trains:                        ▒▒▒▒▒▒▒▒  (fraction)
 Energy Intensity of Trucks:
   - Average or Long-Distance:                        ▒▒▒▒▒▒▒▒  (kcal/t-km)
   - For Local Transportation (Short Distance)        ▒▒▒▒▒▒▒▒  (kcal/t-km)
 Energy Intensity of Diesel Freight Trains:           ▒▒▒▒▒▒▒▒  (kcal/t-km)
 Average Ratio Between Energy Intensity (Final Energy)
   of: - Steam Train to Diesel Train:                 ▒▒▒▒▒▒▒▒  (fraction)
       - Electric Train to Diesel Train:              ▒▒▒▒▒▒▒▒  (fraction)
 Energy Intensity of Barges:                          ▒▒▒▒▒▒▒▒  (kcal/t-km)
 Energy Intensity of Pipelines:                       ▒▒▒▒▒▒▒▒  (kcal/t-km)
          Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.
```

FORM NUMBER - Z320
PURPOSE

You advance to this menu by selecting F10 on Menu Z310. Form Z320 allows you to update passenger transportation data for the year specified on Menu Z215.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z330.

Esc Press this key to return to Menu Z220.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z320)

SUBMOD-1 TP Input File - Trans. Data - Passenger Intercity Year: [redacted]

Average Intercity Distance Travelled: [redacted] (km/person/year)
Inverse of Car Ownership Ratio: [redacted] (population/car)
Average Intercity Distance Driven by Car: [redacted] (km/car/year)
Share in Intercity Passenger Travel (excluding
travel made by car) of: - Buses: [redacted] (fraction)
- Trains: [redacted] (fraction)
- Airplanes: [redacted] (fraction)
Elect. Train Share in Total Intercity Travel by Train: [redacted] (fraction)
Steam Train share in Total Intercity Travel by Train: [redacted] (fraction)
Average Load Factor of Cars in Intercity Travel: [redacted] (person/car)
Average Load Factor of Intercity Buses: [redacted] (person/bus)
Average Load Factor of Intercity Train: [redacted] (person/train)
Average Capacity Utilization Factor of Airplanes: [redacted] (fraction)
Specific Gasoline Consumption of Cars in
Intercity Travel: [redacted] (liter/vehicle/100 km)
Diesel Consumption of Intercity Buses: [redacted] (liter/vehicle/100 km)
Diesel Consumption of Intercity Passenger Trains: [redacted] (kcal/tranin-km)
Specific Energy Consumption of Airplanes: [redacted] (kcal/seat-km)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z330
PURPOSE

You advance to this menu by selecting F10 on Menu Z320. Form Z330 allows you to update urban passenger transportation data for the year specified on Menu Z215.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and return to Menu Z220.

Esc Press this key to return to Menu Z220.

```
ENPEP Module: MAED        Planning Study:          Case:        (Z330)
 SUBMOD-1 - TP INPUT FILE - Trans. Data - Passenger Urban        Year:
 Average Intracity (urban) Distance Travelled:                  (km/person/day)
 Share in Total Demand for Urban Passenger Transportation
   of: - Cars:                                                  (fraction)
       - Mass Transportation Systems:                           (fraction)
 Share of Electric Cars in Total Urban Car Travel:              (fraction)
 Share of Electric Modes (Tramway, Underground, etc.)
   in Total Demand for Urban Mass Transportation:               (fraction)
 Average Load Factor of Cars in Urban Travel:                   (person/car)
 Average Load Factor of Intracity Buses:                        (person/bus)
 Average Load Factor of Urban Electric Mass
   Transit Systems:                                             (person/vehicle)
 Specific Gasoline Consumption of Cars in
   Intracity Travel:                                            (liter/vehicle/100 km)
 Specific Electricity Consumption of Electric
   Cars in Intracity (urban) Travel:                            (kW.h/vehicle-km)
 Diesel Consumption of Intracity Buses:                         (liter/vehicle-100 km)
 Specific Consumption of Intracity Electric
   Mass Transportation Systems:                                 (kW.h/vehicle-km)
         Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.
```

FORM NUMBER - Z340
PURPOSE

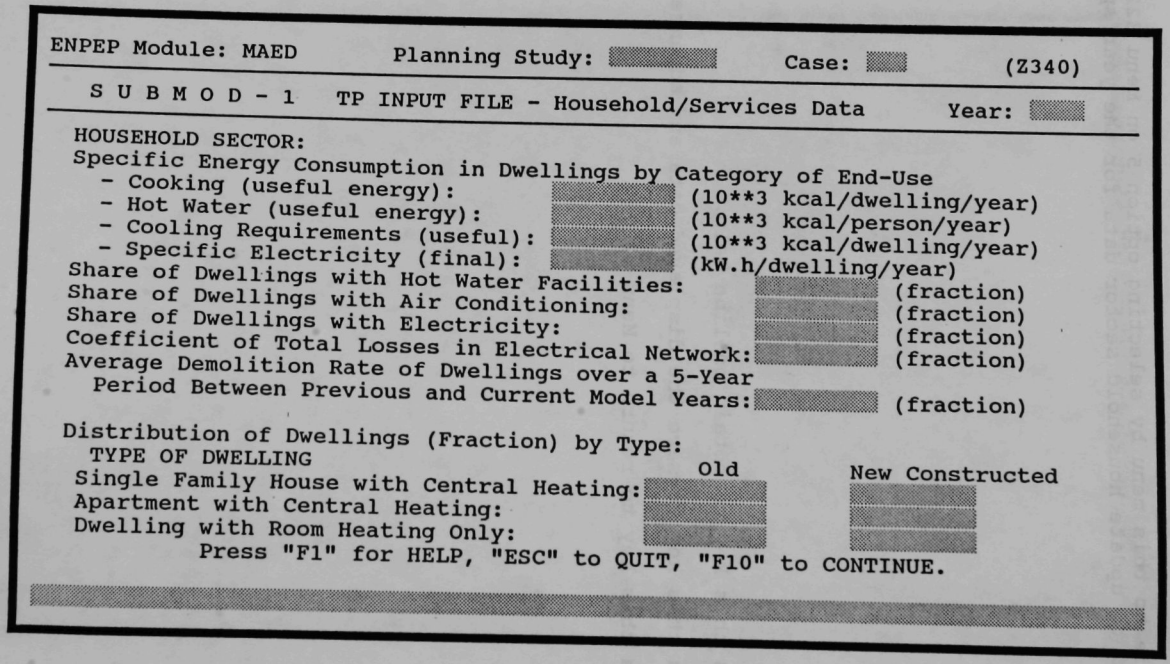
You advance to this menu by selecting option 5 on Menu Z220. Form Z340 allows you to update household sector data for the year specified on Menu Z215.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z350.

Esc Press this key to return to Menu Z220.


ENPEP Module: MAED Planning Study: Case: (Z340)
S U B M O D - 1 TP INPUT FILE - Household/Services Data Year:
HOUSEHOLD SECTOR:
Specific Energy Consumption in Dwellings by Category of End-Use
- Cooking (useful energy): (10**3 kcal/dwelling/year)
- Hot Water (useful energy): (10**3 kcal/person/year)
- Cooling Requirements (useful): (10**3 kcal/dwelling/year)
- Specific Electricity (final): (kW.h/dwelling/year)
Share of Dwellings with Hot Water Facilities: (fraction)
Share of Dwellings with Air Conditioning: (fraction)
Share of Dwellings with Electricity: (fraction)
Coefficient of Total Losses in Electrical Network: (fraction)
Average Demolition Rate of Dwellings over a 5-Year
Period Between Previous and Current Model Years: (fraction)
Distribution of Dwellings (Fraction) by Type:
TYPE OF DWELLING
Old
New Constructed
Single Family House with Central Heating:
Apartment with Central Heating:
Dwelling with Room Heating Only:
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z350
PURPOSE

You advance to this menu by selecting F10 on Menu Z340. Form Z350 allows you to update household sector heating data for the year selected on Menu Z215.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z360.

Esc Press this key to return to Menu Z220.

ENPEP Module: MAED Planning Study: [ ] Case: [ ] (Z350)

SUBMOD-1 TP INPUT file - Household/Services Data (cont) Year: [ ]

HOUSEHOLD (cont)
Average Floor Area Heated (I) and Specific Heat Loss Rate (II)
in New Dwellings by Type.

DWELLING TYPE:	I sqm/dwelling	II kcal/sqm/oC/hour
Single Family House with Central Heating:	[ ]	[ ]
Apartment with Central Heating:	[ ]	[ ]
Dwelling with Room Heat Only:	[ ]	[ ]

Reduction of Average Space Heat Demand of
"Old" Dwelling Relative to that in Base Year,
due to Better Insulation, by Dwelling Type:
- Single Family House with Central Heating: [ ] (fraction)
- Apartment with Central Heating: [ ] (fraction)
- Dwelling with Room Heating Only: [ ] (fraction)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z360
PURPOSE

You advance to this menu by selecting F10 on Menu Z350. Form Z360 allow you to update the service sector data for the year selected on Menu Z215

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z370.

Esc Press this key to return to Menu Z220.

ENPEP Module: MAED Planning Study: [ ] Case: [ ] (Z360)

SUBMOD-1 TP INPUT file - Household/Services Data (cont) Year: [ ]

SERVICES SECTOR:

Average Floor Area per employee in the Services Sector: [ ] (sqm/employee)

Specific Requirements for Thermal Uses of "New" Service Sector Buildings: [ ] (10**3 kcal/sqm/year)

Cooling Requirements in Service Sector: [ ] (10**3 kcal/sqm/year)

Specific Electricity Consumption (Final Energy) in:
- "Old" Service Sector Buildings: [ ] (kW.h/sq.m/year)
- "New" Service Sector Buildings: [ ] (kW.h/sq.m/year)

Share of Service Sector Floor Area Actually Heated: [ ] (fraction)

Share of Air Conditioned Service Sector Floor Area: [ ] (fraction)

Average Demolition Rate of Service Floor Area over a 5-year Period between Previous and Current Model Years: [ ] (fraction)

Reduction of Average Heat demand in "Old" Service Sector Buildings Relative to the Base Year due to Better Insulation: [ ] (fraction)

Share of Low-rise Buildings (e.g. up to 3 Floors) in Total Service Sector Floor Area (for Solar Penetration): [ ] (fraction)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z370
PURPOSE

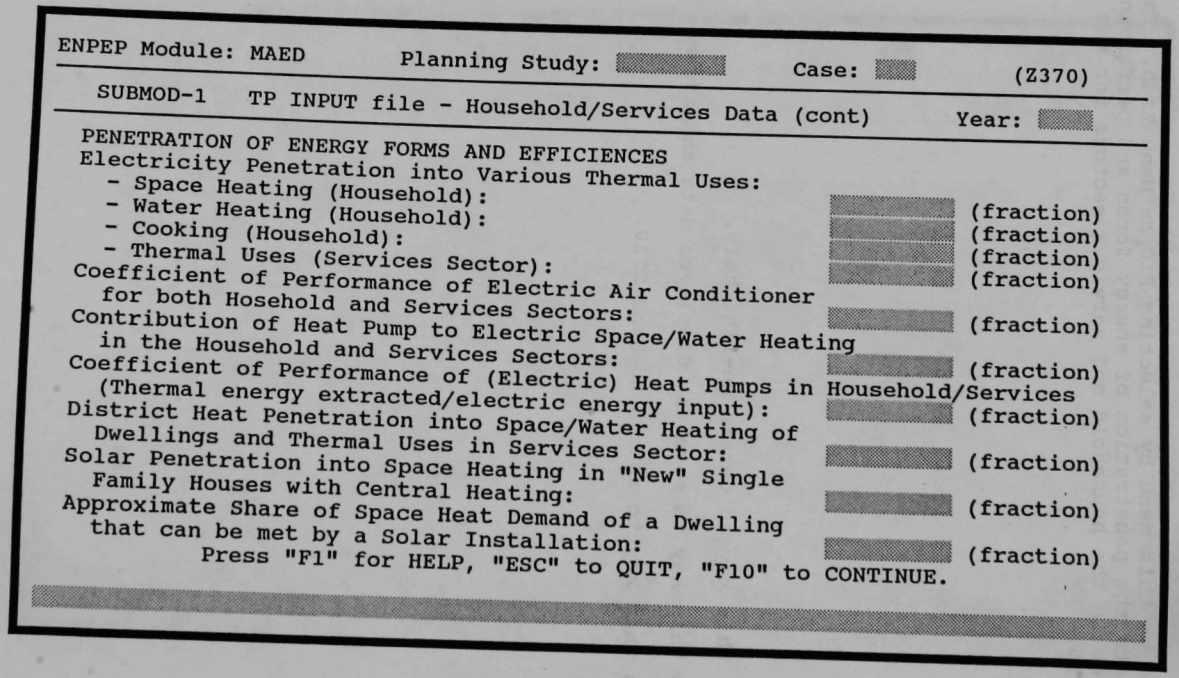
You advance to this menu by selecting F10 on Menu Z360. Form Z370 allows you to update the penetration of energy forms and performance efficiencies in the household and services sectors for the year selected on Menu Z215.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z380.

Esc Press this key to return to Menu Z220.


ENPEP Module: MAED Planning Study: Case: (Z370)
SUBMOD-1 TP INPUT file - Household/Services Data (cont) Year:
PENETRATION OF ENERGY FORMS AND EFFICIENCES
Electricity Penetration into Various Thermal Uses:
- Space Heating (Household): (fraction)
- Water Heating (Household): (fraction)
- Cooking (Household): (fraction)
- Thermal Uses (Services Sector): (fraction)
Coefficient of Performance of Electric Air Conditioner for both Hosehold and Services Sectors: (fraction)
Contribution of Heat Pump to Electric Space/Water Heating in the Household and Services Sectors: (fraction)
Coefficient of Performance of (Electric) Heat Pumps in Household/Services (Thermal energy extracted/electric energy input): (fraction)
District Heat Penetration into Space/Water Heating of Dwellings and Thermal Uses in Services Sector: (fraction)
Solar Penetration into Space Heating in "New" Single Family Houses with Central Heating: (fraction)
Approximate Share of Space Heat Demand of a Dwelling that can be met by a Solar Installation: (fraction)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z380
PURPOSE

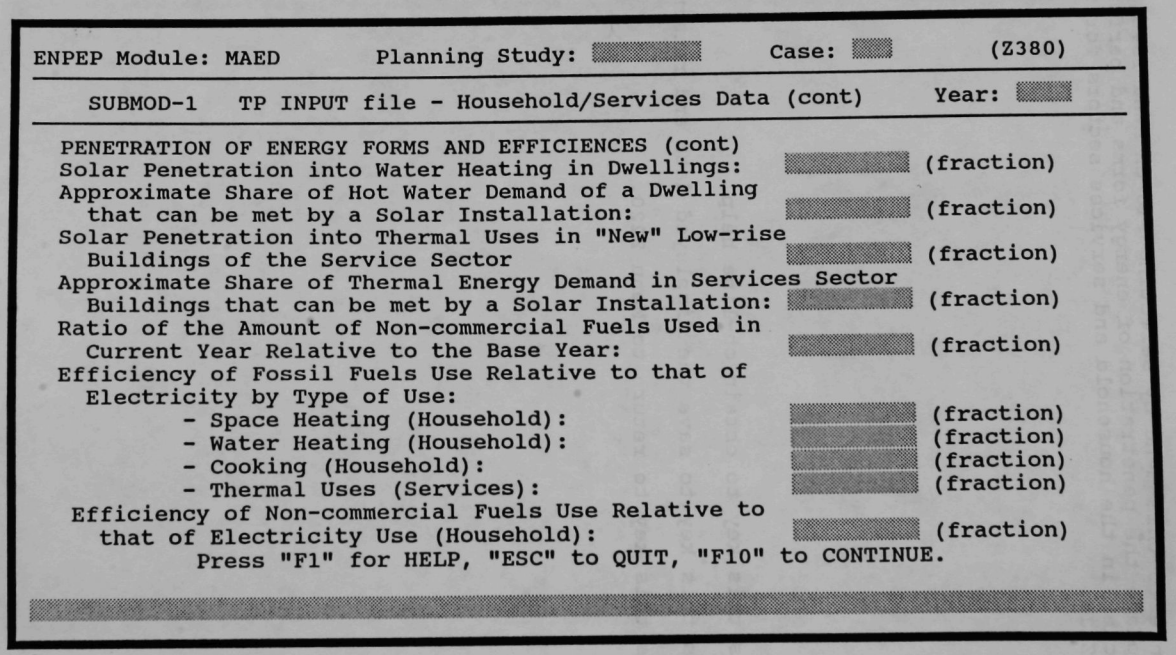
You advance to this menu by selecting F10 on Menu Z370. Form Z380 allo you to update the penetration of energy forms and performance efficiencies in the household and services sectors for the year selecte on Menu Z215.

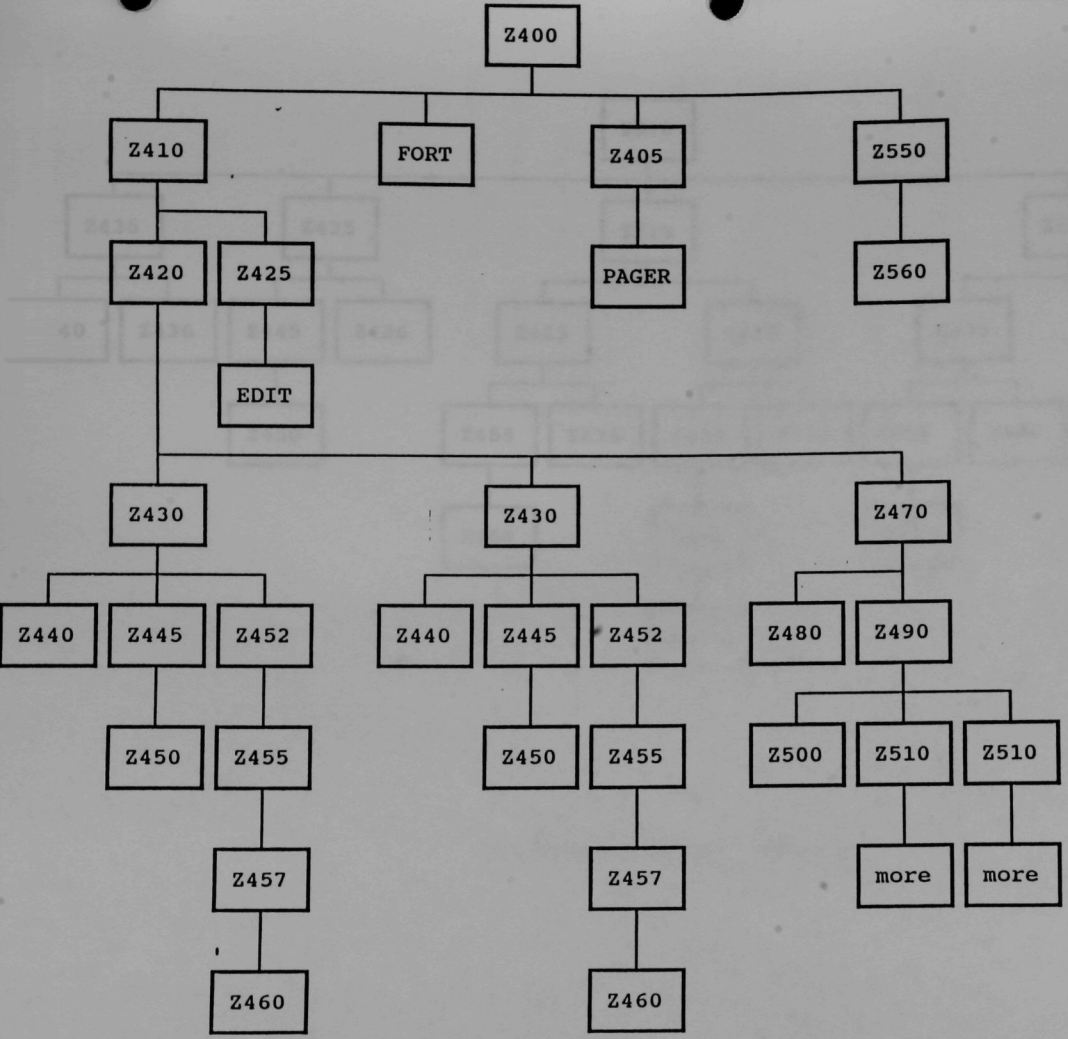
OPTIONS

F1 Press this key to obtain on-line help.

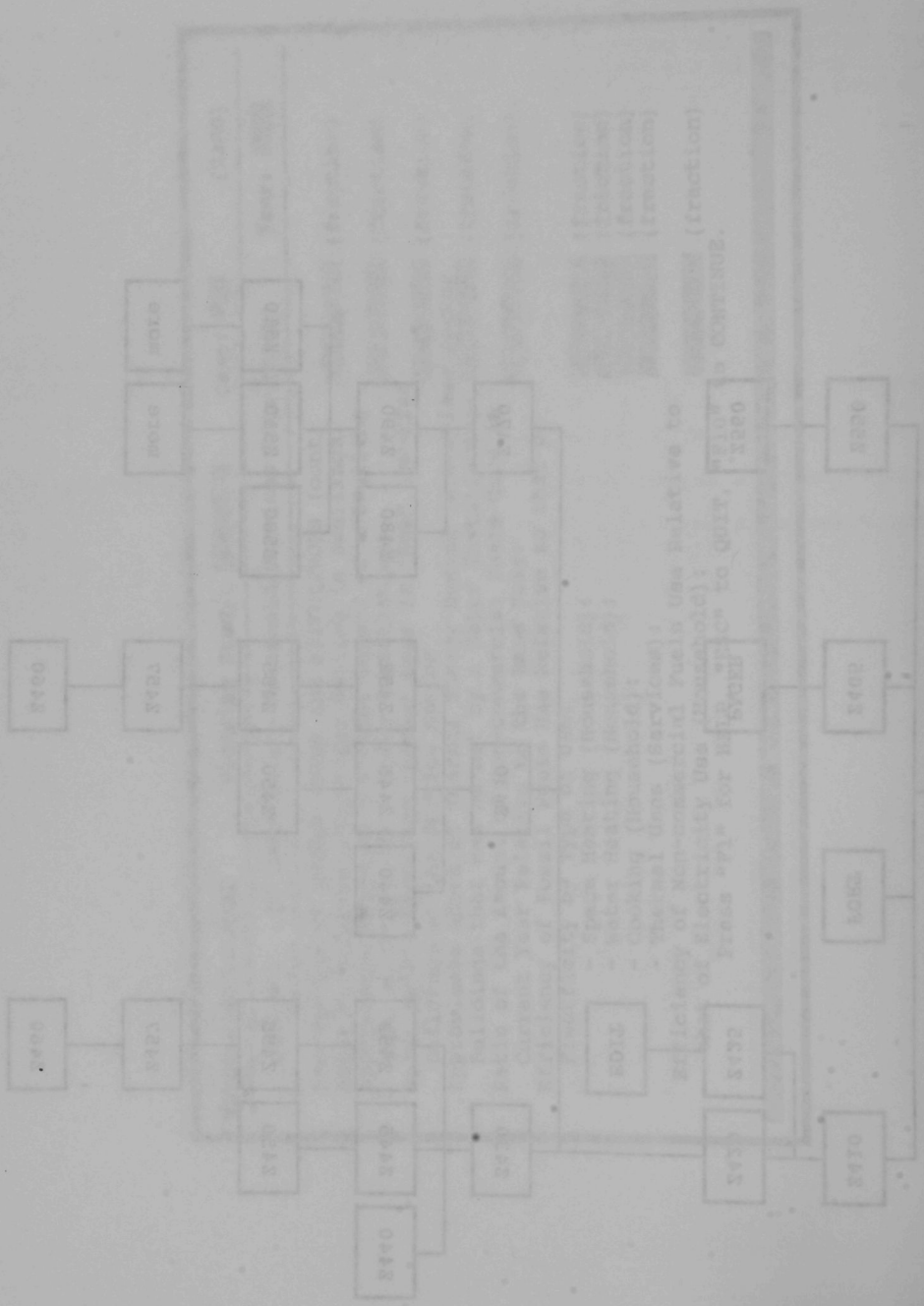
F10 Press this key to save the displayed data and return to Menu Z220.

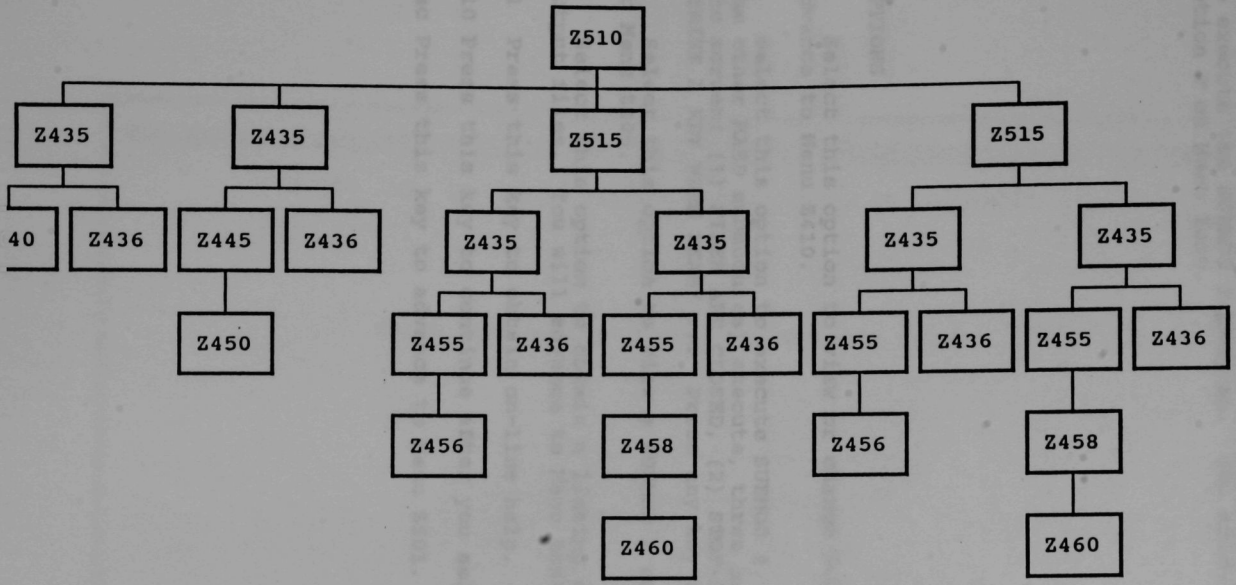
Esc Press this key to return to Menu Z220.


ENPEP Module: MAED Planning Study: Case: (Z380)
SUBMOD-1 TP INPUT file - Household/Services Data (cont) Year:
PENETRATION OF ENERGY FORMS AND EFFICIENCES (cont)
Solar Penetration into Water Heating in Dwellings: (fraction)
Approximate Share of Hot Water Demand of a Dwelling
that can be met by a Solar Installation: (fraction)
Solar Penetration into Thermal Uses in "New" Low-rise
Buildings of the Service Sector (fraction)
Approximate Share of Thermal Energy Demand in Services Sector
Buildings that can be met by a Solar Installation: (fraction)
Ratio of the Amount of Non-commercial Fuels Used in
Current Year Relative to the Base Year: (fraction)
Efficiency of Fossil Fuels Use Relative to that of
Electricity by Type of Use:
- Space Heating (Household): (fraction)
- Water Heating (Household): (fraction)
- Cooking (Household): (fraction)
- Thermal Uses (Services): (fraction)
Efficiency of Non-commercial Fuels Use Relative to
that of Electricity Use (Household): (fraction)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

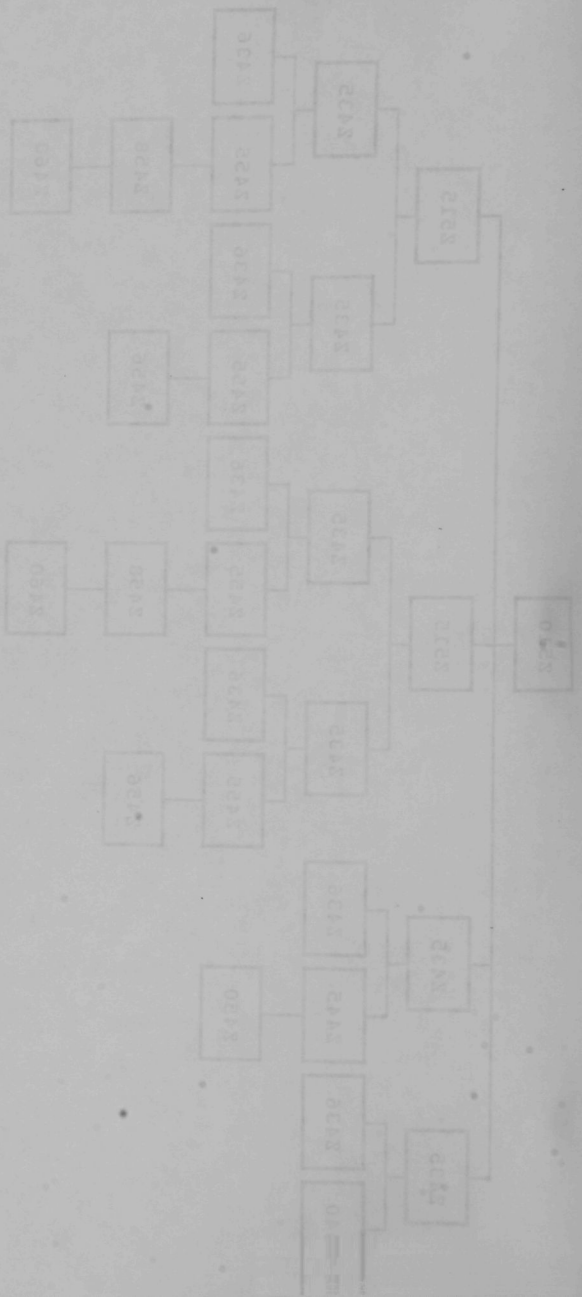


SUB-MODULE 2 OF MAED





SUB-MODULE 2 OF MAED (continued)



FORM NUMBER - Z400
PURPOSE

Menu Z400 allows you to view or change the SUBMOD 2 input and output and to execute the SUBMOD 2 program. You advance to this menu by selecting option 2 on Menu Z030.

OPTIONS

1 Select this option to view or change SUBMOD 2 input data. You will advance to Menu Z410.

2 Select this option to execute SUBMOD 2. After SUBMOD 2 (or any of the other MAED submodules) execute, three messages will be diplayed on the screen: (1) FILES ARE CLOSED, (2) STOP-PROGRAM TERMINATED, and (3) STRIKE A KEY WHEN READY ... Press any key to return to Menu Z400.

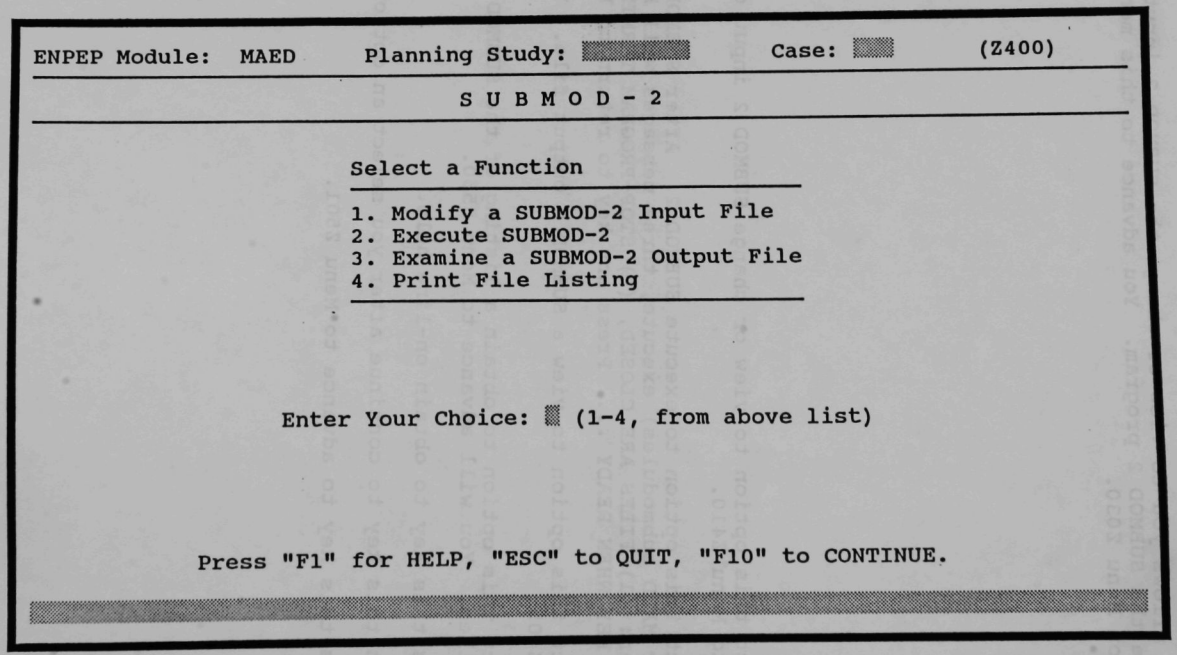
3 Select this option to view a SUBMOD 2 output file. You will advance to Menu Z405.

4 Select this option to obtain a listing of the SUBMOD 2 input or output files. You will advance to Menu Z550.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to advance to Menu Z501.


ENPEP Module: MAED Planning Study: Case: (Z400)
S U B M O D - 2
Select a Function
1. Modify a SUBMOD-2 Input File
2. Execute SUBMOD-2
3. Examine a SUBMOD-2 Output File
4. Print File Listing
Enter Your Choice: (1-4, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z405
PURPOSE

Menu Z405 allows you to view the SUBMOD 2 output. You advance to this menu by selecting option 3 on Menu Z400.

OPTIONS

1 Select this option to view the Standard SUBMOD 2 Report File. This is the recommended choice.

2 Select this option to view the Hourly Electric Demand File.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option. You will advance to the ENPEP paging routine; when you finish viewing the output, press Esc to return to Menu Z405.

Esc Press this key to return to Menu Z400.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z405)

S U B M O D - 2

Select an Output File to Examine

1. Standard Report File (recommended)
2. Hourly Electric Demand File

Enter Your Choice: [redacted] (1-2, from above list)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z410
PURPOSE

The purpose of Menu Z410 is to select a method for viewing or changing SUBMOD 2 input data. You advance to this menu by selecting option 1 on Menu Z400.

OPTIONS

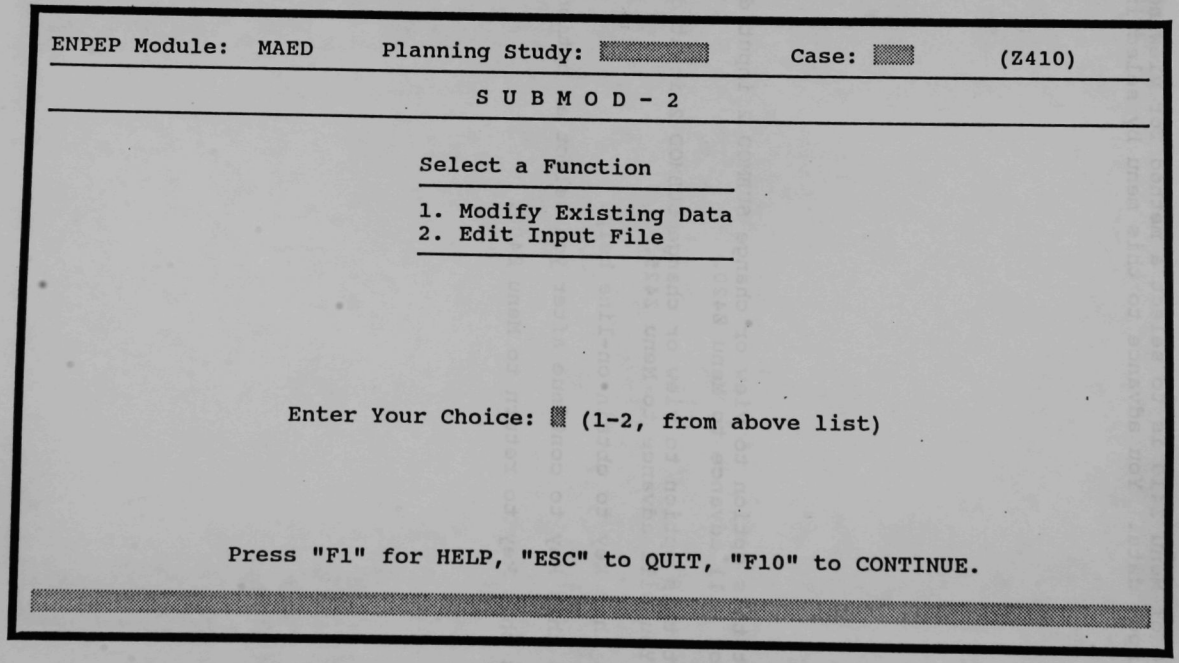
1 Select this option to view or change SUBMOD 2 input data by using forms. You will advance to Menu Z420.

2 Select this option to view or change SUBMOD 2 input data by using the editor. You will advance to Menu Z425.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z400.


ENPEP Module: MAED Planning Study: Case: (Z410)
S U B M O D - 2
Select a Function
1. Modify Existing Data
2. Edit Input File
Enter Your Choice: (1-2, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z420
PURPOSE

Menu Z420 allows you to choose the SUBMOD 2 input data you wish to view or change. You advance to this menu by selecting option 1 on Menu Z410.

OPTIONS

1 Select this option to view or change the Industry/Transportation data for SUBMOD 2. You will advance to Menu Z430.

2 Select this option to view or change the Household/Service Sector data for SUBMOD 2. You will advance to Menu Z430.

3 Select this option to view or change the Annual Program Execution data for SUBMOD 2. You will advance to Menu Z470.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z410.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z420)

S U B M O D - 2

Select an Input File to Modify

1. Initial Industry/Transportation Data (S1)
2. Initial Household/Service Sector Data (S2)
3. Annual Program Execution Data (INPUT)

Enter Your Choice: [redacted] (1-3, from above listing)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z425
PURPOSE

Menu Z425 allows you to choose the SUBMOD 2 input data you wish edit as a card image file. You advance to this menu by selecting option 2 on Menu Z410.

OPTIONS

1 Select this option to view or change the Industry/Transportation data for SUBMOD 2 as an actual card image file. You will advance to the editor and return to Menu Z425 when you finish viewing or changing the file.

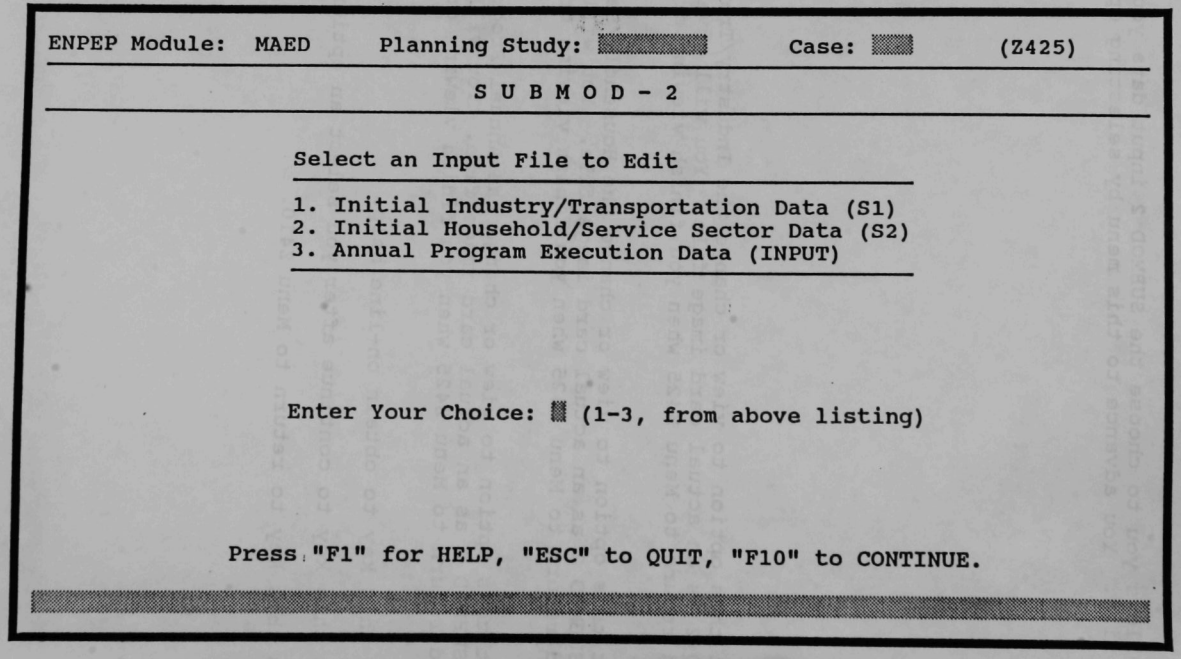
2 Select this option to view or change the Household/Service Sector data for SUBMOD 2 as an actual card image file. You will advance to the editor and return to Menu Z425 when you finish viewing or changing the file.

3 Select this option to view or change the Annual Program Execution data for SUBMOD 2 as an actual card image file. You will advance to the editor and return to Menu Z425 when you finish viewing or changing the file.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z410.


ENPEP Module: MAED Planning Study: Case: (Z425)
S U B M O D - 2
Select an Input File to Edit
1. Initial Industry/Transportation Data (S1)
2. Initial Household/Service Sector Data (S2)
3. Annual Program Execution Data (INPUT)
Enter Your Choice: (1-3, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z430
PURPOSE

Menu Z430 allows you to choose which category of data you wish to view or change. You advance to this menu by selecting option 1 or option 2 on Menu Z420.

OPTIONS

1 Select this option to view or change the Seasonal Load Coefficients for Industry/Transportation (if you choose option 1 on Menu Z420) or for Household Services (if you choose option 2 on Menu Z420). You will advance to Menu Z440.

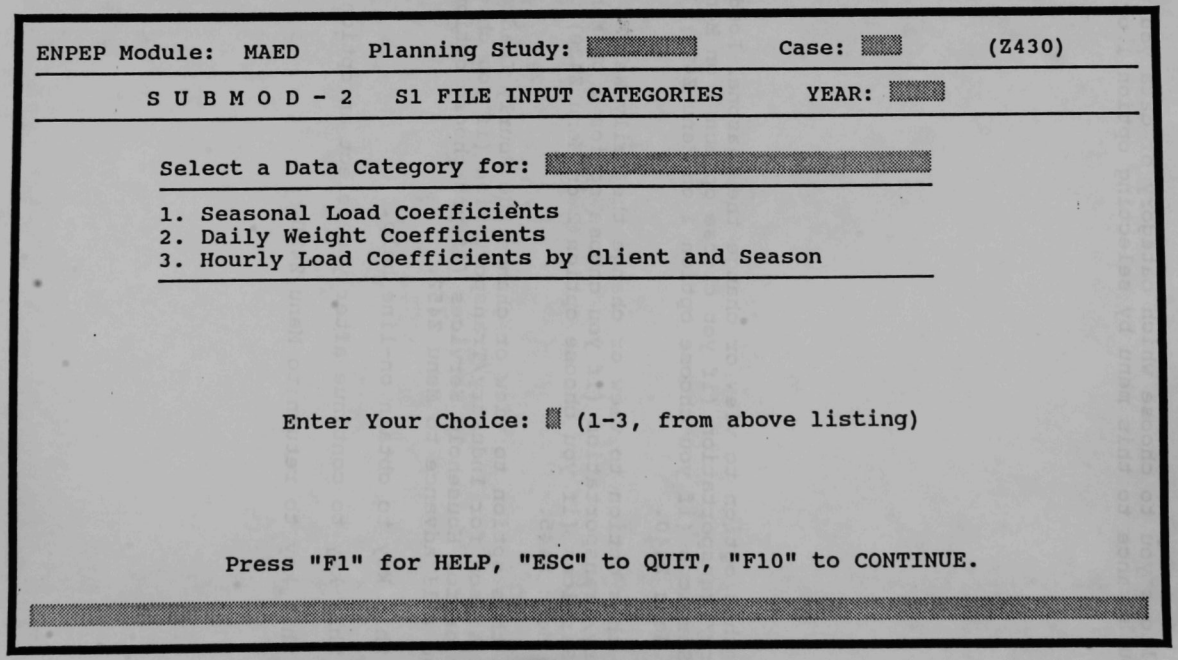
2 Select this option to view or change the Daily Weight Coefficients for Industry/Transportation (if you choose option 1 on Menu Z420) or for Household Services (if you choose option 2 on Menu Z420). You will advance to Menu Z445.

3 Select this option to view or change the Hourly Load Coefficients by client and season for Industry/Transportation (if you choose option 1 on Menu Z420) or for Household Services (if you choose option 2 on Menu Z420). You will advance to Menu Z452.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z420.


ENPEP Module: MAED Planning Study: Case: (Z430)
S U B M O D - 2 S1 FILE INPUT CATEGORIES YEAR:
Select a Data Category for:
1. Seasonal Load Coefficients
2. Daily Weight Coefficients
3. Hourly Load Coefficients by Client and Season
Enter Your Choice: (1-3, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z435
PURPOSE

The purpose of Menu Z435 is to specify if you want to modify or delete the data you chose on Menu Z510 or Menu Z515. You advance to this menu by selecting F10 on Menu Z510 or Menu Z515.

OPTIONS

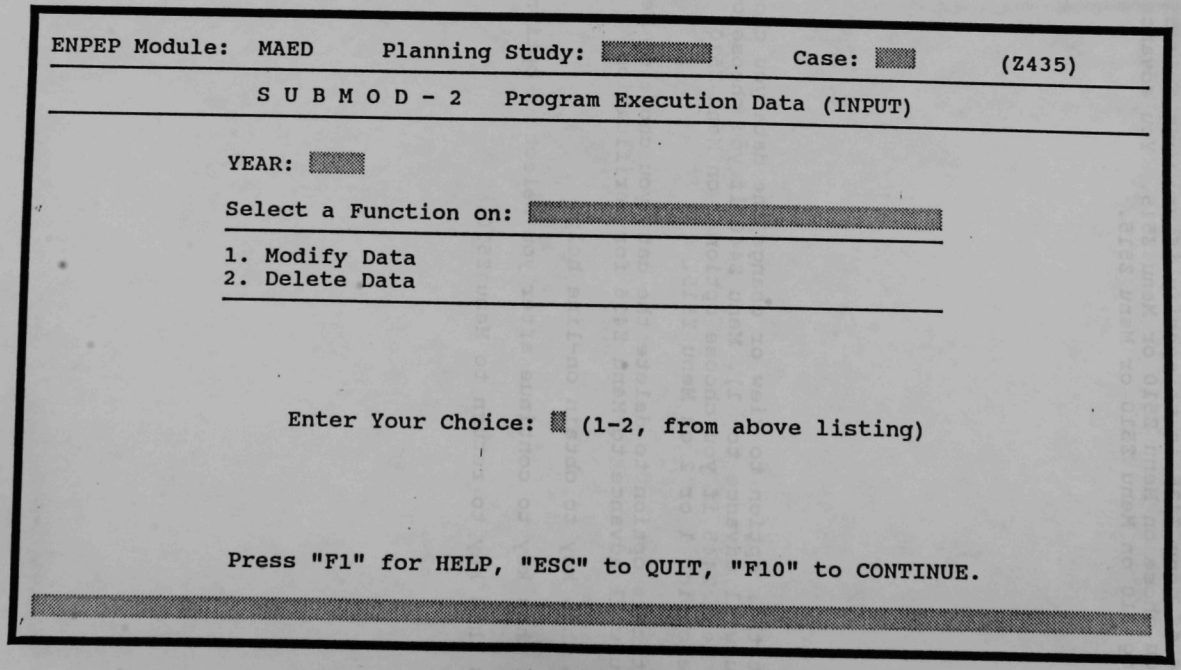
1 Select this option to view or change the data you choose on Menu Z510. You will advance to 1). Menu Z440 if you choose option 1 on Menu Z510 2). Menu Z445 if you choose option 2 on Menu Z510 3). Menu Z455 if you choose option 1 or 2 on Menu Z515.

2 Select this option to delete the data you chose on Menu Z510 or Menu Z515. You will advance to Menu Z436 for verification.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z510.


ENPEP Module: MAED Planning Study: Case: (Z435)
S U B M O D - 2 Program Execution Data (INPUT)
YEAR:
Select a Function on:
1. Modify Data
2. Delete Data
Enter Your Choice: (1-2, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z436
PURPOSE

The purpose of Menu Z436 is to verify if you want to delete the data you choose on Menu Z510. You advance to this menu by selecting option 2 on Menu Z435.

OPTIONS

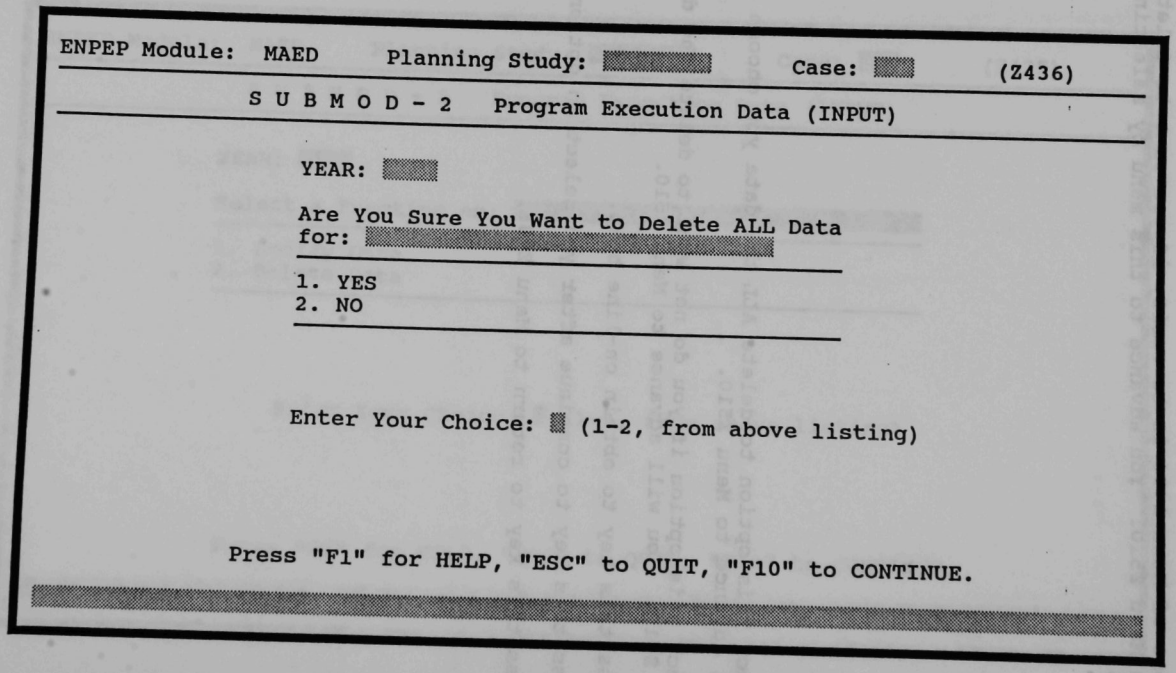
1 Select this option to delete ALL the data you choose on Menu Z510. You will advance to Menu Z510.

2 Select this option if you do not want to delete the data you choose on Menu Z510. You will advance to Menu Z510.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z435.


ENPEP Module: MAED Planning Study: Case: (Z436)
S U B M O D - 2 Program Execution Data (INPUT)
YEAR:
Are You Sure You Want to Delete ALL Data for:
1. YES
2. NO
Enter Your Choice: (1-2, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z440
PURPOSE

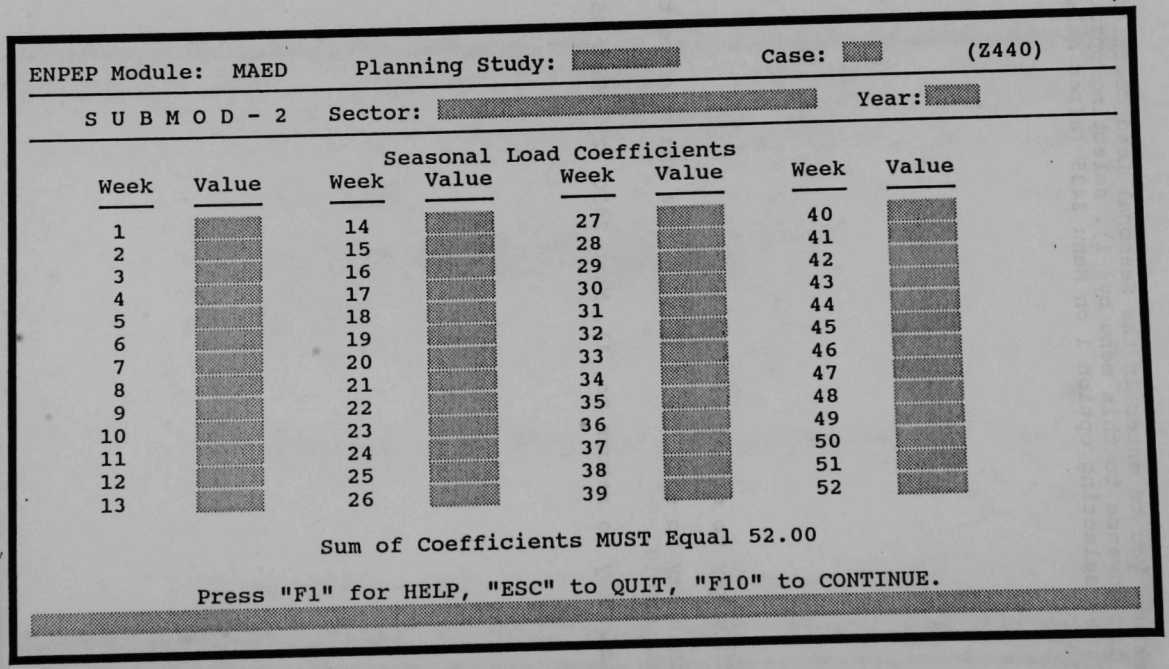
Menu Z440 allows you to enter in the Seasonal Load Coefficients for the 52 weeks. You advance to this menu by 1). selecting option 1 on Menu Z430 or 2). by selecting option 1 on Menu Z435 (after selecting option 1 on Menu Z510).

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to 1). Menu Z430 2.) Menu Z510.

Esc Press this key to return to 1). Menu Z430 2). Menu Z510.


ENPEP Module: MAED Planning Study: Case: (Z440)
S U B M O D - 2 Sector: Year:
Seasonal Load Coefficients
Week Value Week Value Week Value Week Value
1 14 27 40
2 15 28 41
3 16 29 42
4 17 30 43
5 18 31 44
6 19 32 45
7 20 33 46
8 21 34 47
9 22 35 48
10 23 36 49
11 24 37 50
12 25 38 51
13 26 39 52
Sum of Coefficients MUST Equal 52.00
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z445
PURPOSE

Menu Z445 allows you to select which Day Type for Daily Weight Coefficients you wish to view or change. You advance to this menu by 1). selecting option 2 on Menu Z430 or 2). by selecting option 1 on Menu Z435 (after selecting option 2 on Menu Z510).

OPTIONS

0 Select this option to view or change Daily Weight Coefficients for Day Type 0. You will advance to Menu Z450.

1 Select this option to view or change Daily Weight Coefficients for Day Type 1. You will advance to Menu Z450.

2 Select this option to view or change Daily Weight Coefficients for Day Type 2. You will advance to Menu Z450.

3 Select this option to view or change Daily Weight Coefficients for Day Type 3. You will advance to Menu Z450.

4 Select this option to view or change Daily Weight Coefficients for Day Type 4. You will advance to Menu Z450.

5 Select this option to view or change Daily Weight Coefficients for Day Type 5. You will advance to Menu Z450.

6 Select this option to view or change Daily Weight Coefficients for Day Type 6. You will advance to Menu Z450.

7 Select this option to view or change Daily Weight Coefficients for Day Type 7. You will advance to Menu Z450.

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and continue after you select an option.

Esc Press this key to return to 1). Menu Z430 2). Menu Z435.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z445)

S U B M O D - 2

Select a Day Type for Daily Weight Coefficients

Number	Description
0	[redacted]
1	
2	
3	
4	
5	
6	
7	

Enter Your Choice: [redacted] (0-7, from above listing)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z450
PURPOSE

Menu Z450 allows you to enter in the Daily Weight Coefficients for the 52 weeks. You advance to this menu by selecting F10 on Menu Z445.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z445.

Esc Press this key to return to 1). Menu Z430 if option 2 on Menu Z430 was chosen or 2). Menu Z510 if option 2 was chosen on Menu Z510.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z450)

S U B M O D - 2 Sector: [redacted] Year: [redacted]

Daily Weight Coefficients for Day Type: [redacted]

Week	Value	Week	Value	Week	Value	Week	Value
1	[redacted]	14	[redacted]	27	[redacted]	40	[redacted]
2	[redacted]	15	[redacted]	28	[redacted]	41	[redacted]
3	[redacted]	16	[redacted]	29	[redacted]	42	[redacted]
4	[redacted]	17	[redacted]	30	[redacted]	43	[redacted]
5	[redacted]	18	[redacted]	31	[redacted]	44	[redacted]
6	[redacted]	19	[redacted]	32	[redacted]	45	[redacted]
7	[redacted]	20	[redacted]	33	[redacted]	46	[redacted]
8	[redacted]	21	[redacted]	34	[redacted]	47	[redacted]
9	[redacted]	22	[redacted]	35	[redacted]	48	[redacted]
10	[redacted]	23	[redacted]	36	[redacted]	49	[redacted]
11	[redacted]	24	[redacted]	37	[redacted]	50	[redacted]
12	[redacted]	25	[redacted]	38	[redacted]	51	[redacted]
13	[redacted]	26	[redacted]	39	[redacted]	52	[redacted]

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z452
PURPOSE

Menu Z452 allows you to specify which season for Hourly Load Coefficients you wish to view or change. You advance to this menu by selecting option 3 on Menu Z430.

OPTIONS

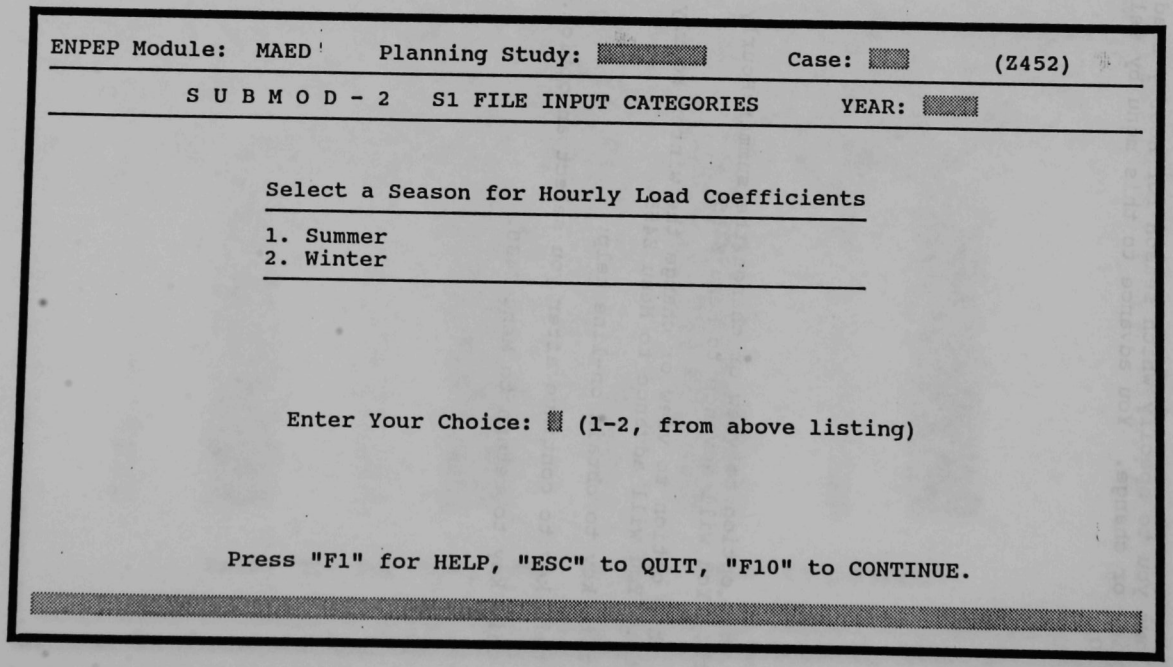
1 Select this option to view or change the summer Hourly Load Coefficients. You will advance to Menu Z455.

2 Select this option to view or change the winter Hourly Load Coefficients. You will advance to Menu Z455.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z430.


ENPEP Module: MAED Planning Study: Case: (Z452)
S U B M O D - 2 S1 FILE INPUT CATEGORIES YEAR:
Select a Season for Hourly Load Coefficients
1. Summer
2. Winter
Enter Your Choice: (1-2, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z455
PURPOSE

Menu Z455 allows you to select which Day Type for Hourly Load Coefficient Client Shares you wish to view or change. You advance to this menu by 1). selecting F10 on Menu Z452 or 2). by selecting option 1 on Menu Z435 (after selecting option 1 on Menu Z510) or 3). by selecting option 1 on Menu Z435 (after selecting option 2 on Menu Z510)

OPTIONS

0 Select this option to view or change Hourly Load Coefficient Client Shares for Day Type 0.

1 Select this option to view or change Hourly Load Coefficient Client Shares for Day Type 1.

2 Select this option to view or change Hourly Load Coefficient Client Shares for Day Type 2.

3 Select this option to view or change Hourly Load Coefficient Client Shares for Day Type 3.

4 Select this option to view or change Hourly Load Coefficient Client Shares for Day Type 4.

5 Select this option to view or change Hourly Load Coefficient Client Shares for Day Type 5.

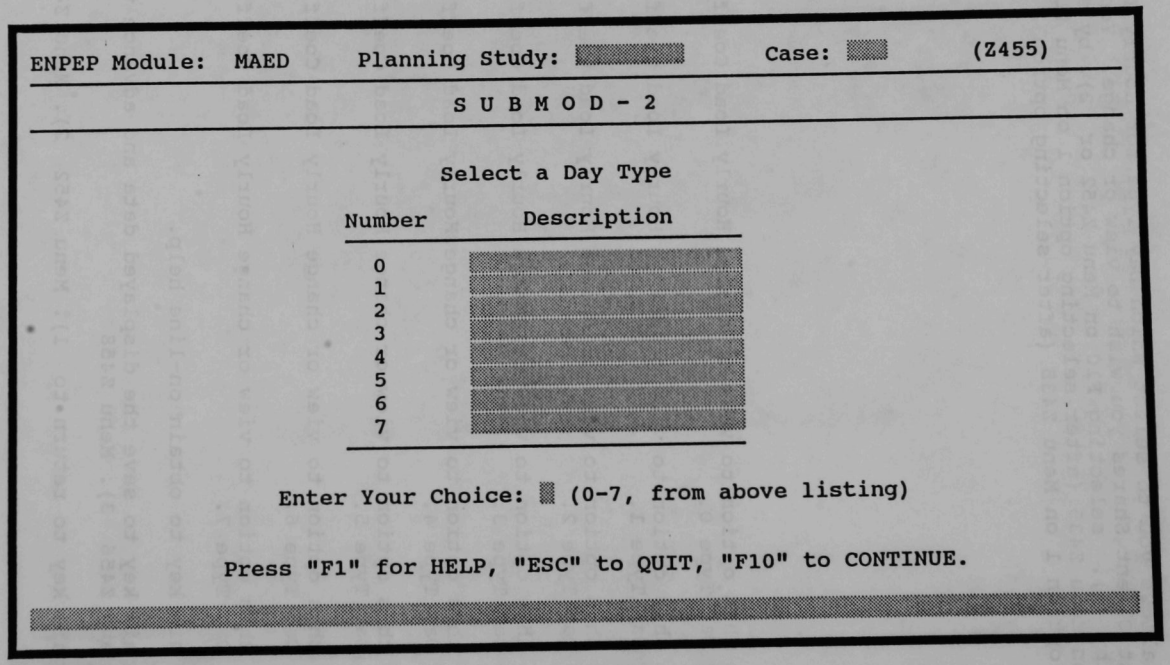
6 Select this option to view or change Hourly Load Coefficient Client Shares for Day Type 6.

7 Select this option to view or change Hourly Load Coefficient Client Shares for Day Type 7.

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to 1). Menu Z457 2). Menu Z456 3). Menu Z458

Esc Press this key to return to 1). Menu Z452 2). Menu Z435 3). Menu Z435.


ENPEP Module: MAED Planning Study: Case: (Z455)
S U B M O D - 2
Select a Day Type
Number Description
0
1
2
3
4
5
6
7
Enter Your Choice: (0-7, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z456
PURPOSE

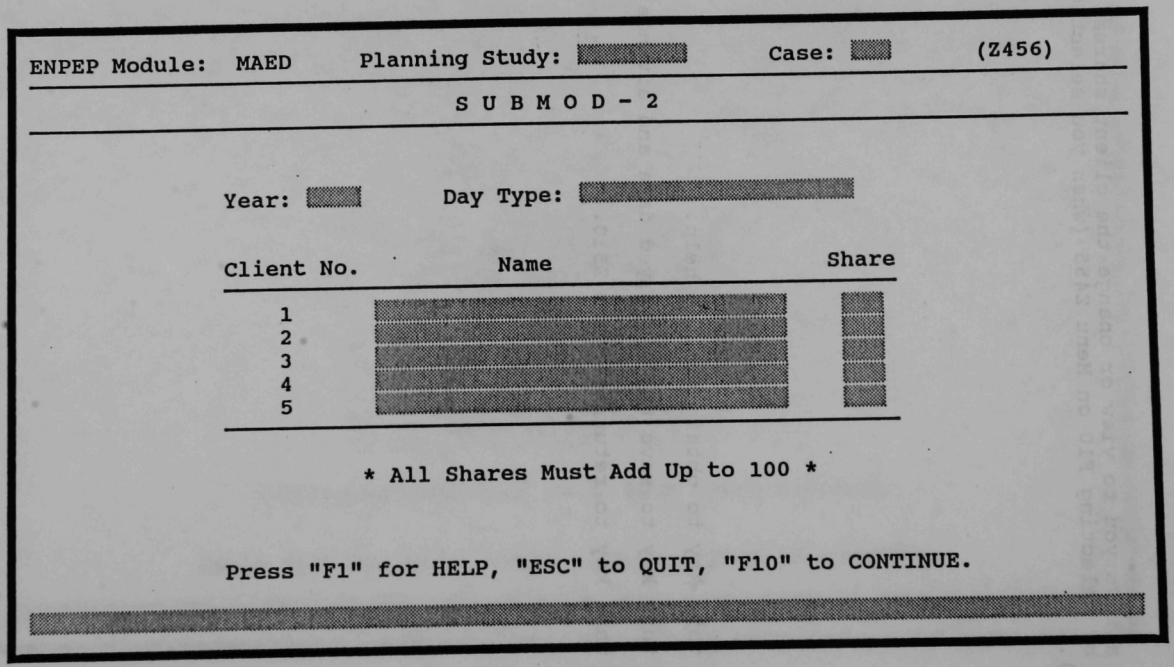
Menu Z456 allows you to view or change the client shares. You advance to this menu by selecting F10 on Menu Z455 (when you select option 1 on Menu Z435).

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z455.

Esc Press this key to return to Menu Z510.


ENPEP Module: MAED Planning Study: Case: (Z456)
S U B M O D - 2
Year: Day Type:
Client No. Name Share
1
2
3
4
5
* All Shares Must Add Up to 100 *
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z457
PURPOSE

Menu Z457 allows you to select which client for Hourly Load Coefficients you wish to view or change. You also can change the client shares on this menu. You advance to this menu by selecting F10 on Menu Z455.

OPTIONS

1 Select this option to view or change Hourly Load Coefficients for client number 1. The client share must be greater than 0 for a client t be considered.

2 Select this option to view or change Hourly Load Coefficients for client number 2. The client share must be greater than 0 for a client t be considered.

3 Select this option to view or change Hourly Load Coefficients for client number 3. The client share must be greater than 0 for a client t be considered.

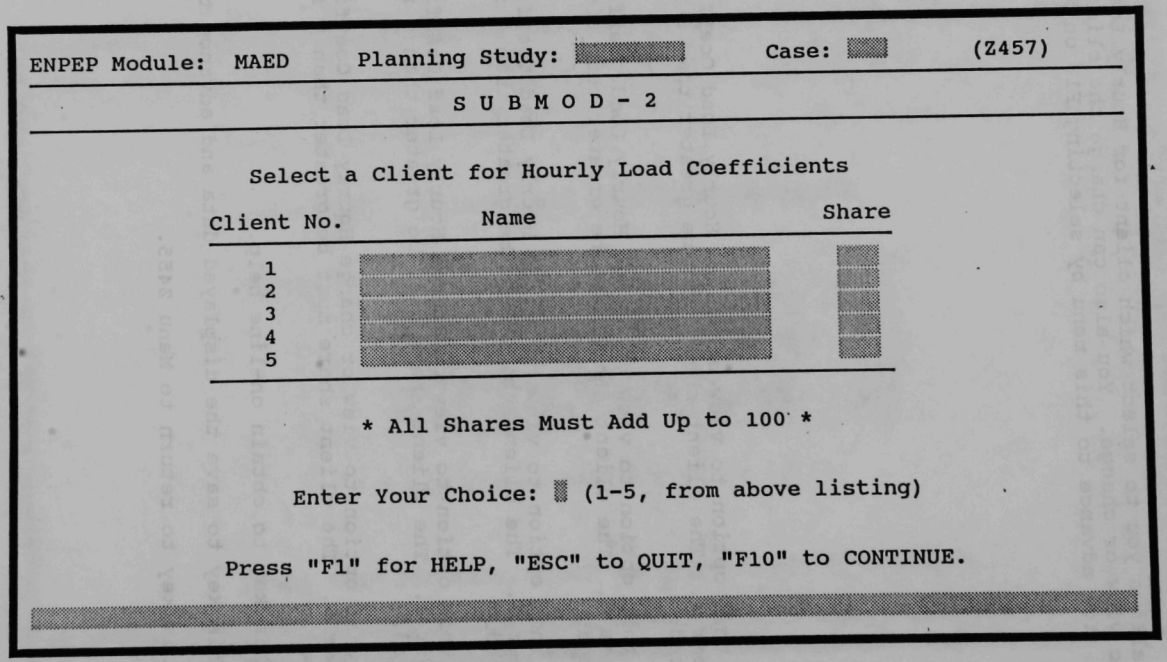
4 Select this option to view or change Hourly Load Coefficients for client number 4. The client share must be greater than 0 for a client t be considered.

5 Select this option to view or change Hourly Load Coefficients for client number 5. The client share must be greater than 0 for a client t be considered.

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z460.

Esc Press this key to return to Menu Z455.


ENPEP Module: MAED Planning Study: Case: (Z457)
S U B M O D - 2
Select a Client for Hourly Load Coefficients
Client No. Name Share
1
2
3
4
5
* All Shares Must Add Up to 100 *
Enter Your Choice: (1-5, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z458
PURPOSE

Menu Z458 allows you to select which client for Hourly Load Coefficients you wish to view or change. You advance to this menu by selecting F10 on Menu Z455. (when you chose option 2 on Menu Z515)

OPTIONS

1 Select this option to view or change Hourly Load Coefficients for client number 1. The client share must be greater than 0.

2 Select this option to view or change Hourly Load Coefficients for client number 2. The client share must be greater than 0.

3 Select this option to view or change Hourly Load Coefficients for client number 3. The client share must be greater than 0.

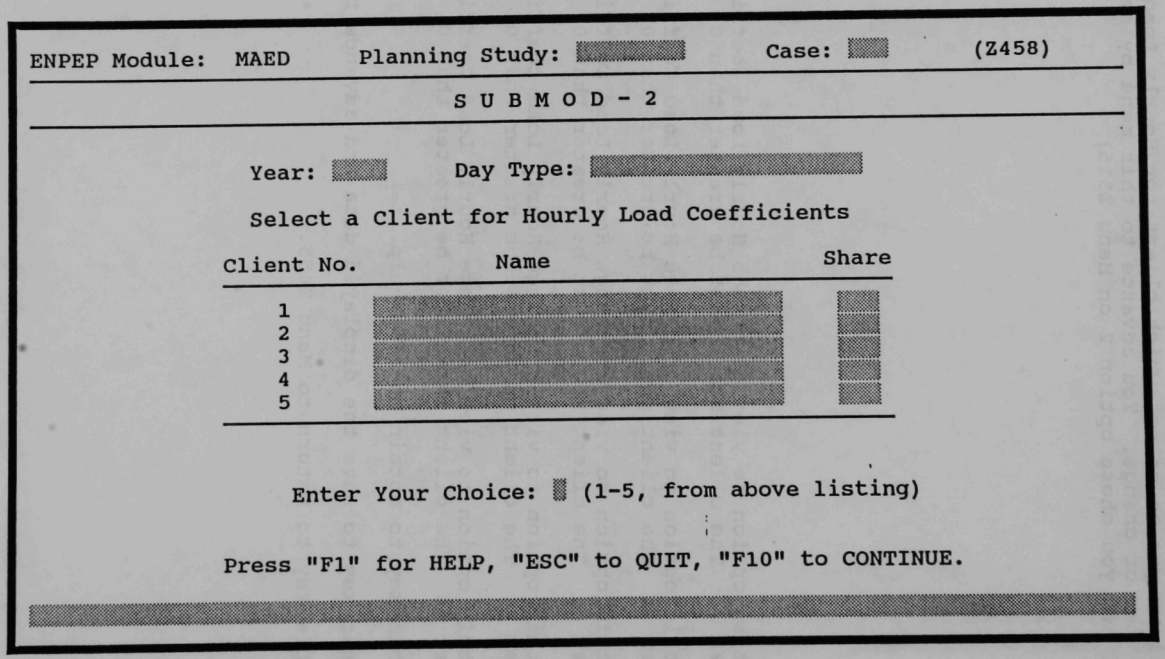
4 Select this option to view or change Hourly Load Coefficients for client number 4. The client share must be greater than 0.

5 Select this option to view or change Hourly Load Coefficients for client number 5. The client share must be greater than 0.

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z460.

Esc Press this key to return to Menu Z455.


ENPEP Module: MAED Planning Study: Case: (Z458)
S U B M O D - 2
Year: Day Type:
Select a Client for Hourly Load Coefficients
Client No. Name Share
1
2
3
4
5
Enter Your Choice: (1-5, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z460
PURPOSE

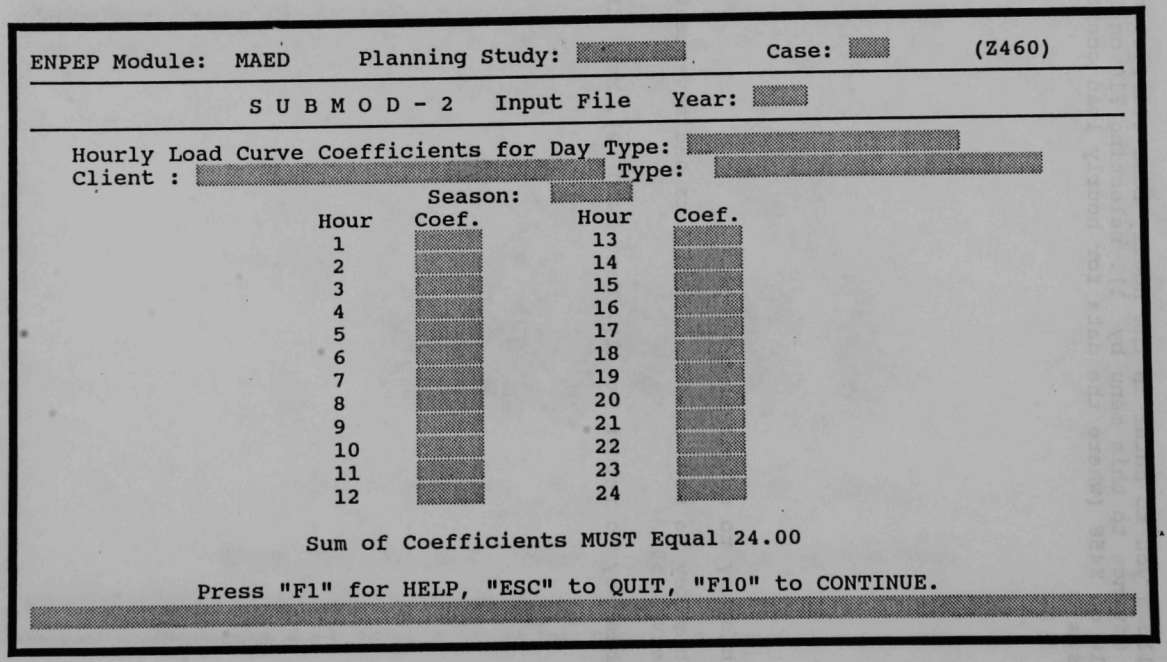
Menu Z460 allows you to enter in the Hourly Load Coefficients for the 24 hours. You advance to this menu by 1). selecting F10 on Z457. 2). selecting F10 on Z458 (where the data for hourly load coefficients already exists.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to 1). Menu Z457 2). Menu Z458.

Esc Press this key to return to 1). Menu Z430 2). Menu Z510.


ENPEP Module: MAED Planning Study: Case: (Z460)
S U B M O D - 2 Input File Year:
Hourly Load Curve Coefficients for Day Type:
Client : Type:
Season:
Hour Coef. Hour Coef.
1 13
2 14
3 15
4 16
5 17
6 18
7 19
8 20
9 21
10 22
11 23
12 24
Sum of Coefficients MUST Equal 24.00
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z470
PURPOSE

The purpose of Menu Z470 is to select the type of data category you wish to view or change. You advance to this menu by selecting option 3 on Menu Z420.

OPTIONS

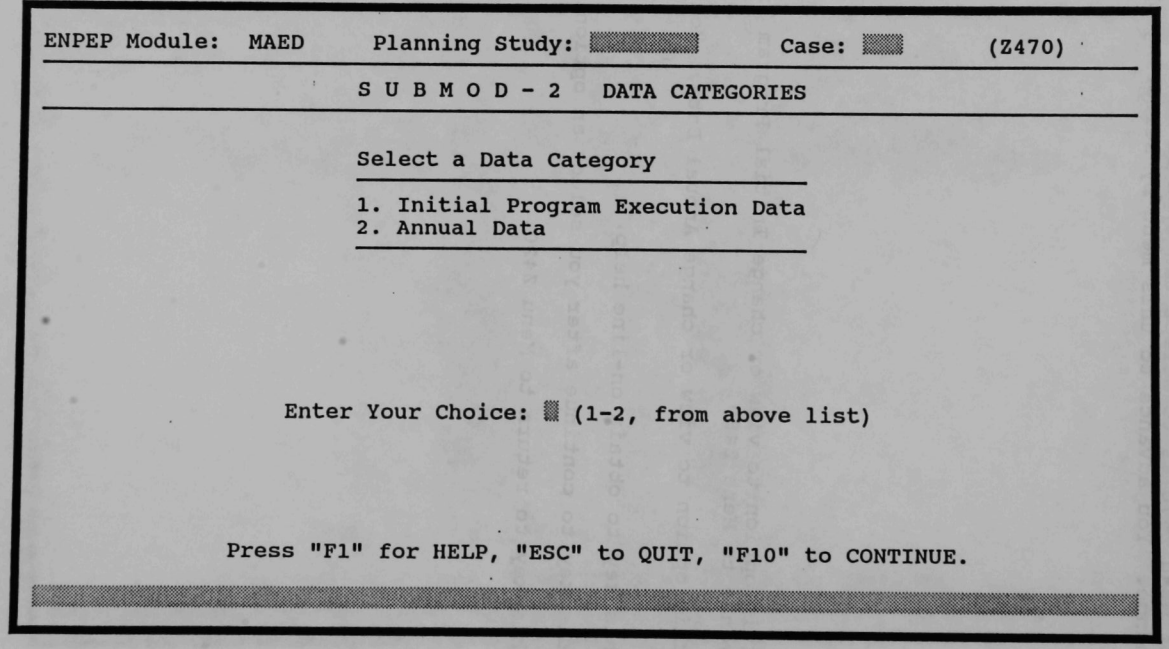
1 Select this option to view or change Initial Program Execution Data. You will advance to Menu Z480.

2 Select this option to view or change Annual Data. You will advance to Menu Z490.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z420.


ENPEP Module: MAED Planning Study: Case: (Z470)
S U B M O D - 2 DATA CATEGORIES
Select a Data Category
1. Initial Program Execution Data
2. Annual Data
Enter Your Choice: (1-2, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z480
PURPOSE

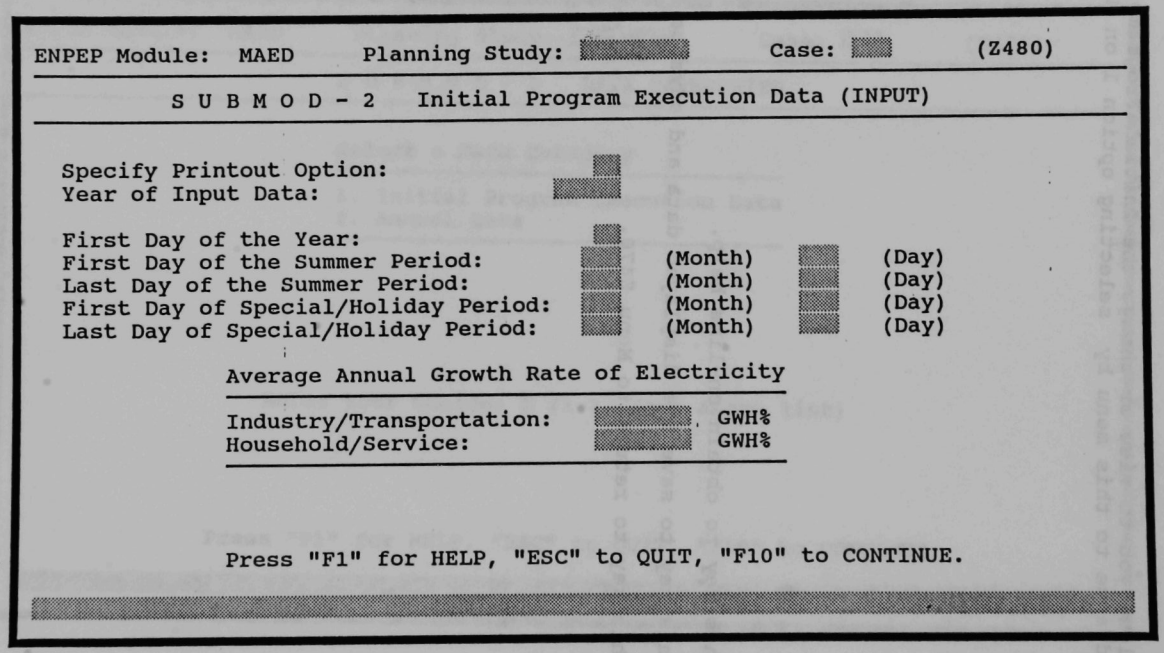
Menu Z480 allows you to view or change the Initial Program Execution Data. You advance to this menu by selecting option 1 on Menu Z470.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z470.

Esc Press this key to return to Menu Z470.


ENPEP Module: MAED Planning Study: Case: (Z480)
S U B M O D - 2 Initial Program Execution Data (INPUT)
Specify Printout Option:
Year of Input Data:
First Day of the Year:
First Day of the Summer Period: (Month) (Day)
Last Day of the Summer Period: (Month) (Day)
First Day of Special/Holiday Period: (Month) (Day)
Last Day of Special/Holiday Period: (Month) (Day)
Average Annual Growth Rate of Electricity
Industry/Transportation: GWH%
Household/Service: GWH%
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z490
PURPOSE

The purpose of Menu Z490 is to select the year and the data category you wish to view or change. You advance to this menu by selecting option 2 on Menu Z470.

OPTIONS

1 Select this option to view or change General data for the year you specified. You will advance to Menu Z500.

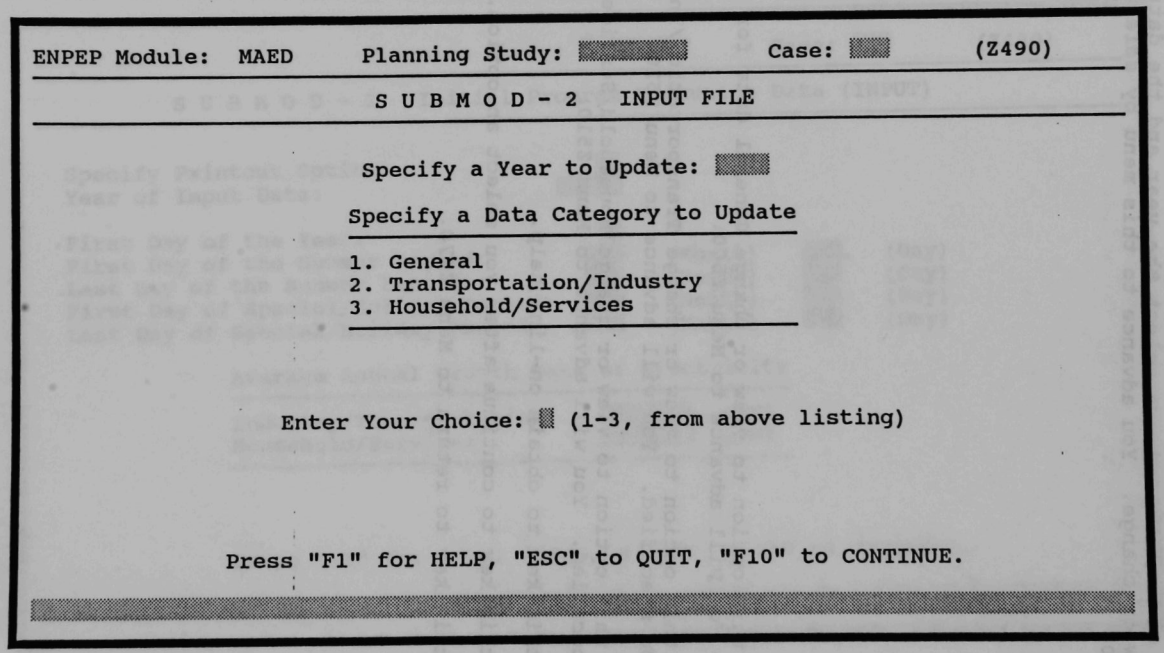
2 Select this option to view or change Transportation/Industry data for the year you specified. You will advance to Menu Z510.

3 Select this option to view or change Household/Services data for the year you specified. You will advance to Menu Z510.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z470.


ENPEP Module: MAED Planning Study: Case: (Z490)
S U B M O D - 2 INPUT FILE
Specify a Year to Update:
Specify a Data Category to Update
1. General
2. Transportation/Industry
3. Household/Services
Enter Your Choice: (1-3, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z500
PURPOSE

Menu Z500 allows you to view or change the Program Execution Data for the year you specified in Menu Z490. You advance to this menu by selecting option 1 on Menu Z490.

OPTIONS

F1 Press this key to obtain on-line help.

F10 Press this key to save the displayed data and advance to Menu Z490.

Esc Press this key to return to Menu Z490.

ENPEP Module: MAED Planning Study: [redacted] Case: [redacted] (Z500)

S U B M O D - 2 Program Execution Data (INPUT) (cont)

Year: [redacted]

First Day of the Year: [redacted]
First Day of the Summer Period: [redacted] (Month) [redacted] (Day)
Last Day of the Summer Period: [redacted] (Month) [redacted] (Day)
First Day of Special/Holiday Period: [redacted] (Month) [redacted] (Day)
Last Day of Special/Holiday Period: [redacted] (Month) [redacted] (Day)

Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z501
PURPOSE

The purpose of Menu Z501 is to see if you want to save the data you have changed. You advance to this menu by selecting option Esc on Menu Z050, Menu Z400, or Menu Z600.

OPTIONS

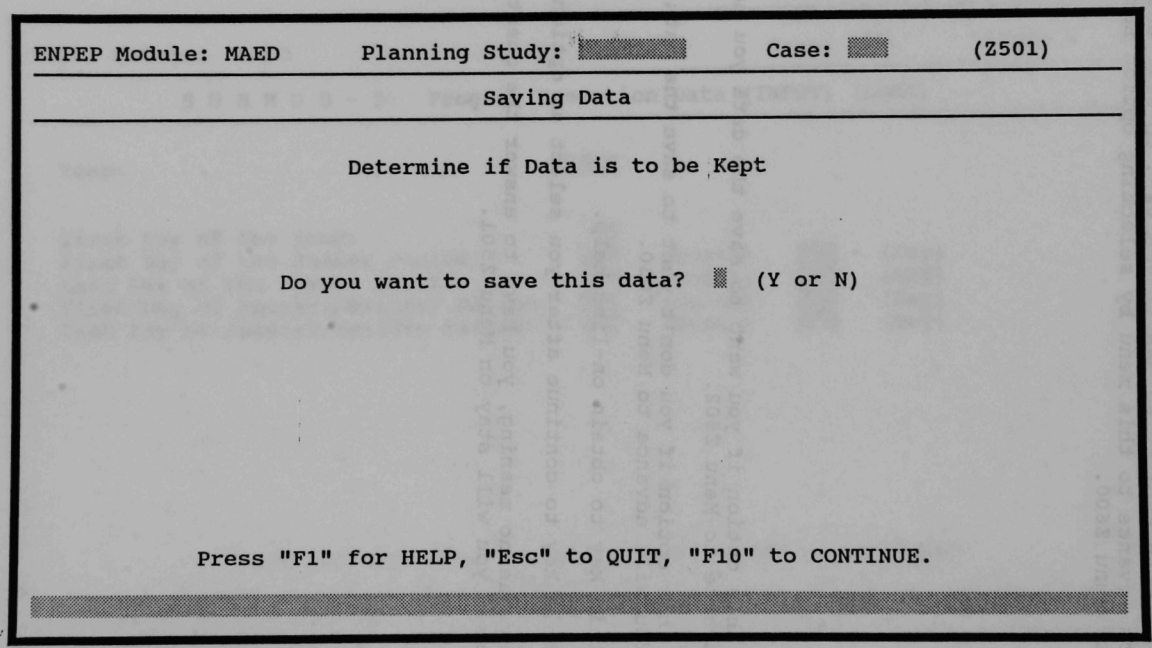
Y Select this option if you want to save the data you have changed. You will advance to Menu Z502.

N Select this option if you don't want to save the data you have changed. You will advance to Menu Z030.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc This key has no meaning, you have to answer the question. If this key is pressed you will stay on Menu Z501.


ENPEP Module: MAED Planning Study: Case: (Z501)
Saving Data
Determine if Data is to be Kept
Do you want to save this data? (Y or N)
Press "F1" for HELP, "Esc" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z502
PURPOSE

The purpose of Menu Z502 is to see if you want to declare the SUBMOD you are leaving as complete or incomplete. You advance to this menu by selecting option Y on Menu Z501.

OPTIONS

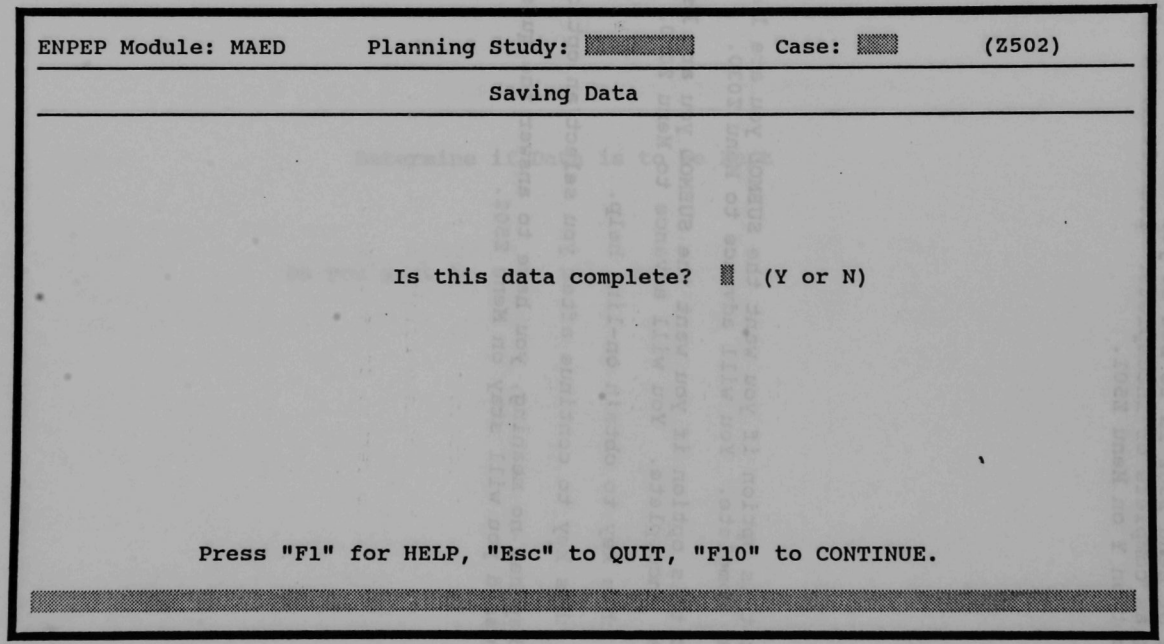
Y Select this option if you want the SUBMOD you are leaving to be declared as complete. You will advance to Menu Z030.

N Select this option if you want the SUBMOD you are leaving to be declared as incomplete. You will advance to Menu Z030.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc This key has no meaning, you have to answer the question. If this key is pressed you will stay on Menu Z502.


ENPEP Module: MAED Planning Study: Case: (Z502)
Saving Data
Is this data complete? (Y or N)
Press "F1" for HELP, "Esc" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z510
PURPOSE

The purpose of Menu Z510 is to select the type of data category you wi
to view or change for the year of Annual data which you specified in M
Z490. You advance to this menu by selecting option 2 or 3 on Menu Z49

OPTIONS

1 Select this option to view, change, create or delete Season Coefficient Data. You will advance to Menu Z435.

2 Select this option to view, change, create or delete Daily Coefficient Data. You will advance to Menu Z435.

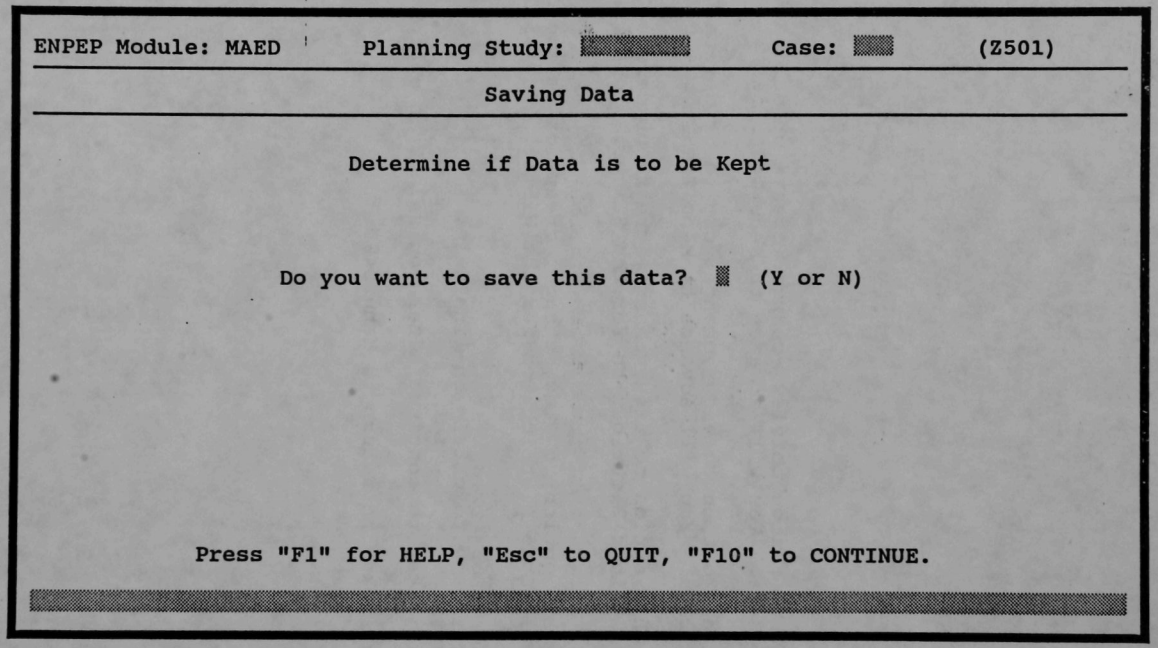
3 Select this option to view, change, create or delete Client Shares Data or Hourly Load Distribution for the Summer. You will advance to Menu Z515.

4 Select this option to view, change, create or delete Client Shares Data or Hourly Load Distribution for the Winter. You will advance to Menu Z515.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z490.


ENPEP Module: MAED Planning Study: Case: (Z501)
Saving Data
Determine if Data is to be Kept
Do you want to save this data? (Y or N)
Press "F1" for HELP, "Esc" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z515
PURPOSE

The purpose of Menu Z515 is to select the type of data category you wish to view or change for the Hourly Load Coefficients which you specified in Menu Z510. You advance to this menu by selecting option 3 or 4 on Menu Z510.

OPTIONS

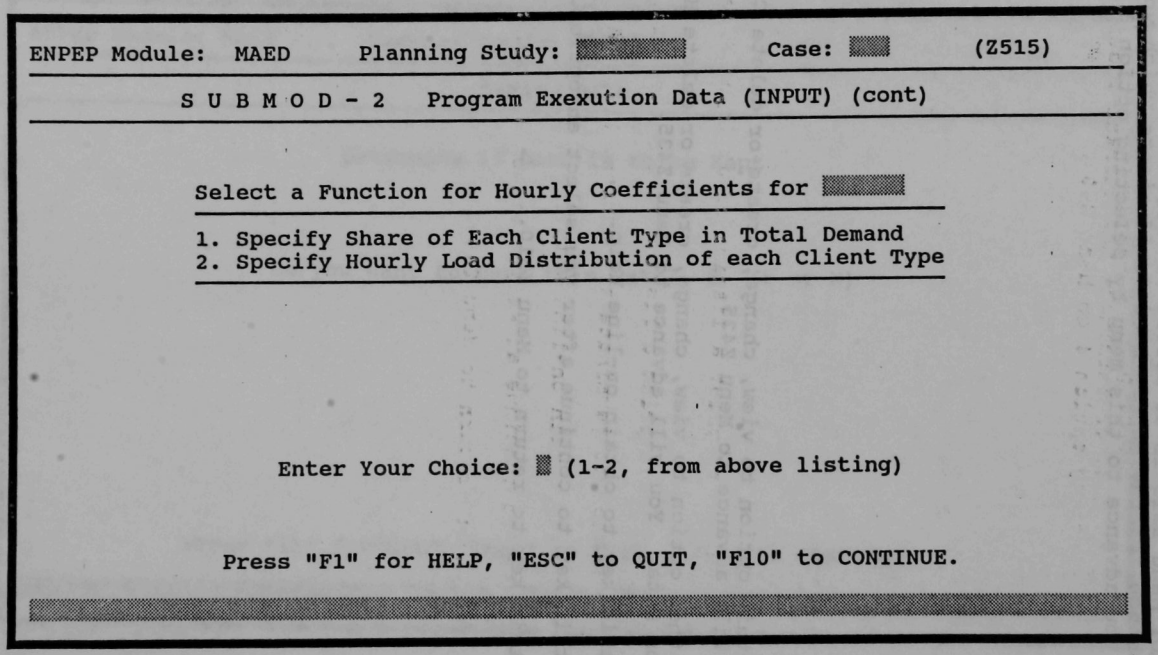
1 Select this option to view, change, create or delete Client Shares Data. You will advance to Menu Z435.

5 Select this option to view, change, create or delete Hourly Load Distribution Data. You will advance to Menu Z435.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z510.


ENPEP Module: MAED Planning Study: Case: (Z515)
S U B M O D - 2 Program Exexution Data (INPUT) (cont)
Select a Function for Hourly Coefficients for
1. Specify Share of Each Client Type in Total Demand
2. Specify Hourly Load Distribution of each Client Type
Enter Your Choice: (1-2, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z550
PURPOSE

The purpose of Menu Z550 is to print a listing of an input file, print a listing of an output file, or terminate the current listing. You advance to this menu by selecting option 4 on Menu Z400.

OPTIONS

1 Select this option to print a listing of an input file. You advance to Menu Z560.

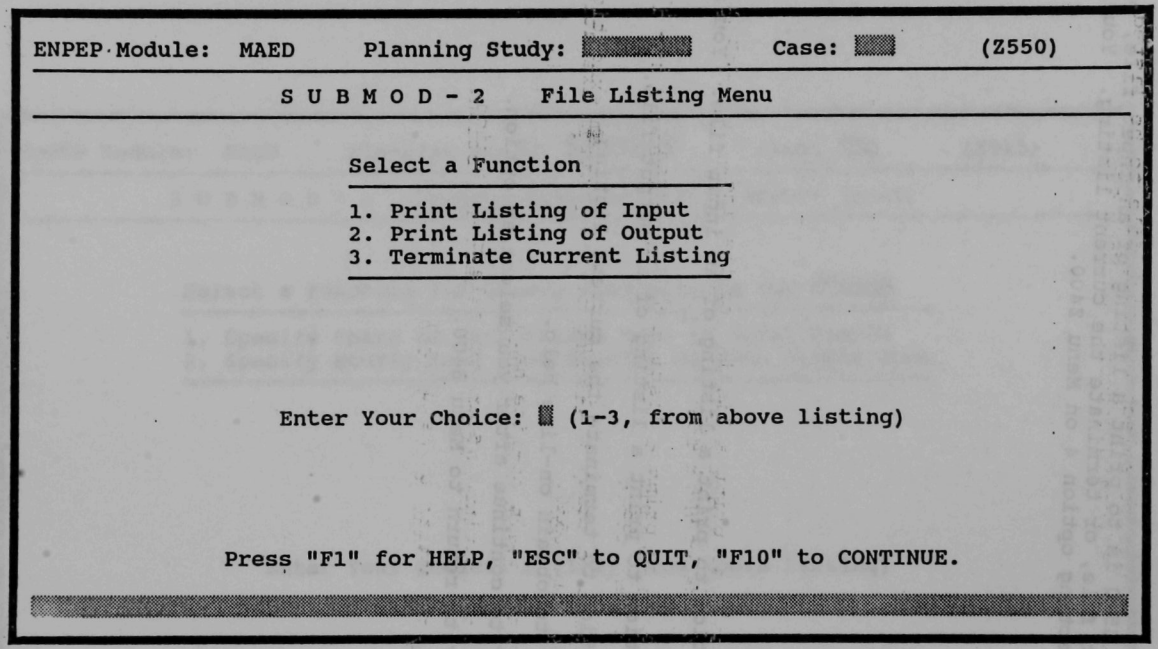
2 Select this option to print a listing of an output file.

3 Select this option to terminate the current listing.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z400.


ENPEP Module: MAED Planning Study: Case: (Z550)
S U B M O D - 2 File Listing Menu
Select a Function
1. Print Listing of Input
2. Print Listing of Output
3. Terminate Current Listing
Enter Your Choice: (1-3, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z560
PURPOSE

The purpose of Menu Z560 is to select an input file to be listed. You advance to this menu by selecting option 1 on Menu Z550.

OPTIONS

1 Select this option to print a listing of the industry/transportation file. You will advance to Menu Z550.

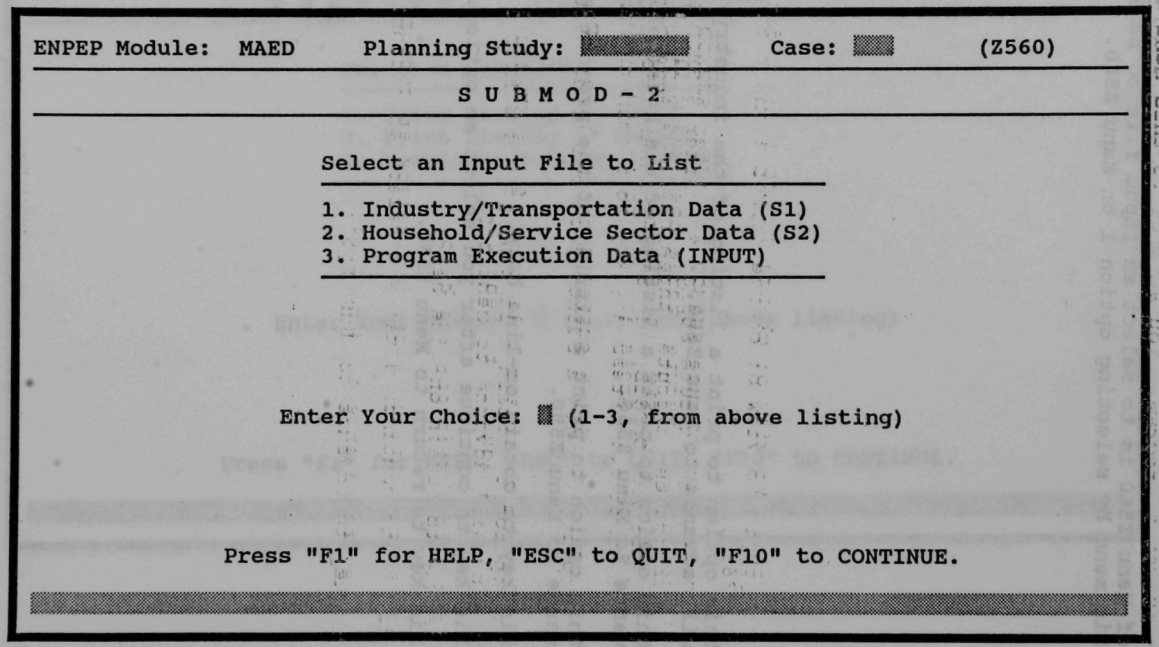
2 Select this option to print a listing of the household/service file. You will advance to Menu Z550.

3 Select this option to print a listing of the program execution file. You will advance to Menu Z550.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z550.


ENPEP Module: MAED Planning Study: Case: (Z560)
S U B M O D - 2
Select an Input File to List
1. Industry/Transportation Data (S1)
2. Household/Service Sector Data (S2)
3. Program Execution Data (INPUT)
Enter Your Choice: (1-3, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z600
PURPOSE

Menu Z600 allows you to view or change the SUBMOD 3 input and output and to execute the SUBMOD 3 program. You advance to this menu by selecting option 3 on Menu Z030.

OPTIONS

1 Select this option to view or change SUBMOD 3 input data. You will advance to Menu Z610.

2 Select this option to execute SUBMOD 3. After SUBMOD 3 (or any of the other MAED submodules) execute, three messages will be diplayed on the screen: (1) FILES ARE CLOSED, (2) STOP-PROGRAM TERMINATED, and (3) STRIKE A KEY WHEN READY ... Press any key to return to Menu Z600.

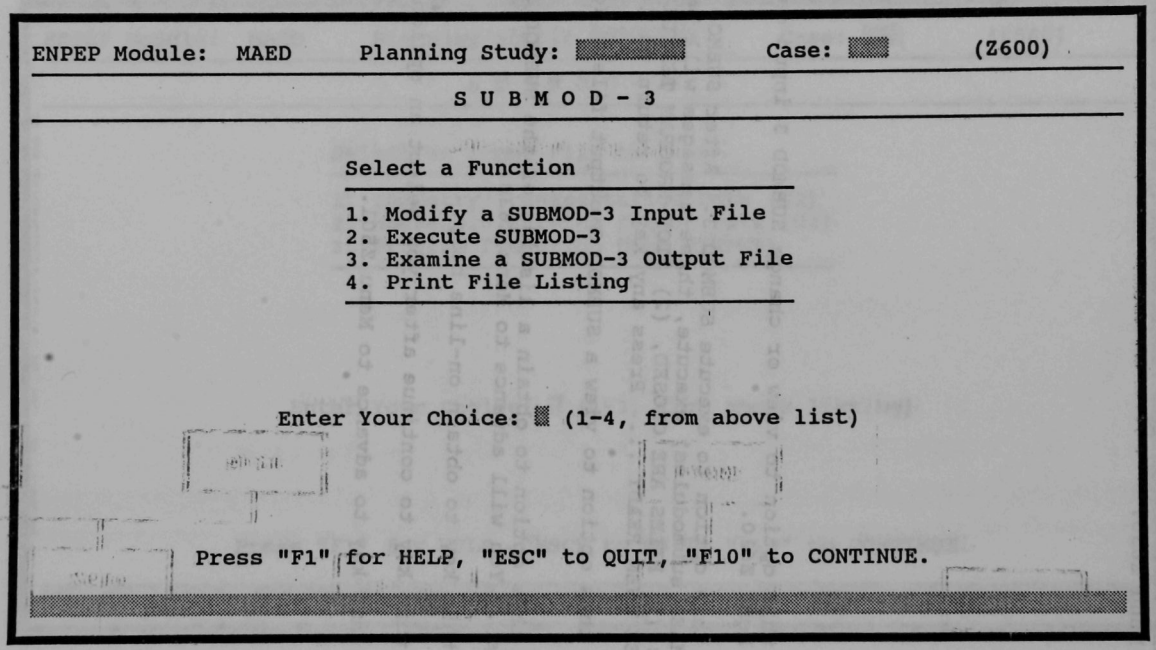
3 Select this option to view a SUBMOD 3 output file. You will advance Menu Z605.

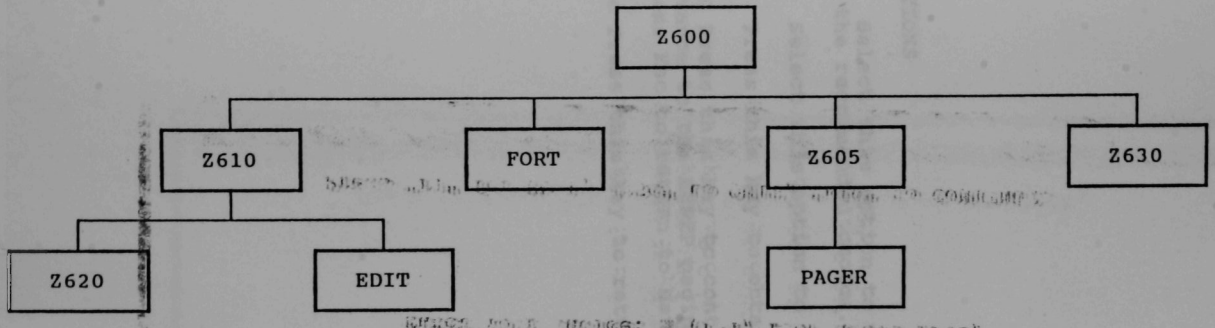
4 Select this option to obtain a listing of the SUBMOD 3 input or output files. You will advance to Menu Z630.

F1 - Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to advance to Menu Z501.


ENPEP Module: MAED Planning Study: Case: (Z600)
S U B M O D - 3
Select a Function
1. Modify a SUBMOD-3 Input File
2. Execute SUBMOD-3
3. Examine a SUBMOD-3 Output File
4. Print File Listing
Enter Your Choice: (1-4, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.



SUB-MODULE 3 of MAED

FORM NUMBER - Z605
PURPOSE

Menu Z605 allows you to view the SUBMOD 3 output. You advance to this menu by selecting option 3 on Menu Z600.

OPTIONS

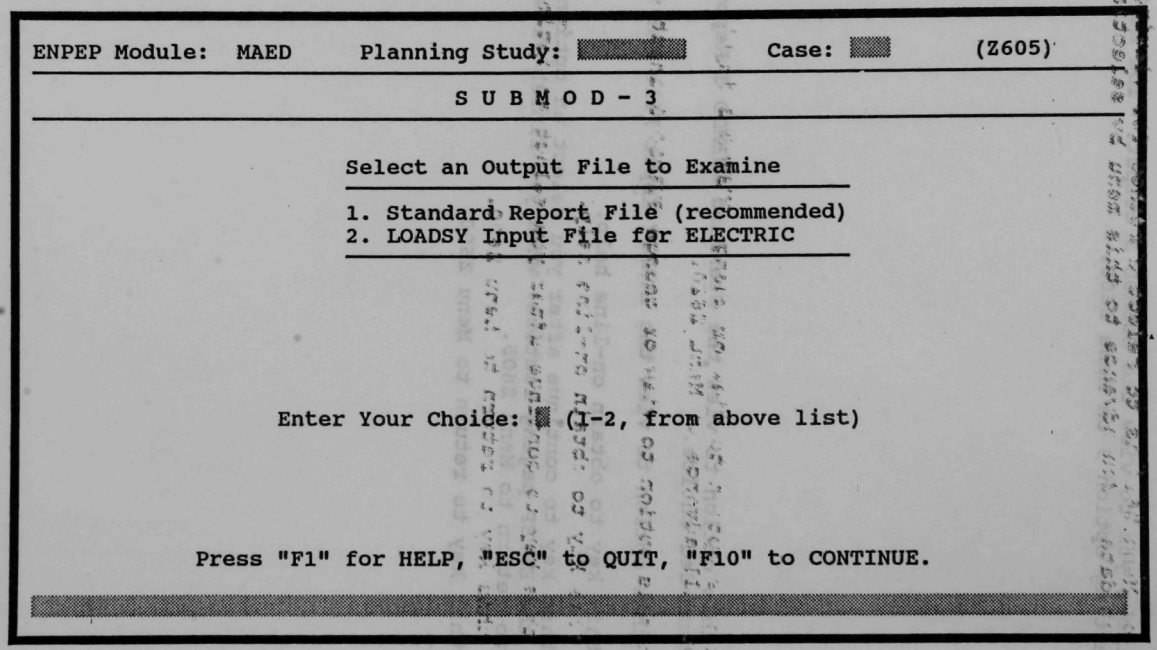
1 Select this option to view the Standard SUBMOD 3 Report File. This is the recommended choice.

2 Select this option to view the LOADSY Input File for ELECTRIC.

F1 Press this key to obtain on-line help.

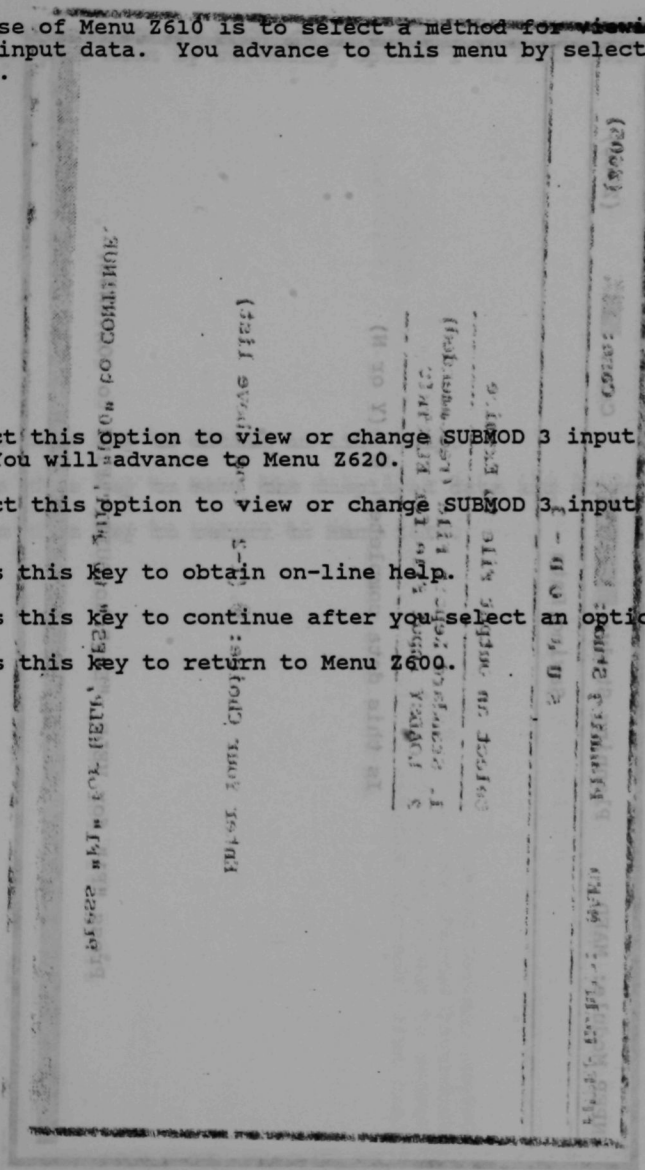
F10 Press this key to continue after you select an option. You will advance to the ENPEP paging routine; when you finish viewing the output, press Esc to return to Menu Z605.

Esc Press this key to return to Menu Z600.


ENPEP Module: MAED Planning Study: Case: (Z605)
S U B M O D - 3
Select an Output File to Examine
1. Standard Report File (recommended)
2. LOADSY Input File for ELECTRIC
Enter Your Choice: (1-2, from above list)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z610
PURPOSE

The purpose of Menu Z610 is to select a method for viewing or changing SUBMOD 3 input data. You advance to this menu by selecting option 1 on Menu Z600.



OPTIONS

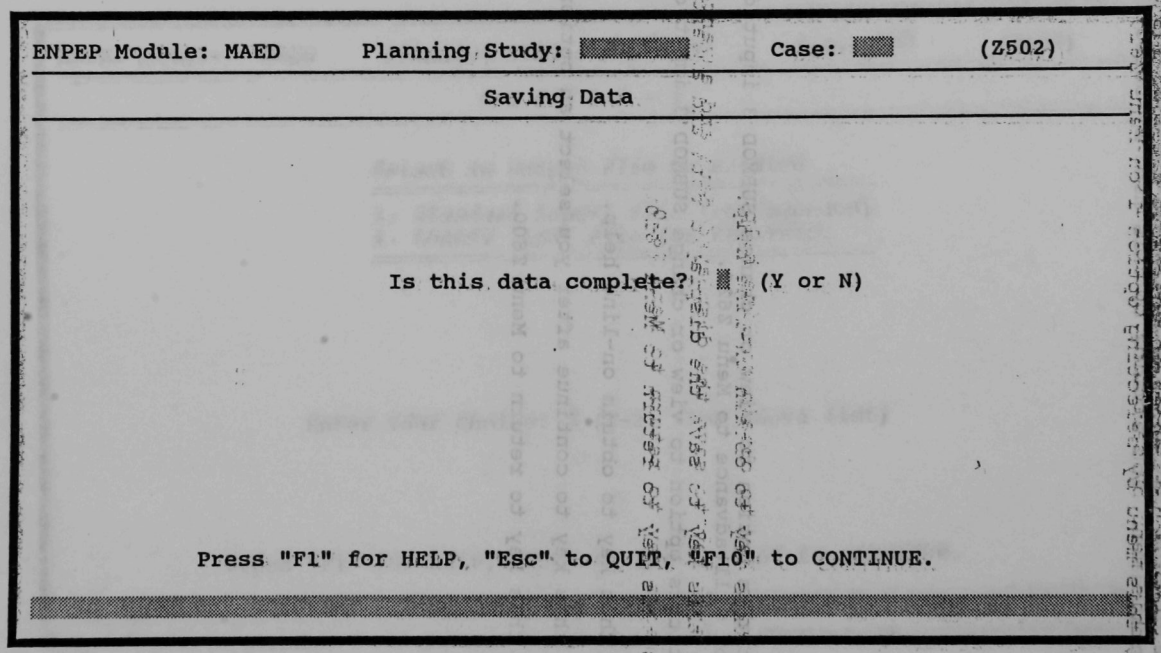
1 Select this option to view or change SUBMOD 3 input data by using forms. You will advance to Menu Z620.

2 Select this option to view or change SUBMOD 3 input data by using th editor.

F1 Press this key to obtain on-line help.

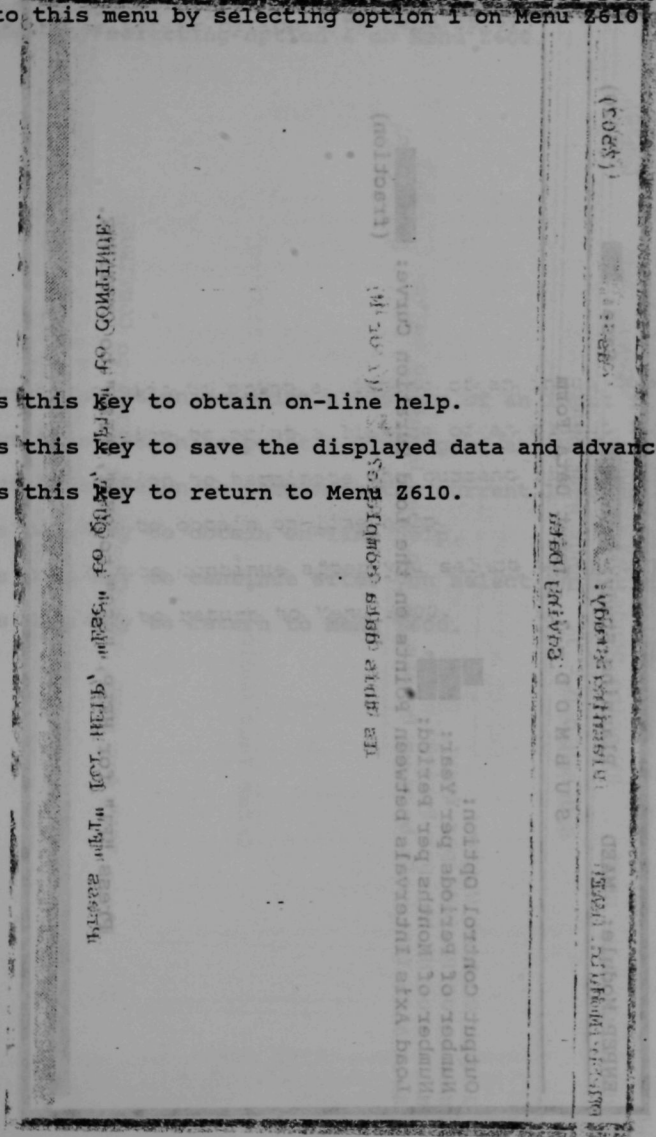
F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z600.


ENPEP Module: MAED Planning Study: Case: (Z502)
Saving Data
Is this data complete? (Y or N)
Press "F1" for HELP, "Esc" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z620
PURPOSE

Menu Z620 allows you to enter in the input data for SUBMOD 3. You advance to this menu by selecting option 1 on Menu Z610.

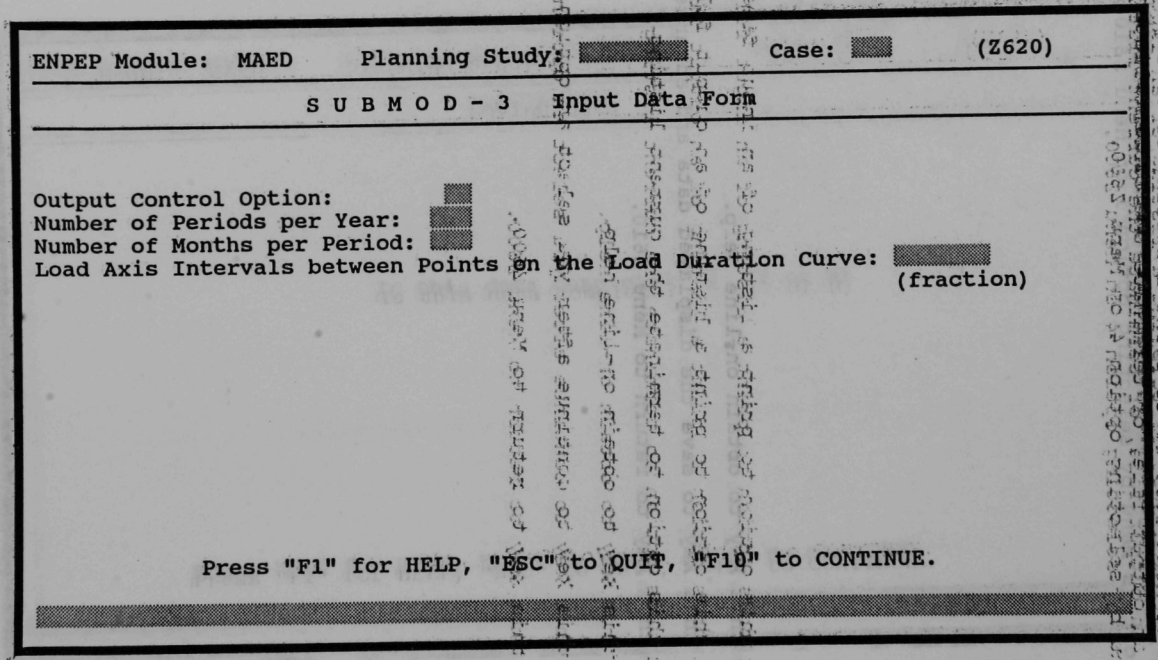


OPTIONS

F1 Press this key to obtain on-line help.

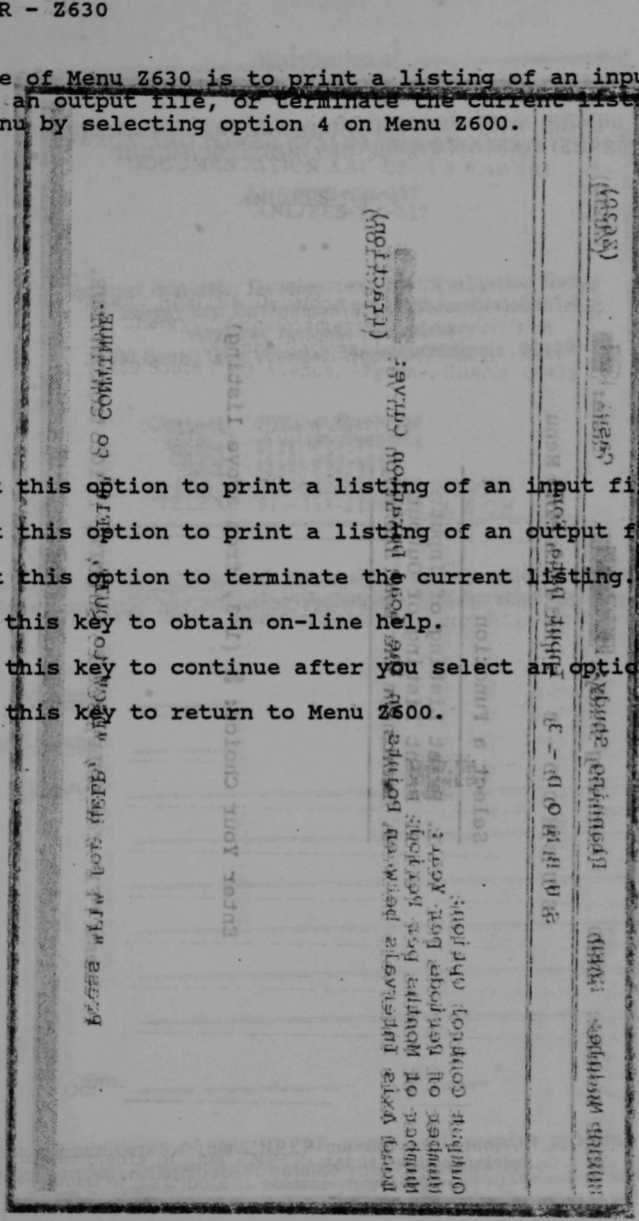
F10 Press this key to save the displayed data and advance to Menu Z610.

Esc Press this key to return to Menu Z610.


ENPEP Module: MAED Planning Study: Case: (Z620)
S U B M O D - 3 Input Data Form
Output Control Option:
Number of Periods per Year:
Number of Months per Period:
Load Axis Intervals between Points on the Load Duration Curve:
(fraction)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

FORM NUMBER - Z630
PURPOSE

The purpose of Menu Z630 is to print a listing of an input file, print a listing of an output file, or terminate the current listing. You advance to this menu by selecting option 4 on Menu Z600.



OPTIONS

1 Select this option to print a listing of an input file.

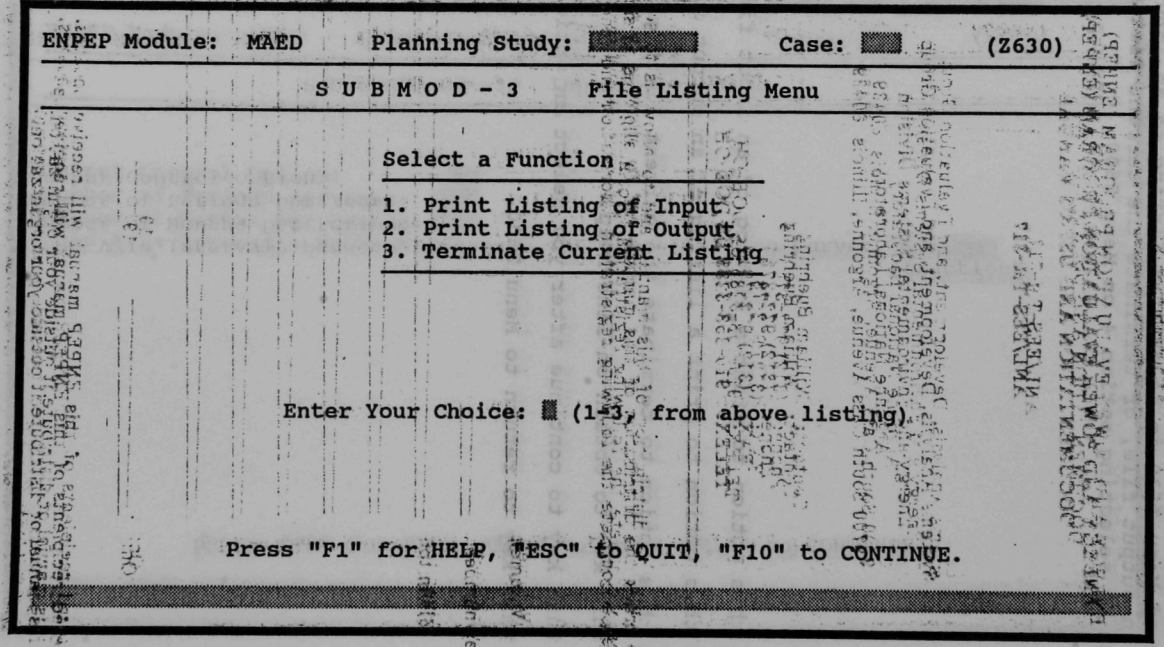
2 Select this option to print a listing of an output file.

3 Select this option to terminate the current listing.

F1 Press this key to obtain on-line help.

F10 Press this key to continue after you select an option.

Esc Press this key to return to Menu Z600.


ENPEP Module: MAED Planning Study: Case: (Z630)
S U B M O D - 3 File Listing Menu
Select a Function
1. Print Listing of Input
2. Print Listing of Output
3. Terminate Current Listing
Enter Your Choice: (1-3, from above listing)
Press "F1" for HELP, "ESC" to QUIT, "F10" to CONTINUE.

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